DS #: 4892

APN:

PROJECT: Draft Final Design Report for Las Vegas Wash Central, Cedar Avenue Channel

SUBMITTAL: 1st

SCANNED BY/DATE:

CHECKED BY/DATE:



ATKINS

Las Vegas Wash Central, Cedar Avenue Channel

Draft Final Design Report

November 22, 2016

Prepared for City of Las Vegas, Nevada

Prepared by ATKINS North America, Inc.
2270 Corporate Circle, Suite 200
Henderson NV 89074-7755
702.263.7275



ATKINS

November 22, 2016

Anita Marquez, P.E.
Engineering Project Manager
City of Las Vegas
Department of Public Works
333 Rancho Drive
Las Vegas, Nevada 89106

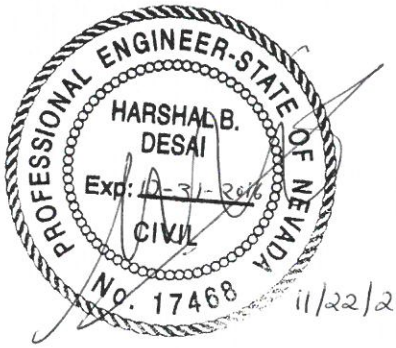
RE: Draft Final Design Report for Las Vegas Wash Central, Cedar Avenue Channel

Dear Ms. Marquez

Transmitted herewith are the Draft Final Design Report and the 70% Design Plan Submittal for the Las Vegas Wash Central, Cedar Avenue Channel Project (Cedar Avenue Channel).

Please feel free to contact me if you have any questions.

Sincerely,



Harshal Desai, PE, CFM

Project Manager

Manogya 11/22/2016

Manogya Khanal, CFM

Engineering Intern

Atkins • 2270 Corporate Circle, Suite 200, Henderson, NV 89074 • Tel. 702.263.7275 • Fax. 702.263.7200 • www.atkinsglobal.com

Executive Summary

This Draft Final Design Report (DFDR) has been prepared to describe the 70% design and analysis of the Las Vegas Wash Central, Cedar Avenue Channel project (hereafter referred to as the CAC). The project improvements extend from the Las Vegas Wash at the downstream end to the intersection of Pecos Road and Stewart Avenue at the upstream end. The regional facilities encompassed in this project are described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers CACH 0000 through 0148 and CACN 0001.

The project involves expanding the existing Cedar Avenue Channel from a trapezoidal channel to a rectangular channel ranging from 25' to 36'wide and from 6 to 17' deep. The project also involves installing approximately 2,000' of RCB storm drain upstream of the channel that varies in size from a 12' x 6' RCB to an 18' x 5' RCB. The proposed storm drain facilities will extend from the upstream end of the Cedar Avenue Channel to the intersection of Pecos Road and Stewart Avenue. The project entails the construction of these facilities and associated collection system including laterals, drop inlets, manholes, and all necessary appurtenances to complete the Cedar Avenue Channel improvements.

It should be noted that the original Scope of Services previously provided for this project assumed that the storm drain improvements would extend west in Stewart Avenue from Pecos Road to Mojave Road and in Pecos Road south of Stewart Avenue to Sunrise Avenue. However, due to preliminary hydrologic/hydraulic analysis and coordination with the City, the project extents were shifted downstream in order to design channel improvements that will increase the limited capacity of the existing Cedar Avenue Channel.

Hydrologic analysis has been performed using the HEC-1 computer program to develop 100-year design flows for the CAC. These design flows were subsequently used in the hydraulic analysis to size the conveyance facilities accordingly. Hydraulic calculations for the storm drain were based on normal depth calculations and WSPG modeling, while the open channel portion of the project was analyzed using HEC-RAS.

This DFDR is based off the Preliminary Design Report (PDR) and the 30% Design Plans that were submitted to the City on June 22, 2015 and the progress made thereafter. Comment response from the 30% design phase is included in the appendix of this DFDR. Constructability review comments are also included with this report.

The 70% Design Plans are provided with this DFDR submittal. Other important aspects of the 70% design effort are presented in this DFDR, including geotechnical investigations, survey summary, required permits, right-of-way information, utility conflicts and construction cost estimates.

The overall, estimated construction cost of the project is **$18,331,418**, which includes a 15-percent contingency to offset the level of detail provided at this submittal phase.

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- Cedar Avenue Channel Capacity Analysis
- Preliminary Design Report and 30% Design Plans
- Meeting Minutes and Emails
- Hydrologic/Hydraulic Models
- Geotechnical Reports
- PDF version of the Draft Final Design Report
- PDF version of the 70% Design Plans

1. Introduction

1.1. Purpose

The purpose of this Draft Final Design Report (DFDR) is to describe the criteria, parameters, considerations, assumptions, and methodology used in the design and analysis of the Las Vegas Wash Central, Cedar Avenue Channel (hereafter referred to as CAC). This DFDR includes pertinent aspects of the project explored to date and facilitates review of the design by the City of Las Vegas (the City), the Clark County Regional Flood Control District (CCRFCD), and other stakeholders.

It is important to note that the proposed drainage system and the associated analysis presented in this DFDR is still a work in progress and represents the latest information corresponding to the 70% milestone submittal. Thus, the analysis, design, and information presented herein are subject to amendments, additions, and revisions in the future as comments are received and more analyses are completed throughout the detailed design phase. The content presented herein will later be updated as necessary and incorporated into the Final Design Report at the 90% milestone.

1.2. Project Description and Location

The scope of services to be provided under the terms of the project contract includes the design and preparation of contract drawings, cost estimates, and reports for the CAC. The project improvements extend from the Las Vegas Wash at the downstream end to the intersection of Pecos Road and Stewart Avenue at the upstream end. The regional facilities encompassed in this project are described in the 2008 and 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers CACH 0000 through 0148 and CACN 0001. The analysis for the facilities are referenced from 2008 MPU and the figures are referenced from 2013 MPU. The proposed alignment of CAC is shown in **Figure 1.**

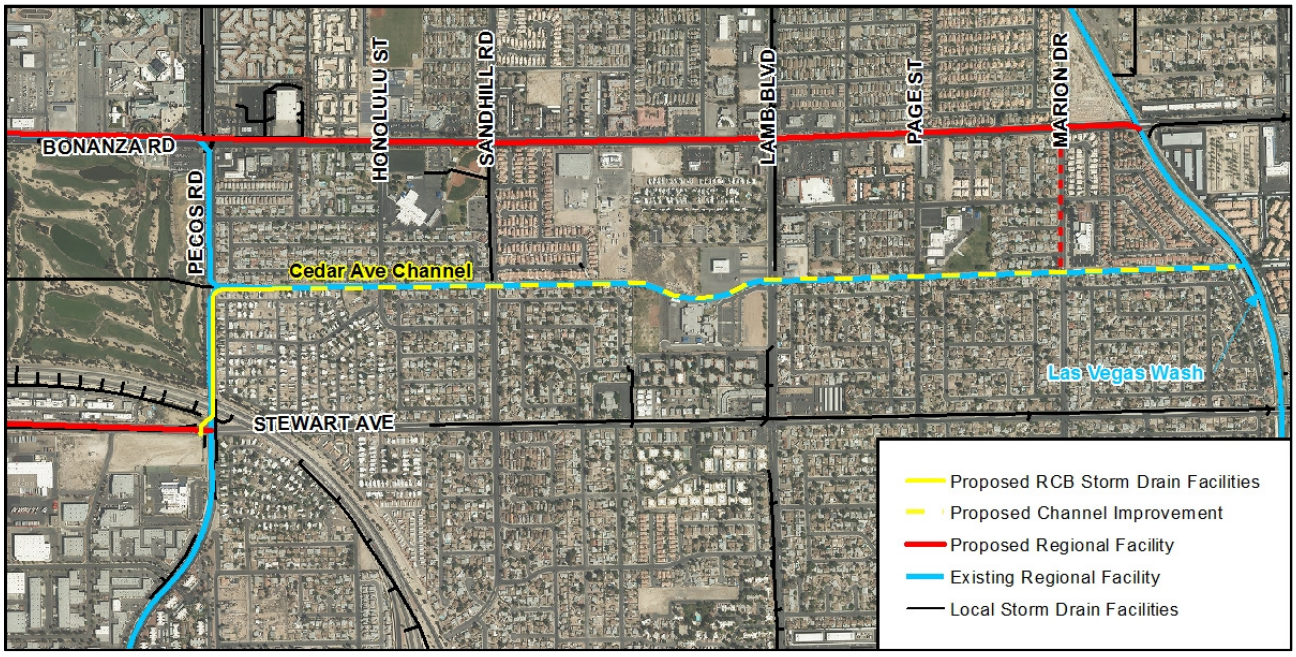


Figure 1 Cedar Avenue Channel Project Alignment

The project involves expanding the existing Cedar Avenue Channel from a trapezoidal channel to a rectangular channel ranging from 25’ to 36’ wide and from 6’ to 17’ deep. The intent of the design is to preserve most of the existing bridge crossings along the channel and make improvements to the channel sections. The design also moves the existing channel centerline approximately 2’ north in certain sections to provide some room on the south side for construction, and save on construction cost.

The project also involves installing approximately 2,000’ of RCB storm drain upstream of the channel that varies in size from a 12’ x 6’ RCB to an 18’ x 5’ RCB. The proposed storm drain facilities will extend from the upstream end of the Cedar Avenue Channel to the intersection of Pecos Road and Stewart Avenue. The project entails the construction of these facilities and associated collection system including laterals, drop inlets, manholes, and all necessary appurtenances to complete this project.

There will also be drop inlet facilities and lateral storm drains required on the north and south of Stewart Avenue, just west of Pecos Road, to collect runoff from the street and convey it to the main storm drain facility. Detailed sizes, location, and alignments of the proposed storm drain facilities are shown on the 70% Design Plans that accompany this report and will be described later in this DFDR.

The project site is located in the area referred to as the “Central Watershed” in the 2013 MPU, within Sections 31 and 32 of Township 20S, Range 62E and Section 36 of Township 20S, Range 61E. The general project location is shown on a vicinity map in **Figure 2**. **Figure 3** is a reproduction of Figure F-32 and Table F-32 from the 2013 MPU that show the original alignment and geometry of the proposed system.

It should be noted that analysis provided in this report is based of 2008 MPU. However, the MPU figures are from 2013 MPU. Master Plan Change will be prepared by CLV for the facilities that are different than the 2008/2013 MPU.

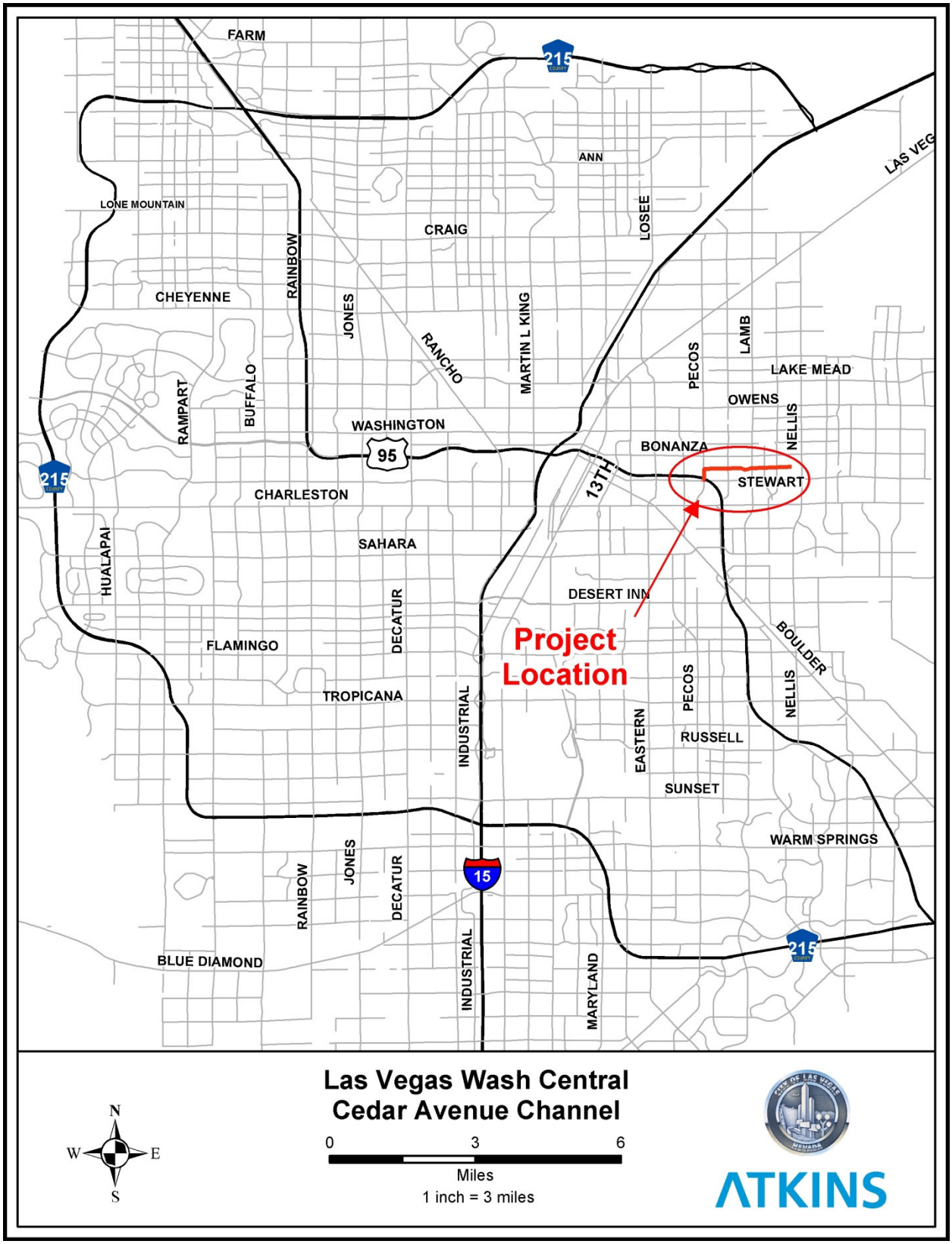


Figure 2 Cedar Avenue Channel Project Vicinity Map

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 32
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

Project Location

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)

US95 I-15 I-215

	1	2	3						A1	A2		
	4	5	6						A3	A4		
		7	8	9	10	A5	A6					
11	12	13	14	15	16	17						
	18	19	20	21	22	23						
	24	25	26	27	28							
	29	30	31	32	33	34						
	35	36	37	38	39	40						
	41	42	43	44	45	46						
	47	48	49	50	51	52						
	53	54	55	56								
	57	58	59									

Figure 3 - 2013 MPU Flood Control Facility Map

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BHSA		**BOULDER HIGHWAY SAHARA AVENUE**						
0000	P2	14' X 10' RCB	1350	3837	CSA13*	SW3	7.93	0.50
0026	P1	14' X 11' RCB	4000	3837	CSA13*	SW3	7.93	1.30
0075	P1	12' X 11' RCB	5280	3837	CSA13*	SW3	7.93	2.11
0175	P1	14' X 14' RCB	6000	3837	CSA13	SW3	7.93	0.67
CABZ		**CEDAR AVENUE - BONANZA**						
0000	E	72" RCP	525					0.30
0010	E	66" RCP	1450					0.30
CACH		**CEDAR AVENUE CHANNEL**						
0000	E	Conc Chnl 10'W 8'D 1.5:1 SS	1681	1544	CCA10-C	SW3	1.81	0.20
0027	E	2: 15'X5' RCBC @ Marion	82	1544	CCA10-C	SW3	1.81	0.35
0029	E	Conc Chnl 10'W 8'D 1.5:1 SS	1284	1544	CCA10-C	SW3	1.81	0.37
0051	E	2: 15'X5' RCBC @ Page	64	1544	CCA10-C	SW3	1.81	0.38
0053	E	Conc Chnl 10'W 6'D 1.5:1 SS	1275	1544	CCA10-C	SW3	1.81	0.38
0079	E	2: 12' X 6' RCBC @ Lamb	100	1387	CCA08-C	SW3	1.61	0.38
0081	E	Conc Chnl 12'W 6'D 1.5:1 SS	2562	1387	CCA08-C	SW3	1.61	0.20
0127	E	3: 12'X4' RCBC @ Sandhill	80	1387	CCA08-C	SW3	1.61	0.20
0129	E	Conc Chnl 10'W 8'D 1.5:1 SS	971	1387	CCA08-C	SW3	1.61	0.26
0146	E	2: 12' X 5.5' RCBC @ Honolulu	62	1387	CCA08-C	SW3	1.61	0.53
0148	E	Conc Chnl 10'W 8'D 1.5:1 SS	959	1387	CCA08-C	SW3	1.61	0.53
CACN		**CEDAR AVENUE - CHARLESTON**						
0000	E	72" RCP (Replace w/ CACN0001)	1867	933	CCA05	SW3	0.96	0.41
0001	P1	10 'X 9' RCB (Replaces CACN0000)	1867	933	CCA05	SW3	0.96	0.41
0034	E	2: 48" RCP (Replace w/ CACN0035)	685	254	CA05	SW3	0.24	0.30
0035	P0	6' X 6' RCB (Replaces CACN0034)	685	254	CA05	SW3	0.24	0.30
0049	E	66" RCP (Replace w/ CACN0050)	2146	254	CA05	SW3	0.24	0.60
0050	P0	6' X 5' RCB (Replaces CACN0049)	2146	254	CA05	SW3	0.24	0.60
CNST		**CEDAR AVENUE CHANNEL - STEWART**						
0000	P1	8' X 7' RCB	2120	690	CCA04	SW3	0.72	0.90
COLM		**COLORADO / LAMB**						
0000	E	72" RCP	1500	470	CCH94	SW3	0.63	0.87
FLAG		**FLAMINGO WASH - ALGONQUIN**						
0000	E	72" RCP	1080	513	FW21	FLAM3A	0.47	0.50
0020	E	66" RCP	460	513	FW21	FLAM3A	0.47	1.00
FLBN		**FLAMINGO - BOULDER HIGHWAY NORTH**						
0001	E	5: 10' X 6' RCB	350	4784	CCFR03	BOULDER4	11.13	0.58
0008	E	3: 14' X 12' RCB	1055	4784	CCFR03	BOULDER4	11.13	0.20
0028	E	3: 14' X 12' RCB	275	4784	CCFR03	BOULDER4	11.13	0.20
0033	E	3: 14' X 12' RCB	500	4784	CCFR03	BOULDER4	11.13	0.20
0038	P1	15' X 10' RCB	6600	2448	CFR03	SW3	3.46	0.59
0167	P1	2: 10' X 6' RCB	700	2046	CCH68-C	SW3	2.86	1.14
0180	P1	2: 10' X 6' RCB	1300	1799	CCCH67-C	SW3	2.55	1.31
0205	P1	10' X 6' RCB	4000	1461	CCH63-C	SW3	1.88	2.30
0281	P1	10' X 7' RCB	3100	1259	CCH56	SW3	1.64	1.33
0312	P1	7' X 4' RCB	1800	555	CCH52	SW3	0.55	4.20
0342	P1	7' X 4'' RCB	2500	555	CCH52	SW3	0.55	4.20
FLBS		**FLAMINGO - BOULDER HIGHWAY SOUTH**						
0000	E	Unlined Median Chnl 0'W 6.5'D 4.5:1 SS	4060	945	CB4	FLAM3A	1.38	1.30
0167	E	Unlined Median Chnl 0'W 3.5'D 9:1 SS	8850	452	CB4N	FLAM3A	0.63	0.90
FLDN		**DESERT INN DRAIN EAST**						
0000	E	60" RCP (Replace w/ FLDN0001)	6160	1267	CFW30AW	FLAM3A	2.12	1.22
0001	P0	12' X 6' RCB (Replaces FLDN0000)	6160	1267	CFW30AW	FLAM3A	2.12	1.22
0116	E	54" RCP (Replace w/ FLDN0117)	2330	1178	CFW29	FLAM3A	1.82	1.77
0117	P0	10' X 6' RCB (Replaces FLDN0116)	2330	1178	CFW29	FLAM3A	1.82	1.77
0160	E	48" RCP (Replace w/ FLDN0160)	2950	906	CFW28	FLAM3A	1.51	1.28
0161	P0	10' X 6' RCB (Replaces FLDN0161)	2950	906	CFW28	FLAM3A	1.51	1.28

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
FLMP		**FLAMINGO WASH-MARYLAND PARKWAY SYSTEM**						
0000	P1	8' X 6' RCB	3800	492	CCH60A-C	SW3	0.75	0.49
FLSP		**FLAMINGO WASH - SPENCER**						
0000	E	48" RCP	420	513	FW21	FLAM3A	0.47	1.10
FLWA		**FLAMINGO WASH**						
0000	E	Grass Chnl 107'W 5'D 2:1 SS (Replace w/ FLWA0001)	4570	10952	CFW36*	FLAM5B	36.14	0.40
0001	P1	Conc Chnl 100'W 7.5'D 1:1 SS (Replaces FLWA0000)	4570	10952	CFW36*	FLAM5B	36.14	0.40
0078	E	3 Span Bridge 108.25'W 5.5'D @ Nellis	120	10952	CFW36	FLAM5B	36.14	0.70
0080	E	Conc Chnl 50'W 8.5'D 1:1 SS	5080	10952	CFW36	FLAM5B	36.14	1.20
0174	E	9: 10' X 6' RCBC @ Lamb	110	10822	CFW34	FLAM5B	35.66	1.40
0176	E	Conc Chnl 60'W 9'D 1:1 SS	1180	10822	CFW34	FLAM5B	35.66	0.70
0200	E	Conc Chnl 70'W 8'D to 12'D w/ Pier 0:1 SS	1245	10822	CFW34	FLAM5B	35.66	0.50
0226	E	Free Span Bridge 100'W 10'D @ I-515	170	10822	CFW34	FLAM5B	35.66	0.80
0228	E	Conc Chnl 70'W 8'D to 12'D 0:1 SS	1500	10788	CFW33	FLAM5B	35.36	0.80
0255	E	2 Span Bridge 150'W 9'D @ Boulder Hwy	65	10788	CFW33	FLAM5B	35.36	1.00
0256	E	Conc Chnl 60'W 7.5'D 0:1 SS	40	8146	CFW33W	FLAM5B	24.23	1.00
0257	E	2 Span Bridge 150'W 9'D @ Boulder Hwy	60	8146	CFW33W	FLAM5B	24.23	1.00
0258	E	Conc Chnl 60'W 7.5'D 0:1 SS	750	8146	CFW33W	FLAM5B	24.23	0.44
0273	E	Free Span Bridge 60'W 9'D @ MMMHP	20	8146	CFW33W	FLAM5B	24.23	0.40
0274	E	Conc Chnl 60'W 8.1'D 0:1 SS	1370	8146	CFW33W	FLAM5B	24.23	1.00
0295	E	Conc Chnl 60'W 8.1'D 0:1 SS	430	7669	CFW31	FLAM5B	22.62	0.80
0307	E	Conc Chnl 60'W 8.1'D 2:1 SS	410	7669	CFW31	FLAM5B	22.62	0.70
0314	E	Conc Chnl 60'W 8.1'D 2:1 SS	1500	7195	CFW30B	FLAM5B	21.25	0.90
0347	E	5: 10' X 8' RCBC @ Mojave	80	7195	CFW30B	FLAM5B	21.25	0.94
0348	E	Conc Chnl 30'W 12'D 1:1 SS	1150	7195	CFW30B	FLAM5B	21.25	0.70
0375	E	5: 10' X 8' RCBC @ Desert Inn	140	7102	CFW30A	FLAM5B	20.96	2.70
0377	E	Conc Chnl 50'W 9.5'D 0:1 SS	1372	6964	CFW23	FLAM5B	19.36	1.04
0399	E	Free Span Bridge 60'W 16'D @ McLeod	120	6964	CFW23	FLAM5B	19.36	0.50
0401	E	Conc Chnl 50'W 11.5'D 0:1 SS	123	6964	CFW23	FLAM5B	19.36	0.50
0406	E	Conc Chnl 33'W 11.5'D 0:1 SS	690	6964	CFW23	FLAM5B	19.36	1.01
0419	E	Conc Chnl 33'-50'W 9.8'D 0:1 SS	200	6964	CFW23	FLAM5B	19.36	2.00
0423	E	Conc Chnl 50'W 9.8'D 0:1 SS	1686	6964	CFW23	FLAM5B	19.36	0.76
0455	E	Conc Chnl 50'-75'W 9.8'D 0:1 SS	169	6964	CFW23	FLAM5B	19.36	1.83
0458	E	Conc Chnl 75'-80'W 9.8'D 0:1 SS	347	6964	CFW23	FLAM5B	19.36	1.50
0471	E	5: 10' X 8' RCBC @ Eastern	110	5781	CFW22W	FLAM5B	14.95	1.30
0472	P1	Add 1: 22' X 8' RCBC @ Eastern	110	5781	CFW22W	FLAM5B	14.95	0.50
0473	E	Grass Chnl 60'W 15'D 2:1 SS	100	5781	CFW22W	FLAM5B	14.95	0.47
0477	E	3 Span Bridge 47'W 15'D	10	5781	CFW22W	FLAM5B	14.95	0.80
0478	E	Grass Chnl 60'W 15'D 2:1 SS	520	5781	CFW22W	FLAM5B	14.95	0.47
0481	E	3: 90" CMAP @ Tioga (Replace w/ FLWA0482)	60	5781	CFW22W	FLAM5B	14.95	0.87
0482	P1	4: 20' X 8' RCBC @ Tioga (Replaces FLWA0481)	60	5781	CFW22W	FLAM5B	14.95	0.87
0483	E	Grass Chnl 60'W 15'D 2:1 SS	300	5781	CFW22W	FLAM5B	14.95	0.63
0492	E	3 Span Bridge 47'W 15'D	10	5781	CFW22W	FLAM5B	14.95	0.50
0493	E	Grass Chnl 60'W 15'D 2:1 SS	1520	5781	CFW22W	FLAM5B	14.95	0.46
0555	E	3 Span Bridge 47'W 15'D	10	5701	CFW21	FLAM5B	14.55	0.50
0556	E	Earth Chnl 60'W 15'D 2:1 SS (Replace w/ FLWA0557)	520	5701	CFW21	FLAM5B	14.55	0.54
0557	P1	Gabion Chnl 30'W 10.5'D 2:1 SS (Replaces FLWA0556)	520	5701	CFW21	FLAM5B	14.55	0.54
LVBZ		**LAS VEGAS WASH - BONANZA**						
0000	P1	2: 12' X 7' RCB	3400	1636	CBN15-C	SW3	2.40	0.40
0064	P1	2: 12' X 6' RCB	2630	1449	CBN12-C	SW3	2.12	0.40
0114	P1	2: 12' X 6' RCB	2740	1256	CBN10-C	SW3	1.79	0.40
0166	E	54" RCP (Replace w/ LVBZ0167)	1095	1051	CBN09	SW3	1.54	0.45
0167	P0	10' X 9' RCB (Replaces LVBZ0166)	1095	1051	CBN09	SW3	1.54	0.45
0187	E	48" RCP (Replace w/ LVBZ0188)	1235	1051	CBN09	SW3	1.54	0.71
0188	P0	9' X 9' RCB (Replaces LVBZ0187)	1235	1051	CBN09	SW3	1.54	0.71
0210	E	42" RCP (Replace w/ LVBZ0211)	704	911	CBN08	SW3	1.30	1.37
0211	P0	8' X 7' RCB (Replaces LVBZ0210)	704	911	CBN08	SW3	1.30	1.37
0223	E	36" RCP (Replace w/ LVBZ0224)	2275	722	CBN03	SW3	1.09	0.72
0224	P0	8' X 7' RCB (Replaces LVBZ0223)	2275	722	CBN03	SW3	1.09	0.72

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVCA		**LAS VEGAS WASH - CHARLESTON**						
0000	P1	12' X 9' RCB	4600	1104	CCH77-C	SW3	1.34	0.30
LVCO		**COLORADO AVENUE SYSTEM**						
0000	E	18' X 8' RCB	610	1015	CNEL06	SW3	1.30	0.24
0012	E	14' X 8' RCB	2560	1015	CNEL06	SW3	1.30	0.24
0064	E	10' X 8' RCB	2165	827	CCCH94	SW3	0.98	0.24
0106	E	10' X 8' RCB	590	394	CCH92-C	SW3	0.35	0.24
0109	E	10' X 5' RCB	2350	394	CCH92-C	SW3	0.35	0.67
LVMD		**LAS VEGAS WASH - MIDDLE**						
1032	E	Earth Chnl 75'W 10'-12'D 1:1 SS (Replace w/ LVMD1033)	715	15156	CNLWY	CLVWASH5	118.28	0.30
1033	P1	Conc Chnl 75'W 11'D 1:1 SS (Replaces LVMD1032)	739	15156	CNLWY	CLVWASH5	118.28	0.30
1045	E	5 Span Bridge 75'W 10'D 1:1 SS (Replace w/ LVMD1046)	120	15156	CNLWY	CLVWASH5	118.28	0.52
1046	P1	Bridge 75'W 9.5'D 1:1 SS @ Nellis (Replaces LVMD1045)	120	15156	CNLWY	CLVWASH5	118.28	0.52
1047	E	Earth Chnl 80'W 8'D 2:1 SS (Replace w/ LVMD1048)	340	15083	CCNEL06	CLVWASH5	117.81	0.50
1048	P1	Conc Chnl 120'W 8'D 0:1 SS (Replaces LVMD1047)	340	15083	CCNEL06	CLVWASH5	117.81	0.50
1053	E	Earth Chnl 80'W 8'D 2:1 SS (Replace w/ LVMD1054)	860	14811	CNEL04-2	CLVWASH5	116.51	0.50
1054	P1	Conc Chnl 120'W 8'D 0:1 SS (Replaces LVMD1053)	860	14811	CNEL04-2	CLVWASH5	116.51	0.50
1068	E	5 Span Bridge 90'W 6'D 2:1 SS (Replace w/ LVMD1069)	120	14438	CCST03-C	CLVWASH5	114.87	0.50
1069	P1	5 Span Bridge 110'W 8'D 2:1 SS (Replaces LVMD1068)	120	14438	CCST03-C	CLVWASH5	114.87	0.50
1070	E	Earth Chnl 90'W 10'-12'D 1.5:1 SS (Replace w/ LVMD1071)	2587	14438	CCST03-C	CLVWASH5	114.87	0.43
1071	P1	Conc Chnl 90'W 9'D 1.5:1 SS (Replaces LVMD1070)	2587	14438	CCST03-C	CLVWASH5	114.87	0.43
1119	E	5 Span Bridge 90'W 12'D 2:1 SS @ Stewart	120	14354	CCCA10-C	CLVWASH5	114.40	0.20
1120	E	Earth Chnl 90'W 12'D 1:1 SS (Replace w/ LVMD1121)	1400	14354	CCCA10-C	CLVWASH5	114.40	0.20
1121	P1	Conc Chnl 90'W 10.5'D 1:1 SS (Replaces LVMD1120)	1400	14354	CCCA10-C	CLVWASH5	114.40	0.20
1148	E	Earth Chnl 70'W 18'-20'D 1.5:1 SS (Replace w/ LVMD1149)	1675	13944	CCBN15-C	CLVWASH5	112.59	0.41
1149	P1	Conc Chnl 70'W 10'D 1.5:1 SS (Replaces LVMD1148)	1675	13944	CCBN15-C	CLVWASH5	112.59	0.41
1176	E	5 Span Bridge 110'W 20'D 2:1 SS @ Bonanza	120	12690	CLVW04-C	CLVWASH5	106.80	0.57
1178	E	Earth Chnl 30'W 18'-20'D 2:1 SS (Replace w/ LVMD1179)	1500	12690	CLVW04-C	CLVWASH5	106.80	0.57
1179	P1	Conc Chnl 60'W 9.5'D 2:1 SS (Replaces LVMD1178)	1500	12690	CLVW04-C	CLVWASH5	106.80	0.57
LVNE		**LAS VEGAS WASH - NELLIS**						
0000	P1	2: 13' X 10' RCB	4675	2303	CNEL02-C	WEST3	3.39	0.20
LVOE		**OWENS AVENUE - EAST**						
0345	P1	13' X 11' RCB	1685	2369	DLVOE	SW5	22.79	0.60
LVWH		**WASHINGTON AVENUE CHANNEL**						
0389	E	12' X 8' RCB	2110	1607	(1/2) CV1-C	SW5SC	15.16	0.90
0426	E	16' X 8' RCB	150	1607	(1/2) CV1-C	SW5SC	15.16	1.08
0429	E	Splitter Structure (2: 12' X 8' RCB)	190	2870	DCLC21	SW5	22.79	1.90
0431	E	3: 14.33' X 10' RCB	665	2870	DCLC21	SW5	22.79	0.15
0446	E	Junction Structure	69	2870	DCLC21	SW5	22.79	0.15
0447	E	3: 14.33' X 10' RCB	1955	4978	CCAL93	SW5	22.19	0.15
NLFL		**NELLIS FLAMINGO STORM DRAIN**						
0028	P0	Add 1: 7' X 6' RCB	1530	338^	CM3^	FLAM3A	1.27	0.39
0029	E	76" & 48" RCP	1530	391^	CM3^	FLAM3A	1.27	0.39
0059	E	60" RCP	1370	143^	CM3^	FLAM3A	1.27	0.30
0060	P0	Add 1: 12' X 6' RCB	1370	586^	CM3^	FLAM3A	1.27	0.34
0084	E	48" RCP	2490	79^	CM2^	FLAM3A	0.98	0.30
0085	P0	Add 1: 11' X 6' RCB	2490	505^	CM2^	FLAM3A	0.98	0.30
0131	E	42" RCP	650	350	M1	FLAM3A	0.51	0.23
0144	E	36" RCP	620	350	M1	FLAM3A	0.51	0.20
NLWY		**NELLIS - WYOMING CHANNEL**						
0000	E	Conc Chnl 8'W 4'D 1.3:1 SS	260	338	FW35	FLAM3A	0.47	1.71
0004	E	15' X 6' RCAC	80	338	FW35	FLAM3A	0.47	1.30
0006	E	Conc Chnl 8'W 4'D 1.3:1 SS	400	338	FW35	FLAM3A	0.47	0.38
0014	E	12' X 4' RCBC @ Winterwood	70	338	FW35	FLAM3A	0.47	0.40
0015	E	Conc Chnl 8'W 4'D 1.3:1 SS	720	338	FW35	FLAM3A	0.47	0.38
0028	E	12' X 4' RCBC @ Wyoming	90	338	FW35	FLAM3A	0.47	0.80
0030	E	Conc Chnl 8'W 4'D 1.3:1 SS	250	338	FW35	FLAM3A	0.47	0.38
SAEA		**SAHARA AVENUE - EASTERN LATERAL**						
0000	P1	10' X 8' RCB	1440	564	CFR02	SW3	0.66	0.20

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
VAVD		**VEGAS VALLEY DRIVE**						
0000	P1	8' X 6' RCB	1300	606	CFW32WW	FLAM3A	0.84	2.10
0025	P1	84" RCP	5300	606	CFW32WW	FLAM3A	0.84	1.60
VBCH		**VAN BUSKIRK CHANNEL**						
0000	E	12' X 3' RCB	500	888	CVB16	FLAM3A	1.16	1.00
0008	E	8' X 5' RCB	5490	888	CVB16	FLAM3A	1.16	1.00
VBEA		**VAN BUSKIRK - EASTERN AVE**						
0000	P1	14' X 6' RCB	3020	1561	CVB11	FLAM3A	3.35	1.30
VBMC		**VAN BUSKIRK - McLEOD DRIVE**						
0000	E	2: 8' X 8' RCB	3850	997	CVB13	FLAM3A	3.43	0.50
VBTW		**VAN BUSKIRK - TWAIN**						
0000	E	18" RCP	6640	541	CB2	FLAM3A	0.74	0.70
WAGC		**WASHINGTON AVENUE CHANNEL - GRAND CENTRAL**						
0000	E	2: 12' X 4' RCB	700	557	LC21	SW3	0.60	0.20
0014	E	1: 12' X 4' RCB and 1: 11' X 4' RCB	2440	557	LC21	SW3	0.60	0.20
WAPR		**WASHINGTON AVENUE CHANNEL PARALLEL**						
0132	E	2: 9' X 8' RCB	387	1607	(1/2) CV1-C	SW5SC	15.16	1.67

** The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.*

*** As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.*

^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).

REGIONAL FLOOD CONTROL DISTRICT

2013 LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FACILITY INVENTORY
FIGURE F - 32

LEGEND

ID (Facility Identifier) AABB
- Parent Stream Name
- Stream Name

River Mile 0000
- Distance Above Confluence with Parent Stream (Miles)
- Miles in Hundredths

Existing Facility.....E
Proposed or Modified Facility.....P
Contingency Level
- Category B.....P0
- Master Plan.....P1
- Preliminary Design.....P2
- Design.....P3

Bottom Width.....W
Depth.....D
Side Slope, H:V.....SS

Construction Features

Cast in Place Concrete Pipe	CIPCP	Reinforced Concrete Arch Culvert	RCAC
Corrugated Metal Arch Pipe Culvert	CMAP	Reinforced Concrete Box	RCB
Corrugated Metal Pipe Culvert	CMPC	Reinforced Concrete Box Culvert	RCBC
High Density Polyethylene	HDPE	Reinforced Concrete Pipe	RCP
Horizontal Elliptical Reinforced Concrete Pipe	HERCP	Reinforced Concrete Pipe Culvert	RCPC
Reinforced Concrete Arch Pipe	RCAP	Storm Sewer Pipe	SSP

Figure 3 (continued) - 2013 MPU Facility Inventory Table

1.3. Inventory of the Existing Condition

The watershed area impacting the CAC encompasses approximately 3.5-square-miles of urbanized area in the central portion of the City, and can be subdivided into two areas. The first watershed area is generally bounded by Maryland Parkway on the west (which is the ultimate condition boundary), Bonanza Road on the North, Charleston Boulevard on the south, and the Pecos Road on the east. The second watershed area is bounded by Pecos Road on the west, Bonanza Road on the north, Las Vegas Wash on the east, and the CAC on the south. The overall drainage pattern in the study area is from west to east, with surface runoff being conveyed on surface streets and in local channels and minor storm drain facilities. **Figure 7** in **Section 2** of this report shows the watershed boundary of the CAC.

Panel 32003C2186F and 32003C2187F of Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs) shows the majority of the project area is not within a Special Flood Hazard Area. A small reach at the end of the proposed channel lies within a Zone AE flood zone. FIRMettes showing the flood zone boundaries in the study area in included in **Appendix B**.

During early phases of the project, field investigations were performed by Atkins in the study area to assess drainage patterns, confirm design data that was collected, and evaluate the current condition of the project site and tributary areas. Detailed topography, aerial photos, and previously completed drainage studies were also reviewed and relevant information extracted in order to inventory the existing condition and understand constraints and design considerations in the study area. In addition, photos were taken during field investigations and compiled in a photo library included in **Appendix B**.

A few observations regarding the existing condition are summarized in the following paragraphs.

The intersection of Stewart Avenue and Pecos Road is the main collection point for the proposed storm drain facilities. The flows impacting this intersection come primarily from the west on the surface of Stewart Avenue. There are existing drop inlets and lateral storm drains on the north and south side of Pecos Road that collect a small portion of the surface flow. There is also a drainage swale that runs from south to north along the west side of Pecos Road that connects to a headwall under Stewart Avenue. The flow collected at the headwall and in the drop inlets is conveyed through local storm drains to an existing 72" RCP in Pecos Road that drains north and eventually discharges to the Cedar Avenue Channel. These facilities are undersized and do not have adequate capacity to convey the 100-year flow impacting the intersection.

South of Stewart Avenue, Pecos Road has relatively minor surface flows on the street because the majority of the flow in the area is already conveyed in the existing 66" RCP (which transitions to dual 48" RCPs) in Pecos Road and in local, on-site storm drains that convey flow through parking lots and commercial areas immediately west of Pecos Road. The drainage facilities in Pecos Road are adequately sized and will connect to proposed storm drain facilities constructed with this project. More detailed information regarding the drainage patterns and hydrology in this area is included in Section 2.

Any flow that is not collected by drop inlets on Stewart Avenue will bypass the intersection and continue east on Stewart Avenue. There is an existing low point with under sized drop inlets further downstream on Stewart Avenue, west of Marion Drive, where flow will pond up during storm events. This project will help alleviate or reduce some of the flooding problems occurring downstream on Stewart Avenue.

The Cedar Avenue Channel collects flow from the 72" RCP in Pecos Road, as well as another 72" RCP that combines 66" RCP bringing flow from the Desert Pines Golf Course and 60" RCP bring flow from Bonanza Road. The channel conveys this flow eastward under 5 bridge structures at Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive until eventually discharging to the Las Vegas Wash at the downstream end. Additional flow comes into the channel via drop inlets at each of the bridge structures. During an early progress meeting on the project, the City stated that the Cedar Avenue Channel was limited in capacity and has experienced overtopping at Lamb Boulevard in the past. Atkins performed necessary hydraulics analysis to confirm that the channel had limited capacity to convey the project design flows in the existing condition.

The overall intent of the project is to collect as much of the 100-year flow as possible at Stewart Avenue and Pecos Road and to increase the conveyance capacity of the Cedar Avenue Channel, thereby improving flood protection in this area.

1.4. Existing Facilities and Adjacent Completed Projects Summary

There are completed and ongoing projects and storm drain facilities in the study area that are related to this project and may impact the storm drain design considerations/constraints. The major projects and facilities are described below.

1.4.1. Pecos Road Storm Drain

There is a 66" RCP storm drain in Pecos Road that conveys flow north from Charleston Boulevard. The pipe transitions to dual 48" RCPs north of Sunrise Avenue in order to cross over a 36" sewer line. After crossing the sewer and Stewart Avenue, the dual 48" RCP transitions to a large 72" RCP that continues north and then east until discharging to the Cedar Avenue Channel. The 72" RCP will be replaced and upsized with this project, while the dual 48" RCP and 66" RCP will remain in place and connect with proposed storm drain facilities constructed with this project.

1.4.2. Stewart Avenue Storm Drain

There is a 24" RCP storm drain in Stewart Avenue that extends from just west of Mojave Road to Pecos Road. This storm drain collects flow from existing drop inlets on Stewart Avenue (just west of Pecos) and eventually connects to the 72" RCP in Pecos Road. The 24" RCP facility will connect with proposed storm drain facilities constructed with this project.

1.4.3. Desert Pines Golf Course Storm Drain

The Desert Pines Golf Course, located east of Pecos Road and north of US 95, has a 60" RCP storm drain running from west to east through the middle of the golf course. This facility collects flow from Cedar Avenue and the golf course and conveys it to Pecos Road. At Pecos Road, it combines with another 60" RCP that comes from the north (from Bonanza Road), and then continues as a 72" storm drain that eventually discharges to the upstream end of the Cedar Avenue Channel.

1.4.4. BOMO Force Main – Phase 2

This ongoing CLV sewer project has a proposed alignment in Pecos Road and Stewart Avenue in the immediate vicinity of the proposed storm drain improvements. Coordination with this project is ongoing. Atkins reviewed the latest layout (obtained as of 27 October,

2016) of the BOMO system prepared by HDR. Coordination with this project should continue through final design.

1.4.5. Multi-Family Residential Development (APN 140-31-501-021)

There is an ongoing land development project for a multi-family residential site that is located just north of the Cedar Avenue Channel and west of Lamb Boulevard. Coordination with the City and the design engineer (L.R. Nelson) has occurred and will continue as necessary. The development intends to discharge runoff directly to the Cedar Avenue Channel, so coordination on hydrology/hydraulics as well as the trail widths and easements in this area will be needed going forward.

1.4.6. Las Vegas Wash Project

The Las Vegas Wash project (CCPW/CLV) at the downstream end of the Cedar Avenue Channel is proposed to convey all flow in the Cedar Avenue Channel within an 18' x 12' RCB confluence (based on the 100% QA/QC set, not for construction designed by CH2MHill/Stanley Consultants). Atkins has coordinated with the City the design consultants on several occasions and it was agreed that the proposed RCB should be widened to 22 – 25 feet, instead of 18 feet as was shown on the preliminary plans. This will improve the hydraulics of the channel and make it possible to potentially bring more flow into the channel from Bonanza Road in the future. However, this Las Vegas Wash project at the downstream end of the channel is currently on hold, so the design at the confluence has not been finalized. For the purpose of this preliminary design report and per the direction of the City, it was assumed that the confluence will be at least 22 feet wide. Further information regarding the channel design and confluence at the downstream end of the channel is available in **Section 4**.

1.4.7. Cedar Drainage Trail

The Cedar Drainage Trail was constructed along the north side of the Cedar Avenue Channel, extending from Pecos Road to the pedestrian bridge at the Las Vegas Wash. The project also included installation of light poles and landscaping. The wider channel improvements completed with this project will preserve a functional trail, although the trail width will be reduced in several locations.

1.5. Report Organization

The technical information compiled and presented in this report will facilitate review of the drainage analysis/design and is based on best available data at the time of the 70% milestone submittal. The report has been organized into five main sections: Section 1 serves as an overall introduction; Section 2 and 3 contain detailed information about the hydrologic and hydraulic (H&H) analysis and the proposed design; Section 4 includes summaries of several other design works and activities, including general design considerations, constructability issues, geotechnical investigations, survey summary, right-of-way summary, etc.; Section 5 summarizes the utility conflicts and utility coordination effort that has taken place to date; Section 6 is the final section and includes the construction cost estimate. The 70% design plans also accompany this report and include pertinent information for review, such as proposed facility sizes, horizontal/vertical alignments, utility conflicts, lateral locations, etc.

1.6. Technical Appendix and Data CD

A technical appendix is provided electronically on the Data CD at the end of this report with all supporting documentation and analysis including comment matrix from 30% design phase and constructability review. The electronic Data CD also has other relevant electronic data and information used in the development of this DFDR, such as a PDF version of the entire report, 70% design plans in pdf version, previous meeting minutes and hydrologic and hydraulic model files.

2. Hydrologic Analysis

2.1. General

This section includes information about the criteria and methodology used in the hydrologic analysis of the CAC. The criteria, methodology, and analyses are generally consistent with the Clark County Regional Flood Control District's (CCRFCD) Hydrologic Criteria and Drainage Design Manual (hereafter referred to as the Design Manual). Any deviations from the Design Manual are discussed in more detail later in this section.

2.2. Previous and/or Related Drainage Studies

Several drainage studies, hydrologic models, and reports were reviewed in conjunction with this project. May of the drainage studies were provided to Atkins by the City for small or local developments in the study area. These were all reviewed and incorporated as necessary. The more significant or major drainage studies used as a reference included:

- **2013 Las Vegas Valley Flood Control Master Plan Update**, prepared by PBS&J, September 2008. This study was reviewed and used as a reference for the hydrologic analysis and parameterization (CN methodology, land use, soils, routing, lag time, etc.). The 2008 MPU HEC-1 model developed for the Central Watershed was used as a base model for this project.

- **Central Neighborhood Flood Control Master Plan** prepared by PBS&J, March 2005. This study was used as a reference and to check the overall watershed boundary and to estimate the interim condition flow in the 72" RCP in Pecos Road.

2.3. Technical Memorandums and Report

After performing data collection, field investigations, survey, and preliminary H&H analysis, Atkins compiled two different technical memorandums and a preliminary design report to summarize the analysis, results, channel capacities, and recommended drainage plan and assumptions that were used in developing this DFDR and the 70% design plans. These memorandums/report were submitted and reviewed by the City and CCRFCD, who agreed on the overall design concepts and design flows. These include:

- **Preliminary Drainage Memorandum.** Atkins submitted the Preliminary Drainage Memorandum on May 5, 2014 to estimate peak flows impacting the intersection of Stewart Avenue and Pecos Road, to determine if revisions to the storm drain extents were warranted, and to make storm drain facility recommendations.

- **Cedar Avenue Channel Capacity Analysis.** Atkins submitted the Cedar Avenue Channel Capacity Analysis on June 13, 2014 to determine the existing channel conveyance capacity and to understand potential project impacts on the downstream channel and adjacent properties.

- Preliminary Design Report (PDR). Atkins submitted the Preliminary Design Report and the 30% Design Plans on June 22, 2015 to present hydrologic and hydraulic analyses done at the 30% design phase. The response to comments from the PDR and 30% design Submittal can be found in **Appendix A**. The design presented on this report is based off the PDR and the progress made thereafter.

A copy of both memorandums and the PDR are provided on the **Data CD** as a reference and to provide background information related to design alternatives that were investigated and decisions that have been made to date. The **Data CD** also contains emails and Meeting Minutes where key decisions were made.

2.4. Topography Data and Survey

Detailed 1-foot aerial topography data was obtained for the study area with this project. In general, the 1-foot topography data extends to Charleston Boulevard on the south, Maryland Parkway on the west, Pecos Road on the east, and Cedar Avenue on the north. An additional corridor along the Cedar Avenue Channel was also obtained for that portion of the project area. 5-ft contour data from Clark County was used for watershed areas outside of the detailed topography extents.

Detailed field survey (and manhole dipping) was also performed to determine accurate horizontal and vertical information for the manholes, sanitary sewers, storm drains, and other utilities.

2.5. Hydrologic Design Scenarios

Atkins performed hydrologic analysis to determine the peak 100-year design flows in the study area in the ultimate condition. The hydrologic analysis and the storm drain recommendations described in this report are based on the ultimate condition, which assumes that the project watershed is fully developed and that all proposed regional facilities are built and functioning. This is the condition represented in the HEC-1 model and fully described in this DFDR that will be used as the design basis throughout the project.

The main difference between the watershed today and the ultimate condition is the assumption that the proposed regional facility in Bonanza Road (LVBZ0000-0014) will be complete, which will convey the 100-year flow from Bonanza Road to the Cedar Avenue Channel at Marion Drive (see **Section 2.9** for more information about this alternate alignment).

Since the watershed area is more than 95% developed, any other changes in land use, impervious areas, and flow rates between the existing and ultimate (future) condition are considered negligible.

Throughout early design phases of this project, an interim condition model was developed in order to support alternative analysis and decision making, especially with regards to the Cedar Avenue Channel. The interim condition model is identical to the ultimate condition model except that the Bonanza Regional system does not bring flow into the channel at Marion Drive as described above. The interim condition model is provided on the **Data CD** for reference purposes if needed.

Qualitative assessments of the existing condition flow in the Cedar Avenue Channel have also been made based on the Central Neighbourhood Study and assumptions that the inflow facilities

into the channel are at full flow capacity (normal depth calculations), but detailed HEC-1 modeling of the existing condition was not required for this project.

2.6. Hydrologic Analysis and Parameterization

The methodology used to develop the hydrologic model and input parameters is discussed in detail in **Appendix B** with all supporting information and tables. A brief description of methods is provided as a summary below:

2.6.1. Subbasin Delineation

The 2008/2013 MPU and Central Neighbourhood Flood Control Master Plan (CNS) subbasin delineations were used as a starting point and were modified and subdivided as necessary based on field investigations, aerial photos, drainage studies, and the detailed 1-ft topography data that was obtained for the project. The subbasins used in this design project were more refined than the MPU subbasins in order to analyse and evaluate detailed roadway drainage patterns, storm drain sizes, and street flow capacities. The subbasins used in the HEC-1 model are shown on the Hydrologic Summary Map **(Figure 7)** at the end of this section of the report.

2.6.2. Hydrologic Parameters

- **Rainfall** – The 6-hour, 100-year and 10-year precipitation depth were used in the model based on the McCarran Airport Rainfall Area from the Design Manual. The SDN3 storm distribution was used since the watershed area is less than 8 square miles.

- **Depth-Area Reduction Factor –** The depth-area reduction factors (DARFs) from Table 503 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area.

- **Soils** – Soils data in the hydrologic analysis was based on the same soils information that was used in the 2008 MPU, which is the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. It should be noted that NRCS has updated the available soils data since that time; however, in an effort to be consistent with the MPU and other design projects that have been completed in the area, the 2008 MPU soils data was used in the CAC hydrologic analysis and design.

  A separate hydrologic analysis was performed using the 2014 soils data to understand the impact of the change. Total flow in the channel increases as a result of the new soil. However, the increase in flow does not affect the proposed design of the channel. The results of this analysis is discussed in **Section 4.1** of this report. The HEC-1 model is included in **Appendix B**.

- **Land Use** – Land use data was based on the 2008 MPU and updated as needed. Minor updates and revisions were made to the land use data based on aerial imagery to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

- **Curve Numbers** – Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the

Design Manual. Curve number information was compiled for each subbasin using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers.

- **Lag Time** – All subbasins within the project watershed are less than 0.5 square miles. The time of concentration for subbasins of this size is computed with the time of concentration equation (velocity method) from the CCRFCD Design Manual.

- **Routing** – The routings in the HEC-1 model through streets or storm drains were performed using the Muskingum-Cunge method for floodwave routing to be consistent with the 2008 MPU.

Detailed summary tables and supporting calculations for all parameters listed above are provided in **Appendix B**.

2.6.3. Computer Modeling

HEC-1 Version 4.1 (dated June 1998) was used for the CAC hydrologic modeling in order to be consistent with the MPU process. Descriptive information has been included in the HEC-1 input file on the "ID" and "KM" cards. The HEC-1 model is included in **Appendix B** and electronic model files are also provided on the Data CD that accompanies this report.

2.6.4. Concentration Points

Peak flows were combined in HEC-1 using concentration points that were inserted into the HEC-1 model. Several concentration points are located at the Pecos/Stewart intersection and along the Cedar Avenue Channel (as shown in **Figure 7** and **Figure 8**) since these are the main design locations in the study area.

2.6.5. Referenced Portions of the Model (Flow Diversions)

There are a few portions of the model that are based on reference studies/models:

At the intersection of Pecos Road and Charleston Boulevard, 206 cfs is conveyed north in an existing 66" RCP that collects flow from Charleston Boulevard and turns north in Pecos Road (see HEC-1 node CCHAR). The flow of 206 cfs is based on a referenced model from the Central Neighborhood Flood Control Master Plan. It is assumed that this flow of 206 cfs is the same in the interim and ultimate condition, since subbasin CH70-C will still drain to Charleston Boulevard, and there will be still be some bypass flow on Charleston Boulevard even when the future regional facility is built in Boulder Highway. A small inflow hydrograph (see HEC-1 node CHAR) was added to the model to represent existing flow on Charleston Boulevard from upstream watersheds in order to have a total peak flow of 206 cfs at the intersection of Pecos Road and Charleston Boulevard.

In order to account for flows that will enter the Cedar Avenue Channel from Bonanza Road area, portions of the 2008 MPU Central Watershed model (SW3) were copied and included directly in the HEC-1 model. The referenced portions of the model establish the 100-year peak flows in Bonanza Road. At the intersection of Pecos Road and Bonanza Road, the HEC-1 model has a diversion (DBN09) to represent the 202 cfs that is conveyed

south in the existing 60" RCP toward the Cedar Avenue Channel (based on full flow capacity normal depth calculations).

Similarly, at Marion Street and Bonanza Road, the referenced 2008 MPU model (at HEC-1 node CBN15-C) represents the flow that will be conveyed south in Marion Drive in the ultimate condition. Refer to **Section 2.9** or the 2008 MPU model for more details if necessary.

Also, it should be noted that the 2008 MPU assumes that the existing 60" RCP in Pecos Road south of Bonanza Road will be abandoned (see **Figure** 4). However, the Cedar Avenue Channel has been designed to accommodate this flow. Therefore, in the future, the 60" RCP can remain in place without any adverse impacts on the channel, which may reduce the size of the future regional facility in Bonanza. This assumption will need to be confirmed during the design of the Bonanza Road regional facility.

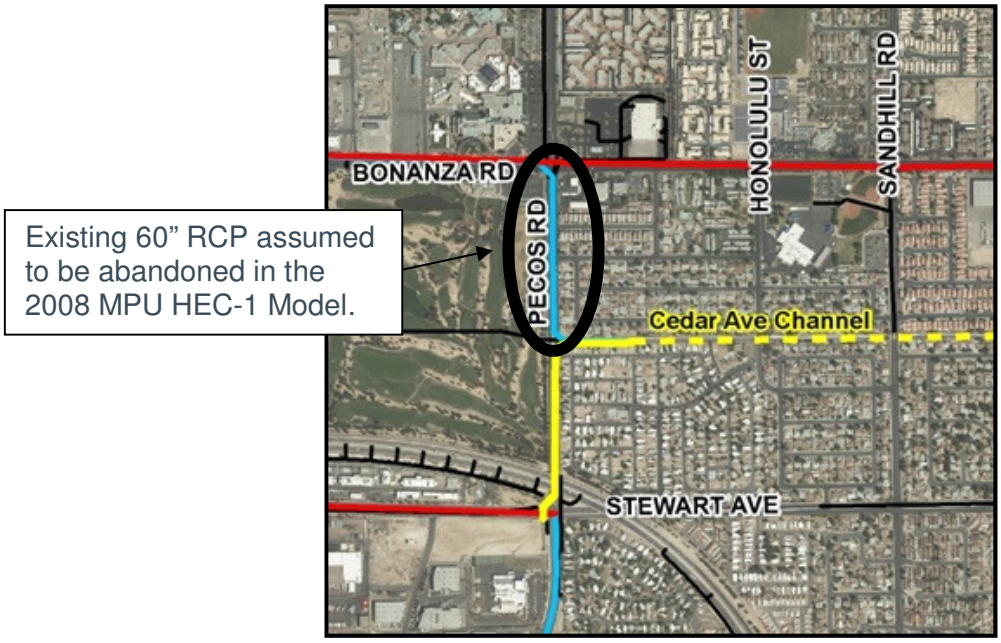


Figure 4. Existing 60" RCP in Pecos Rd

2.7. Hydrologic Analysis Results

The 100-year peak flows from the ultimate condition HEC-1 model for the subbasins, diversions, and combination points are summarized on the Hydrologic Summary Map **(Figure 7**) at the end of this section. **Table 1** summarizes the main design flows at key locations. The table also includes the MPU Flows from the 2008 MPU for comparison purposes.

Table 1. Summary of Design Flows at Key Locations

Location	HEC-1 Combo Point	Ultimate Flow (cfs)	MPU Flow (cfs)
Downstream of Pecos/Stewart intersection (total flow in the proposed SD)	CCA05	702	-
Outlet of 2:72" RCP's (at upstream end of channel)	CCA06	1085	1170
Honolulu Street	CCA08	1173	-
Sandhill Road	CCA09	1210	-
Red Bandana Street	CCA10	1236	-
Lamb Blvd	CCA11	1310	1387
Page Street	CCA12	1359	-
Marion Drive (Upstream)	CCA13a	1410	-
Marion Drive (Downstream)	CCA13	2924*	-
Las Vegas Wash	CCA14	2961*	1544

*Includes Bonanza Avenue flow

2.8. Stewart Avenue Collection and Bypass Flow

After the initial HEC-1 model was run, it was subsequently modified through an iterative process in order to represent the flow collected in the proposed drop inlets and storm drains at the intersection of Stewart Avenue and Pecos. In other words, initial hydrologic results were used in the hydraulic analysis to size collection facilities, and then the hydrologic model was updated afterward to divert flows to proposed storm drain facilities and determine the remaining bypass flow on the streets. This provides consistency between the hydrologic and hydraulic analysis and results in a model that is representative of the post-project condition.

As shown in **Figure 8**, 745 cfs flows east on Stewart Avenue towards Pecos road. A portion of that flow (approximately 445 cfs) is collected and conveyed in proposed drop inlets/laterals as well as the existing 24" RCP in Stewart Avenue. An additional 55 cfs enters the storm drain system from the drainage swale and headwall south of Stewart Avenue, for a total peak 100-year flow in the storm drain of 502 cfs (HEC-1 node CCA05-2a). 50% clogging was assumed at the drop inlets.

The existing dual 48" RCP on Pecos Road conveys 210 cfs and will connect with the proposed storm drain system north of Stewart Avenue, resulting in a combined total flow of 688 cfs (HEC-1 node CCA05-4). Some minor existing storm drains will connect to the system downstream of this point and add an additional 14 cfs which increases the total flow in the system to 702 cfs (HEC-1 node CCA05).

The flow bypassing the proposed storm drain system on Stewart Avenue is approximately 315 cfs. There is an additional 79 cfs in the street on Pecos Road that is bypassed east on Stewart Avenue. The total bypass flow on Stewart Avenue is 357 cfs (HEC-1 node CSTEWBY) when timing in th hydrology is accounted for. While this is a significant improvement compared to the existing condition, there will still be a flow conveyed eastward on the surface of Stewart Avenue. According to the Central Neighborhood Flood Control Master Plan, there is an additional 300 cfs that drains to

Stewart Avenue from tributary areas north of Stewart Avenue between Pecos Road and the Las Vegas Wash. This flow will combine with the bypass flow of 357 cfs at the low point in Stewart Avenue west of Marion Drive, resulting in more than 500 cfs at this location. The existing 48" RCP in Stewart Avenue does not have adequate capacity to convey the flow to the Las Vegas Wash and thus ponding will occur. Atkins recommends that this area be reviewed in more detail and a proposed regional facility in Stewart Avenue (between the low point and the Las Vegas Wash) be considered for inclusion in the Las Vegas Valley MPU.

Atkins performed sensitivity analysis to determine the maximum and minimum range of flows that reaches the channel and bypasses east on Stewart Avenue. The range of flow was obtained by modelling a 50% clogged drop inlets and 100% efficient drop inlets, and using different modelling approaches such as WSPG, HEC-RAS, XPSWMM to compare the results. **Figure 5** summarizes the range of flows. The maximum flow that is collected in the storm drain is 766 cfs, and the maximum flow that is bypassed east on Stewart Avenue is 398 cfs. The details of the modelling approaches used can be found in **Section 3.3.** The details of the analysis can be found in Meeting Minutes from Progress Meeting #15 which is included in the **Data CD**.

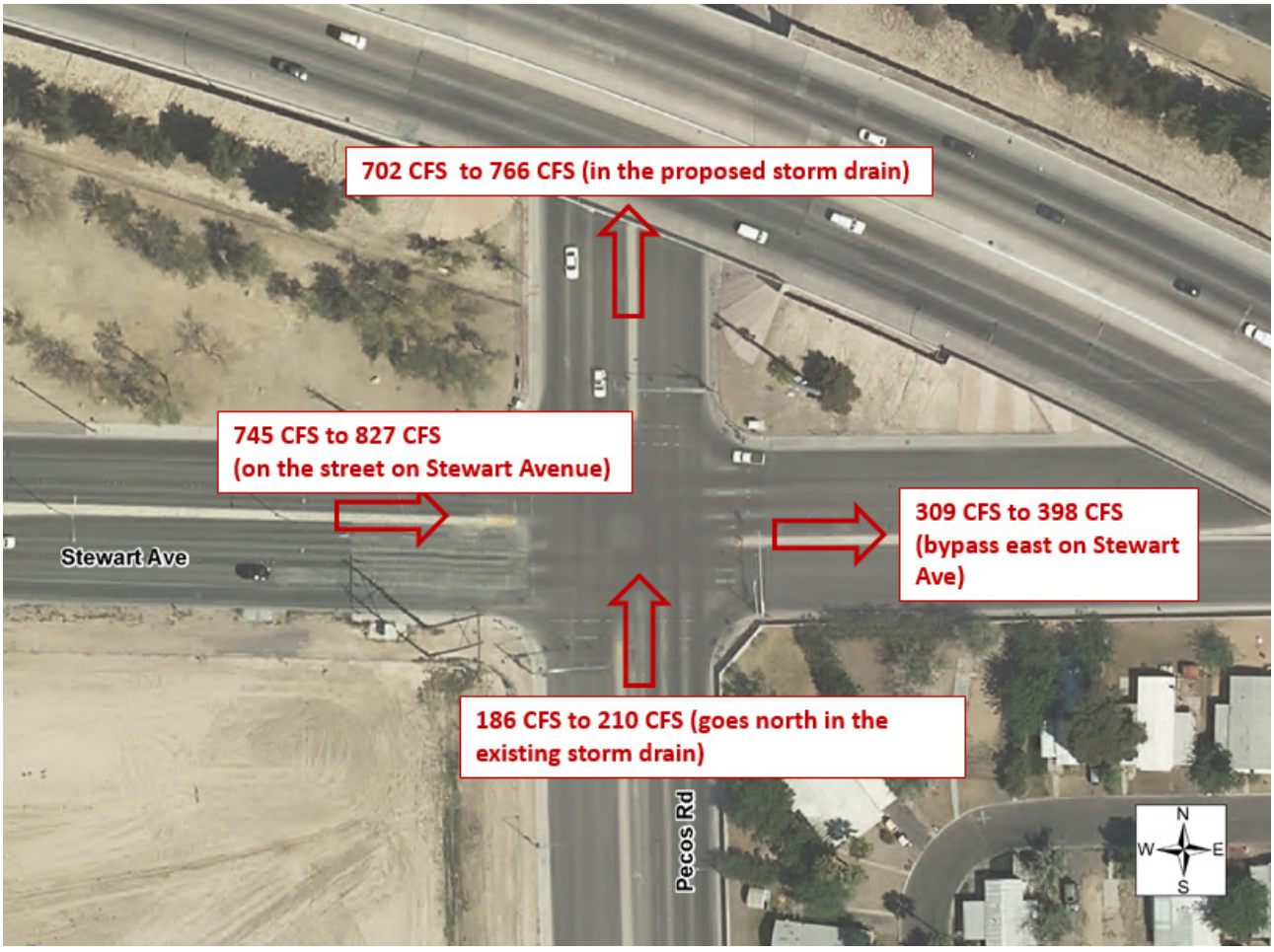


Figure 5: Summary of Range of Flows

2.9. Marion Drive Confluence

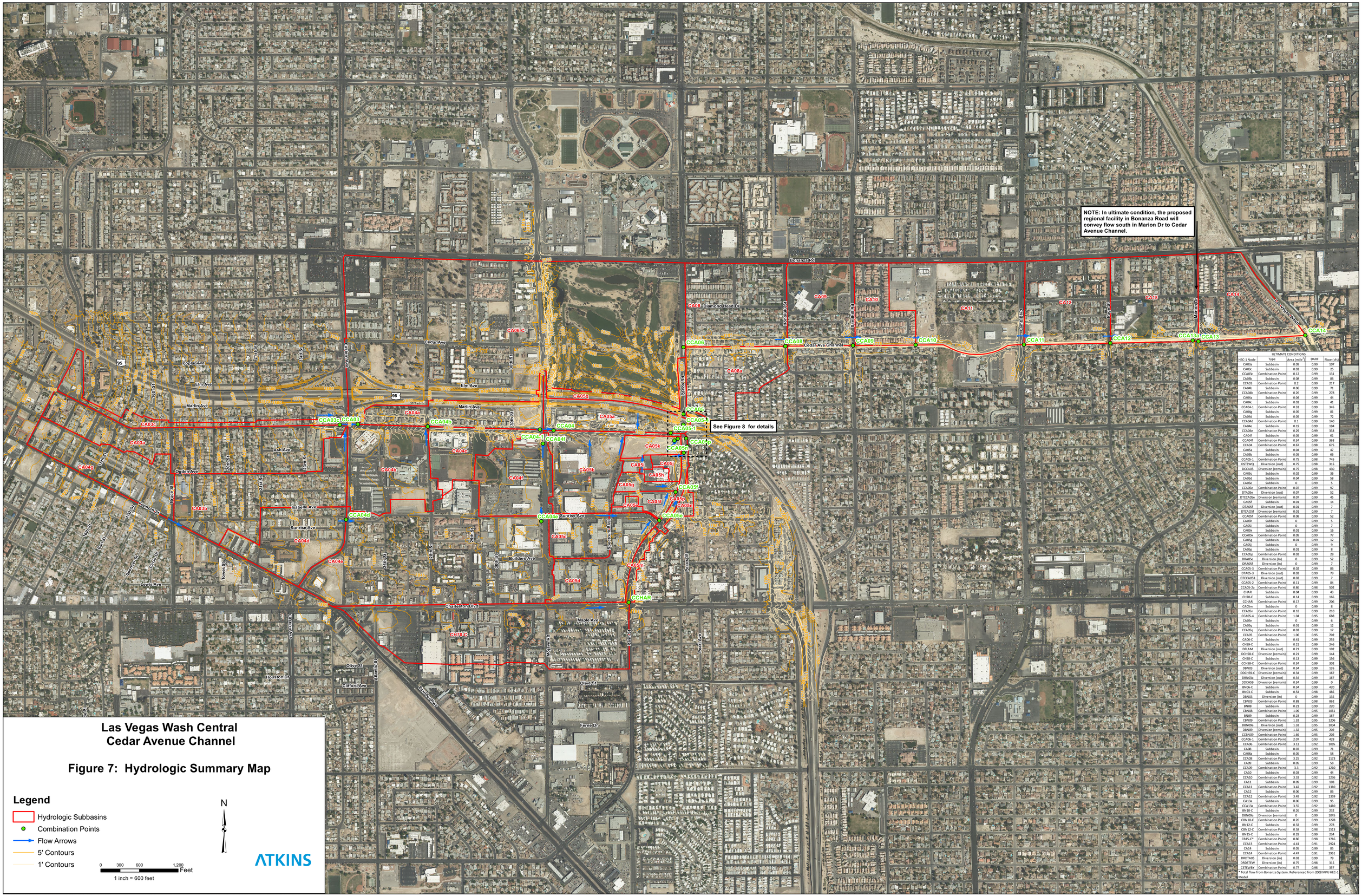
The Las Vegas Wash CMAR project determined that connecting the proposed regional facility in Bonanza Road to the Las Vegas Wash would be difficult because of the bridge configuration, right-of-way, and other design constraints. As a result, they proposed to re-route the proposed regional facility down Marion Drive to the Cedar Avenue Channel instead of connecting directly to the Las Vegas Wash. This results in increased flow in the Cedar Avenue Channel and a need for a major confluence structure and a larger channel to accommodate the combined flow.

As described previously, this alternative alignment and future regional facility in Marion Drive has been incorporated into the ultimate condition HEC-1 model using the 2008 MPU as a reference. The resulting flows in the area are shown on **Figure 6**.



Figure 6. Future Bonanza Regional Facility and Marion Drive Confluence

As shown above, the 100-year ultimate condition flow in the Bonanza Road regional facility is around 1,783 cfs, while the channel has a 100-year flow of 1,208 cfs. This results in a combined total flow of 2,875 cfs to be conveyed in the Cedar Avenue Channel downstream of Marion Drive. The design of the channel and future confluence to accommodate this increased flow will be described in the next section.



Las Vegas Wash Central
Cedar Avenue Channel

Figure 7: Hydrologic Summary Map

Legend

- Hydrologic Subbasins
- Combination Points
- Flow Arrows
- 5' Contours
- 1' Contours

0 300 600 1,200 Feet

1 inch = 600 feet

N

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ULTIMATE CONDITIONS

HEC-1 Node	Type	Area (mile^2)	DARF	Flow (cfs)
CA03a	Subbasin	0.09	0.99	107
CA03c	Subbasin	0.02	0.99	25
CCA03c	Combination Point	0.12	0.99	131
CA03b	Subbasin	0.08	0.99	86
CCA03	Combination Point	0.2	0.99	217
CA04b	Subbasin	0.06	0.99	71
CCA04b	Combination Point	0.26	0.99	278
CA04a	Subbasin	0.04	0.99	44
CA04c	Subbasin	0.03	0.99	41
CCA04-1	Combination Point	0.33	0.99	349
CA04g	Subbasin	0.05	0.99	81
CA04d	Subbasin	0.05	0.99	72
CCA04d	Combination Point	0.1	0.99	140
CA04e	Subbasin	0.19	0.99	194
CCA04e	Combination Point	0.29	0.99	333
CA04f	Subbasin	0.05	0.99	63
CCA04f	Combination Point	0.34	0.99	363
CA04h	Combination Point	0.67	0.98	675
CA05a	Subbasin	0.04	0.99	47
CA05b	Subbasin	0.05	0.99	66
CCA05-1	Combination Point	0.75	0.98	745
DSTEWQ	Diversion (out)	0.75	0.98	315
DCCA05	Diversion (remain)	0.75	0.98	430
CA05c	Subbasin	0.02	0.99	36
CA05d	Subbasin	0.04	0.99	58
CA05e	Subbasin	0	0.99	5
CCA05e	Combination Point	0.07	0.99	97
DTA05e	Diversion (out)	0.07	0.99	52
DTCCA05e	Diversion (remain)	0.07	0.99	45
CA05f	Subbasin	0.01	0.99	14
DTA05f	Diversion (out)	0.01	0.99	7
DTCCA05f	Diversion (remain)	0.01	0.99	7
CCA05f	Combination Point	0.08	0.99	52
CA05h	Subbasin	0	0.99	5
CA05i	Subbasin	0	0.99	7
CA05k	Subbasin	0.01	0.99	16
CCA05k	Combination Point	0.09	0.99	77
CA05g	Subbasin	0.01	0.99	12
CA05j	Subbasin	0	0.99	9
CA05p	Subbasin	0.01	0.99	8
CCA05p	Combination Point	0.02	0.99	28
DRA05e	Diversion (in)	0	0.99	52
DRA05f	Diversion (in)	0	0.99	7
CCA05-3	Combination Point	0.02	0.99	86
DTA05-3	Diversion (out)	0.02	0.99	79
DTCCA05J	Diversion (out)	0.02	0.99	7
CCA05-2	Combination Point	0.11	0.99	84
CCA05-2a	Combination Point	0.86	0.98	509
CHAR	Subbasin	0.04	0.99	43
CH70-C	Subbasin	0.14	0.99	165
CCHAR	Combination Point	0.17	0.99	206
CA05m	Subbasin	0	0.99	8
CCA05n	Combination Point	0.18	0.99	210
CCA05-4	Combination Point	1.04	0.95	688
CA05n	Subbasin	0	0.99	6
CA05q	Subbasin	0.01	0.99	12
CCA05q	Combination Point	0.02	0.99	17
CCA05	Combination Point	1.06	0.95	702
CA06-C	Subbasin	0.41	0.99	255
CH59-C	Subbasin	0.21	0.99	246
DFLAM	Diversion (out)	0.21	0.99	102
DCH58-C	Diversion (remain)	0.21	0.99	144
CH58-C	Subbasin	0.13	0.99	156
CCH58-C	Combination Point	0.34	0.99	309
DBN03	Diversion (out)	0.34	0.99	135
DDCH59-C	Diversion (remain)	0.34	0.99	167
DBN03a	Diversion (out)	0.34	0.99	167
DDCH59	Diversion (remain)	0.34	0.99	0
BN06-C	Subbasin	0.34	0.99	420
BN03-C	Subbasin	0.54	0.98	485
DBN03	Diversion (in)	0	0.99	135
CBN03	Combination Point	0.88	0.98	862
BN08	Subbasin	0.21	0.99	220
CBN08	Combination Point	1.09	0.95	1061
BN09	Subbasin	0.23	0.99	167
CBN09	Combination Point	1.32	0.95	1206
DBN09a	Diversion (out)	1.32	0.95	1004
DBN09	Diversion (remain)	1.32	0.95	202
CCBN09	Combination Point	1.66	0.95	202
CCA06-1	Combination Point	2.07	0.93	428
CCA06	Combination Point	3.13	0.92	1085
CA08	Subbasin	0.07	0.99	71
CA08a	Subbasin	0.05	0.99	58
CCA08	Combination Point	3.25	0.92	1173
CA09	Subbasin	0.05	0.99	58
CCA09	Combination Point	3.3	0.92	1210
CA10	Subbasin	0.03	0.99	44
CCA10	Combination Point	3.33	0.92	1236
CA11	Subbasin	0.09	0.99	103
CCA11	Combination Point	3.42	0.92	1310
CA12	Subbasin	0.06	0.99	86
CCA12	Combination Point	3.49	0.92	1359
CA13a	Subbasin	0.06	0.99	95
CCA13a	Combination Point	3.55	0.92	1410
BN10-C	Subbasin	0.26	0.99	232
DBN09a	Diversion (remain)	0	0.99	1045
CBN10-C	Combination Point	0.26	0.99	1278
BN12-C	Subbasin	0.32	0.99	278
CBN12-C	Combination Point	0.58	0.98	1513
BN15-C	Subbasin	0.28	0.99	234
CB15-C*	Combination Point	0.86	0.98	1718
CCA13	Combination Point	4.41	0.91	2924
CA14	Subbasin	0.05	0.99	85
CCA14	Combination Point	4.47	0.91	2961
DROTA05	Diversion (in)	0.02	0.99	79
DROSTEW	Diversion (in)	0.75	0.98	315
CSTEWBY	Combination Point	0.77	0.98	357

* Total Flow from Bonanza System. Referenced from 2008 MPU HEC-1 Model

Stewart Avenue

CSTEWBY
357 CFS
Bypass Flow

CCA05-3
79 CFS
Bypass Flow

Pecos Road

CCA05p

CCA05n
210 CFS
(existing dual 48" RCP SD)

CCA05
702 CFS

CCA05-4
688 CFS

315 CFS
Bypass Flow

CCA05-2a
502 CFS

64 CFS

55 CFS

CCA05-2
84 CFS

82 CFS

82 CFS

100 CFS

100 CFS

CCA05k

19 CFS

CCA05-1
745 CFS

Las Vegas Wash Central
Cedar Avenue Channel

Figure 8: Stewart Avenue Bypass and Collection

- Existing Local Facilities
- Proposed Drop Inlets
- Proposed Storm Drain
- Combination Points (HEC-1 Nodes)

N

0 15 30 60 Feet

1 inch = 30 feet

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3. Proposed Design and Hydraulic Analysis

3.1. General

This section includes information about the proposed design of the storm drain and channel facilities. It also presents the hydraulic analysis, criteria, and methodology that were used to develop the 70% design of the Cedar Avenue Channel.

3.2. Proposed Design

For the purpose of organizing the information presented in this Section, the project improvements are grouped into two categories: (1) the storm drain system improvements (from Pecos Road/Stewart Avenue to the existing Cedar Avenue Channel and (2) the channel improvements (from the upstream end of the Cedar Avenue Channel to the Las Vegas Wash). The overall design concepts are described below:

3.2.1. Pecos/Stewart Storm Drain System

The proposed storm drain system has been designed to collect as much flow as possible from Stewart Avenue to alleviate downstream flooding.

The proposed storm drain system is comprised of new drop inlets and laterals on Stewart Avenue that collect surface flow and connect to a mainline storm drain on the north side of Stewart Avenue.

The mainline storm drain consist of an 18’ x 5’ RCB north of Stewart Avenue and west of Pecos Road that transitions into a dual 8’X5’ RCB at the Pecos Road/Stewart Avenue intersection in order to cross over an existing 36” sewer. After crossing the sewer, the dual 8’ x 5’ RCB transitions into an 18’ x 5’ RCB north of the intersection. At this location, the existing dual 48” RCPs in Pecos Road will connect to the 18’ x 5’ RCB. The storm drain then transitions to a 12’ x 6’ RCB that continues north in Pecos Road before turning east and eventually discharging to the Cedar Avenue Channel. The proposed storm drain facilities are shown in a schematic in **Figure 10**.

There are three laterals that go across Stewart Avenue and connect to the mainline storm drain. The sizes and schematic of the laterals are also shown in **Figure 10**. This configuration of the laterals represents the most efficient scenario as it collects the maximum flow. Although three trenches and work zones will be required during construction, having only one lateral go across Stewart Avenue to connect to the mainline would not collect as much flow.

The above mentioned design of the storm drain system is driven by several constraints:

- There is an existing 36” sewer running through the Pecos Road/Stewart Avenue intersection. The sewer line is not very deep and limits the storm drain to be short and shallow. There is not enough room to cross the sewer line using a mega box (18’ x 5’ RCB) with a thicker slab. Therefore, the transition of an 18’ x 5’ RCB to a dual 8’ x 5’ RCB is required. The total capacity of the storm drain is controlled by the capacity of the dual 8’ x 5’ RCB, which is around 500 cfs. Several alternatives were investigated to relocate the sewer, but the feasibility and costs did not result

in suitable alternatives. Additional information is described in project meeting minutes.

- 5' tall RCBs at Pecos/Stewart intersection provides essentially no cover or paving over the box, and therefore would require a thicker roof slab that is monolithic with the pavement and adequate for driving. The 5' tall boxes were recommended by the City for easy maintenance access.

- The mainline storm drain is also constrained by the existing invert at the downstream connection point in the Cedar Avenue Channel. Therefore, the slope is relatively flat and governed by crossing over the sewer and tying into the channel.

- Lateral 3 (5' x 3' RCB) contains a grade break to go over the utilities and gain enough cover on top.

3.2.2. Cedar Avenue Channel

As discussed in the Cedar Avenue Channel Capacity Analysis, the channel is limited in capacity and has experienced overtopping in the existing condition. Similarly, it does not have adequate capacity to convey the ultimate condition flows. The proposed design is intended to increase the conveyance capacity of the channel in order to improve the existing conveyance and to accommodate the design flows that will be discharged to the channel after the proposed storm drain is complete. From upstream to downstream, the proposed channel improvements include:

Upstream of Honolulu Street: For this section of the channel, no changes have been proposed. The channel will remain a trapezoidal channel with a 10' bottom width, 1.5:1 side slopes, and around 8.25' of depth. The bridge crossing (dual 12' x 5.5' RCB) at Honolulu Street will remain in place.

Honolulu Street to Sandhill Road: The new channel section between Honolulu. Street and Sandhill Road is proposed to be a 25' wide rectangular channel. It will transition to a 36' wide channel just upstream of Sandhill Road Crossing. The bridge crossing at Sandhill Road (1: 12' x 4' RCB and 2: 11' x 4' RCB) will remain in place as replacing Sandhill with a 4' tall megabox results in negligible hydraulic changes. Culverts at Sandhill cannot be replaced with anything taller than 4' as Sandhill Road cannot be reprofiled. Details of this analysis is provided in notes from Progress Meeting #17 in **Data CD**.

Sandhill Road to Lamb Boulevard: In this section, the channel is shifted approximately 2' north from its existing centerline. The shift north is required because south end of the existing channel is very close to the fencing and block walls. The shift of the channel is discussed in **Section 4.3.2.**

For about 700' downstream of Sandhill Road, the new channel section is proposed as a 36' wide rectangular section. At this location, it transition into a 31' wide rectangular section, which is necessary because the right-of-way constricts from 60' wide to 50' wide in this area. Contracting the channel allows for minimum trail widths to be maintained (see **Section 4.2.2**).

The 31' wide rectangular channel section then continues on downstream and ties into the proposed dual 15' x 6' RCB culvert crossing (which replaces the existing dual 12' x 6' RCB culverts) at Lamb Boulevard. The culverts are being replaced because the dual 15' x 6' RCBs results in much better hydraulics between Sandhill and Lamb as can be seen in **Figure 9**. The centerline of the proposed culverts will be 4' north of the centerline of the existing culvert.

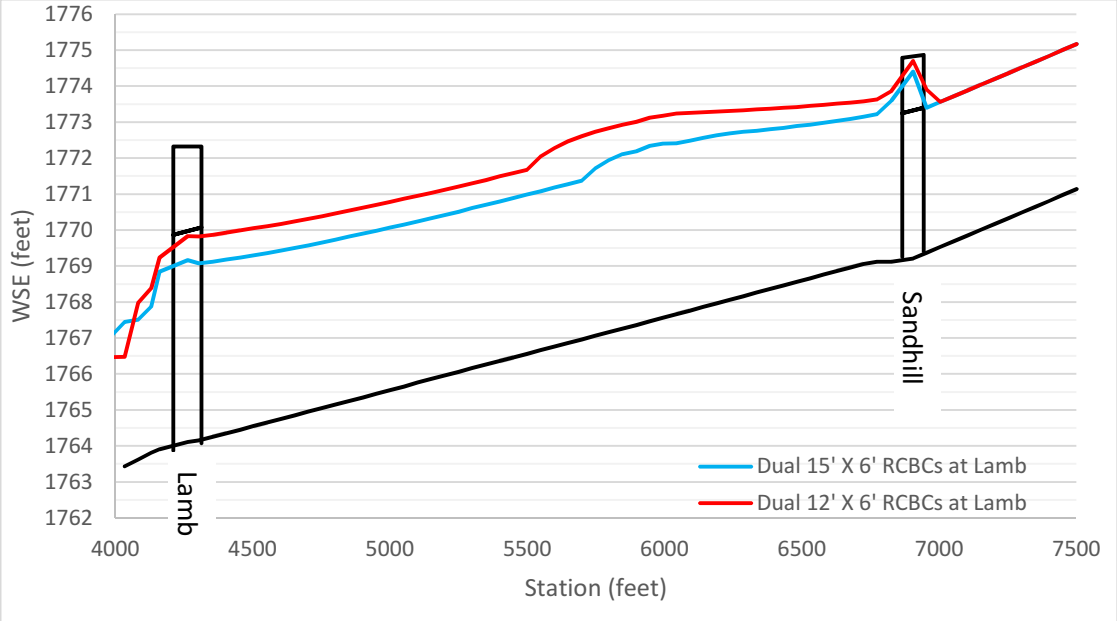


Figure 9 Comparison in WSE between existing and proposed culverts at Lamb

In addition, a 1-foot tall vertical wall on the north side of the channel is proposed to extend 1,500 feet upstream from Lamb Boulevard to provide additional freeboard (see **Section 3.4** for freeboard analysis).

Lamb Boulevard to Page Street: Immediately downstream of the Lamb crossings, the proposed channel transitions from 31' to 29' in order to maintain 8' minimum train width and 12' access ramp width. The 29' wide channel shifts north by approximately 2' after the access ramp and continues for about 700' to provide room for construction on the south side, and then transitions back into a 31' wide channel.

Page Street to Marion Drive: The proposed channel is a 31' wide rectangular channel downstream of Page Street. It remains the same throughout the section.

Downstream of Marion Drive: Downstream of Marion Drive, the proposed 31' rectangular channel continues for approximately 200 feet. At this point, there is a channel transition which will accommodate future flow from the Bonanza regional facility while dropping 7 feet in elevation and narrowing into a 22' wide rectangular section. The rectangular channel will be deep (ranging from 15' to 17' deep) and extend at 0.2% slope until connecting to the Las Vegas Wash.

The design of the channel section downstream of Marion Drive assumes that the alternative alignment for the Bonanza Road regional facility will be used as described in Section 2. It was assumed that the future regional facility in Marion Drive would be

approximately 20 feet wide in order to accommodate the 100-year flow from Bonanza Road of 1,785 cfs. The future facility will combine with the Cedar Avenue Channel downstream of Marion Drive Bridge (which will remain in place).

The 7 feet drop in elevation is needed downstream of Marion Bridge to accommodate for additional 1,785 cfs from future Bonanza Road regional facility. It should be noted that excavating and constructing this section of the channel will require the use of a temporary retaining wall, such as driven piles, for stabilization. The only way the drop in the channel can be avoided is if the Bonanza Road future facility does not enter Cedar Avenue Channel.

The future 20' wide regional facility coming into the channel from Marion Drive will need to consist of dual 10' wide boxes (or similar geometry with a center pier) as the Cedar Drainage Trail will be maintained on top of the box. Span cannot be 20' wide for structural integrity purposes. This conceptual confluence layout is included in the design plans and is subject to review and revision during future design phases.

Figure 11 summarizes the proposed design for the Cedar Avenue Channel.

The channel design was driven by several constraints which are listed below:

- The Cedar Drainage Trail runs alongside the entire length of the channel, making it difficult to widen the channel and still accommodate the trail and access ramps.
- The existing channel profile is very flat and does not provide topographic relief or option to steepen the channel to increase conveyance capacity
- The design intent was to maintain most of the existing crossings/bridges at the cross street to avoid costs associated replacing the culvert crossings and disturbing traffic. The only crossing/bridge that is being replaced is at Lamb Boulevard because replacing Lamb improves hydraulics of the channel. Sandhill Bridge will remain in place as replacing it results in negligible hydraulics change.
- Between Sandhill Road and Lamb Boulevard, the right-of-way constricts from 60' to 50' limiting the corridor even further.
- Channel is shifted north by approximately 2' between Sandhill and Lamb to provide room for construction in the south side of the channel.
- Between Lamb and Page, a portion of the channel shifts north by approximately 2' to provide room in the south side.
- Design of the downstream end of the channel (past Marion Drive) was dictated by the proposal to bring in more flow from Bonanza Road and by the constraint to tie into the proposed, narrow confluence structure proposed as part of the Las Vegas Wash CMAR project.
- Constructability of the channel in a narrow corridor with the above constraints will require specialized construction methods and caution. Refer to **Section 4.3** for additional information.

Atkins worked with the City during various workshops and progress meetings in order to review alternatives and develop the proposed design described above. Constructability review was also performed after the 30% Design Phase. The constructability review comment matrix can be found in **Appendix A** The proposed design incorporates constructability review comments, and is the result of the coordination that occurred in order to come up with cost-effective, feasible design concepts that provide maximum flood control in accordance with the regional master plan in the area. The proposed design is still in the process of being reviewed and optimized and is subject to revision as the design phase continues.



Las Vegas Wash Central
Cedar Avenue Channel

Figure 10: Pecos/Stewart Storm Drain System

Proposed Storm Drain

- 12'x6' RCB
- 18'x5' RCB
- 2:8'x5' RCB
- 5'x3' RCB
- 7'x3' RCB
- 8'x4' RCB

Proposed Drop Inlets

N

0 50 100 200 Feet

1 inch = 100 feet

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Lighthouse Ave

No Proposed Improvements
Existing Trapezoidal Channel
10' W, 1.5:1 SS, 8.25' D

Honolulu St

2:12'x5.5' RCB

Montebello Ave

Buoy St

Transition from
25' BW to 36' BW

Sandhill Rd

1:12'x4' RCB &
2:11'x4' RCB

Lehman St

Montebello Ave

Transition from
36' BW to 31' BW

Montebello Ave

Lamb Blvd

2:15'x6' RCB

Transition from
31' BW to 29' BW

Prince Cary Ct

Transition from
29' BW to 31' BW

2:15'x5' RCB

Montebello Ave

Rhoda St

Page St

Julene Ct

Page St

Montebello Ave

Miratan St

Martha St

Marion Dr

Transition from
31' BW to 22' BW
Channel drops 7 feet with 3.4% Slope

2:15'x5' RCB

Lancewood Ave

Montebello Av

Carlin Ave

Barlow Ln

Las Vegas Wash Central
Cedar Avenue Channel
Figure 11: Proposed Channel Design

- 22' BW Reactangular Channel
- 31' BW Rectangular Channel
- 29' BW Rectangular Channel
- 25' BW Rectangular Channel
- 36' BW Reactangular Channel
- 1-foot Vertical Wall
- Parcels

N

0 100 200 Feet

1 inch = 200 feet

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3.3. Hydraulic Analysis Methodology and Results

3.3.1. Pecos/Stewart Storm Drain System

WSPG Model and Facility Sizing

The Pecos/Stewart Storm Drain mainline and laterals were analysed and sized using the Water Surface Pressure Gradient (WSPG) computer program. The computational procedure used in WSPG is based on solving Bernoulli's equation for the total energy at each section and Manning's equation for friction losses between sections in a reach. The program accounts for energy losses at junctions, angle points, and transitions and uses basic hydraulic principles to calculate hydraulic data such as flow area, wetted perimeter, critical depth, hydraulic grade line, Froude number, momentum, etc. The geometry, slopes, and sizes of the mainline were input into WSPG along with the design flows, and the model was run in order to ensure that the hydraulic grade line (HGL) or depth of flow remained at least 1 foot below final grade at all locations. The mainline WSPG model is included in **Appendix C**. An additional model which uses Manning's n of 0.013 is included in the **Data CD** along with the original model.

The hydraulic grade line can be seen for the entire storm drain system and the laterals on the submitted 70% Design Plans.

3.3.2. Cedar Avenue Channel

HEC-RAS Model and Facility Sizing

The hydraulic analysis for Cedar Avenue Channel was performed using the steady state routines within the HEC-RAS computer model, Version 4.1.0 (USACE, 2010) based on the 100-year peak flows for the ultimate condition. An existing condition scenario was also analysed in HEC-RAS to evaluate the current water surface profile today. The parameters used in the hydraulic analysis are described below:

- **Channel Geometry**: Channel geometry is based on detailed field survey obtained by Atkins at several channel cross sections as well as upstream and downstream of all of the bridge crossings. The HEC-RAS 'XS Interpolation' tool was also used to interpolate cross sections every 50 feet between the surveyed cross sections. Detailed 1-foot topography was also obtained and used as necessary in the modeling effort in locations where survey was not available. Channel geometry for cross sections upstream and downstream of structures are provided in **Appendix C**.

- **Manning's Roughness**: Manning's roughness of 0.015 is used for the entire channel reach. An additional model which uses manning's roughness of 0.013 is in included in the **Data CD**.

- **Downstream Boundary Condition:** The HEC-RAS model is executed for the subcritical flow regime based on steady-state flow routines. The model utilizes a normal depth boundary condition at the downstream and upstream ends based on the proposed channel design slopes.

- **Expansion and Contraction Coefficients**: Default values of 0.1 and 0.3 for the contraction and expansion coefficients, respectively, are utilized for cross-sections with gradual transitions where the flow is subcritical. However, these coefficients are increased to 0.3 and 0.5 in the vicinity of each structure.

- **Hydraulic Structures**: The five crossings (Honolulu, Sandhill, Lamb, Page and Marion) are modelled as bridges based on the detailed field survey obtained by Atkins. The geometry and hydraulic parameters for each structures were incorporated into the model using 'Bridge Editor' in HEC-RAS.

Results from HEC-RAS can be found in **Appendix C**. The complete HEC-RAS model, which consists of existing and proposed channel geometries, is included on the Data CD. **Figure 12** below summarizes shows the channel profile and WSE and compares the proposed channel invert with the existing channel invert elevation. The proposed channel design is adequate to convey interim and ultimate condition flows.

The hydraulic grade line for the channel can be seen on the 70% Design Plans.

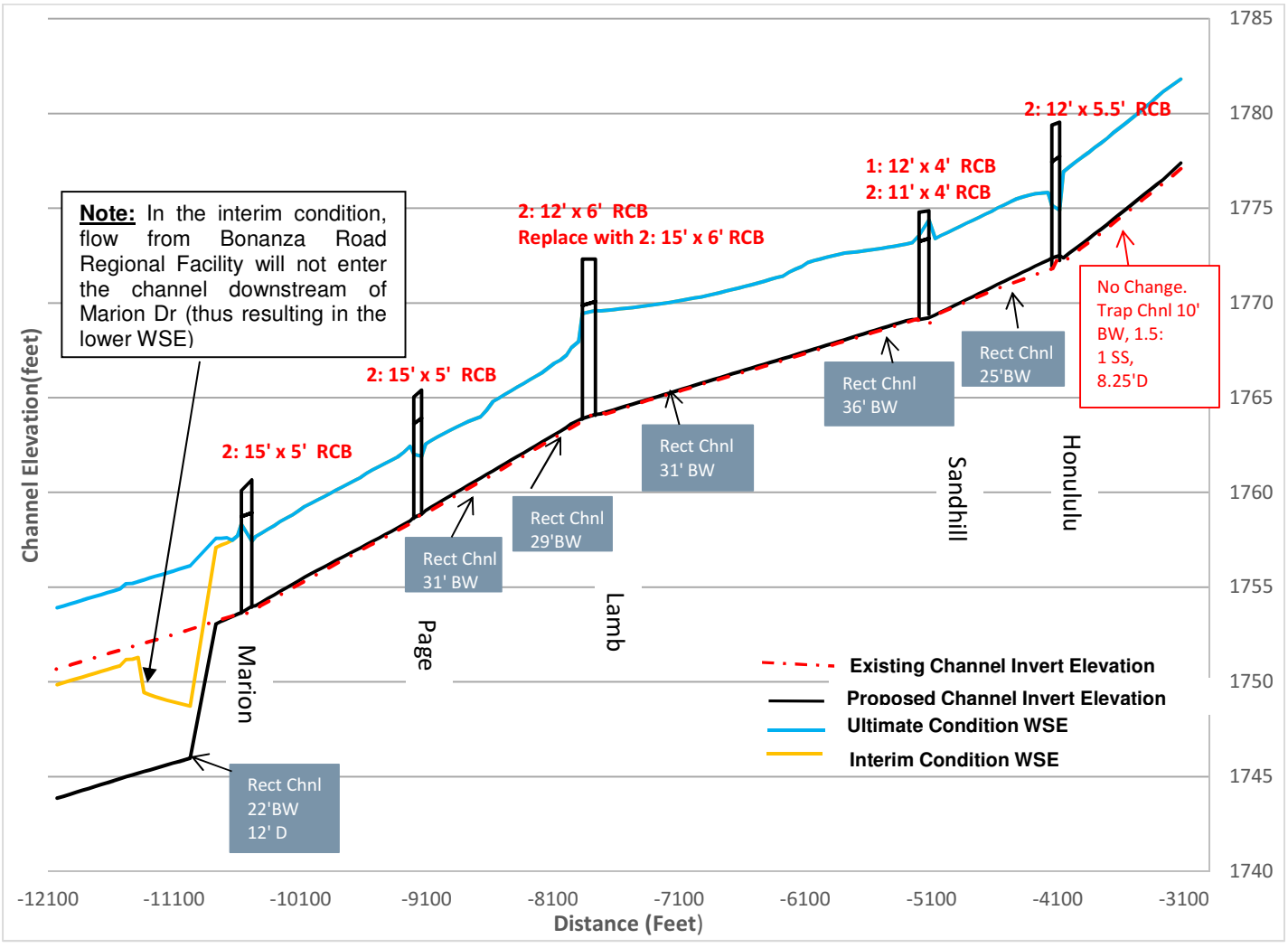


Figure 12. HEC-RAS Profile - Water Surface Elevation (WSE)

The proposed channel design was analyzed to verify if the freeboard criteria presented in HCDDM is met at all model cross sections. The proposed channel has adequate capacity to convey the design flow plus freeboard and an extra tolerance for super-elevation at most channel locations. For a short section upstream of Lamb Boulevard, adequate freeboard was not available because the channel transitions from 36' wide to 31' wide. To address this issue, Atkins proposes a 1' tall wall along the north side of the channel segment. The proposed 1' tall vertical wall provides extra freeboard. Detailed freeboard calculations and a summary table are provided in **Appendix C**.

Freeboard criteria is met at every bridge except for the downstream face of Sandhill crossing and the downstream face of Marion crossing. However, in both of these cases, the available freeboard is greater than 1 foot.

3.3.3. Sensitivity Analysis and XPSWMM

XPSWMM model was used to compare the results of HEC-1, WSPG and HEC-RAS. XPSWMM is a dynamic model that links rainfall runoff, street flow and inlets, storm drain hydraulic and open channel hydraulics into a single model.

The purpose of this comparison was to perform sensitivity analysis to identify if the proposed system operates as intended. A range of flow that can reach the channel was developed using all the approaches (HEC-1, FlowMaster, WSPG and XPSWMM), and updating parameters such as drop inlet clogging and freeboard requirements. **Figure 5** in the previous section summarizes the range of flow that reaches the channel and bypasses east on Stewart Avenue. The results from XPSWMM model were discussed at Progress Meeting #15 which is included in **Data CD.**

3.4. Drop Inlets

Five drop inlets are proposed on Stewart Avenue at the intersection with Pecos Road. The size and locations of the drop inlets were designed in accordance with the criteria established in the CCFRCD Design Manual. The proposed drop inlets have been analyzed to ensure adequate collection that will allow the storm drain to function as intended. The key design criteria used in the design of the drop inlets is discussed below.

All of the proposed drop inlets along Stewart Avenue are Type CM that were designed with a maximum length of 15 feet. The software FlowMaster (Bentley Systems, Inc, 2009) was used to calculate the inlet interception and bypass flow at each drop inlet location based on the roadway longitudinal and cross slopes. The hydraulic computations in FlowMaster are based on HEC-22 methodology.

The drop inlets were sized using a 50% clogging factor to account for conditions that decrease the capacity of the standard inlets. These conditions include plugging from debris and sediment, pavement overlaying, and the general deterioration of inlet conditions over time. This 50% clogging condition was applied in the grate using the option available in FlowMaster Software.

Five new drop inlets have been proposed along Stewart Avenue – two on the south side and three 2 were determined from the ultimate HEC-1 model. Subsequent flows downstream from each inlet were adjusted as necessary to account for intercepted flow and bypass flow.

A drop inlet summary table showing sizes, types, and flows and associated inlet hydraulic calculations is included in **Appendix C**. All drop inlets are shown on the 70% design plans.

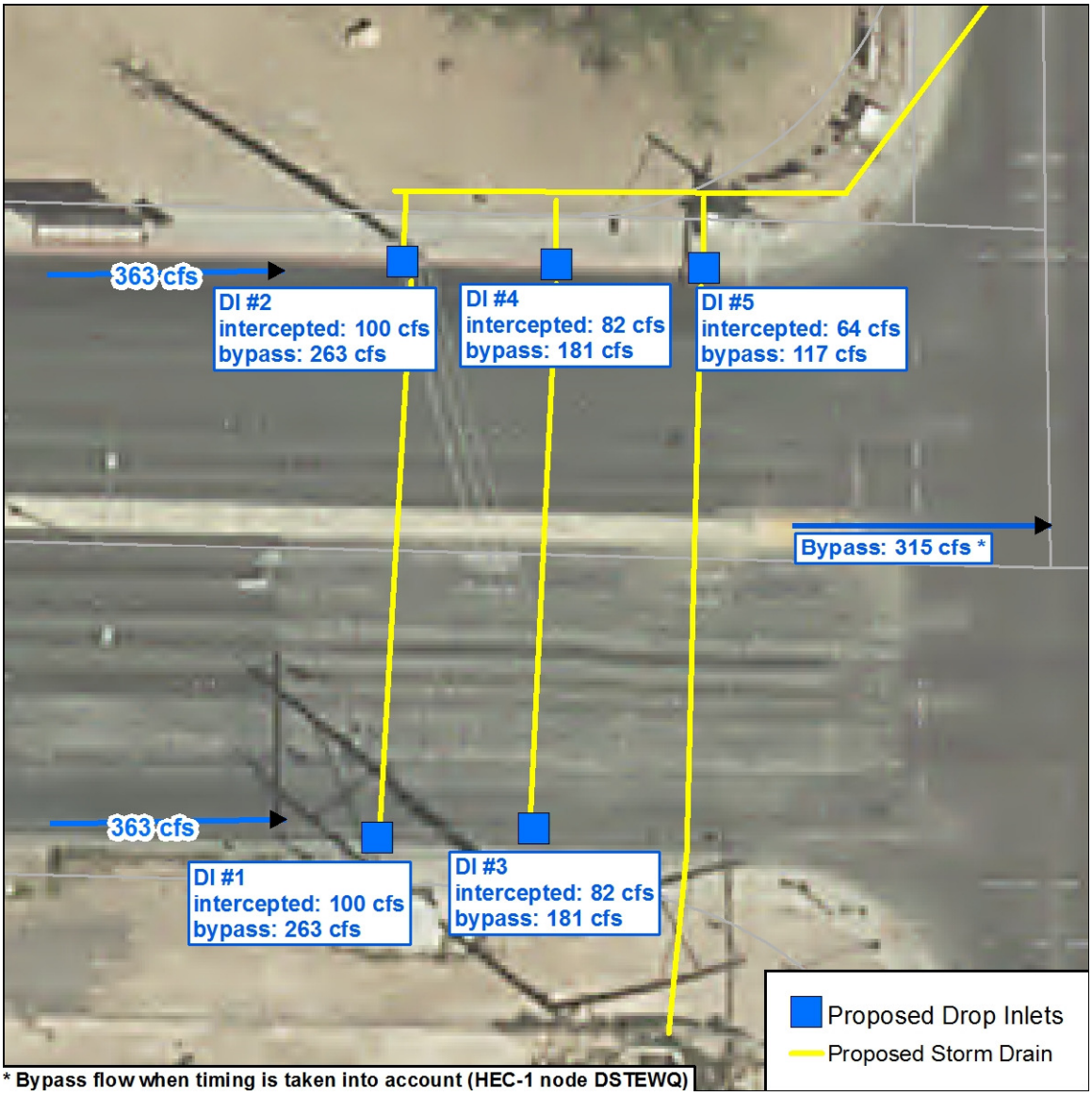


Figure 13. Proposed Drop Inlets

There are existing drop inlets along Pecos Road. These drop inlets collect nuisance flows and do not have an impact the proposed storm drain or channel.

4. Other Design Works and Considerations

This section has been included in the DFDR to summarize key considerations and factors that influenced the 70% design of the CAC. This information has been provided for reference and also to aid with decision making during future design phases. This section also includes a summary of other activities that were performed during the 70% design phase. Pertinent aspects of the project explored to date are included below.

4.1. 2014 Soils Data

As a part of the analysis, Atkins reviewed the latest NRCS soils data (from August 2014) in the project area and noticed some differences between this dataset and the 2008 MPU soils dataset. In order to quantify and better understand the impacts of the new soils data on the hydrologic analysis, Atkins calculated revised CNs in the study area based on hydrologic soils groups shown in the new soils data. These CN values were then incorporated into a separate HEC-1 model for flow comparison. **Table 2** shows the comparison of flows at key locations

Table 2. Summary of Flow Comparison at Key Locations (2014 Soils)

Location	HEC-1 Combo Point	Ultimate Flow 2008 MPU Soils (cfs)	Ultimate Flow 2014 Soils (cfs)
Downstream of Pecos/Stewart intersection (total flow in the proposed SD)	CCA05	702	673
Outlet of 2:72" RCP's (at upstream end of channel)	CCA06	1085	1112
Honolulu Street	CCA08	1173	1207
Sandhill Road	CCA09	1210	1237
Red Bandana Street	CCA10	1236	1260
Lamb Blvd	CCA11	1310	1347
Page Street	CCA12	1359	1396
Marion Drive (Upstream)	CCA13a	1410	1440
Marion Drive (Downstream)	CCA13	2924*	2952*
Las Vegas Wash	CCA14	2961*	2977*

*Includes Bonanza Avenue flow

It should be noted that the new soils dataset was used only in the Cedar Avenue Channel watershed. Portions of the model that are based on referenced studies were not changed.

As shown in **Table 2**, the total flow in the storm drain system decreases from 702 cfs to 673 cfs (HEC-1 node CCA05). However, the total flow in the channel increases with the new 2014 soils dataset. Atkins modelled the proposed channel in HEC-RAS with the new increased flows to quantify the impacts of the change. **Figure 14** shows the comparison between the ultimate WSE from the 2008 MPU soils model and 2014 soils model. The difference in WSE is negligible, and thus the proposed design of the channel is still relevant.

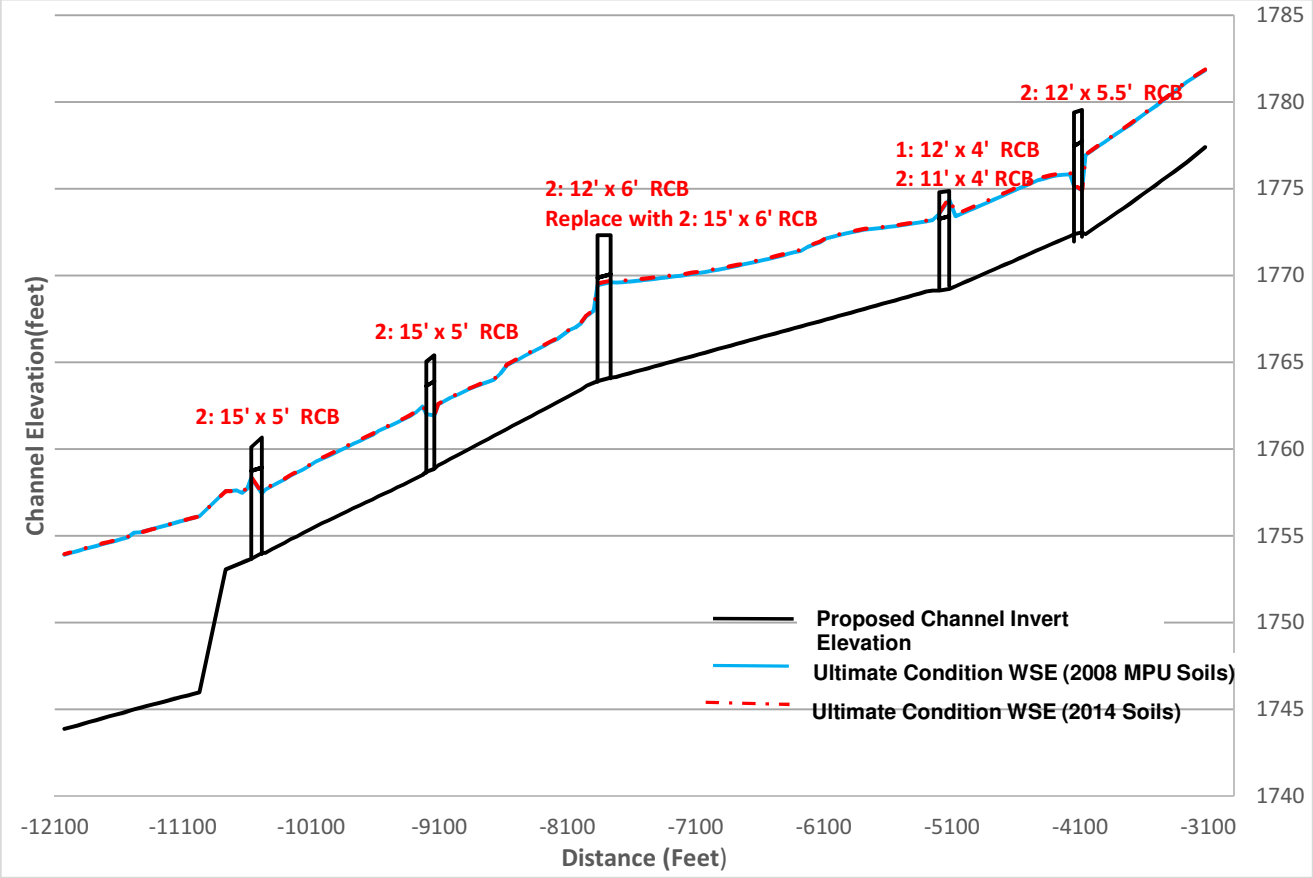


Figure 14. Comparison in WSE

4.2. General Design Considerations

The following is a summary of several design considerations that are pertinent to the overall design of the project now and into the future.

4.2.1. Future Facility in Stewart Avenue

Upstream of the proposed improvements, there is approximately 675 cfs on Stewart Avenue at Mojave Road (see combination point CCA04 in the HEC-1 model). This flow is conveyed east on the surface of Stewart Avenue until it reaches the proposed drop inlets and storm drain at the intersection of Stewart Avenue and Pecos Road.

In the future, the proposed regional facility CNST 0000 (8' X 7' RCB) should be constructed on Stewart Avenue, upstream of the current project between Pecos Road and Mojave Road. This facility will reduce surface flow on Stewart Avenue in order to meet dry lane criteria and can tie into the upstream end of the 18' x 5' RCB installed with this project (north of Stewart Avenue and west of Pecos Road).

A lateral storm drain extending a quarter-mile to the south in Mojave Road could also be installed to collect surface flow in this area. The proposed regional facility and potential lateral storm drain are shown in **Figure 15**.

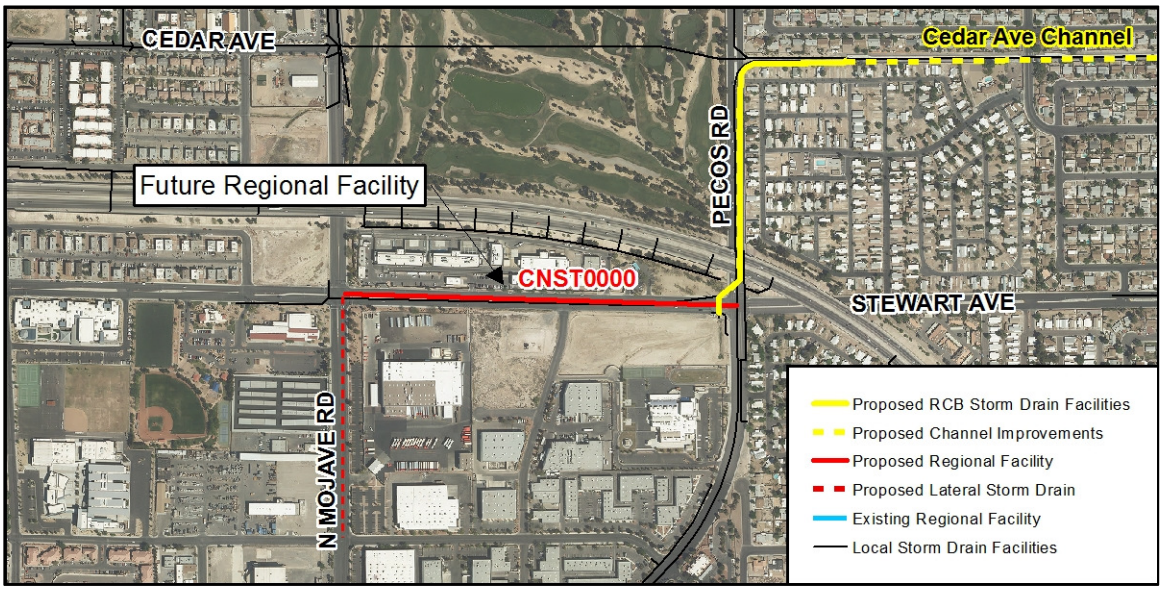


Figure 15. Future Regional Facility in Stewart Avenue

4.2.2. Cedar Drainage Trail

The Cedar Drainage Trail width was kept as wide as possible with the intent to match existing trail widths. At least 8' trail width is maintained throughout the channel as directed by the City after the Progress Meeting #17 (see **Data CD** for meeting minutes and related email). The revised trail widths for each section are described below:

- **Honolulu Street to Sandhill Road:** Original trail width maintained
- **Sandhill Road to channel bend:** Channel is shifted north by approximately 2'. The trail width varies from 9.5' to 8' minimum to allow for channel width and for constructability reasons. The trail lighting is protected-in-place.

  Access ramp is removed from this section as this section of the trail is narrow and having an access ramp would result in only 4' of trail. 20' access gate with post and cable will be installed along the trail instead of an access ramp. This part of the channel will be accessed through the culverts at Lamb. The City has maintenance equipment that will fit through the 6' tall RCBCs at Lamb.
- **Channel bend to Lamb Boulevard:** The trail width is reduced to 8' in this section to shift the channel north.
- **Lamb Boulevard to Page Street:** The trail was reduced but still maintains 12' of width except at the access ramp where the trail is 8'.
- **Page Street to Marion Drive:** The trail was reduced but still maintains 12' of width except at the access ramp where the trail is 8'.
- **Marion Drive to Las Vegas Wash:** The existing trail width has been maintained. In the future, the trail will need to be shifted to north adjacent to the right-of-way boundary from Marion Drive to the end of the access ramp in order to accommodate

the future regional facility that will convey flow from Bonanza Road. The trail would be reduced to 10 feet in the future for that particular section.

4.2.3. Cedar Avenue Channel Access Ramps

Because of proposed widening of the Cedar Avenue channel, the new access ramps into the wider channel section will encroach further into the trail and reduce the existing trail width in these already narrow sections. Effort has been made to provide as much width as possible while still maintaining the required channel and access ramp widths. The minimum amount of trail width remaining adjacent to the access ramps is shown in **Table 3** and a cross-section of the channel/ramp/trail is shown in **Figure 16**. The table and figure are referenced directly from the 70% design plans so refer to those for more information.

Table 3. Minimum Trail Widths at Channel Access Ramps

Access Ramp Location	Paved Trail Width (Adjacent to Access Ramp)
Honolulu Street	8’
Sandhill Road	No ramp
Lamb Boulevard	8’
Page Street	8’
Marion Drive	8’

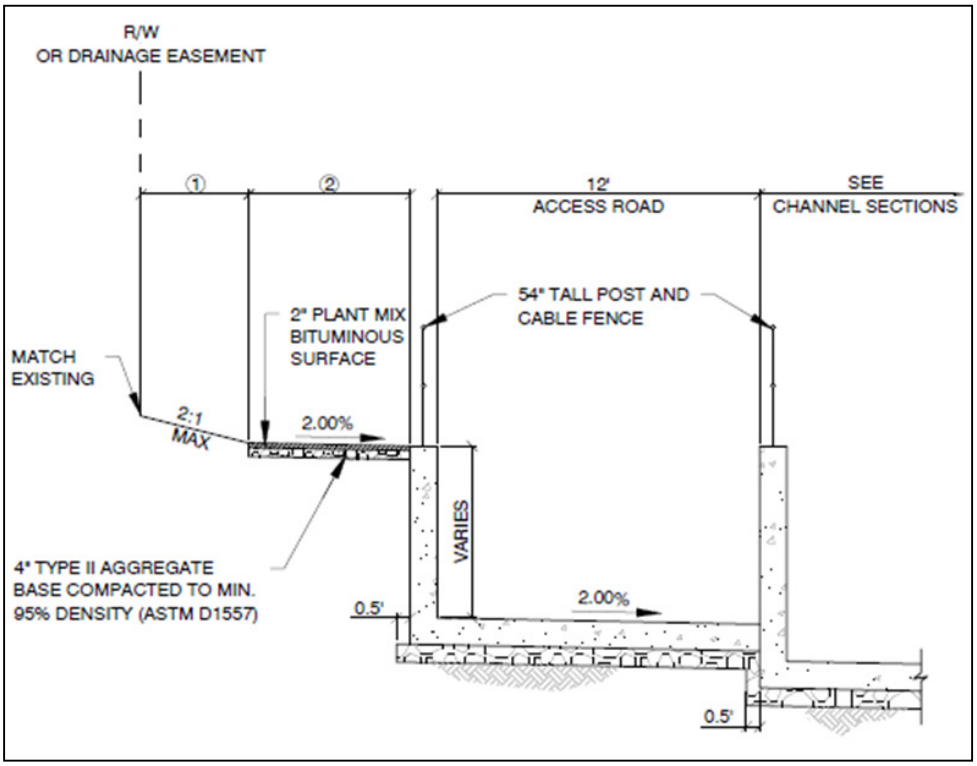


Figure 16. Channel Cross-Section Schematic at Access Ramps

4.3. Constructability

4.3.1. RCB Storm Drain Constructability

- The dual 8’ x 5’ RCBs and the junction structure in Pecos Road just north of Stewart Avenue will need to cross over the existing 36” sewer. There will be 6” minimum clearance over the sewer line.

- 5’ tall RCBs at Pecos/Stewart intersection provides essentially no cover or paving over the box, and therefore would require a thicker roof slab that is monolithic with the pavement and adequate for driving. The 5’ tall boxes were recommended by the City for easy maintenance access.

- Installation of the 18’x5’ RCB storm drain will require the use of forklifts to set pre-cast boxes or cast-in-place construction under I-515/US 95 due to the existing bridge over Pecos Road.

- The radius at which the mainline storm drain curves from Stewart Avenue to Pecos Road is the minimum radius required for fabrication of precast boxes. The mainline storm drain then has a reverse curve downstream to follow the alignment of the existing 72” RCP storm drain.

- Installation of the RCB once it exits Pecos Road and continues east toward the connection point with the channel will require shoring and careful construction as to not impact the existing wall and property on the south side.

- The RCB runs parallel along a 66” RCP SD as it exits Pecos Road and continues east towards the existing channel. The proposed RCB and the 66” RCP cannot be combined before it reaches the channel because the invert of the RCP is lower than the invert of the RCB. The construction of RCB along this segment will require a shoring wall system (such as driven piles) on both sides of the trench to stabilize the existing 66” RCP and backfill on the north and the property walls on the south.

- Per the geotechnical report, there is groundwater in the vicinity of the storm drain and when plotted it rises above the invert. Dewatering will likely be required. Refer to geotechnical report for additional constructability considerations related to dewatering. Please refer to **Section 4.3**.

4.3.2. Concrete Channel Constructability

- Construction on the south side of the channel will be very close to existing fencing and block walls. Typically, there is around 5’ to 7’ of clearance, which will be a small width to excavate the channel and meet OSHA requirements. Additionally, there are swimming pools in the backyards of residences in the backyards of residences. In all of these areas temporary retaining wall systems, such as driven piles, or permanent retaining walls that can be constructed without impacting the existing properties, will be required to stabilize the temporary construction excavations.

  Between Sandhill and Page, portions of the channel have been shifted north approximately 2’ to provide additional clearance during construction, and to reduce the need to use retaining walls. The shift in channel alignment is necessary as most

of the properties on the south have swimming pools that will require temporary shoring during construction.

- The channel becomes very deep (17 feet) east of Marion Drive to the end of the channel improvements, and will require the use of a temporary retaining wall, such as driven piles, in order to excavate and construct the channel. As mentioned in previous sections, the channel must be this deep to accommodate the flow combining the future Bonanza system. The depth of the channel can be reduced if the Bonanza system discharges directly into Las Vegas Wash and does not enter Cedar Avenue Channel.

- The entire construction corridor is narrow, and the existing channel is sloping at 0.20%. Constructing the channel at such a flat slope will be difficult.

- Right-of-way along the channel is narrow and does not have enough width for two vehicles to drive past one another. A longitudinal construction joint must be included in the design so that for one side of the channel can be constructed first. After the concrete has gained strength, the contractor can use the completed section as an access corridor to deliver and place concrete for the second half of the channel.

- Per the geotechnical report, there is groundwater in the area and when plotted it rises above or is at subgrade in the upstream section of the channel and at the downstream section of the channel. Dewatering will likely be required. Refer to geotechnical report for additional constructability considerations related to dewatering. Please refer to **Section 4.3**.

- Channel wall heights are bound by the existing improvements on each side of the channel.

4.3.3. Project Phasing

The following recommendations were agreed upon with the City with regard to project phasing:

- It is assumed that the Cedar Avenue Channel improvements described in this report will not be installed until the Las Vegas Wash is complete at the downstream end of the channel. This includes the Cedar Avenue Channel/Las Vegas Wash confluence structure that will be designed and constructed outside of this project.

- It was assumed that once the Las Vegas Wash improvements are complete, the Cedar Avenue Channel will be constructed from the downstream end to the upstream end. In other words, the storm drain proposed in this project should not be built prior to the downstream channel improvements in order to avoid any adverse impacts on properties adjacent to the channel.

- There will be some variability in the future depending on final design configurations and decisions made with respect to the Las Vegas Wash and the alternative alignment of the Bonanza Regional Facility. A Master Plan Amendment will be required to finalize the regional flood control plan for the area.

- Construction Specifications will be provided with the next phase of the project.

4.4. Geotechnical Investigations

Ninyo & Moore completed geotechnical investigations during the 30% design phase. The results of these investigations are summarized in the Draft Geotechnical Data Report, Draft Geotechnical Interpretive Report, and Hydrogeologic Aquifer Testing Report. The main sections of these reports are provided in **Appendix D**. All of the supporting data and appendix material is only included on the PDF versions of the reports on the **Data CD**.

The Geotechnical Data Report includes the findings of the field exploration and laboratory testing, while the Geotechnical Interpretive Report includes the findings of the geologic review, the results of the field exploration and laboratory testing programs, and presents recommendations for design and construction of the proposed project. The Hydrogeologic Aquifer Testing Report includes results of hydrogeologic aquifer testing and a summary of hydrogeologic and groundwater conditions along the project.

It is anticipated that groundwater dewatering will be required in some areas during construction. Based on the Hydrogeologic Aquifer Testing Report, the dewatering flow rate is expected to be lower than the 250 gpm threshold limit for a *DeMinimis* discharge permit. It is anticipated that the construction dewatering groundwater might be discharged to the CLV sanitary sewer system. This will be further coordinated with the City during the next design phase.

During future design phases, additional coordination and planning for dewatering can occur in order to obtain approval from the City's Environmental Division for dewatering and to prepare an application for approval.

4.5. Record of Survey

The Record of Survey (ROS) establishes a record alignment of the project to be used as a basis to assist in locating existing monuments during the field/construction phase of the project. Research of available record information, parcel maps, subdivisions maps, and other records of survey was performed to create the ROS for this project.

The ROS was formally submitted for approval to the City of Las Vegas Surveyor on June 11, 2015, as directed in the project scope. The City of Las Vegas Surveyor approved the ROS on August 5, 2015.

The Record of Survey is included in **Appendix E**.

4.6. Summary of Permits

A draft summary of the permits and approvals needed for this project has been compiled into a summary matrix shown in **Table 4**. This list is preliminary and may be revised as the project moves forward. Further coordination and effort will be required in future design phases to complete permit applications and assist the City in obtaining required permits for the project.

Table 4. Summary Matrix of Required Permits

Permit	Issuing Agency	Regulated Activity	Phase
City of Las Vegas - Excavation Permit	CLV Department of Public Works Land Development Services	Underground construction on private property or within CLV ROW	Construction
City of Las Vegas - Soils Report Submittal	CLV Department of Public Works Land Development Services	Soils associated with construction activity within CLV ROW (required for off-site construction projects)	Construction
City of Las Vegas - Construction Permit	CLV Department of Public Works Land Development Services	Off-site improvements within a City of Las Vegas ROW	Construction
City of Las Vegas - Grading Permit	CLV Department of Building and Safety	On-site grading activities	Construction
City of Las Vegas - Temporary Stock Pile Permit	CLV Department of Building and Safety	Temporary stock piling of earth materials on private or BLM parcels not covered by grading permit	Construction
City of Las Vegas - Traffic Barricade Plan Approval	CLV Construction Services	Traffic barricade plan associated with construction or discharge activity impacting a CLV ROW	Construction
Dust Control Permit	Clark County Department of Air Quality Management (DAQM)	In accordance with DAQM Regulations, dust control permit required for grading or other land-disturbance activities in Clark County.	Construction
NPDES General Storm Water Permit for Construction	NDEP Bureau of Water Pollution Control	Activity that disturbs 1 acre or greater and discharges storm water runoff from the construction site into a municipal separate storm water sewer system, or “waters of the US” as defined by Section 404 of the CWA.	Construction
NPDES Discharge Permit	NDEP Bureau of Water Pollution Control	Point source discharge to surface water, i.e. natural channel, roadway or storm drain. Required for dewatering during construction.	Design
NDOT ROW Encroachment Permit	Nevada Department of Transportation (NDOT)	NDOT requires this permit for construction activities in NDOT ROW.	Design
CCRFCD Section 8 Resource Screening Analysis	Clark County Regional Flood Control District	U.S. BLM requires each new regional facility be reviewed to ensure full compliance with environmental regulatory requirements	Design
Individual 404 Permit for Impacts to the Water of USA	U.S. Army Corp of Engineers	Coordinate with RFCD. Perform jurisdictional determination. Send jurisdictional determination to the Corp. Prepare and submit permit to the Corp.	Design
OTHER AGENCY APPROVALS AND COORDINATION:			
Entity	**Issuing Agency**	**Regulated Activity**	**Phase**
City of Las Vegas Department of Public Works Flood Control Section	City of Las Vegas	Design Plan/Drainage Study Review/Approval	Design
Clark County Regional Flood Control District	Clark County Regional Flood Control District	Design Plan/Drainage Study Review/Approval, also check of Federal Emergency Management Agency (FEMA) maps	Design
Utility Services Coordination	Various (Refer to Section 5 of this PDR for more information)	Coordination required with utilities and agencies having facilities within the limits of or adjacent to the project. Identify and resolve potential utility conflicts.	Design

4.7. Right-of-Way Summary

Atkins performed a review of the existing right-of-way in the study area and possible acquisition requirements based on the proposed alignment and facilities identified in this report.

Figure 17 and **Figure 18** show the existing right-of-way conditions based on research of available records, including Clark County Assessor Maps, Parcel Maps, and Record of Surveys. The majority of the proposed alignment is contained within the existing public right-of-way located in the jurisdiction of City of Las Vegas. A portion of the project on Pecos Road will be under US95 and within Nevada Department of Transportation (NDOT) right-of-way.

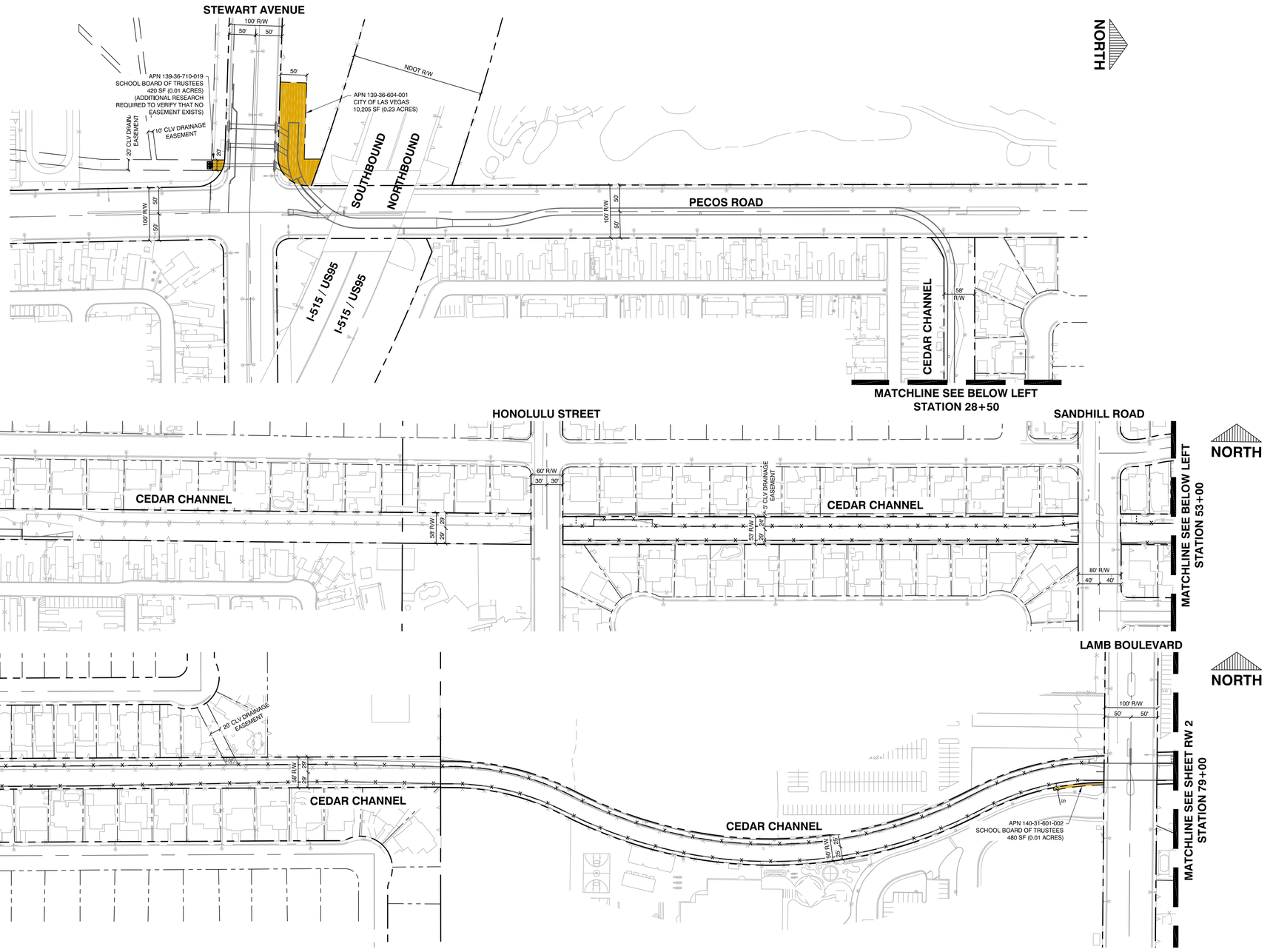
The start of the mainline construction is located on City of Las Vegas owned property. A permanent drainage easement will be required to construct and maintain the facility in the proposed location.

Additionally, a small permanent drainage easement will be required to construct and maintain the 5' x 3' RCB stormdrain and headwall on the south side of Stewart Avenue in APN 139-36-710-019 owned by the School Board of Trustees. There is an existing drainage easement on the School Board property, but it stops short of the Stewart Avenue right-of-way. The City will need to acquire a drainage easement at this location from the School Board of Trustees. Additional coordination with NV Energy is also needed as they have an existing power easement at the location.

A small 5-foot wide permanent drainage easement on the south side of the channel right-of-way at Lamb Boulevard is required for the 5' manway. The easement would be located in parcel 140-31-602-001, which is owned by the School Board of Trustees. At APN 140-32-103-002, owned by the Las Vegas VOA Elderly Housing, 30' of channel right-of-way is required. Currently, records only show that 30' as a trail easement.

The limits of the proposed easements and right-of-way are shown on **Figure 17** and **Figure 18**. At this time it does not appear that any Authorization to Enter Property (AEP) easements will be required.

Coordination with NDOT and an NDOT Encroachment Permit will be required under US95 in order to construct the proposed facilities within NDOT right-of-way. It is intended that this permit be prepared and submitted with the 90% submittal. Coordination with NDOT will take place during next phase of the design. Input on the design from NDOT will be requested.



LEGEND

- PERMANENT RIGHT OF WAY
- PERMANENT DRAINAGE EASEMENT
- AUTHORIZATION TO ENTER PROPERTY
- LVVWD EASEMENT

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866

BID# XX.XXXX

DATE: 11/18/2016

DESIGNED BY: SMB

DRAWN BY: MM

CHECKED BY: HD

SUBMITTAL STAGE:
70% - PRELIMINARY

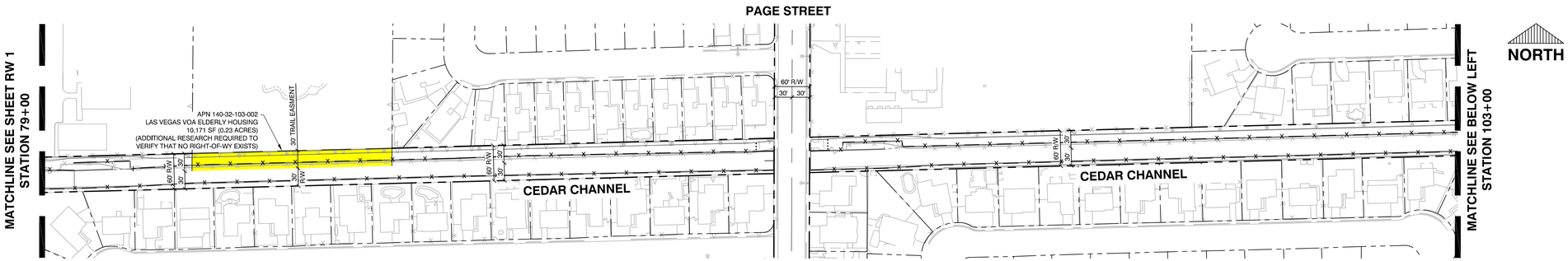
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CEDAR AVENUE CHANNEL

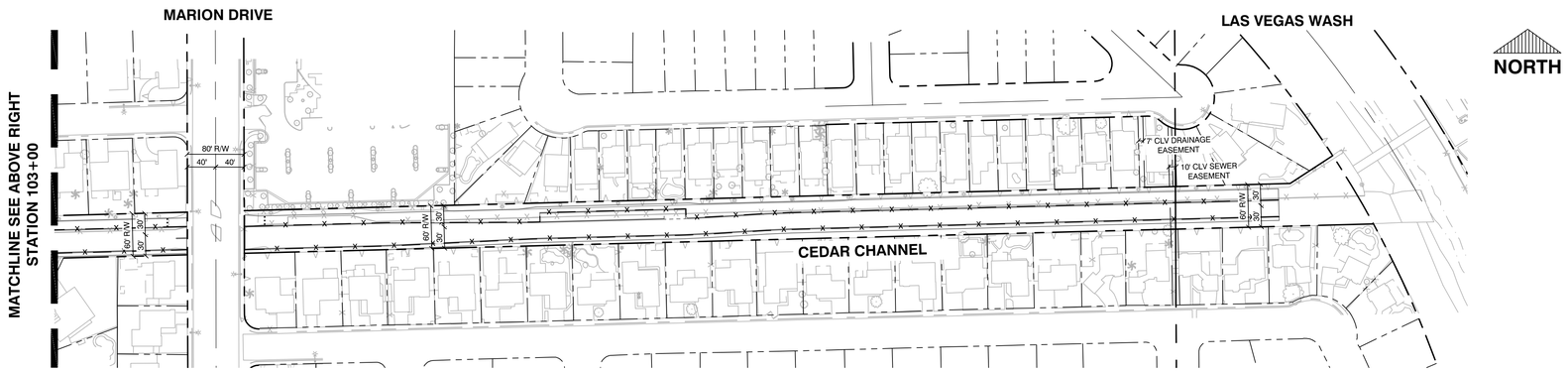
SHEET
RIGHT OF WAY PLAN 1
FIGURE 17

SHEET
RW 1
1 OF 2

DRAWING NO.
XXX-XXXX

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LEGEND

- PERMANENT RIGHT OF WAY
- AUTHORIZATION TO ENTER PROPERTY
- PERMANENT DRAINAGE EASEMENT
- LVVWD EASEMENT

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
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	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866

DATE: 11/18/2016

SUBMITTAL STAGE:
70% - PRELIMINARY

BID# XX.XXXX

DESIGNED BY: SMB

DRAWN BY: MM

CHECKED BY: XXX

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
RIGHT OF WAY PLAN 2
FIGURE 18

SHEET
RW 2
2 OF 2

DRAWING NO.
XXX-XXXX

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5. Utility Issues and Conflicts Summary

5.1. Utility Data Collection and Conflicts

This section includes discussion regarding the utility research and coordination and the test hole locations. The proposed project alignment runs through a well-established area mainly consisting of the existing Cedar Avenue Channel corridor and collector and arterial streets.

Research of the underground utilities was based on survey of surface features, dipping manholes, aerial photography, and obtaining and reviewing design and as-built drawings from utility companies and the City of Las Vegas, which dated as far back as the mid-1950s. In addition, 35 potholes have also been completed to aid in determination of the location and depth of existing underground utilities.

The following utilities and agencies were contacted:

- Zayo (formerly American Fiber Systems, Inc.)
- AT&T Cable Maintenance
- Century Link
- City of Las Vegas
- Cox Communications
- Extenet Systems, Inc
- Freeway Arterials System of Transportation (FAST)
- Kern River Gas Transmission Company
- Kinder Morgan Energy Partners
- Level 3 Communications, LLC
- Las Vegas Valley Water District (LVVWD)
- NV Energy (Distribution)
- NV Energy (Transmission)
- Southern Nevada Water Authority (SNWA)
- Southwest Gas Corporation
- Sprint LD
- Sprint Nextel Engineering
- TWT Telecom
- Verizon Business Communications

Existing utilities have been identified from the agencies above and are shown on the 70% design plans. Colored linework is used on the design plans to identify the SUE quality (A, B, C, or D). Please refer to the design plans for detailed information.

The following is an inventory of existing utilities that are anticipated to be in conflict with the proposed storm drain and channel facilities. For the purpose of organizing the information below, the utility conflicts are discussed either by the main trunk line, channel segment or the individual street segment it corresponds to.

Main Trunk Line – Pecos Road north of Stewart Avenue to Cedar Channel

- Existing 60”x38” HE RCP SD will need to be removed for the installation of the proposed 18’x5’ RCB SD and the dual 8’x5’ RCB SD.

- Existing underground power conduit running north from the intersection near the west side Pecos right-of-way is in conflict with the proposed dual 8’x5’ RCB storm drain and will require relocation.

- Existing streetlight conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x4’ RCB storm drain and will require relocation.

- Existing 2” ITS conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x5’ RCB storm drain and will require relocation.

- Existing 10” HP Steel Gas running north/south in Pecos Road on the west side of the street is anticipated to be in conflict with the proposed dual 8’x5’ RCB storm drain and will require relocation.

- Existing 36” RCP SS running north/south in Pecos Road is not anticipated to be in conflict based on survey data of the upstream and downstream manholes. Based on the manhole data and results from test holes, there will be 6” of clearance between the existing pipe and the proposed dual 8’x5’ RCB SD.

- Existing ITS conduits crossing Pecos Road north of Stewart Avenue are anticipated to be in conflict with the proposed dual 8’x5’ RCB SD and will require relocation.

- Existing 72” RCP SD that runs north/south to the Cedar Channel will need to be removed for the installation of the proposed junction structure, 18’x5’ RCB SD and the 12’x6’ RCB SD.

Channel – Honolulu Drive to Sandhill Road

- Existing trail lighting conduit runs east/west near the north Cedar Channel right-of-way. It is not anticipated that this conduit will be in conflict with the proposed channel access ramp but it is recommended a test hole be performed to verify the horizontal location and clearance from the access ramp.

Channel – Sandhill Road to Lamb Boulevard

- Existing trail lighting conduit runs east/west near the north Cedar Channel right-of-way. This conduit will not be in conflict with the proposed channel.

- Existing 4” underground power conduit runs east/west on the north side of the existing channel starting near Sta 59+50 and continuing to Lamb Boulevard. Test hole results verify the conduit is not in conflict.

Channel – Lamb Boulevard to Page Street

- The proposed 15’ x 6’ RCB culverts at Lamb Boulevard will be in conflict with the existing 36” RCP waterline. The waterline will need to be relocated.

- The proposed 15’ x 6’ RCB culverts at Lamb Boulevard will be in conflict with existing 12” VCP SS and manhole. The manhole will need to be relocated and the SS will need to be reprofiled.

- Existing 4” underground power conduit runs east/west on the north side of the existing channel from Lamb Boulevard to Page Street. The conduit will be in conflict with the proposed channel access ramp.

Channel – Page Street to Marion Drive

- Existing 4” underground power conduit runs east/west on the north side of the existing channel from Page Street to Marion Drive. The conduit will be in conflict with the proposed channel access ramp.

Channel – Marion Drive to Las Vegas Wash

- Existing 6” and 8” SS that crosses the proposed channel near Sta 118+75 will be in conflict with the proposed channel and will need to be relocated.

Stewart Laterals – Stewart Avenue west of Pecos Road

- Existing 18” ACP waterlines will need to be relocated to provide the required horizontal clearance from the proposed drop inlets. The line is also in conflict vertically with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs, and thus will be reprofiled.

- Existing traffic signal conduit running east/west in the middle of Stewart Avenue is in conflict with the proposed 8’x3’, 7’x3’ and 5’x3’ RCB SDs based on test hole data received from the CLV from the BOM project which shows the line 2.66 below existing grade at the west side of the intersection. The conduit will require relocation.

- Existing streetlight conduit running east/west in the middle of Stewart Avenue is in conflict with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs and will require relocation.

- Existing ITS conduit running east/west in the middle of Stewart Avenue is in conflict with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs and will require relocation. Existing 8” SS will be in conflict with the proposed 7’x3’ and 5’x3’ RCB SDs and will require relocation.

- Existing underground power conduit running east/west on the north side of Stewart Avenue is in conflict with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs and will require relocation.

The remaining existing utilities, other than those identified above, do not appear to be in conflict with the proposed storm drain system and channel. However, existing underground utilities are required to be protected during the excavation for the placement of the proposed storm drain system. Additionally, more utilities may be identified for relocations as the final design proceeds and as potholes are completed. A complete list of utility crossings is included in **Appendix F.**

5.2. Utility Potholing

Horrocks Engineers completed a total of 35 potholes. The pothole locations and numeric identifiers are shown on the 70% Design Plans. A table showing the information collected for each pothole is included in **Appendix F**. Test Hole Summary Sheets obtained from Horrocks Engineers is also included in **Appendix F**.

6. Construction Cost Estimate

It is estimated that the project will have a total construction cost of **$18,331,418**.

All of the improvements are shown to be funded by the Clark County Regional Flood Control District.

A 15-percent contingency has been added to the cost estimate to offset the level of detail that has been provided at this stage.

The detailed cost estimate and associated quantities are shown in **Table 5.**

Table 5
Las Vegas Wash Central Cedar Avenue
Channel Preliminary Cost Estimate - 70%
Submittal

			CCRFCD		TOTAL			
#	ITEM	DESCRIPTION	QUANTITY	COST	QUANTITY	UNIT	UNIT COST	TOTAL COST
	200.01	MOBILIZATION & DEMOBILIZATION	1	$700,000.00	1	LS	$700,000.00	$700,000.00
	202.01	REMOVE BITUMINOUS SURFACE	17321	$103,926.00	17,321	SY	$6.00	$103,926.00
	202.02	REMOVE EXISTING CONCRETE PAVEMENT	576	$8,640.00	576	SY	$15.00	$8,640.00
	202.03	REMOVE EXISTING SIDEWALK	2130	$6,390.00	2,130	SF	$3.00	$6,390.00
	202.04	REMOVE EXISTING CURB AND GUTTER	385	$2,695.00	385	LF	$7.00	$2,695.00
	202.05	REMOVE EXISTING MEDIAN ISLAND	2614	$10,456.00	2,614	SF	$4.00	$10,456.00
	202.06	REMOVE EXISTING RCP STORM DRAIN	2185	$43,700.00	2,185	LF	$20.00	$43,700.00
	202.07	REMOVE EXISTING MANHOLE	6	$15,000.00	6	EA	$2,500.00	$15,000.00
	202.08	REMOVE EXISTING DROP INLET	6	$9,000.00	6	EA	$1,500.00	$9,000.00
	202.09	REMOVE EXISTING SANITARY SEWER	90	$900.00	90	LF	$10.00	$900.00
	202.10	REMOVE EXISTING CHANNEL	279928	$1,679,568.00	279,928	SF	$6.00	$1,679,568.00
	202.11	2-INCH ROTOMILL	1383	$6,915.00	1,383	SY	$5.00	$6,915.00
	202.12	REMOVE EXISTING HEADWALL	1	$15,000.00	1	LS	$15,000.00	$15,000.00
	212.01	REMOVE AND REPLACE EXISTING LANDSCAPING	1	$75,000.00	1	LS	$75,000.00	$75,000.00
	270.01	DEWATERING	1	$200,000.00	1	LS	$200,000.00	$200,000.00
	302.01	TYPE II AGGREGATE BASE	36169	$904,225.00	36,169	CY	$25.00	$904,225.00
	402.01	2-INCH PLANTMIX BITUMINOUS SURFACE	11528	$115,280.00	11,528	SY	$10.00	$115,280.00
	402.02	8-INCH PLANTMIX BITUMINOUS SURFACE	4617	$253,935.00	4,617	SY	$55.00	$253,935.00
	413.01	1-INCH UTACS BONDED WITH A PMM, S3 GRADATION	7920	$55,440.00	7,920	SY	$7.00	$55,440.00
	502.01	22-FOOT WIDE REINFORCED CONCRETE CHANNEL	1053	$1,210,950.00	1,053	LF	$1,150.00	$1,210,950.00
	502.02	25-FOOT WIDE REINFORCED CONCRETE CHANNEL	913	$753,225.00	913	LF	$825.00	$753,225.00
	502.03	29-FOOT WIDE REINFORCED CONCRETE CHANNEL	646	$581,400.00	646	LF	$900.00	$581,400.00
	502.04	31-FOOT WIDE REINFORCED CONCRETE CHANNEL	4105	$3,899,750.00	4,105	LF	$950.00	$3,899,750.00
	502.05	36-FOOT WIDE REINFORCED CONCRETE CHANNEL	1120	$1,136,800.00	1,120	LF	$1,015.00	$1,136,800.00
	502.06	CHANNEL ACCESS RAMP	510	$114,750.00	510	LF	$225.00	$114,750.00
	502.07	JUNCTION STRUCTURE	1	$50,000.00	1	LS	$50,000.00	$50,000.00
	502.08	5-FT X 3-FT REINFORCED CONCRETE BOX	115	$28,750.00	115	LF	$250.00	$28,750.00
	502.09	7-FT X3-FT REINFORCED CONCRETE BOX	85	$31,025.00	85	LF	$365.00	$31,025.00
	502.10	8-FT X 4-FT REINFORCED CONCRETE BOX	220	$93,500.00	220	LF	$425.00	$93,500.00
	502.11	8-FT X 5-FT REINFORCED CONCRETE BOX	143	$71,500.00	143	LF	$500.00	$71,500.00
	502.12	12-FT X6-FT REINFORCED CONCRETE BOX	1495	$1,457,625.00	1,495	LF	$975.00	$1,457,625.00
	502.13	15-FT X6-FT REINFORCED CONCRETE BOX	200	$195,200.00	200	LF	$976.00	$195,200.00
	502.14	18-FT X5-FT REINFORCED CONCRETE BOX	320	$395,200.00	320	LF	$1,235.00	$395,200.00
	502.15	TRANSITION STRUCTURE (DUAL 48" RCP'S TO 8'X4' RCP)	10	$4,250.00	10	LF	$425.00	$4,250.00
	502.16	TRANSITION STRUCTURE (18'X5' RCB TO 12'X6' RCB)	30	$37,050.00	30	LF	$1,235.00	$37,050.00
	502.17	TEMPORARY RETAINING WALL	21470	$644,100.00	21,470	SF	$30.00	$644,100.00
	603.01	18-INCH REINFORCED CONCRETE PIPE (CLASS III)	25	$4,750.00	25	LF	$190.00	$4,750.00
	603.02	24-INCH REINFORCED CONCRETE PIPE (CLASS III)	11	$2,200.00	11	LF	$200.00	$2,200.00
	609.02	48-INCH ACCESS MANHOLE W/ STEPS	4	$14,000.00	4	EA	$3,500.00	$14,000.00
	609.03	15-FOOT TYPE "C" MODIFIED DROP INLET	4	$80,000.00	4	EA	$20,000.00	$80,000.00
	609.04	CULVERT HEADWALL	1	$4,000.00	1	EA	$4,000.00	$4,000.00
	613.01	L TYPE CURB AND GUTTER	385	$9,625.00	385	LF	$25.00	$9,625.00
	613.02	CONCRETE SIDEWALK	2130	$10,650.00	2,130	SF	$5.00	$10,650.00
	613.03	TACK-ON MEDIAN	2614	$20,912.00	2,614	SF	$8.00	$20,912.00
	616.01	42-INCH POST AND CABLE FENCE	7550	$105,700.00	7,550	LF	$14.00	$105,700.00
	616.02	54-INCH POST AND CABLE FENCE	7660	$114,900.00	7,660	LF	$15.00	$114,900.00
	616.03	20-FOOT WIDE DOUBLE SWING ACCESS GATE	1	$1,500.00	1	EA	$1,500.00	$1,500.00
	622.01	CONSTRUCTION SURVEYING	1	$75,000.00	1	LS	$75,000.00	$75,000.00
	623.01	REMOVE AND REPLACE TRAIL LIGHT	2	$6,000.00	2	EA	$3,000.00	$6,000.00
	624.01	TRAFFIC CONTROL AND MAINTENANCE	1	$200,000.00	1	LS	$200,000.00	$200,000.00
	628.01	6-INCH SOLID WHITE LINE (POLYUREA)	214	$428.00	214	LF	$2.00	$428.00
	628.02	24-INCH STOP BAR (TYPE 2 PMF)	182	$1,092.00	182	SF	$6.00	$1,092.00
	628.03	24-INCH CROSSWALK (TYPE 2 PMF)	820	$4,920.00	820	SF	$6.00	$4,920.00
	628.04	WHITE "ARROW" LEGEND (TYPE 2 PMF)	6	$360.00	6	EA	$60.00	$360.00
	628.05	YIELD TRIANGLE WHITE (TYPE 2 PMF)	30	$180.00	30	SF	$6.00	$180.00
	629.01	INSTALL 18" PVC WATERLINE RELOCATION	1	$54,455.00	1	LS	$54,455.00	$54,455.00
	629.02	INSTALL 36" STL WATERLINE RELOCATION	1	$83,950.00	1	LS	$83,950.00	$83,950.00
	629.03	ADJUST EXSTING WATER VALVE COVER TO FINISH GRADE	2	$1,500.00	2	LF	$750.00	$1,500.00
	630.01	12-INCH PVC SDR 35 SANITARY SEWER PIPE	90	$18,000.00	90	LF	$200.00	$18,000.00
	630.02	48-INCH SANITARY SEWER MANHOLE	1	$12,000.00	1	EA	$12,000.00	$12,000.00
	633.01	REFLECTIVE RAISED PAVEMENT MARKERS	309	$927.00	309	EA	$3.00	$927.00
	633.02	NON-REFLECTIVE RAISED PAVEMENT MARKERS	723	$2,169.00	723	EA	$3.00	$2,169.00
	637.01	DUST CONTROL	1	$150,000.00	1	LS	$150,000.00	$150,000.00
	637.02	NPDES DISCHARGE PERMIT	1	$50,000.00	1	LS	$50,000.00	$50,000.00
		TOTAL		**$15,940,363.00**				**$15,940,363.00**
		Contingencies (15%)		$2,391,054.45				$2,391,054.45
		GRAND TOTAL		**$18,331,417.45**			**TOTAL PROJECT**	**$18,331,417.45**

Electronic Data CD

PLACE HOLDER

Atkins North America, Inc.
2270 Corporate Circle, Suite 200
Henderson NV 89074-7755
702.263.7275
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November 22, 2016

Anita Marquez, P.E.
Engineering Project Manager
City of Las Vegas
Department of Public Works
333 Rancho Drive
Las Vegas, Nevada 89106

RE: Draft Final Design Report for Las Vegas Wash Central, Cedar Avenue Channel

Dear Ms. Marquez

Transmitted herewith are the Draft Final Design Report and the 70% Design Plan Submittal for the Las Vegas Wash Central, Cedar Avenue Channel Project (Cedar Avenue Channel).

Please feel free to contact me if you have any questions.

Sincerely,

Harshal Desai, PE, CFM
Project Manager

Manogya Khanal, CFM
Engineering Intern

Executive Summary

This Draft Final Design Report (DFDR) has been prepared to describe the 70% design and analysis of the Las Vegas Wash Central, Cedar Avenue Channel project (hereafter referred to as the CAC). The project improvements extend from the Las Vegas Wash at the downstream end to the intersection of Pecos Road and Stewart Avenue at the upstream end. The regional facilities encompassed in this project are described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers CACH 0000 through 0148 and CACN 0001.

The project involves expanding the existing Cedar Avenue Channel from a trapezoidal channel to a rectangular channel ranging from 25' to 36'wide and from 6 to 17' deep. The project also involves installing approximately 2,000' of RCB storm drain upstream of the channel that varies in size from a 12' x 6' RCB to an 18' x 5' RCB. The proposed storm drain facilities will extend from the upstream end of the Cedar Avenue Channel to the intersection of Pecos Road and Stewart Avenue. The project entails the construction of these facilities and associated collection system including laterals, drop inlets, manholes, and all necessary appurtenances to complete the Cedar Avenue Channel improvements.

It should be noted that the original Scope of Services previously provided for this project assumed that the storm drain improvements would extend west in Stewart Avenue from Pecos Road to Mojave Road and in Pecos Road south of Stewart Avenue to Sunrise Avenue. However, due to preliminary hydrologic/hydraulic analysis and coordination with the City, the project extents were shifted downstream in order to design channel improvements that will increase the limited capacity of the existing Cedar Avenue Channel.

Hydrologic analysis has been performed using the HEC-1 computer program to develop 100-year design flows for the CAC. These design flows were subsequently used in the hydraulic analysis to size the conveyance facilities accordingly. Hydraulic calculations for the storm drain were based on normal depth calculations and WSPG modeling, while the open channel portion of the project was analyzed using HEC-RAS.

This DFDR is based off the Preliminary Design Report (PDR) and the 30% Design Plans that were submitted to the City on June 22, 2015 and the progress made thereafter. Comment response from the 30% design phase is included in the appendix of this DFDR. Constructability review comments are also included with this report.

The 70% Design Plans are provided with this DFDR submittal. Other important aspects of the 70% design effort are presented in this DFDR, including geotechnical investigations, survey summary, required permits, right-of-way information, utility conflicts and construction cost estimates.

The overall, estimated construction cost of the project is **$18,331,418**, which includes a 15-percent contingency to offset the level of detail provided at this submittal phase.

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Electronic Data CD

- Preliminary Drainage Memorandum
- Cedar Avenue Channel Capacity Analysis
- Preliminary Design Report and 30% Design Plans
- Meeting Minutes and Emails
- Hydrologic/Hydraulic Models
- Geotechnical Reports
- PDF version of the Draft Final Design Report
- PDF version of the 70% Design Plans

1. Introduction

1.1. Purpose

The purpose of this Draft Final Design Report (DFDR) is to describe the criteria, parameters, considerations, assumptions, and methodology used in the design and analysis of the Las Vegas Wash Central, Cedar Avenue Channel (hereafter referred to as CAC). This DFDR includes pertinent aspects of the project explored to date and facilitates review of the design by the City of Las Vegas (the City), the Clark County Regional Flood Control District (CCRFCD), and other stakeholders.

It is important to note that the proposed drainage system and the associated analysis presented in this DFDR is still a work in progress and represents the latest information corresponding to the 70% milestone submittal. Thus, the analysis, design, and information presented herein are subject to amendments, additions, and revisions in the future as comments are received and more analyses are completed throughout the detailed design phase. The content presented herein will later be updated as necessary and incorporated into the Final Design Report at the 90% milestone.

1.2. Project Description and Location

The scope of services to be provided under the terms of the project contract includes the design and preparation of contract drawings, cost estimates, and reports for the CAC. The project improvements extend from the Las Vegas Wash at the downstream end to the intersection of Pecos Road and Stewart Avenue at the upstream end. The regional facilities encompassed in this project are described in the 2008 and 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers CACH 0000 through 0148 and CACN 0001. The analysis for the facilities are referenced from 2008 MPU and the figures are referenced from 2013 MPU. The proposed alignment of CAC is shown in **Figure 1.**

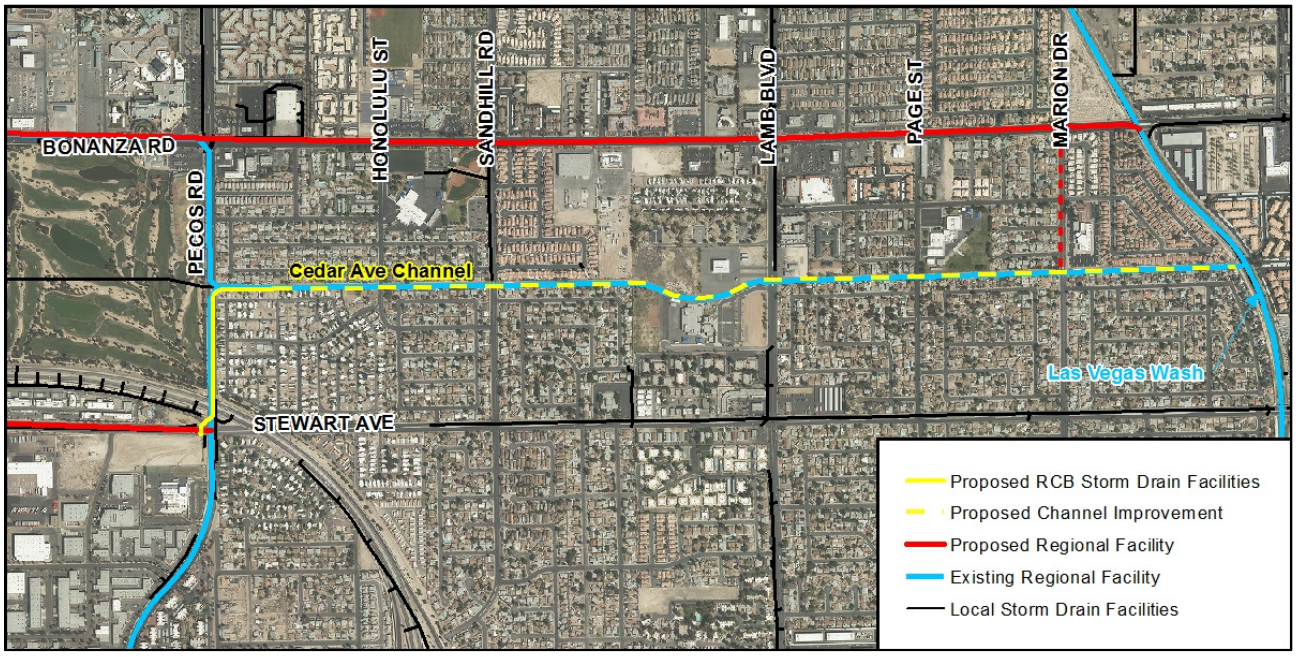


Figure 1 Cedar Avenue Channel Project Alignment

The project involves expanding the existing Cedar Avenue Channel from a trapezoidal channel to a rectangular channel ranging from 25’ to 36’ wide and from 6’ to 17’ deep. The intent of the design is to preserve most of the existing bridge crossings along the channel and make improvements to the channel sections. The design also moves the existing channel centerline approximately 2’ north in certain sections to provide some room on the south side for construction, and save on construction cost.

The project also involves installing approximately 2,000’ of RCB storm drain upstream of the channel that varies in size from a 12’ x 6’ RCB to an 18’ x 5’ RCB. The proposed storm drain facilities will extend from the upstream end of the Cedar Avenue Channel to the intersection of Pecos Road and Stewart Avenue. The project entails the construction of these facilities and associated collection system including laterals, drop inlets, manholes, and all necessary appurtenances to complete this project.

There will also be drop inlet facilities and lateral storm drains required on the north and south of Stewart Avenue, just west of Pecos Road, to collect runoff from the street and convey it to the main storm drain facility. Detailed sizes, location, and alignments of the proposed storm drain facilities are shown on the 70% Design Plans that accompany this report and will be described later in this DFDR.

The project site is located in the area referred to as the “Central Watershed” in the 2013 MPU, within Sections 31 and 32 of Township 20S, Range 62E and Section 36 of Township 20S, Range 61E. The general project location is shown on a vicinity map in **Figure 2**. **Figure 3** is a reproduction of Figure F-32 and Table F-32 from the 2013 MPU that show the original alignment and geometry of the proposed system.

It should be noted that analysis provided in this report is based of 2008 MPU. However, the MPU figures are from 2013 MPU. Master Plan Change will be prepared by CLV for the facilities that are different than the 2008/2013 MPU.

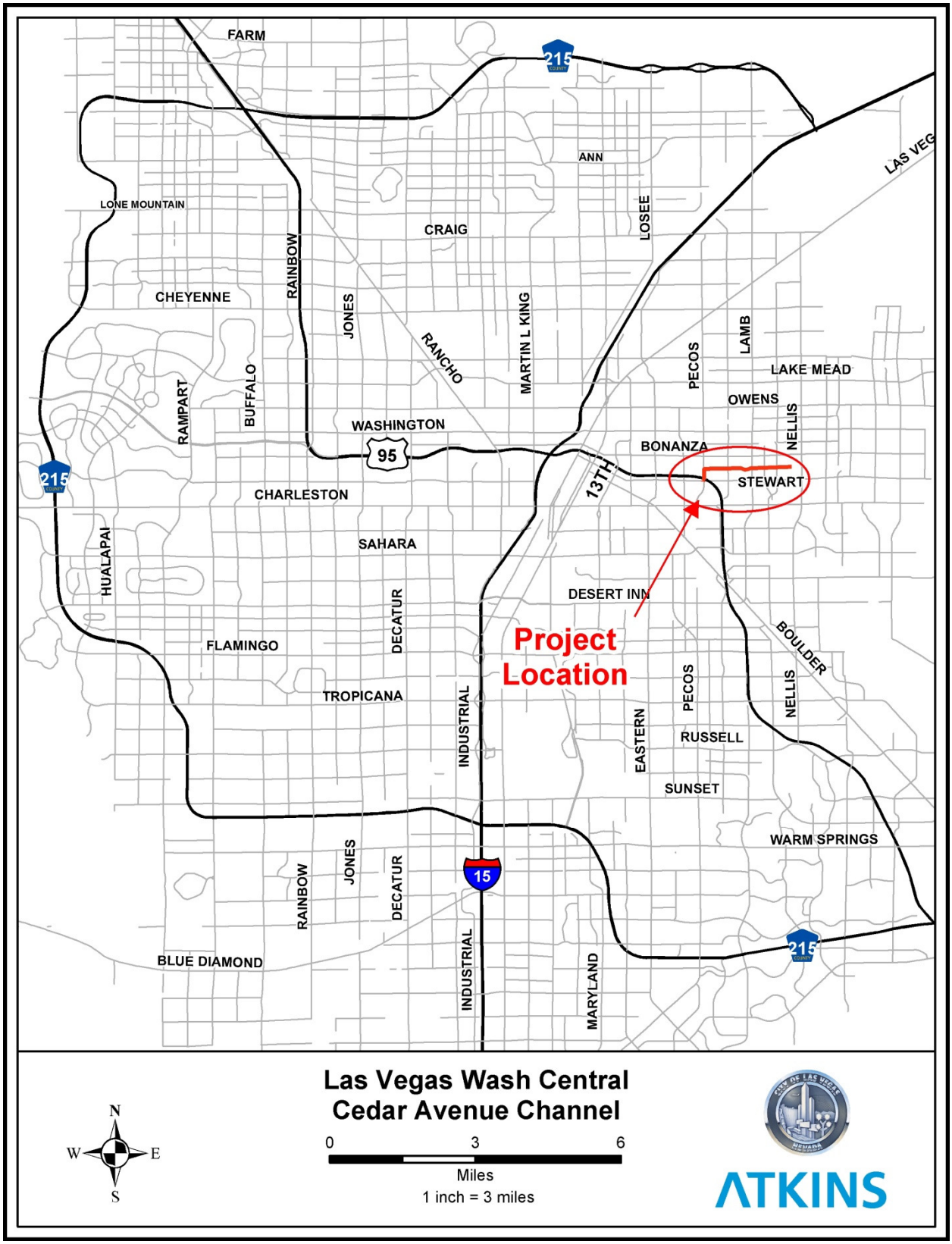


Figure 2 Cedar Avenue Channel Project Vicinity Map

Figure 3 2013 MPU Flood Control Facility Map (F-32)

Figure 3 (continued). 2013 MPU Facility Inventory Table (F-32)

1.3. Inventory of the Existing Condition

The watershed area impacting the CAC encompasses approximately 3.5-square-miles of urbanized area in the central portion of the City, and can be subdivided into two areas. The first watershed area is generally bounded by Maryland Parkway on the west (which is the ultimate condition boundary), Bonanza Road on the North, Charleston Boulevard on the south, and the Pecos Road on the east. The second watershed area is bounded by Pecos Road on the west, Bonanza Road on the north, Las Vegas Wash on the east, and the CAC on the south. The overall drainage pattern in the study area is from west to east, with surface runoff being conveyed on surface streets and in local channels and minor storm drain facilities. **Figure 7** in **Section 2** of this report shows the watershed boundary of the CAC.

Panel 32003C2186F and 32003C2187F of Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs) shows the majority of the project area is not within a Special Flood Hazard Area. A small reach at the end of the proposed channel lies within a Zone AE flood zone. FIRMettes showing the flood zone boundaries in the study area in included in **Appendix B**.

During early phases of the project, field investigations were performed by Atkins in the study area to assess drainage patterns, confirm design data that was collected, and evaluate the current condition of the project site and tributary areas. Detailed topography, aerial photos, and previously completed drainage studies were also reviewed and relevant information extracted in order to inventory the existing condition and understand constraints and design considerations in the study area. In addition, photos were taken during field investigations and compiled in a photo library included in **Appendix B**.

A few observations regarding the existing condition are summarized in the following paragraphs.

The intersection of Stewart Avenue and Pecos Road is the main collection point for the proposed storm drain facilities. The flows impacting this intersection come primarily from the west on the surface of Stewart Avenue. There are existing drop inlets and lateral storm drains on the north and south side of Pecos Road that collect a small portion of the surface flow. There is also a drainage swale that runs from south to north along the west side of Pecos Road that connects to a headwall under Stewart Avenue. The flow collected at the headwall and in the drop inlets is conveyed through local storm drains to an existing 72" RCP in Pecos Road that drains north and eventually discharges to the Cedar Avenue Channel. These facilities are undersized and do not have adequate capacity to convey the 100-year flow impacting the intersection.

South of Stewart Avenue, Pecos Road has relatively minor surface flows on the street because the majority of the flow in the area is already conveyed in the existing 66" RCP (which transitions to dual 48" RCPs) in Pecos Road and in local, on-site storm drains that convey flow through parking lots and commercial areas immediately west of Pecos Road. The drainage facilities in Pecos Road are adequately sized and will connect to proposed storm drain facilities constructed with this project. More detailed information regarding the drainage patterns and hydrology in this area is included in Section 2.

Any flow that is not collected by drop inlets on Stewart Avenue will bypass the intersection and continue east on Stewart Avenue. There is an existing low point with under sized drop inlets further downstream on Stewart Avenue, west of Marion Drive, where flow will pond up during storm events. This project will help alleviate or reduce some of the flooding problems occurring downstream on Stewart Avenue.

The Cedar Avenue Channel collects flow from the 72" RCP in Pecos Road, as well as another 72" RCP that combines 66" RCP bringing flow from the Desert Pines Golf Course and 60" RCP bring flow from Bonanza Road. The channel conveys this flow eastward under 5 bridge structures at Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive until eventually discharging to the Las Vegas Wash at the downstream end. Additional flow comes into the channel via drop inlets at each of the bridge structures. During an early progress meeting on the project, the City stated that the Cedar Avenue Channel was limited in capacity and has experienced overtopping at Lamb Boulevard in the past. Atkins performed necessary hydraulics analysis to confirm that the channel had limited capacity to convey the project design flows in the existing condition.

The overall intent of the project is to collect as much of the 100-year flow as possible at Stewart Avenue and Pecos Road and to increase the conveyance capacity of the Cedar Avenue Channel, thereby improving flood protection in this area.

1.4. Existing Facilities and Adjacent Completed Projects Summary

There are completed and ongoing projects and storm drain facilities in the study area that are related to this project and may impact the storm drain design considerations/constraints. The major projects and facilities are described below.

1.4.1. Pecos Road Storm Drain

There is a 66" RCP storm drain in Pecos Road that conveys flow north from Charleston Boulevard. The pipe transitions to dual 48" RCPs north of Sunrise Avenue in order to cross over a 36" sewer line. After crossing the sewer and Stewart Avenue, the dual 48" RCP transitions to a large 72" RCP that continues north and then east until discharging to the Cedar Avenue Channel. The 72" RCP will be replaced and upsized with this project, while the dual 48" RCP and 66" RCP will remain in place and connect with proposed storm drain facilities constructed with this project.

1.4.2. Stewart Avenue Storm Drain

There is a 24" RCP storm drain in Stewart Avenue that extends from just west of Mojave Road to Pecos Road. This storm drain collects flow from existing drop inlets on Stewart Avenue (just west of Pecos) and eventually connects to the 72" RCP in Pecos Road. The 24" RCP facility will connect with proposed storm drain facilities constructed with this project.

1.4.3. Desert Pines Golf Course Storm Drain

The Desert Pines Golf Course, located east of Pecos Road and north of US 95, has a 60" RCP storm drain running from west to east through the middle of the golf course. This facility collects flow from Cedar Avenue and the golf course and conveys it to Pecos Road. At Pecos Road, it combines with another 60" RCP that comes from the north (from Bonanza Road), and then continues as a 72" storm drain that eventually discharges to the upstream end of the Cedar Avenue Channel.

1.4.4. BOMO Force Main – Phase 2

This ongoing CLV sewer project has a proposed alignment in Pecos Road and Stewart Avenue in the immediate vicinity of the proposed storm drain improvements. Coordination with this project is ongoing. Atkins reviewed the latest layout (obtained as of 27 October,

2016) of the BOMO system prepared by HDR. Coordination with this project should continue through final design.

1.4.5. Multi-Family Residential Development (APN 140-31-501-021)

There is an ongoing land development project for a multi-family residential site that is located just north of the Cedar Avenue Channel and west of Lamb Boulevard. Coordination with the City and the design engineer (L.R. Nelson) has occurred and will continue as necessary. The development intends to discharge runoff directly to the Cedar Avenue Channel, so coordination on hydrology/hydraulics as well as the trail widths and easements in this area will be needed going forward.

1.4.6. Las Vegas Wash Project

The Las Vegas Wash project (CCPW/CLV) at the downstream end of the Cedar Avenue Channel is proposed to convey all flow in the Cedar Avenue Channel within an 18' x 12' RCB confluence (based on the 100% QA/QC set, not for construction designed by CH2MHill/Stanley Consultants). Atkins has coordinated with the City the design consultants on several occasions and it was agreed that the proposed RCB should be widened to 22 – 25 feet, instead of 18 feet as was shown on the preliminary plans. This will improve the hydraulics of the channel and make it possible to potentially bring more flow into the channel from Bonanza Road in the future. However, this Las Vegas Wash project at the downstream end of the channel is currently on hold, so the design at the confluence has not been finalized. For the purpose of this preliminary design report and per the direction of the City, it was assumed that the confluence will be at least 22 feet wide. Further information regarding the channel design and confluence at the downstream end of the channel is available in **Section 4**.

1.4.7. Cedar Drainage Trail

The Cedar Drainage Trail was constructed along the north side of the Cedar Avenue Channel, extending from Pecos Road to the pedestrian bridge at the Las Vegas Wash. The project also included installation of light poles and landscaping. The wider channel improvements completed with this project will preserve a functional trail, although the trail width will be reduced in several locations.

1.5. Report Organization

The technical information compiled and presented in this report will facilitate review of the drainage analysis/design and is based on best available data at the time of the 70% milestone submittal. The report has been organized into five main sections: Section 1 serves as an overall introduction; Section 2 and 3 contain detailed information about the hydrologic and hydraulic (H&H) analysis and the proposed design; Section 4 includes summaries of several other design works and activities, including general design considerations, constructability issues, geotechnical investigations, survey summary, right-of-way summary, etc.; Section 5 summarizes the utility conflicts and utility coordination effort that has taken place to date; Section 6 is the final section and includes the construction cost estimate. The 70% design plans also accompany this report and include pertinent information for review, such as proposed facility sizes, horizontal/vertical alignments, utility conflicts, lateral locations, etc.

1.6. Technical Appendix and Data CD

A technical appendix is provided electronically on the Data CD at the end of this report with all supporting documentation and analysis including comment matrix from 30% design phase and constructability review. The electronic Data CD also has other relevant electronic data and information used in the development of this DFDR, such as a PDF version of the entire report, 70% design plans in pdf version, previous meeting minutes and hydrologic and hydraulic model files.

2. Hydrologic Analysis

2.1. General

This section includes information about the criteria and methodology used in the hydrologic analysis of the CAC. The criteria, methodology, and analyses are generally consistent with the Clark County Regional Flood Control District's (CCRFCD) Hydrologic Criteria and Drainage Design Manual (hereafter referred to as the Design Manual). Any deviations from the Design Manual are discussed in more detail later in this section.

2.2. Previous and/or Related Drainage Studies

Several drainage studies, hydrologic models, and reports were reviewed in conjunction with this project. May of the drainage studies were provided to Atkins by the City for small or local developments in the study area. These were all reviewed and incorporated as necessary. The more significant or major drainage studies used as a reference included:

- **2013 Las Vegas Valley Flood Control Master Plan Update**, prepared by PBS&J, September 2008. This study was reviewed and used as a reference for the hydrologic analysis and parameterization (CN methodology, land use, soils, routing, lag time, etc.). The 2008 MPU HEC-1 model developed for the Central Watershed was used as a base model for this project.

- **Central Neighborhood Flood Control Master Plan** prepared by PBS&J, March 2005. This study was used as a reference and to check the overall watershed boundary and to estimate the interim condition flow in the 72" RCP in Pecos Road.

2.3. Technical Memorandums and Report

After performing data collection, field investigations, survey, and preliminary H&H analysis, Atkins compiled two different technical memorandums and a preliminary design report to summarize the analysis, results, channel capacities, and recommended drainage plan and assumptions that were used in developing this DFDR and the 70% design plans. These memorandums/report were submitted and reviewed by the City and CCRFCD, who agreed on the overall design concepts and design flows. These include:

- **Preliminary Drainage Memorandum.** Atkins submitted the Preliminary Drainage Memorandum on May 5, 2014 to estimate peak flows impacting the intersection of Stewart Avenue and Pecos Road, to determine if revisions to the storm drain extents were warranted, and to make storm drain facility recommendations.

- **Cedar Avenue Channel Capacity Analysis.** Atkins submitted the Cedar Avenue Channel Capacity Analysis on June 13, 2014 to determine the existing channel conveyance capacity and to understand potential project impacts on the downstream channel and adjacent properties.

- Preliminary Design Report (PDR). Atkins submitted the Preliminary Design Report and the 30% Design Plans on June 22, 2015 to present hydrologic and hydraulic analyses done at the 30% design phase. The response to comments from the PDR and 30% design Submittal can be found in **Appendix A**. The design presented on this report is based off the PDR and the progress made thereafter.

A copy of both memorandums and the PDR are provided on the **Data CD** as a reference and to provide background information related to design alternatives that were investigated and decisions that have been made to date. The **Data CD** also contains emails and Meeting Minutes where key decisions were made.

2.4. Topography Data and Survey

Detailed 1-foot aerial topography data was obtained for the study area with this project. In general, the 1-foot topography data extends to Charleston Boulevard on the south, Maryland Parkway on the west, Pecos Road on the east, and Cedar Avenue on the north. An additional corridor along the Cedar Avenue Channel was also obtained for that portion of the project area. 5-ft contour data from Clark County was used for watershed areas outside of the detailed topography extents.

Detailed field survey (and manhole dipping) was also performed to determine accurate horizontal and vertical information for the manholes, sanitary sewers, storm drains, and other utilities.

2.5. Hydrologic Design Scenarios

Atkins performed hydrologic analysis to determine the peak 100-year design flows in the study area in the ultimate condition. The hydrologic analysis and the storm drain recommendations described in this report are based on the ultimate condition, which assumes that the project watershed is fully developed and that all proposed regional facilities are built and functioning. This is the condition represented in the HEC-1 model and fully described in this DFDR that will be used as the design basis throughout the project.

The main difference between the watershed today and the ultimate condition is the assumption that the proposed regional facility in Bonanza Road (LVBZ0000-0014) will be complete, which will convey the 100-year flow from Bonanza Road to the Cedar Avenue Channel at Marion Drive (see **Section 2.9** for more information about this alternate alignment).

Since the watershed area is more than 95% developed, any other changes in land use, impervious areas, and flow rates between the existing and ultimate (future) condition are considered negligible.

Throughout early design phases of this project, an interim condition model was developed in order to support alternative analysis and decision making, especially with regards to the Cedar Avenue Channel. The interim condition model is identical to the ultimate condition model except that the Bonanza Regional system does not bring flow into the channel at Marion Drive as described above. The interim condition model is provided on the **Data CD** for reference purposes if needed.

Qualitative assessments of the existing condition flow in the Cedar Avenue Channel have also been made based on the Central Neighbourhood Study and assumptions that the inflow facilities

into the channel are at full flow capacity (normal depth calculations), but detailed HEC-1 modeling of the existing condition was not required for this project.

2.6. Hydrologic Analysis and Parameterization

The methodology used to develop the hydrologic model and input parameters is discussed in detail in **Appendix B** with all supporting information and tables. A brief description of methods is provided as a summary below:

2.6.1. Subbasin Delineation

The 2008/2013 MPU and Central Neighbourhood Flood Control Master Plan (CNS) subbasin delineations were used as a starting point and were modified and subdivided as necessary based on field investigations, aerial photos, drainage studies, and the detailed 1-ft topography data that was obtained for the project. The subbasins used in this design project were more refined than the MPU subbasins in order to analyse and evaluate detailed roadway drainage patterns, storm drain sizes, and street flow capacities. The subbasins used in the HEC-1 model are shown on the Hydrologic Summary Map **(Figure 7)** at the end of this section of the report.

2.6.2. Hydrologic Parameters

- **Rainfall** – The 6-hour, 100-year and 10-year precipitation depth were used in the model based on the McCarran Airport Rainfall Area from the Design Manual. The SDN3 storm distribution was used since the watershed area is less than 8 square miles.

- **Depth-Area Reduction Factor –** The depth-area reduction factors (DARFs) from Table 503 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area.

- **Soils** – Soils data in the hydrologic analysis was based on the same soils information that was used in the 2008 MPU, which is the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. It should be noted that NRCS has updated the available soils data since that time; however, in an effort to be consistent with the MPU and other design projects that have been completed in the area, the 2008 MPU soils data was used in the CAC hydrologic analysis and design.

  A separate hydrologic analysis was performed using the 2014 soils data to understand the impact of the change. Total flow in the channel increases as a result of the new soil. However, the increase in flow does not affect the proposed design of the channel. The results of this analysis is discussed in **Section 4.1** of this report. The HEC-1 model is included in **Appendix B**.

- **Land Use** – Land use data was based on the 2008 MPU and updated as needed. Minor updates and revisions were made to the land use data based on aerial imagery to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

- **Curve Numbers** – Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the

Design Manual. Curve number information was compiled for each subbasin using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers.

- **Lag Time** – All subbasins within the project watershed are less than 0.5 square miles. The time of concentration for subbasins of this size is computed with the time of concentration equation (velocity method) from the CCRFCD Design Manual.

- **Routing** – The routings in the HEC-1 model through streets or storm drains were performed using the Muskingum-Cunge method for floodwave routing to be consistent with the 2008 MPU.

Detailed summary tables and supporting calculations for all parameters listed above are provided in **Appendix B**.

2.6.3. Computer Modeling

HEC-1 Version 4.1 (dated June 1998) was used for the CAC hydrologic modeling in order to be consistent with the MPU process. Descriptive information has been included in the HEC-1 input file on the "ID" and "KM" cards. The HEC-1 model is included in **Appendix B** and electronic model files are also provided on the Data CD that accompanies this report.

2.6.4. Concentration Points

Peak flows were combined in HEC-1 using concentration points that were inserted into the HEC-1 model. Several concentration points are located at the Pecos/Stewart intersection and along the Cedar Avenue Channel (as shown in **Figure 7** and **Figure 8**) since these are the main design locations in the study area.

2.6.5. Referenced Portions of the Model (Flow Diversions)

There are a few portions of the model that are based on reference studies/models:

At the intersection of Pecos Road and Charleston Boulevard, 206 cfs is conveyed north in an existing 66" RCP that collects flow from Charleston Boulevard and turns north in Pecos Road (see HEC-1 node CCHAR). The flow of 206 cfs is based on a referenced model from the Central Neighborhood Flood Control Master Plan. It is assumed that this flow of 206 cfs is the same in the interim and ultimate condition, since subbasin CH70-C will still drain to Charleston Boulevard, and there will be still be some bypass flow on Charleston Boulevard even when the future regional facility is built in Boulder Highway. A small inflow hydrograph (see HEC-1 node CHAR) was added to the model to represent existing flow on Charleston Boulevard from upstream watersheds in order to have a total peak flow of 206 cfs at the intersection of Pecos Road and Charleston Boulevard.

In order to account for flows that will enter the Cedar Avenue Channel from Bonanza Road area, portions of the 2008 MPU Central Watershed model (SW3) were copied and included directly in the HEC-1 model. The referenced portions of the model establish the 100-year peak flows in Bonanza Road. At the intersection of Pecos Road and Bonanza Road, the HEC-1 model has a diversion (DBN09) to represent the 202 cfs that is conveyed

south in the existing 60" RCP toward the Cedar Avenue Channel (based on full flow capacity normal depth calculations).

Similarly, at Marion Street and Bonanza Road, the referenced 2008 MPU model (at HEC-1 node CBN15-C) represents the flow that will be conveyed south in Marion Drive in the ultimate condition. Refer to **Section 2.9** or the 2008 MPU model for more details if necessary.

Also, it should be noted that the 2008 MPU assumes that the existing 60" RCP in Pecos Road south of Bonanza Road will be abandoned (see **Figure** 4). However, the Cedar Avenue Channel has been designed to accommodate this flow. Therefore, in the future, the 60" RCP can remain in place without any adverse impacts on the channel, which may reduce the size of the future regional facility in Bonanza. This assumption will need to be confirmed during the design of the Bonanza Road regional facility.

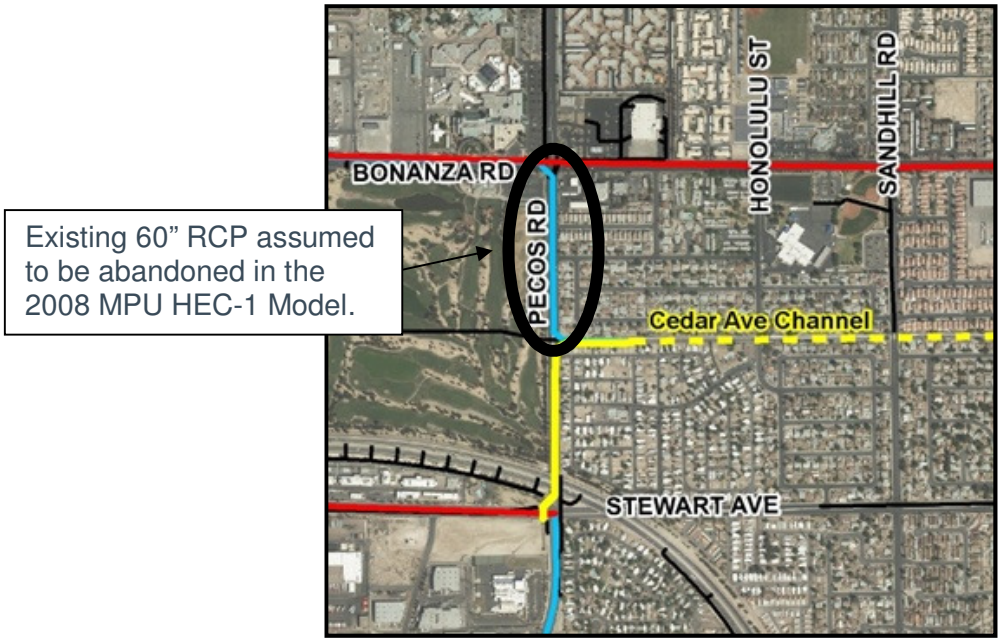


Figure 4. Existing 60" RCP in Pecos Rd

2.7. Hydrologic Analysis Results

The 100-year peak flows from the ultimate condition HEC-1 model for the subbasins, diversions, and combination points are summarized on the Hydrologic Summary Map **(Figure 7**) at the end of this section. **Table 1** summarizes the main design flows at key locations. The table also includes the MPU Flows from the 2008 MPU for comparison purposes.

Table 1. Summary of Design Flows at Key Locations

Location	HEC-1 Combo Point	Ultimate Flow (cfs)	MPU Flow (cfs)
Downstream of Pecos/Stewart intersection (total flow in the proposed SD)	CCA05	702	-
Outlet of 2:72" RCP's (at upstream end of channel)	CCA06	1085	1170
Honolulu Street	CCA08	1173	-
Sandhill Road	CCA09	1210	-
Red Bandana Street	CCA10	1236	-
Lamb Blvd	CCA11	1310	1387
Page Street	CCA12	1359	-
Marion Drive (Upstream)	CCA13a	1410	-
Marion Drive (Downstream)	CCA13	2924*	-
Las Vegas Wash	CCA14	2961*	1544

*Includes Bonanza Avenue flow

2.8. Stewart Avenue Collection and Bypass Flow

After the initial HEC-1 model was run, it was subsequently modified through an iterative process in order to represent the flow collected in the proposed drop inlets and storm drains at the intersection of Stewart Avenue and Pecos. In other words, initial hydrologic results were used in the hydraulic analysis to size collection facilities, and then the hydrologic model was updated afterward to divert flows to proposed storm drain facilities and determine the remaining bypass flow on the streets. This provides consistency between the hydrologic and hydraulic analysis and results in a model that is representative of the post-project condition.

As shown in **Figure 8**, 745 cfs flows east on Stewart Avenue towards Pecos road. A portion of that flow (approximately 445 cfs) is collected and conveyed in proposed drop inlets/laterals as well as the existing 24" RCP in Stewart Avenue. An additional 55 cfs enters the storm drain system from the drainage swale and headwall south of Stewart Avenue, for a total peak 100-year flow in the storm drain of 502 cfs (HEC-1 node CCA05-2a). 50% clogging was assumed at the drop inlets.

The existing dual 48" RCP on Pecos Road conveys 210 cfs and will connect with the proposed storm drain system north of Stewart Avenue, resulting in a combined total flow of 688 cfs (HEC-1 node CCA05-4). Some minor existing storm drains will connect to the system downstream of this point and add an additional 14 cfs which increases the total flow in the system to 702 cfs (HEC-1 node CCA05).

The flow bypassing the proposed storm drain system on Stewart Avenue is approximately 315 cfs. There is an additional 79 cfs in the street on Pecos Road that is bypassed east on Stewart Avenue. The total bypass flow on Stewart Avenue is 357 cfs (HEC-1 node CSTEWBY) when timing in th hydrology is accounted for. While this is a significant improvement compared to the existing condition, there will still be a flow conveyed eastward on the surface of Stewart Avenue. According to the Central Neighborhood Flood Control Master Plan, there is an additional 300 cfs that drains to

Stewart Avenue from tributary areas north of Stewart Avenue between Pecos Road and the Las Vegas Wash. This flow will combine with the bypass flow of 357 cfs at the low point in Stewart Avenue west of Marion Drive, resulting in more than 500 cfs at this location. The existing 48" RCP in Stewart Avenue does not have adequate capacity to convey the flow to the Las Vegas Wash and thus ponding will occur. Atkins recommends that this area be reviewed in more detail and a proposed regional facility in Stewart Avenue (between the low point and the Las Vegas Wash) be considered for inclusion in the Las Vegas Valley MPU.

Atkins performed sensitivity analysis to determine the maximum and minimum range of flows that reaches the channel and bypasses east on Stewart Avenue. The range of flow was obtained by modelling a 50% clogged drop inlets and 100% efficient drop inlets, and using different modelling approaches such as WSPG, HEC-RAS, XPSWMM to compare the results. **Figure 5** summarizes the range of flows. The maximum flow that is collected in the storm drain is 766 cfs, and the maximum flow that is bypassed east on Stewart Avenue is 398 cfs. The details of the modelling approaches used can be found in **Section 3.3.** The details of the analysis can be found in Meeting Minutes from Progress Meeting #15 which is included in the **Data CD**.

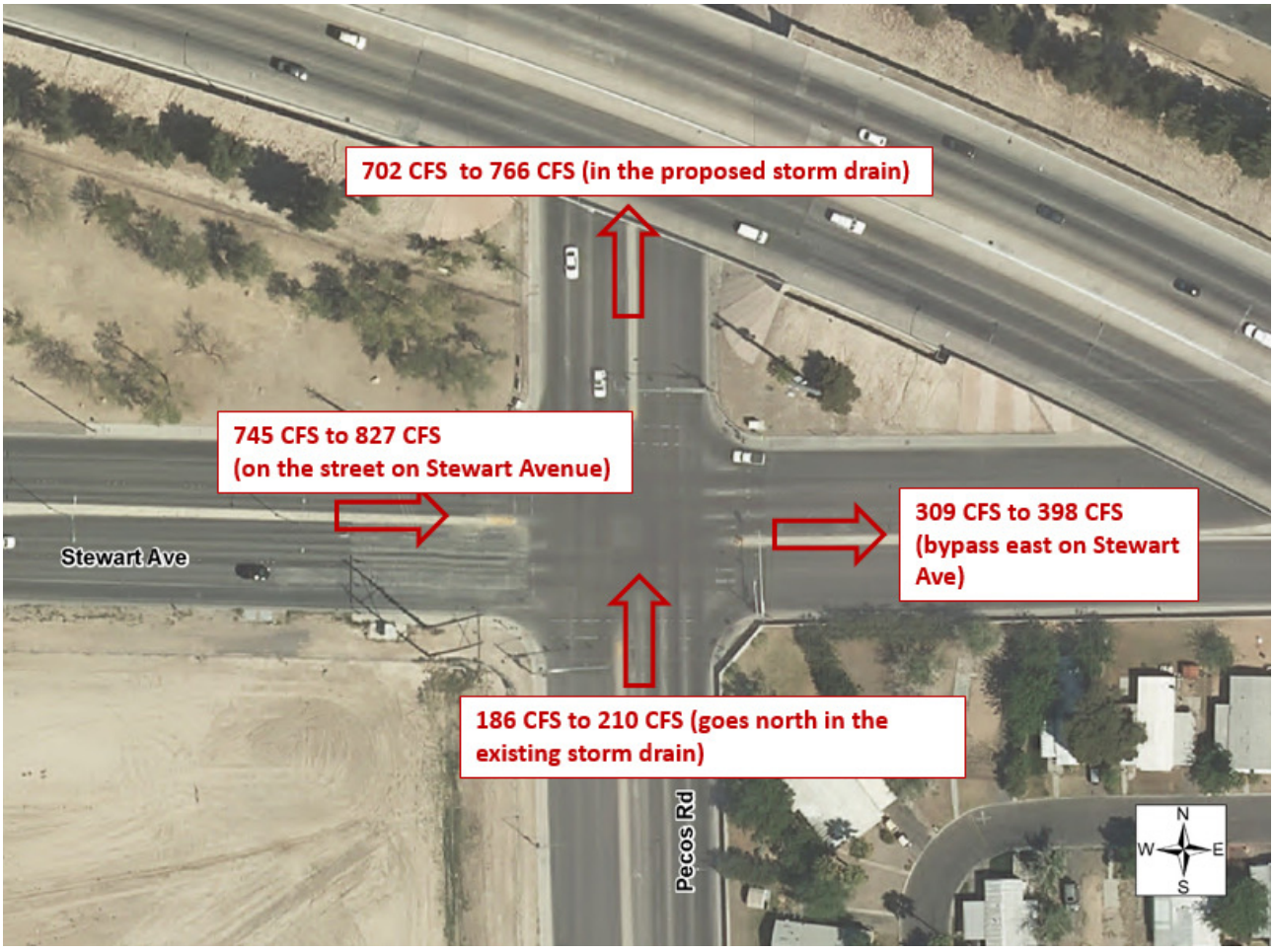


Figure 5: Summary of Range of Flows

2.9. Marion Drive Confluence

The Las Vegas Wash CMAR project determined that connecting the proposed regional facility in Bonanza Road to the Las Vegas Wash would be difficult because of the bridge configuration, right-of-way, and other design constraints. As a result, they proposed to re-route the proposed regional facility down Marion Drive to the Cedar Avenue Channel instead of connecting directly to the Las Vegas Wash. This results in increased flow in the Cedar Avenue Channel and a need for a major confluence structure and a larger channel to accommodate the combined flow.

As described previously, this alternative alignment and future regional facility in Marion Drive has been incorporated into the ultimate condition HEC-1 model using the 2008 MPU as a reference. The resulting flows in the area are shown on **Figure 6**.



Figure 6. Future Bonanza Regional Facility and Marion Drive Confluence

As shown above, the 100-year ultimate condition flow in the Bonanza Road regional facility is around 1,783 cfs, while the channel has a 100-year flow of 1,208 cfs. This results in a combined total flow of 2,875 cfs to be conveyed in the Cedar Avenue Channel downstream of Marion Drive. The design of the channel and future confluence to accommodate this increased flow will be described in the next section.

Figure 7 Hydrologic Summary Map

Figure 8 Stewart Avenue Bypass and Collection

3. Proposed Design and Hydraulic Analysis

3.1. General

This section includes information about the proposed design of the storm drain and channel facilities. It also presents the hydraulic analysis, criteria, and methodology that were used to develop the 70% design of the Cedar Avenue Channel.

3.2. Proposed Design

For the purpose of organizing the information presented in this Section, the project improvements are grouped into two categories: (1) the storm drain system improvements (from Pecos Road/Stewart Avenue to the existing Cedar Avenue Channel and (2) the channel improvements (from the upstream end of the Cedar Avenue Channel to the Las Vegas Wash). The overall design concepts are described below:

3.2.1. Pecos/Stewart Storm Drain System

The proposed storm drain system has been designed to collect as much flow as possible from Stewart Avenue to alleviate downstream flooding.

The proposed storm drain system is comprised of new drop inlets and laterals on Stewart Avenue that collect surface flow and connect to a mainline storm drain on the north side of Stewart Avenue.

The mainline storm drain consist of an 18’ x 5’ RCB north of Stewart Avenue and west of Pecos Road that transitions into a dual 8’X5’ RCB at the Pecos Road/Stewart Avenue intersection in order to cross over an existing 36” sewer. After crossing the sewer, the dual 8’ x 5’ RCB transitions into an 18’ x 5’ RCB north of the intersection. At this location, the existing dual 48” RCPs in Pecos Road will connect to the 18’ x 5’ RCB. The storm drain then transitions to a 12’ x 6’ RCB that continues north in Pecos Road before turning east and eventually discharging to the Cedar Avenue Channel. The proposed storm drain facilities are shown in a schematic in **Figure 10**.

There are three laterals that go across Stewart Avenue and connect to the mainline storm drain. The sizes and schematic of the laterals are also shown in **Figure 10**. This configuration of the laterals represents the most efficient scenario as it collects the maximum flow. Although three trenches and work zones will be required during construction, having only one lateral go across Stewart Avenue to connect to the mainline would not collect as much flow.

The above mentioned design of the storm drain system is driven by several constraints:

- There is an existing 36” sewer running through the Pecos Road/Stewart Avenue intersection. The sewer line is not very deep and limits the storm drain to be short and shallow. There is not enough room to cross the sewer line using a mega box (18’ x 5’ RCB) with a thicker slab. Therefore, the transition of an 18’ x 5’ RCB to a dual 8’ x 5’ RCB is required. The total capacity of the storm drain is controlled by the capacity of the dual 8’ x 5’ RCB, which is around 500 cfs. Several alternatives were investigated to relocate the sewer, but the feasibility and costs did not result

in suitable alternatives. Additional information is described in project meeting minutes.

- 5' tall RCBs at Pecos/Stewart intersection provides essentially no cover or paving over the box, and therefore would require a thicker roof slab that is monolithic with the pavement and adequate for driving. The 5' tall boxes were recommended by the City for easy maintenance access.

- The mainline storm drain is also constrained by the existing invert at the downstream connection point in the Cedar Avenue Channel. Therefore, the slope is relatively flat and governed by crossing over the sewer and tying into the channel.

- Lateral 3 (5' x 3' RCB) contains a grade break to go over the utilities and gain enough cover on top.

3.2.2. Cedar Avenue Channel

As discussed in the Cedar Avenue Channel Capacity Analysis, the channel is limited in capacity and has experienced overtopping in the existing condition. Similarly, it does not have adequate capacity to convey the ultimate condition flows. The proposed design is intended to increase the conveyance capacity of the channel in order to improve the existing conveyance and to accommodate the design flows that will be discharged to the channel after the proposed storm drain is complete. From upstream to downstream, the proposed channel improvements include:

Upstream of Honolulu Street: For this section of the channel, no changes have been proposed. The channel will remain a trapezoidal channel with a 10' bottom width, 1.5:1 side slopes, and around 8.25' of depth. The bridge crossing (dual 12' x 5.5' RCB) at Honolulu Street will remain in place.

Honolulu Street to Sandhill Road: The new channel section between Honolulu. Street and Sandhill Road is proposed to be a 25' wide rectangular channel. It will transition to a 36' wide channel just upstream of Sandhill Road Crossing. The bridge crossing at Sandhill Road (1: 12' x 4' RCB and 2: 11' x 4' RCB) will remain in place as replacing Sandhill with a 4' tall megabox results in negligible hydraulic changes. Culverts at Sandhill cannot be replaced with anything taller than 4' as Sandhill Road cannot be reprofiled. Details of this analysis is provided in notes from Progress Meeting #17 in **Data CD**.

Sandhill Road to Lamb Boulevard: In this section, the channel is shifted approximately 2' north from its existing centerline. The shift north is required because south end of the existing channel is very close to the fencing and block walls. The shift of the channel is discussed in **Section 4.3.2.**

For about 700' downstream of Sandhill Road, the new channel section is proposed as a 36' wide rectangular section. At this location, it transition into a 31' wide rectangular section, which is necessary because the right-of-way constricts from 60' wide to 50' wide in this area. Contracting the channel allows for minimum trail widths to be maintained (see **Section 4.2.2**).

The 31' wide rectangular channel section then continues on downstream and ties into the proposed dual 15' x 6' RCB culvert crossing (which replaces the existing dual 12' x 6' RCB culverts) at Lamb Boulevard. The culverts are being replaced because the dual 15' x 6' RCBs results in much better hydraulics between Sandhill and Lamb as can be seen in **Figure 9**. The centerline of the proposed culverts will be 4' north of the centerline of the existing culvert.

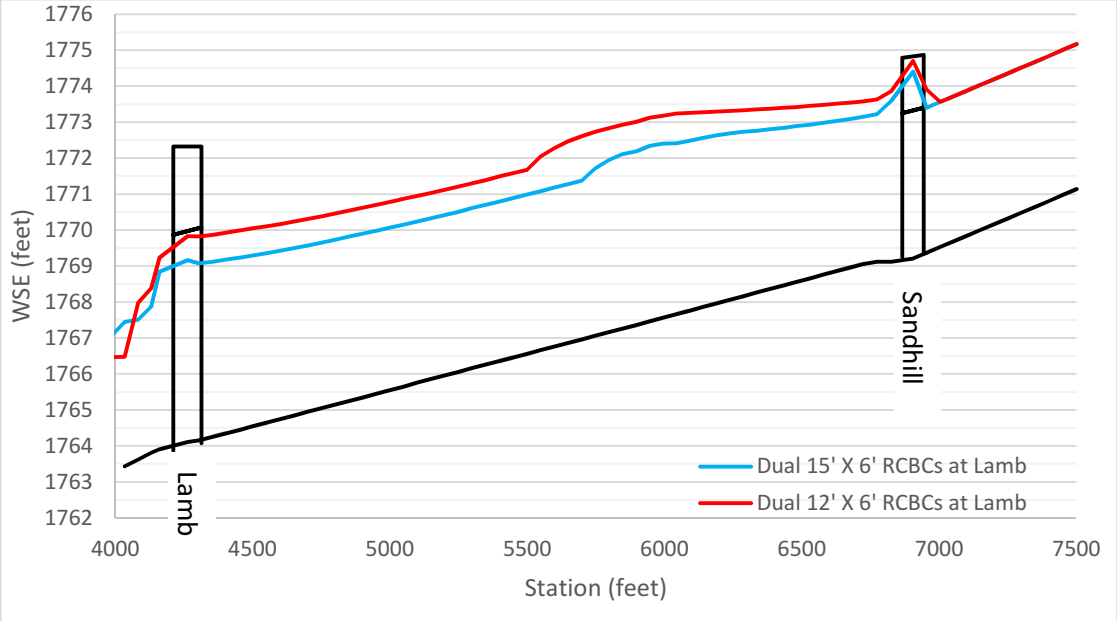


Figure 9 Comparison in WSE between existing and proposed culverts at Lamb

In addition, a 1-foot tall vertical wall on the north side of the channel is proposed to extend 1,500 feet upstream from Lamb Boulevard to provide additional freeboard (see **Section 3.4** for freeboard analysis).

Lamb Boulevard to Page Street: Immediately downstream of the Lamb crossings, the proposed channel transitions from 31' to 29' in order to maintain 8' minimum train width and 12' access ramp width. The 29' wide channel shifts north by approximately 2' after the access ramp and continues for about 700' to provide room for construction on the south side, and then transitions back into a 31' wide channel.

Page Street to Marion Drive: The proposed channel is a 31' wide rectangular channel downstream of Page Street. It remains the same throughout the section.

Downstream of Marion Drive: Downstream of Marion Drive, the proposed 31' rectangular channel continues for approximately 200 feet. At this point, there is a channel transition which will accommodate future flow from the Bonanza regional facility while dropping 7 feet in elevation and narrowing into a 22' wide rectangular section. The rectangular channel will be deep (ranging from 15' to 17' deep) and extend at 0.2% slope until connecting to the Las Vegas Wash.

The design of the channel section downstream of Marion Drive assumes that the alternative alignment for the Bonanza Road regional facility will be used as described in Section 2. It was assumed that the future regional facility in Marion Drive would be

approximately 20 feet wide in order to accommodate the 100-year flow from Bonanza Road of 1,785 cfs. The future facility will combine with the Cedar Avenue Channel downstream of Marion Drive Bridge (which will remain in place).

The 7 feet drop in elevation is needed downstream of Marion Bridge to accommodate for additional 1,785 cfs from future Bonanza Road regional facility. It should be noted that excavating and constructing this section of the channel will require the use of a temporary retaining wall, such as driven piles, for stabilization. The only way the drop in the channel can be avoided is if the Bonanza Road future facility does not enter Cedar Avenue Channel.

The future 20' wide regional facility coming into the channel from Marion Drive will need to consist of dual 10' wide boxes (or similar geometry with a center pier) as the Cedar Drainage Trail will be maintained on top of the box. Span cannot be 20' wide for structural integrity purposes. This conceptual confluence layout is included in the design plans and is subject to review and revision during future design phases.

Figure 11 summarizes the proposed design for the Cedar Avenue Channel.

The channel design was driven by several constraints which are listed below:

- The Cedar Drainage Trail runs alongside the entire length of the channel, making it difficult to widen the channel and still accommodate the trail and access ramps.
- The existing channel profile is very flat and does not provide topographic relief or option to steepen the channel to increase conveyance capacity
- The design intent was to maintain most of the existing crossings/bridges at the cross street to avoid costs associated replacing the culvert crossings and disturbing traffic. The only crossing/bridge that is being replaced is at Lamb Boulevard because replacing Lamb improves hydraulics of the channel. Sandhill Bridge will remain in place as replacing it results in negligible hydraulics change.
- Between Sandhill Road and Lamb Boulevard, the right-of-way constricts from 60' to 50' limiting the corridor even further.
- Channel is shifted north by approximately 2' between Sandhill and Lamb to provide room for construction in the south side of the channel.
- Between Lamb and Page, a portion of the channel shifts north by approximately 2' to provide room in the south side.
- Design of the downstream end of the channel (past Marion Drive) was dictated by the proposal to bring in more flow from Bonanza Road and by the constraint to tie into the proposed, narrow confluence structure proposed as part of the Las Vegas Wash CMAR project.
- Constructability of the channel in a narrow corridor with the above constraints will require specialized construction methods and caution. Refer to **Section 4.3** for additional information.

Atkins worked with the City during various workshops and progress meetings in order to review alternatives and develop the proposed design described above. Constructability review was also performed after the 30% Design Phase. The constructability review comment matrix can be found in **Appendix A** The proposed design incorporates constructability review comments, and is the result of the coordination that occurred in order to come up with cost-effective, feasible design concepts that provide maximum flood control in accordance with the regional master plan in the area. The proposed design is still in the process of being reviewed and optimized and is subject to revision as the design phase continues.

Figure 10. Pecos/Stewart Storm Drain System

Figure 11 Proposed Channel Design

3.3. Hydraulic Analysis Methodology and Results

3.3.1. Pecos/Stewart Storm Drain System

WSPG Model and Facility Sizing

The Pecos/Stewart Storm Drain mainline and laterals were analysed and sized using the Water Surface Pressure Gradient (WSPG) computer program. The computational procedure used in WSPG is based on solving Bernoulli's equation for the total energy at each section and Manning's equation for friction losses between sections in a reach. The program accounts for energy losses at junctions, angle points, and transitions and uses basic hydraulic principles to calculate hydraulic data such as flow area, wetted perimeter, critical depth, hydraulic grade line, Froude number, momentum, etc. The geometry, slopes, and sizes of the mainline were input into WSPG along with the design flows, and the model was run in order to ensure that the hydraulic grade line (HGL) or depth of flow remained at least 1 foot below final grade at all locations. The mainline WSPG model is included in **Appendix C**. An additional model which uses Manning's n of 0.013 is included in the **Data CD** along with the original model.

The hydraulic grade line can be seen for the entire storm drain system and the laterals on the submitted 70% Design Plans.

3.3.2. Cedar Avenue Channel

HEC-RAS Model and Facility Sizing

The hydraulic analysis for Cedar Avenue Channel was performed using the steady state routines within the HEC-RAS computer model, Version 4.1.0 (USACE, 2010) based on the 100-year peak flows for the ultimate condition. An existing condition scenario was also analysed in HEC-RAS to evaluate the current water surface profile today. The parameters used in the hydraulic analysis are described below:

- **Channel Geometry**: Channel geometry is based on detailed field survey obtained by Atkins at several channel cross sections as well as upstream and downstream of all of the bridge crossings. The HEC-RAS 'XS Interpolation' tool was also used to interpolate cross sections every 50 feet between the surveyed cross sections. Detailed 1-foot topography was also obtained and used as necessary in the modeling effort in locations where survey was not available. Channel geometry for cross sections upstream and downstream of structures are provided in **Appendix C**.

- **Manning's Roughness**: Manning's roughness of 0.015 is used for the entire channel reach. An additional model which uses manning's roughness of 0.013 is in included in the **Data CD**.

- **Downstream Boundary Condition:** The HEC-RAS model is executed for the subcritical flow regime based on steady-state flow routines. The model utilizes a normal depth boundary condition at the downstream and upstream ends based on the proposed channel design slopes.

- **Expansion and Contraction Coefficients**: Default values of 0.1 and 0.3 for the contraction and expansion coefficients, respectively, are utilized for cross-sections with gradual transitions where the flow is subcritical. However, these coefficients are increased to 0.3 and 0.5 in the vicinity of each structure.

- **Hydraulic Structures**: The five crossings (Honolulu, Sandhill, Lamb, Page and Marion) are modelled as bridges based on the detailed field survey obtained by Atkins. The geometry and hydraulic parameters for each structures were incorporated into the model using 'Bridge Editor' in HEC-RAS.

Results from HEC-RAS can be found in **Appendix C**. The complete HEC-RAS model, which consists of existing and proposed channel geometries, is included on the Data CD. **Figure 12** below summarizes shows the channel profile and WSE and compares the proposed channel invert with the existing channel invert elevation. The proposed channel design is adequate to convey interim and ultimate condition flows.

The hydraulic grade line for the channel can be seen on the 70% Design Plans.

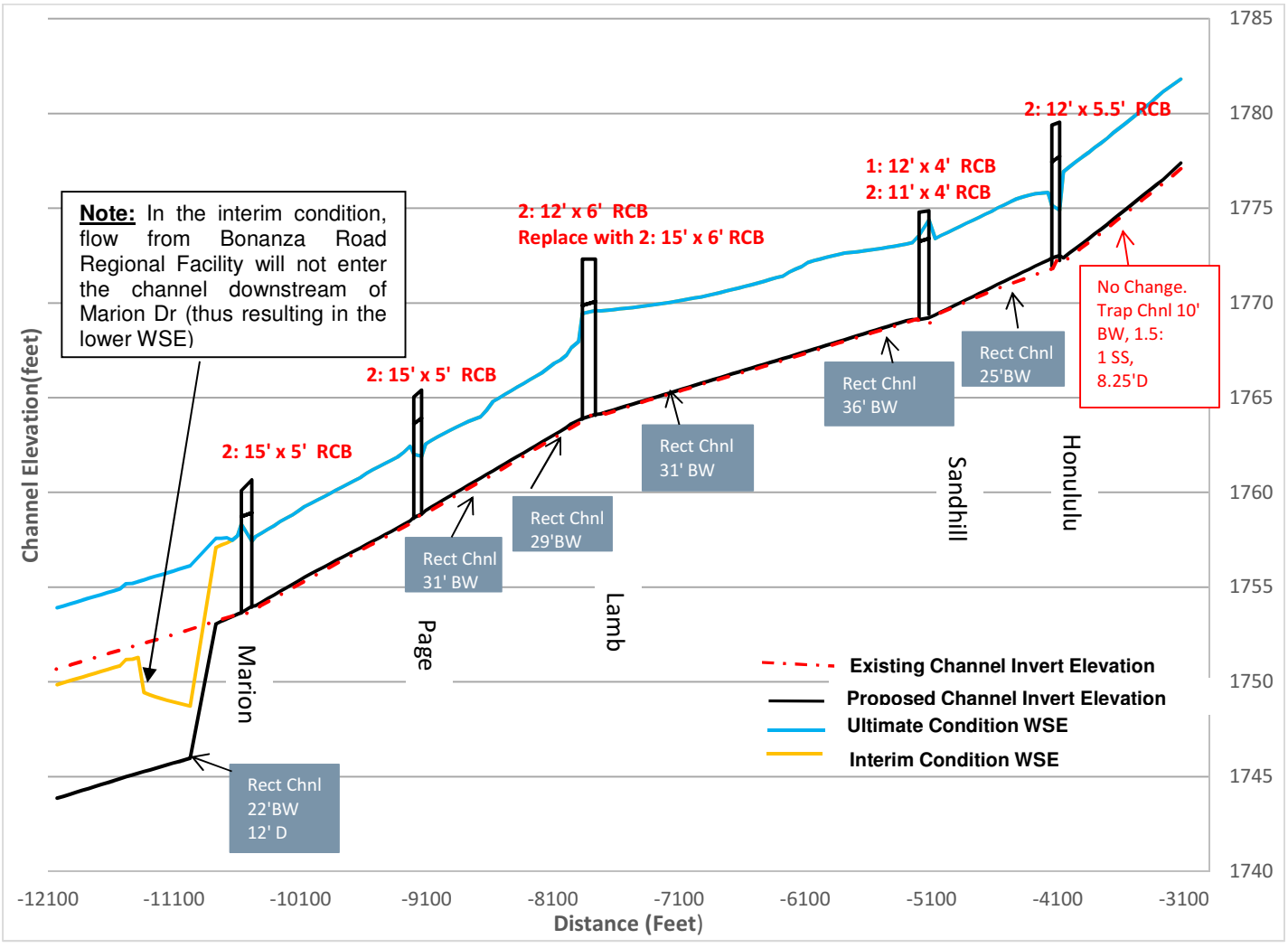


Figure 12. HEC-RAS Profile - Water Surface Elevation (WSE)

The proposed channel design was analyzed to verify if the freeboard criteria presented in HCDDM is met at all model cross sections. The proposed channel has adequate capacity to convey the design flow plus freeboard and an extra tolerance for super-elevation at most channel locations. For a short section upstream of Lamb Boulevard, adequate freeboard was not available because the channel transitions from 36' wide to 31' wide. To address this issue, Atkins proposes a 1' tall wall along the north side of the channel segment. The proposed 1' tall vertical wall provides extra freeboard. Detailed freeboard calculations and a summary table are provided in **Appendix C**.

Freeboard criteria is met at every bridge except for the downstream face of Sandhill crossing and the downstream face of Marion crossing. However, in both of these cases, the available freeboard is greater than 1 foot.

3.3.3. Sensitivity Analysis and XPSWMM

XPSWMM model was used to compare the results of HEC-1, WSPG and HEC-RAS. XPSWMM is a dynamic model that links rainfall runoff, street flow and inlets, storm drain hydraulic and open channel hydraulics into a single model.

The purpose of this comparison was to perform sensitivity analysis to identify if the proposed system operates as intended. A range of flow that can reach the channel was developed using all the approaches (HEC-1, FlowMaster, WSPG and XPSWMM), and updating parameters such as drop inlet clogging and freeboard requirements. **Figure 5** in the previous section summarizes the range of flow that reaches the channel and bypasses east on Stewart Avenue. The results from XPSWMM model were discussed at Progress Meeting #15 which is included in **Data CD.**

3.4. Drop Inlets

Five drop inlets are proposed on Stewart Avenue at the intersection with Pecos Road. The size and locations of the drop inlets were designed in accordance with the criteria established in the CCFRCD Design Manual. The proposed drop inlets have been analyzed to ensure adequate collection that will allow the storm drain to function as intended. The key design criteria used in the design of the drop inlets is discussed below.

All of the proposed drop inlets along Stewart Avenue are Type CM that were designed with a maximum length of 15 feet. The software FlowMaster (Bentley Systems, Inc, 2009) was used to calculate the inlet interception and bypass flow at each drop inlet location based on the roadway longitudinal and cross slopes. The hydraulic computations in FlowMaster are based on HEC-22 methodology.

The drop inlets were sized using a 50% clogging factor to account for conditions that decrease the capacity of the standard inlets. These conditions include plugging from debris and sediment, pavement overlaying, and the general deterioration of inlet conditions over time. This 50% clogging condition was applied in the grate using the option available in FlowMaster Software.

Five new drop inlets have been proposed along Stewart Avenue – two on the south side and three 2 were determined from the ultimate HEC-1 model. Subsequent flows downstream from each inlet were adjusted as necessary to account for intercepted flow and bypass flow.

A drop inlet summary table showing sizes, types, and flows and associated inlet hydraulic calculations is included in **Appendix C**. All drop inlets are shown on the 70% design plans.

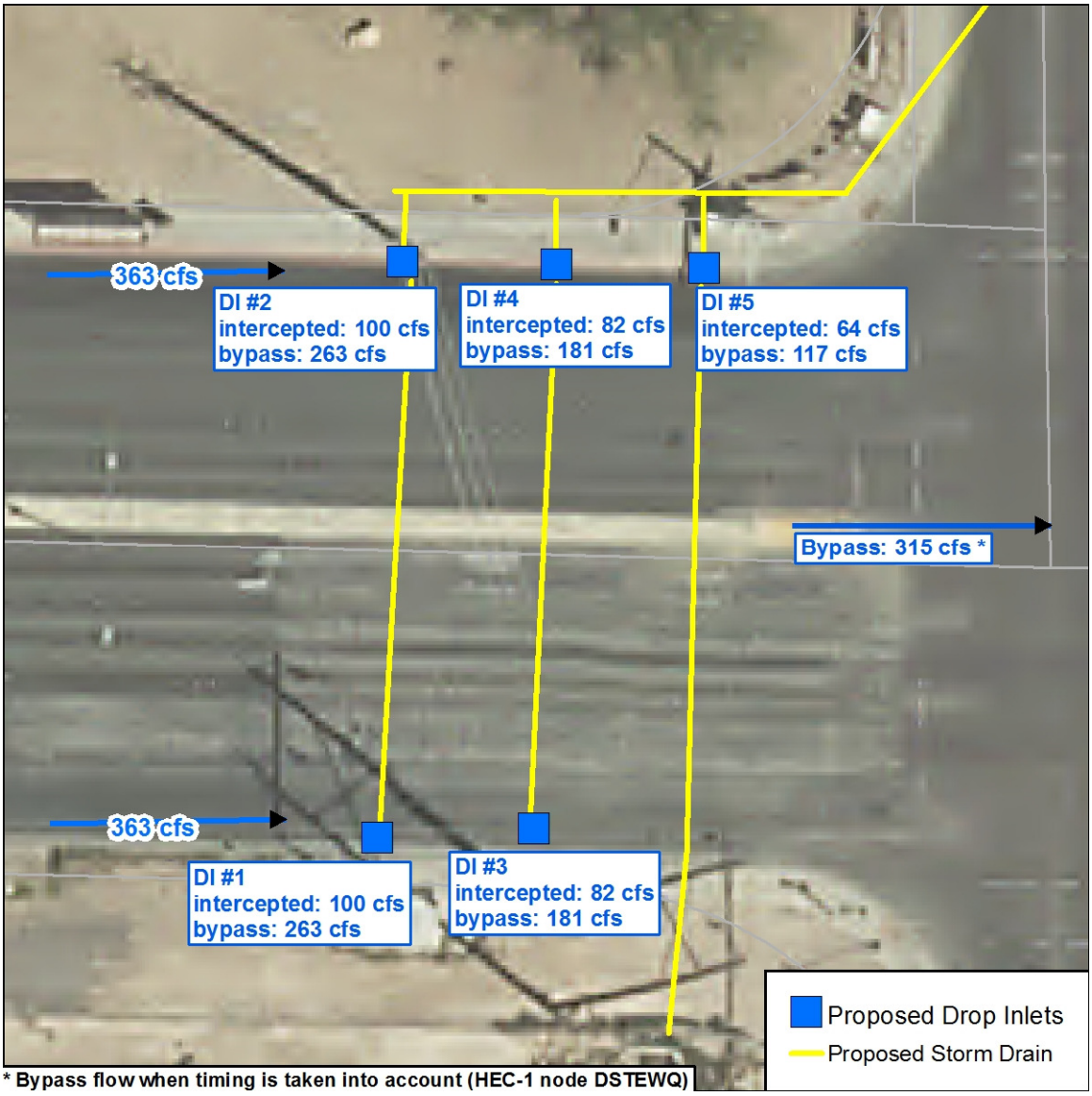


Figure 13. Proposed Drop Inlets

There are existing drop inlets along Pecos Road. These drop inlets collect nuisance flows and do not have an impact the proposed storm drain or channel.

4. Other Design Works and Considerations

This section has been included in the DFDR to summarize key considerations and factors that influenced the 70% design of the CAC. This information has been provided for reference and also to aid with decision making during future design phases. This section also includes a summary of other activities that were performed during the 70% design phase. Pertinent aspects of the project explored to date are included below.

4.1. 2014 Soils Data

As a part of the analysis, Atkins reviewed the latest NRCS soils data (from August 2014) in the project area and noticed some differences between this dataset and the 2008 MPU soils dataset. In order to quantify and better understand the impacts of the new soils data on the hydrologic analysis, Atkins calculated revised CNs in the study area based on hydrologic soils groups shown in the new soils data. These CN values were then incorporated into a separate HEC-1 model for flow comparison. **Table 2** shows the comparison of flows at key locations

Table 2. Summary of Flow Comparison at Key Locations (2014 Soils)

Location	HEC-1 Combo Point	Ultimate Flow 2008 MPU Soils (cfs)	Ultimate Flow 2014 Soils (cfs)
Downstream of Pecos/Stewart intersection (total flow in the proposed SD)	CCA05	702	673
Outlet of 2:72" RCP's (at upstream end of channel)	CCA06	1085	1112
Honolulu Street	CCA08	1173	1207
Sandhill Road	CCA09	1210	1237
Red Bandana Street	CCA10	1236	1260
Lamb Blvd	CCA11	1310	1347
Page Street	CCA12	1359	1396
Marion Drive (Upstream)	CCA13a	1410	1440
Marion Drive (Downstream)	CCA13	2924*	2952*
Las Vegas Wash	CCA14	2961*	2977*

*Includes Bonanza Avenue flow

It should be noted that the new soils dataset was used only in the Cedar Avenue Channel watershed. Portions of the model that are based on referenced studies were not changed.

As shown in **Table 2**, the total flow in the storm drain system decreases from 702 cfs to 673 cfs (HEC-1 node CCA05). However, the total flow in the channel increases with the new 2014 soils dataset. Atkins modelled the proposed channel in HEC-RAS with the new increased flows to quantify the impacts of the change. **Figure 14** shows the comparison between the ultimate WSE from the 2008 MPU soils model and 2014 soils model. The difference in WSE is negligible, and thus the proposed design of the channel is still relevant.

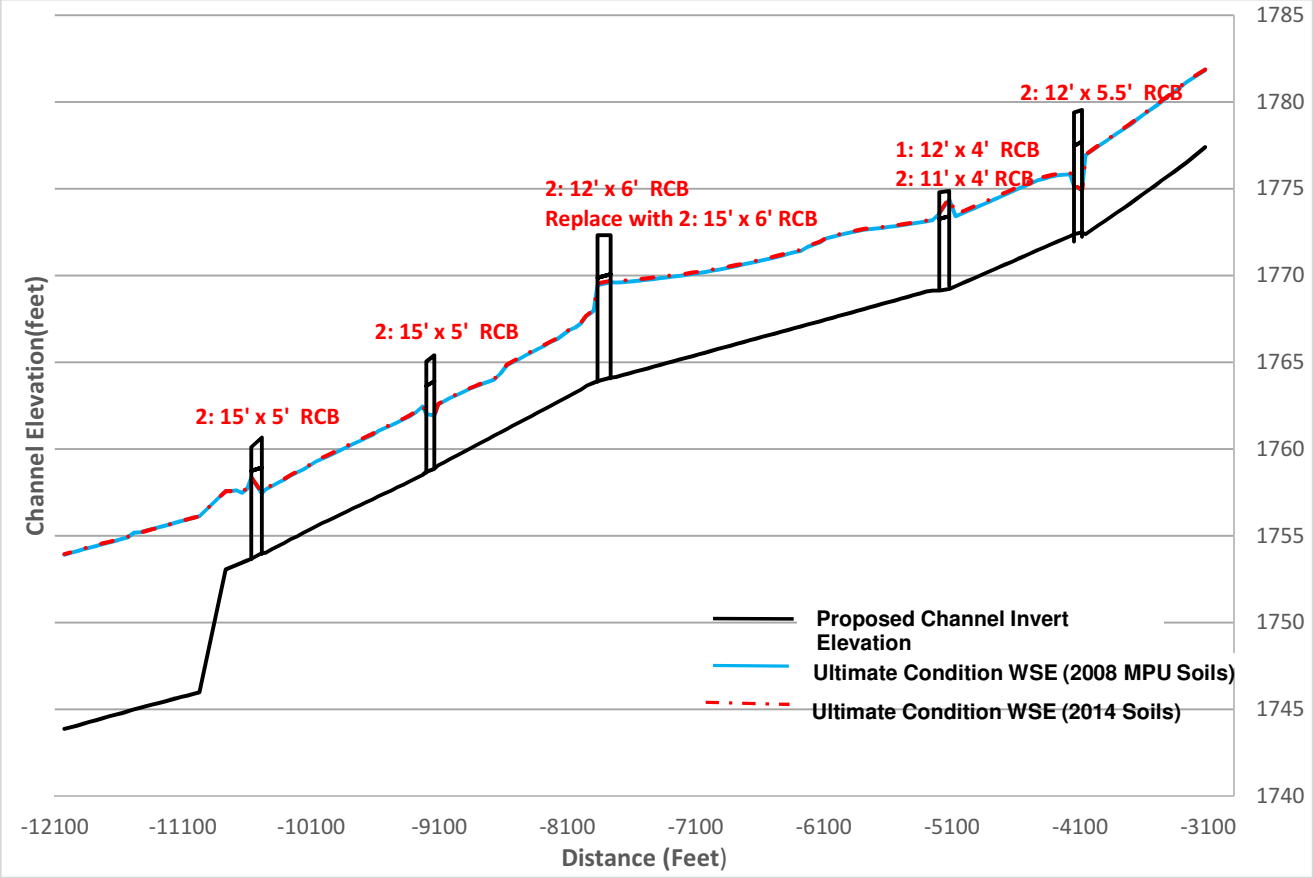


Figure 14. Comparison in WSE

4.2. General Design Considerations

The following is a summary of several design considerations that are pertinent to the overall design of the project now and into the future.

4.2.1. Future Facility in Stewart Avenue

Upstream of the proposed improvements, there is approximately 675 cfs on Stewart Avenue at Mojave Road (see combination point CCA04 in the HEC-1 model). This flow is conveyed east on the surface of Stewart Avenue until it reaches the proposed drop inlets and storm drain at the intersection of Stewart Avenue and Pecos Road.

In the future, the proposed regional facility CNST 0000 (8' X 7' RCB) should be constructed on Stewart Avenue, upstream of the current project between Pecos Road and Mojave Road. This facility will reduce surface flow on Stewart Avenue in order to meet dry lane criteria and can tie into the upstream end of the 18' x 5' RCB installed with this project (north of Stewart Avenue and west of Pecos Road).

A lateral storm drain extending a quarter-mile to the south in Mojave Road could also be installed to collect surface flow in this area. The proposed regional facility and potential lateral storm drain are shown in **Figure 15**.

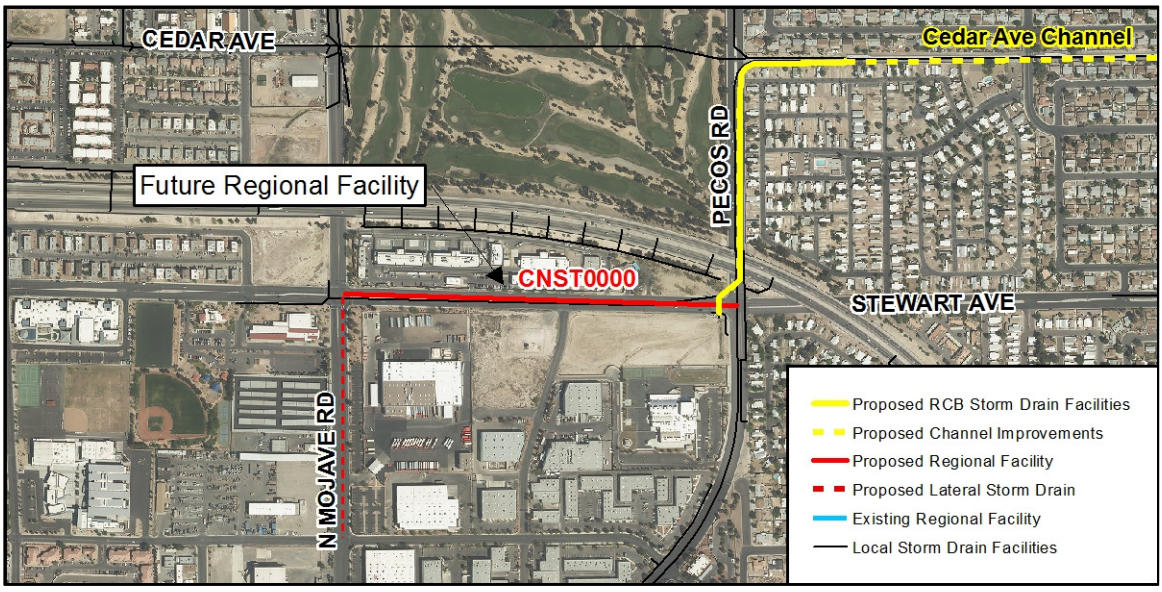


Figure 15. Future Regional Facility in Stewart Avenue

4.2.2. Cedar Drainage Trail

The Cedar Drainage Trail width was kept as wide as possible with the intent to match existing trail widths. At least 8' trail width is maintained throughout the channel as directed by the City after the Progress Meeting #17 (see **Data CD** for meeting minutes and related email). The revised trail widths for each section are described below:

- **Honolulu Street to Sandhill Road:** Original trail width maintained
- **Sandhill Road to channel bend:** Channel is shifted north by approximately 2'. The trail width varies from 9.5' to 8' minimum to allow for channel width and for constructability reasons. The trail lighting is protected-in-place.

  Access ramp is removed from this section as this section of the trail is narrow and having an access ramp would result in only 4' of trail. 20' access gate with post and cable will be installed along the trail instead of an access ramp. This part of the channel will be accessed through the culverts at Lamb. The City has maintenance equipment that will fit through the 6' tall RCBCs at Lamb.
- **Channel bend to Lamb Boulevard:** The trail width is reduced to 8' in this section to shift the channel north.
- **Lamb Boulevard to Page Street:** The trail was reduced but still maintains 12' of width except at the access ramp where the trail is 8'.
- **Page Street to Marion Drive:** The trail was reduced but still maintains 12' of width except at the access ramp where the trail is 8'.
- **Marion Drive to Las Vegas Wash:** The existing trail width has been maintained. In the future, the trail will need to be shifted to north adjacent to the right-of-way boundary from Marion Drive to the end of the access ramp in order to accommodate

the future regional facility that will convey flow from Bonanza Road. The trail would be reduced to 10 feet in the future for that particular section.

4.2.3. Cedar Avenue Channel Access Ramps

Because of proposed widening of the Cedar Avenue channel, the new access ramps into the wider channel section will encroach further into the trail and reduce the existing trail width in these already narrow sections. Effort has been made to provide as much width as possible while still maintaining the required channel and access ramp widths. The minimum amount of trail width remaining adjacent to the access ramps is shown in **Table 3** and a cross-section of the channel/ramp/trail is shown in **Figure 16**. The table and figure are referenced directly from the 70% design plans so refer to those for more information.

Table 3. Minimum Trail Widths at Channel Access Ramps

Access Ramp Location	Paved Trail Width (Adjacent to Access Ramp)
Honolulu Street	8’
Sandhill Road	No ramp
Lamb Boulevard	8’
Page Street	8’
Marion Drive	8’

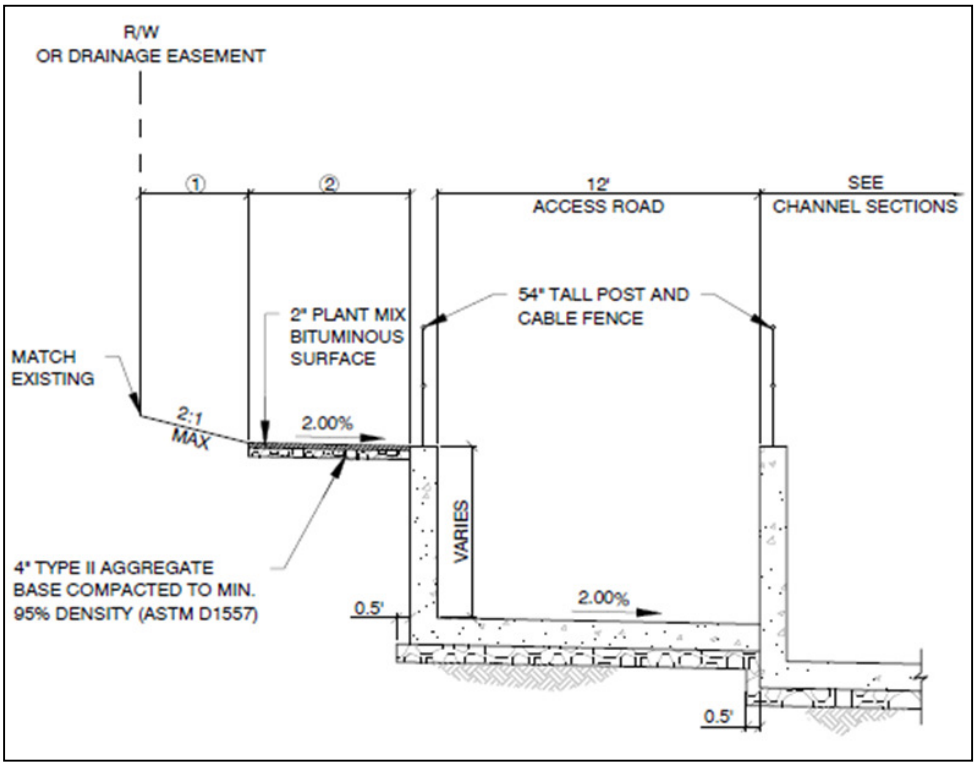


Figure 16. Channel Cross-Section Schematic at Access Ramps

4.3. Constructability

4.3.1. RCB Storm Drain Constructability

- The dual 8’ x 5’ RCBs and the junction structure in Pecos Road just north of Stewart Avenue will need to cross over the existing 36” sewer. There will be 6” minimum clearance over the sewer line.

- 5’ tall RCBs at Pecos/Stewart intersection provides essentially no cover or paving over the box, and therefore would require a thicker roof slab that is monolithic with the pavement and adequate for driving. The 5’ tall boxes were recommended by the City for easy maintenance access.

- Installation of the 18’x5’ RCB storm drain will require the use of forklifts to set pre-cast boxes or cast-in-place construction under I-515/US 95 due to the existing bridge over Pecos Road.

- The radius at which the mainline storm drain curves from Stewart Avenue to Pecos Road is the minimum radius required for fabrication of precast boxes. The mainline storm drain then has a reverse curve downstream to follow the alignment of the existing 72” RCP storm drain.

- Installation of the RCB once it exits Pecos Road and continues east toward the connection point with the channel will require shoring and careful construction as to not impact the existing wall and property on the south side.

- The RCB runs parallel along a 66” RCP SD as it exits Pecos Road and continues east towards the existing channel. The proposed RCB and the 66” RCP cannot be combined before it reaches the channel because the invert of the RCP is lower than the invert of the RCB. The construction of RCB along this segment will require a shoring wall system (such as driven piles) on both sides of the trench to stabilize the existing 66” RCP and backfill on the north and the property walls on the south.

- Per the geotechnical report, there is groundwater in the vicinity of the storm drain and when plotted it rises above the invert. Dewatering will likely be required. Refer to geotechnical report for additional constructability considerations related to dewatering. Please refer to **Section 4.3**.

4.3.2. Concrete Channel Constructability

- Construction on the south side of the channel will be very close to existing fencing and block walls. Typically, there is around 5’ to 7’ of clearance, which will be a small width to excavate the channel and meet OSHA requirements. Additionally, there are swimming pools in the backyards of residences in the backyards of residences. In all of these areas temporary retaining wall systems, such as driven piles, or permanent retaining walls that can be constructed without impacting the existing properties, will be required to stabilize the temporary construction excavations.

  Between Sandhill and Page, portions of the channel have been shifted north approximately 2’ to provide additional clearance during construction, and to reduce the need to use retaining walls. The shift in channel alignment is necessary as most

of the properties on the south have swimming pools that will require temporary shoring during construction.

- The channel becomes very deep (17 feet) east of Marion Drive to the end of the channel improvements, and will require the use of a temporary retaining wall, such as driven piles, in order to excavate and construct the channel. As mentioned in previous sections, the channel must be this deep to accommodate the flow combining the future Bonanza system. The depth of the channel can be reduced if the Bonanza system discharges directly into Las Vegas Wash and does not enter Cedar Avenue Channel.

- The entire construction corridor is narrow, and the existing channel is sloping at 0.20%. Constructing the channel at such a flat slope will be difficult.

- Right-of-way along the channel is narrow and does not have enough width for two vehicles to drive past one another. A longitudinal construction joint must be included in the design so that for one side of the channel can be constructed first. After the concrete has gained strength, the contractor can use the completed section as an access corridor to deliver and place concrete for the second half of the channel.

- Per the geotechnical report, there is groundwater in the area and when plotted it rises above or is at subgrade in the upstream section of the channel and at the downstream section of the channel. Dewatering will likely be required. Refer to geotechnical report for additional constructability considerations related to dewatering. Please refer to **Section 4.3**.

- Channel wall heights are bound by the existing improvements on each side of the channel.

4.3.3. Project Phasing

The following recommendations were agreed upon with the City with regard to project phasing:

- It is assumed that the Cedar Avenue Channel improvements described in this report will not be installed until the Las Vegas Wash is complete at the downstream end of the channel. This includes the Cedar Avenue Channel/Las Vegas Wash confluence structure that will be designed and constructed outside of this project.

- It was assumed that once the Las Vegas Wash improvements are complete, the Cedar Avenue Channel will be constructed from the downstream end to the upstream end. In other words, the storm drain proposed in this project should not be built prior to the downstream channel improvements in order to avoid any adverse impacts on properties adjacent to the channel.

- There will be some variability in the future depending on final design configurations and decisions made with respect to the Las Vegas Wash and the alternative alignment of the Bonanza Regional Facility. A Master Plan Amendment will be required to finalize the regional flood control plan for the area.

- Construction Specifications will be provided with the next phase of the project.

4.4. Geotechnical Investigations

Ninyo & Moore completed geotechnical investigations during the 30% design phase. The results of these investigations are summarized in the Draft Geotechnical Data Report, Draft Geotechnical Interpretive Report, and Hydrogeologic Aquifer Testing Report. The main sections of these reports are provided in **Appendix D**. All of the supporting data and appendix material is only included on the PDF versions of the reports on the **Data CD**.

The Geotechnical Data Report includes the findings of the field exploration and laboratory testing, while the Geotechnical Interpretive Report includes the findings of the geologic review, the results of the field exploration and laboratory testing programs, and presents recommendations for design and construction of the proposed project. The Hydrogeologic Aquifer Testing Report includes results of hydrogeologic aquifer testing and a summary of hydrogeologic and groundwater conditions along the project.

It is anticipated that groundwater dewatering will be required in some areas during construction. Based on the Hydrogeologic Aquifer Testing Report, the dewatering flow rate is expected to be lower than the 250 gpm threshold limit for a *DeMinimis* discharge permit. It is anticipated that the construction dewatering groundwater might be discharged to the CLV sanitary sewer system. This will be further coordinated with the City during the next design phase.

During future design phases, additional coordination and planning for dewatering can occur in order to obtain approval from the City's Environmental Division for dewatering and to prepare an application for approval.

4.5. Record of Survey

The Record of Survey (ROS) establishes a record alignment of the project to be used as a basis to assist in locating existing monuments during the field/construction phase of the project. Research of available record information, parcel maps, subdivisions maps, and other records of survey was performed to create the ROS for this project.

The ROS was formally submitted for approval to the City of Las Vegas Surveyor on June 11, 2015, as directed in the project scope. The City of Las Vegas Surveyor approved the ROS on August 5, 2015.

The Record of Survey is included in **Appendix E**.

4.6. Summary of Permits

A draft summary of the permits and approvals needed for this project has been compiled into a summary matrix shown in **Table 4**. This list is preliminary and may be revised as the project moves forward. Further coordination and effort will be required in future design phases to complete permit applications and assist the City in obtaining required permits for the project.

Table 4. Summary Matrix of Required Permits

Permit	Issuing Agency	Regulated Activity	Phase
City of Las Vegas - Excavation Permit	CLV Department of Public Works Land Development Services	Underground construction on private property or within CLV ROW	Construction
City of Las Vegas - Soils Report Submittal	CLV Department of Public Works Land Development Services	Soils associated with construction activity within CLV ROW (required for off-site construction projects)	Construction
City of Las Vegas - Construction Permit	CLV Department of Public Works Land Development Services	Off-site improvements within a City of Las Vegas ROW	Construction
City of Las Vegas - Grading Permit	CLV Department of Building and Safety	On-site grading activities	Construction
City of Las Vegas - Temporary Stock Pile Permit	CLV Department of Building and Safety	Temporary stock piling of earth materials on private or BLM parcels not covered by grading permit	Construction
City of Las Vegas - Traffic Barricade Plan Approval	CLV Construction Services	Traffic barricade plan associated with construction or discharge activity impacting a CLV ROW	Construction
Dust Control Permit	Clark County Department of Air Quality Management (DAQM)	In accordance with DAQM Regulations, dust control permit required for grading or other land-disturbance activities in Clark County.	Construction
NPDES General Storm Water Permit for Construction	NDEP Bureau of Water Pollution Control	Activity that disturbs 1 acre or greater and discharges storm water runoff from the construction site into a municipal separate storm water sewer system, or “waters of the US” as defined by Section 404 of the CWA.	Construction
NPDES Discharge Permit	NDEP Bureau of Water Pollution Control	Point source discharge to surface water, i.e. natural channel, roadway or storm drain. Required for dewatering during construction.	Design
NDOT ROW Encroachment Permit	Nevada Department of Transportation (NDOT)	NDOT requires this permit for construction activities in NDOT ROW.	Design
CCRFCD Section 8 Resource Screening Analysis	Clark County Regional Flood Control District	U.S. BLM requires each new regional facility be reviewed to ensure full compliance with environmental regulatory requirements	Design
Individual 404 Permit for Impacts to the Water of USA	U.S. Army Corp of Engineers	Coordinate with RFCD. Perform jurisdictional determination. Send jurisdictional determination to the Corp. Prepare and submit permit to the Corp.	Design
OTHER AGENCY APPROVALS AND COORDINATION:			
Entity	**Issuing Agency**	**Regulated Activity**	**Phase**
City of Las Vegas Department of Public Works Flood Control Section	City of Las Vegas	Design Plan/Drainage Study Review/Approval	Design
Clark County Regional Flood Control District	Clark County Regional Flood Control District	Design Plan/Drainage Study Review/Approval, also check of Federal Emergency Management Agency (FEMA) maps	Design
Utility Services Coordination	Various (Refer to Section 5 of this PDR for more information)	Coordination required with utilities and agencies having facilities within the limits of or adjacent to the project. Identify and resolve potential utility conflicts.	Design

4.7. Right-of-Way Summary

Atkins performed a review of the existing right-of-way in the study area and possible acquisition requirements based on the proposed alignment and facilities identified in this report.

Figure 17 and **Figure 18** show the existing right-of-way conditions based on research of available records, including Clark County Assessor Maps, Parcel Maps, and Record of Surveys. The majority of the proposed alignment is contained within the existing public right-of-way located in the jurisdiction of City of Las Vegas. A portion of the project on Pecos Road will be under US95 and within Nevada Department of Transportation (NDOT) right-of-way.

The start of the mainline construction is located on City of Las Vegas owned property. A permanent drainage easement will be required to construct and maintain the facility in the proposed location.

Additionally, a small permanent drainage easement will be required to construct and maintain the 5' x 3' RCB stormdrain and headwall on the south side of Stewart Avenue in APN 139-36-710-019 owned by the School Board of Trustees. There is an existing drainage easement on the School Board property, but it stops short of the Stewart Avenue right-of-way. The City will need to acquire a drainage easement at this location from the School Board of Trustees. Additional coordination with NV Energy is also needed as they have an existing power easement at the location.

A small 5-foot wide permanent drainage easement on the south side of the channel right-of-way at Lamb Boulevard is required for the 5' manway. The easement would be located in parcel 140-31-602-001, which is owned by the School Board of Trustees. At APN 140-32-103-002, owned by the Las Vegas VOA Elderly Housing, 30' of channel right-of-way is required. Currently, records only show that 30' as a trail easement.

The limits of the proposed easements and right-of-way are shown on **Figure 17** and **Figure 18**. At this time it does not appear that any Authorization to Enter Property (AEP) easements will be required.

Coordination with NDOT and an NDOT Encroachment Permit will be required under US95 in order to construct the proposed facilities within NDOT right-of-way. It is intended that this permit be prepared and submitted with the 90% submittal. Coordination with NDOT will take place during next phase of the design. Input on the design from NDOT will be requested.

Figure 17 Right-of-Way Exhibit A

Figure 18 Right-of-Way Exhibit B

5. Utility Issues and Conflicts Summary

5.1. Utility Data Collection and Conflicts

This section includes discussion regarding the utility research and coordination and the test hole locations. The proposed project alignment runs through a well-established area mainly consisting of the existing Cedar Avenue Channel corridor and collector and arterial streets.

Research of the underground utilities was based on survey of surface features, dipping manholes, aerial photography, and obtaining and reviewing design and as-built drawings from utility companies and the City of Las Vegas, which dated as far back as the mid-1950s. In addition, 35 potholes have also been completed to aid in determination of the location and depth of existing underground utilities.

The following utilities and agencies were contacted:

- Zayo (formerly American Fiber Systems, Inc.)
- AT&T Cable Maintenance
- Century Link
- City of Las Vegas
- Cox Communications
- Extenet Systems, Inc
- Freeway Arterials System of Transportation (FAST)
- Kern River Gas Transmission Company
- Kinder Morgan Energy Partners
- Level 3 Communications, LLC
- Las Vegas Valley Water District (LVVWD)
- NV Energy (Distribution)
- NV Energy (Transmission)
- Southern Nevada Water Authority (SNWA)
- Southwest Gas Corporation
- Sprint LD
- Sprint Nextel Engineering
- TWT Telecom
- Verizon Business Communications

Existing utilities have been identified from the agencies above and are shown on the 70% design plans. Colored linework is used on the design plans to identify the SUE quality (A, B, C, or D). Please refer to the design plans for detailed information.

The following is an inventory of existing utilities that are anticipated to be in conflict with the proposed storm drain and channel facilities. For the purpose of organizing the information below, the utility conflicts are discussed either by the main trunk line, channel segment or the individual street segment it corresponds to.

Main Trunk Line – Pecos Road north of Stewart Avenue to Cedar Channel

- Existing 60”x38” HE RCP SD will need to be removed for the installation of the proposed 18’x5’ RCB SD and the dual 8’x5’ RCB SD.

- Existing underground power conduit running north from the intersection near the west side Pecos right-of-way is in conflict with the proposed dual 8’x5’ RCB storm drain and will require relocation.

- Existing streetlight conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x4’ RCB storm drain and will require relocation.

- Existing 2” ITS conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x5’ RCB storm drain and will require relocation.

- Existing 10” HP Steel Gas running north/south in Pecos Road on the west side of the street is anticipated to be in conflict with the proposed dual 8’x5’ RCB storm drain and will require relocation.

- Existing 36” RCP SS running north/south in Pecos Road is not anticipated to be in conflict based on survey data of the upstream and downstream manholes. Based on the manhole data and results from test holes, there will be 6” of clearance between the existing pipe and the proposed dual 8’x5’ RCB SD.

- Existing ITS conduits crossing Pecos Road north of Stewart Avenue are anticipated to be in conflict with the proposed dual 8’x5’ RCB SD and will require relocation.

- Existing 72” RCP SD that runs north/south to the Cedar Channel will need to be removed for the installation of the proposed junction structure, 18’x5’ RCB SD and the 12’x6’ RCB SD.

Channel – Honolulu Drive to Sandhill Road

- Existing trail lighting conduit runs east/west near the north Cedar Channel right-of-way. It is not anticipated that this conduit will be in conflict with the proposed channel access ramp but it is recommended a test hole be performed to verify the horizontal location and clearance from the access ramp.

Channel – Sandhill Road to Lamb Boulevard

- Existing trail lighting conduit runs east/west near the north Cedar Channel right-of-way. This conduit will not be in conflict with the proposed channel.

- Existing 4” underground power conduit runs east/west on the north side of the existing channel starting near Sta 59+50 and continuing to Lamb Boulevard. Test hole results verify the conduit is not in conflict.

Channel – Lamb Boulevard to Page Street

- The proposed 15’ x 6’ RCB culverts at Lamb Boulevard will be in conflict with the existing 36” RCP waterline. The waterline will need to be relocated.

- The proposed 15’ x 6’ RCB culverts at Lamb Boulevard will be in conflict with existing 12” VCP SS and manhole. The manhole will need to be relocated and the SS will need to be reprofiled.

- Existing 4” underground power conduit runs east/west on the north side of the existing channel from Lamb Boulevard to Page Street. The conduit will be in conflict with the proposed channel access ramp.

Channel – Page Street to Marion Drive

- Existing 4” underground power conduit runs east/west on the north side of the existing channel from Page Street to Marion Drive. The conduit will be in conflict with the proposed channel access ramp.

Channel – Marion Drive to Las Vegas Wash

- Existing 6” and 8” SS that crosses the proposed channel near Sta 118+75 will be in conflict with the proposed channel and will need to be relocated.

Stewart Laterals – Stewart Avenue west of Pecos Road

- Existing 18” ACP waterlines will need to be relocated to provide the required horizontal clearance from the proposed drop inlets. The line is also in conflict vertically with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs, and thus will be reprofiled.

- Existing traffic signal conduit running east/west in the middle of Stewart Avenue is in conflict with the proposed 8’x3’, 7’x3’ and 5’x3’ RCB SDs based on test hole data received from the CLV from the BOM project which shows the line 2.66 below existing grade at the west side of the intersection. The conduit will require relocation.

- Existing streetlight conduit running east/west in the middle of Stewart Avenue is in conflict with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs and will require relocation.

- Existing ITS conduit running east/west in the middle of Stewart Avenue is in conflict with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs and will require relocation. Existing 8” SS will be in conflict with the proposed 7’x3’ and 5’x3’ RCB SDs and will require relocation.

- Existing underground power conduit running east/west on the north side of Stewart Avenue is in conflict with the proposed 8’x4’, 7’x3’ and 5’x3’ RCB SDs and will require relocation.

The remaining existing utilities, other than those identified above, do not appear to be in conflict with the proposed storm drain system and channel. However, existing underground utilities are required to be protected during the excavation for the placement of the proposed storm drain system. Additionally, more utilities may be identified for relocations as the final design proceeds and as potholes are completed. A complete list of utility crossings is included in **Appendix F.**

5.2. Utility Potholing

Horrocks Engineers completed a total of 35 potholes. The pothole locations and numeric identifiers are shown on the 70% Design Plans. A table showing the information collected for each pothole is included in **Appendix F**. Test Hole Summary Sheets obtained from Horrocks Engineers is also included in **Appendix F**.

6. Construction Cost Estimate

It is estimated that the project will have a total construction cost of **$18,331,418**.

All of the improvements are shown to be funded by the Clark County Regional Flood Control District.

A 15-percent contingency has been added to the cost estimate to offset the level of detail that has been provided at this stage.

The detailed cost estimate and associated quantities are shown in **Table 5.**

Table 5
Las Vegas Wash Central Cedar Avenue
Channel Preliminary Cost Estimate - 70%
Submittal

			CCRFCD		TOTAL			
#	ITEM	DESCRIPTION	QUANTITY	COST	QUANTITY	UNIT	UNIT COST	TOTAL COST
	200.01	MOBILIZATION & DEMOBILIZATION	1	$700,000.00	1	LS	$700,000.00	$700,000.00
	202.01	REMOVE BITUMINOUS SURFACE	17321	$103,926.00	17,321	SY	$6.00	$103,926.00
	202.02	REMOVE EXISTING CONCRETE PAVEMENT	576	$8,640.00	576	SY	$15.00	$8,640.00
	202.03	REMOVE EXISTING SIDEWALK	2130	$6,390.00	2,130	SF	$3.00	$6,390.00
	202.04	REMOVE EXISTING CURB AND GUTTER	385	$2,695.00	385	LF	$7.00	$2,695.00
	202.05	REMOVE EXISTING MEDIAN ISLAND	2614	$10,456.00	2,614	SF	$4.00	$10,456.00
	202.06	REMOVE EXISTING RCP STORM DRAIN	2185	$43,700.00	2,185	LF	$20.00	$43,700.00
	202.07	REMOVE EXISTING MANHOLE	6	$15,000.00	6	EA	$2,500.00	$15,000.00
	202.08	REMOVE EXISTING DROP INLET	6	$9,000.00	6	EA	$1,500.00	$9,000.00
	202.09	REMOVE EXISTING SANITARY SEWER	90	$900.00	90	LF	$10.00	$900.00
	202.10	REMOVE EXISTING CHANNEL	279928	$1,679,568.00	279,928	SF	$6.00	$1,679,568.00
	202.11	2-INCH ROTOMILL	1383	$6,915.00	1,383	SY	$5.00	$6,915.00
	202.12	REMOVE EXISTING HEADWALL	1	$15,000.00	1	LS	$15,000.00	$15,000.00
	212.01	REMOVE AND REPLACE EXISTING LANDSCAPING	1	$75,000.00	1	LS	$75,000.00	$75,000.00
	270.01	DEWATERING	1	$200,000.00	1	LS	$200,000.00	$200,000.00
	302.01	TYPE II AGGREGATE BASE	36169	$904,225.00	36,169	CY	$25.00	$904,225.00
	402.01	2-INCH PLANTMIX BITUMINOUS SURFACE	11528	$115,280.00	11,528	SY	$10.00	$115,280.00
	402.02	8-INCH PLANTMIX BITUMINOUS SURFACE	4617	$253,935.00	4,617	SY	$55.00	$253,935.00
	413.01	1-INCH UTACS BONDED WITH A PMM, S3 GRADATION	7920	$55,440.00	7,920	SY	$7.00	$55,440.00
	502.01	22-FOOT WIDE REINFORCED CONCRETE CHANNEL	1053	$1,210,950.00	1,053	LF	$1,150.00	$1,210,950.00
	502.02	25-FOOT WIDE REINFORCED CONCRETE CHANNEL	913	$753,225.00	913	LF	$825.00	$753,225.00
	502.03	29-FOOT WIDE REINFORCED CONCRETE CHANNEL	646	$581,400.00	646	LF	$900.00	$581,400.00
	502.04	31-FOOT WIDE REINFORCED CONCRETE CHANNEL	4105	$3,899,750.00	4,105	LF	$950.00	$3,899,750.00
	502.05	36-FOOT WIDE REINFORCED CONCRETE CHANNEL	1120	$1,136,800.00	1,120	LF	$1,015.00	$1,136,800.00
	502.06	CHANNEL ACCESS RAMP	510	$114,750.00	510	LF	$225.00	$114,750.00
	502.07	JUNCTION STRUCTURE	1	$50,000.00	1	LS	$50,000.00	$50,000.00
	502.08	5-FT X 3-FT REINFORCED CONCRETE BOX	115	$28,750.00	115	LF	$250.00	$28,750.00
	502.09	7-FT X3-FT REINFORCED CONCRETE BOX	85	$31,025.00	85	LF	$365.00	$31,025.00
	502.10	8-FT X 4-FT REINFORCED CONCRETE BOX	220	$93,500.00	220	LF	$425.00	$93,500.00
	502.11	8-FT X 5-FT REINFORCED CONCRETE BOX	143	$71,500.00	143	LF	$500.00	$71,500.00
	502.12	12-FT X6-FT REINFORCED CONCRETE BOX	1495	$1,457,625.00	1,495	LF	$975.00	$1,457,625.00
	502.13	15-FT X6-FT REINFORCED CONCRETE BOX	200	$195,200.00	200	LF	$976.00	$195,200.00
	502.14	18-FT X5-FT REINFORCED CONCRETE BOX	320	$395,200.00	320	LF	$1,235.00	$395,200.00
	502.15	TRANSITION STRUCTURE (DUAL 48" RCP'S TO 8'X4' RCP)	10	$4,250.00	10	LF	$425.00	$4,250.00
	502.16	TRANSITION STRUCTURE (18'X5' RCB TO 12'X6' RCB)	30	$37,050.00	30	LF	$1,235.00	$37,050.00
	502.17	TEMPORARY RETAINING WALL	21470	$644,100.00	21,470	SF	$30.00	$644,100.00
	603.01	18-INCH REINFORCED CONCRETE PIPE (CLASS III)	25	$4,750.00	25	LF	$190.00	$4,750.00
	603.02	24-INCH REINFORCED CONCRETE PIPE (CLASS III)	11	$2,200.00	11	LF	$200.00	$2,200.00
	609.02	48-INCH ACCESS MANHOLE W/ STEPS	4	$14,000.00	4	EA	$3,500.00	$14,000.00
	609.03	15-FOOT TYPE "C" MODIFIED DROP INLET	4	$80,000.00	4	EA	$20,000.00	$80,000.00
	609.04	CULVERT HEADWALL	1	$4,000.00	1	EA	$4,000.00	$4,000.00
	613.01	L TYPE CURB AND GUTTER	385	$9,625.00	385	LF	$25.00	$9,625.00
	613.02	CONCRETE SIDEWALK	2130	$10,650.00	2,130	SF	$5.00	$10,650.00
	613.03	TACK-ON MEDIAN	2614	$20,912.00	2,614	SF	$8.00	$20,912.00
	616.01	42-INCH POST AND CABLE FENCE	7550	$105,700.00	7,550	LF	$14.00	$105,700.00
	616.02	54-INCH POST AND CABLE FENCE	7660	$114,900.00	7,660	LF	$15.00	$114,900.00
	616.03	20-FOOT WIDE DOUBLE SWING ACCESS GATE	1	$1,500.00	1	EA	$1,500.00	$1,500.00
	622.01	CONSTRUCTION SURVEYING	1	$75,000.00	1	LS	$75,000.00	$75,000.00
	623.01	REMOVE AND REPLACE TRAIL LIGHT	2	$6,000.00	2	EA	$3,000.00	$6,000.00
	624.01	TRAFFIC CONTROL AND MAINTENANCE	1	$200,000.00	1	LS	$200,000.00	$200,000.00
	628.01	6-INCH SOLID WHITE LINE (POLYUREA)	214	$428.00	214	LF	$2.00	$428.00
	628.02	24-INCH STOP BAR (TYPE 2 PMF)	182	$1,092.00	182	SF	$6.00	$1,092.00
	628.03	24-INCH CROSSWALK (TYPE 2 PMF)	820	$4,920.00	820	SF	$6.00	$4,920.00
	628.04	WHITE "ARROW" LEGEND (TYPE 2 PMF)	6	$360.00	6	EA	$60.00	$360.00
	628.05	YIELD TRIANGLE WHITE (TYPE 2 PMF)	30	$180.00	30	SF	$6.00	$180.00
	629.01	INSTALL 18" PVC WATERLINE RELOCATION	1	$54,455.00	1	LS	$54,455.00	$54,455.00
	629.02	INSTALL 36" STL WATERLINE RELOCATION	1	$83,950.00	1	LS	$83,950.00	$83,950.00
	629.03	ADJUST EXSTING WATER VALVE COVER TO FINISH GRADE	2	$1,500.00	2	LF	$750.00	$1,500.00
	630.01	12-INCH PVC SDR 35 SANITARY SEWER PIPE	90	$18,000.00	90	LF	$200.00	$18,000.00
	630.02	48-INCH SANITARY SEWER MANHOLE	1	$12,000.00	1	EA	$12,000.00	$12,000.00
	633.01	REFLECTIVE RAISED PAVEMENT MARKERS	309	$927.00	309	EA	$3.00	$927.00
	633.02	NON-REFLECTIVE RAISED PAVEMENT MARKERS	723	$2,169.00	723	EA	$3.00	$2,169.00
	637.01	DUST CONTROL	1	$150,000.00	1	LS	$150,000.00	$150,000.00
	637.02	NPDES DISCHARGE PERMIT	1	$50,000.00	1	LS	$50,000.00	$50,000.00
		TOTAL		**$15,940,363.00**				**$15,940,363.00**
		Contingencies (15%)		$2,391,054.45				$2,391,054.45
		GRAND TOTAL		**$18,331,417.45**			**TOTAL PROJECT**	**$18,331,417.45**

Electronic Data CD

PLACE HOLDER

Atkins North America, Inc.
2270 Corporate Circle, Suite 200
Henderson NV 89074-7755
702.263.7275
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Las Vegas Wash Central, Cedar Avenue Channel
Preliminary Drainage Memorandum

To:	Rosa Cortez, P.E., City of Las Vegas
From:	Harshal Desai, P.E. and Brian Rowley, P.E., Atkins
Date:	May 5, 2014
Subject:	Preliminary Drainage Analysis and Regional Storm Drain Facility Recommendations

BACKGROUND AND PURPOSE

The Las Vegas Wash, Cedar Avenue Channel project (referred to hereafter as CAC) encompasses the design of regional storm drain facilities CACN 0001, CACN 0035, and CNST 0000 as described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU). For scoping purposes at the onset of the project, it was assumed that proposed storm drain improvements would be located in Stewart Avenue (CNST 0000) from Pecos Rd to Mojave Rd and in Pecos Rd (CACN 001 and 0035) from the Cedar Ave Channel to about 600 feet south of Stewart Ave. These alignments are shown as black lines in the vicinity map below (**Figure 1**).

Preliminary hydrologic analysis has been completed to estimate peak flows impacting the intersection of Eastern Ave/Stewart Ave and Pecos Rd and to determine if revisions to the storm drain extents are warranted. The potential extended project alignments under investigation in Stewart Ave and Pecos Rd are shown as dashed yellow lines in **Figure 1**.

This Preliminary Drainage Memorandum (PDM) has been compiled to summarize the drainage analysis and facility recommendations that have been prepared by Atkins for the project. The overall intent of the memo is to facilitate review by the City of Las Vegas (City) and Clark County Regional Flood Control District (CCRFCD) in order to agree on the overall design concept and project extents prior to the design phase.

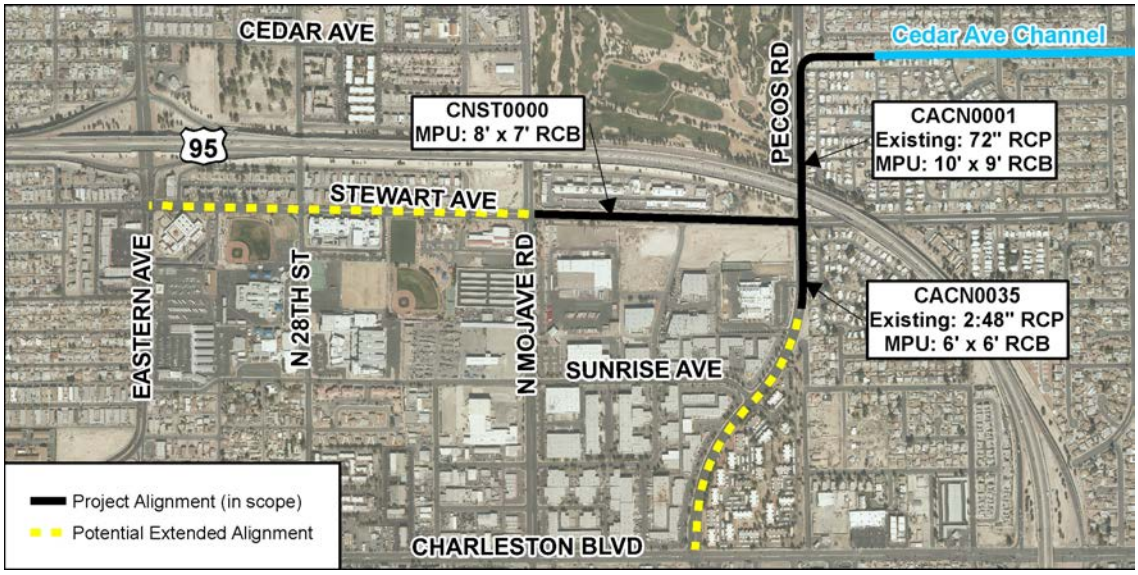


Figure 1: Cedar Avenue Channel Project Vicinity

HYDROLOGY

Atkins has made progress on hydrologic analysis, utility coordination, data collection, plan review, field investigations, and survey for the CAC project. These efforts provided us with knowledge of the existing drainage facilities and patterns in the study area as well as an overall understanding of the peak flows impacting Pecos Road, the intersection of Eastern Ave/Stewart Ave, and the Cedar Avenue Channel. The analysis performed is consistent with the CCRFCD Hydrologic Criteria and Drainage Design Manual. A summary of what was done is provided below.

Subbasin Delineation and Topography

The 2013 MPU and Central Neighborhood Flood Control Master Plan (CNS) subbasin delineations were used as a starting point and were modified and subdivided as necessary based on field investigations, aerial photos, drainage studies, and the detailed 1-ft topography data that was obtained for the project. The subbasins used in this preliminary analysis were more refined than the MPU subbasins in order to analyze and evaluate detailed roadway drainage patterns, storm drain sizes, and street flow capacities.

Most of the revisions to the MPU subbasins were simple and involved subdividing the larger basins or refining some discrepancies around the boundary of the project watershed to include/exclude relatively small areas. However, there were several revisions to MPU subbasin CA03 upstream of Eastern Avenue that were more substantial and resulted in decreased tributary area and flows impacting the intersection of Eastern Ave and Stewart Ave. These revisions are shown in **Figure 2** along with the detailed topography and flow direction lines that were derived using GIS tools.

If you refer to the figure, the area south of US 95 and north of Stewart Ave (shown in blue) that was previously included in MPU subbasin CA03 appears to drain north under US 95 on surface streets and local storm drains and does not impact the project. The area south of Stewart Ave and west of 14th St (shown in orange) drains south to Fremont Street away from the project watershed. The area south of Isabelle Ave and west of Eastern Ave (shown in yellow) drains east on Sunrise Ave and does not impact the project until it reaches the intersection of Stewart Ave and Mohave Rd. The remaining area (shown in red) is the actual tributary area from MPU subbasin CA03 that impacts the intersection of Stewart Ave and Eastern Ave. These basin revisions and resulting impacts on peak flow are further described later in the memo. Please note that these revisions differ from what is shown in the current MPU and should be discussed and reviewed in more detail with the City and CCRFCD to understand any regional planning implications or amendments.

Hydrologic Parameters

The development of the hydrologic parameters is briefly described below. These parameters may be subject to amendment and revision prior to the 30% submittal as more detailed analysis is completed.

- **Rainfall** – The 6-hour, 100-year and 10-year precipitation depth were used in the model based on the McCarran Airport Rainfall Area from the Design Manual. The SDN3 storm distribution was used since the watershed area is less than 8 square miles.

- **Soils** – Soils data in the hydrologic analysis was based on the same soils information that was used in the 2008 MPU, which is the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. It should be noted that NRCS has updated the available soils data since that time; however, in an effort to be

consistent with the MPU and other design projects that have been completed in the area, the 2008 MPU soils data was used in the CAC hydrologic analysis.

- **Land Use** – Land use data was based on the 2008 MPU. Minor updates and revisions were made to the land use data based on aerial imagery to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

- **Curve Numbers** – Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the Design Manual. Curve number information was compiled for each subbasin using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers.

- **Lag Time** – All subbasins within the project watershed are less than 0.5 square miles. The time of concentration for subbasins of this size is computed with the time of concentration equation (velocity method) from the Design Manual.

- **Routing** – The routings in the HEC-1 model through streets or storm drains were performed using the Muskingum-Cunge method for floodwave routing to be consistent with the 2008 MPU.

HEC-1 Model

The HEC-1 model from the 2013 MPU (Central Watershed, SW3 Model) was used as the base HEC-1 model and modified as necessary based on updated subbasin delineations and parameters described above. The model included 100-year and 10-year rainfall scenarios in order to size 100-year regional storm drain facilities and to check the 10-year dry lane criteria on the streets.

Ultimate Condition Design Scenario

The hydrologic analysis and the storm drain recommendations described in this memo are based on the ultimate condition, which assumes that the project watershed is fully developed and that all proposed regional facilities are built and functioning. This is the condition represented in the HEC-1 model that will be used as the design basis throughout the project.

However, in order to support decision making and understand potential project impacts, a qualitative assessment of the existing and interim condition has been performed. The existing condition is the current watershed condition today, and the interim condition is based on the time when the CAC project is complete but prior to full build out of all proposed regional facilities.

For the most part, the differences between existing, interim, and ultimate condition flows are relatively minor in terms of impacts on the CAC storm drain design and the recommendations included in this PDM. However, downstream of the project in the Cedar Avenue Channel, there is an increase in flow in the interim/ultimate condition compared to the existing condition that should be considered carefully to avoid adverse impacts. This will be discussed in more detail in the **Cedar Avenue Channel** section later in the memo.

Results

The subbasin delineations and 10-year and 100-year peak flow results in the study area are shown on **Figure 3**. This Figure shows all of the drainage patterns and results that were used to develop facility recommendations that will be described in the next section of the memo.

These areas do not drain to Stewart Ave and were removed from the project watershed boundary. (preliminary)

BN03-C

CA03

CA04-C

CA06-C

95

Poplar Ave

Elm Ave

Marlin Ave

Ash Ave

Ogden Ave

Isabelle Ave

Sunrise Ave

Stewart Ave

Lewis Ave

Fremont St

16th St

15th St

Bruce St

Circle Dr

Tower St

Eastern Ave

21st St

23rd St

20th St

26th St

Las Vegas Wash Central
Cedar Avenue Channel

Figure 2: Drainage Patterns and MPU Subbasin Revisions

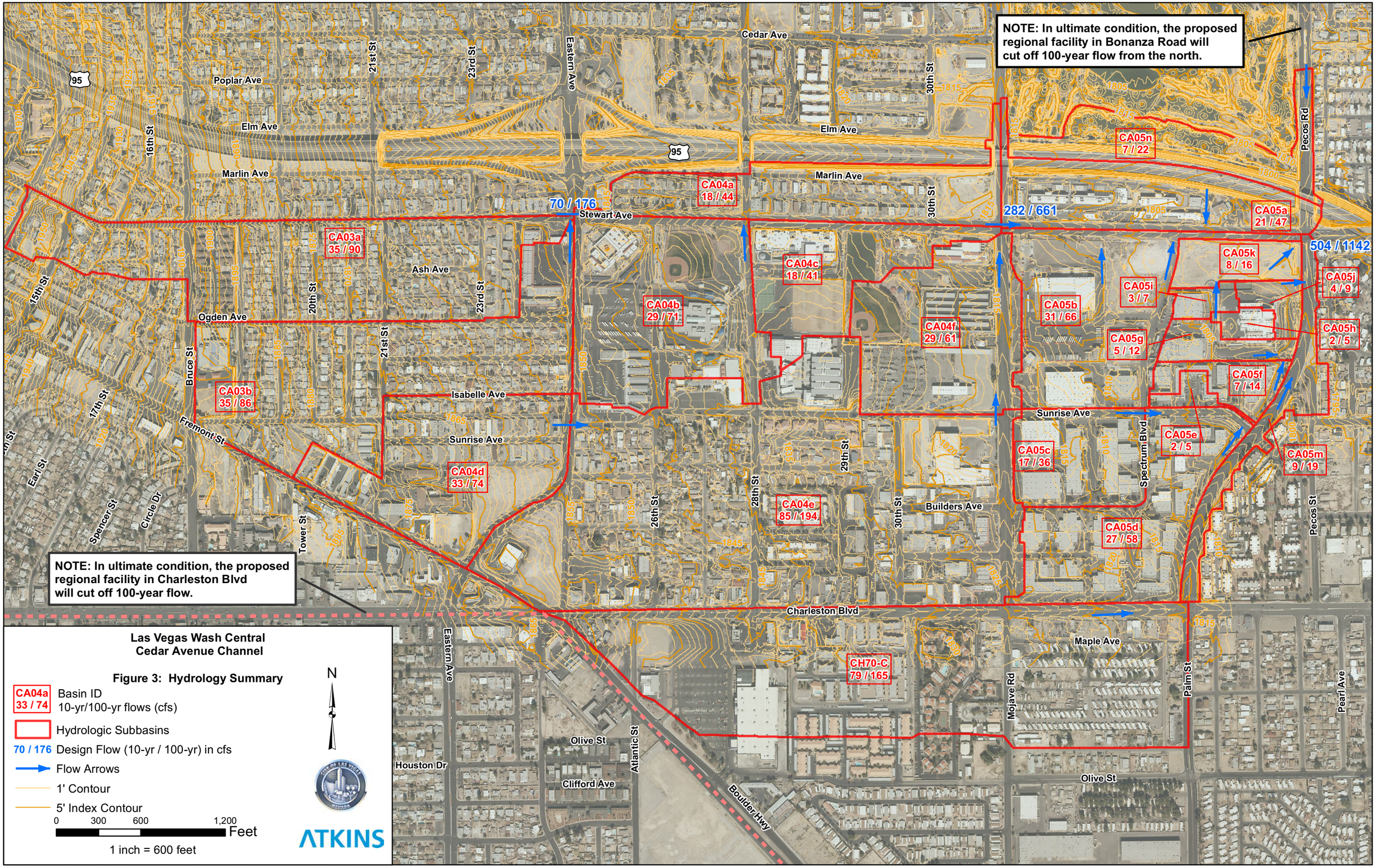
- Area Drains to Stewart/Mohave
- Area Drains to Stewart/Eastern
- Area Drains to Fremont
- Area Drains north Under US95
- MPU Subbasins
- 1' Contour
- 5' Index Contour
- Flow Direction Lines

N

0 200 400 800 Feet

1 inch = 400 feet

ATKINS


NOTE: In ultimate condition, the proposed regional facility in Bonanza Road will cut off 100-year flow from the north.
NOTE: In ultimate condition, the proposed regional facility in Charleston Blvd will cut off 100-year flow.
CA03a 35 / 90
CA03b 35 / 86
CA04a 18 / 44
CA04b 29 / 71
CA04c 18 / 41
CA04d 33 / 74
CA04e 85 / 194
CA04f 29 / 61
CA05a 21 / 47
CA05b 31 / 66
CA05c 17 / 36
CA05d 27 / 58
CA05e 2 / 5
CA05f 7 / 14
CA05g 5 / 12
CA05h 2 / 5
CA05i 3 / 7
CA05j 4 / 9
CA05k 8 / 16
CA05m 9 / 19
CA05n 7 / 22
CH70-C 79 / 165
70 / 176
282 / 661
504 / 1142
Las Vegas Wash Central
Cedar Avenue Channel
Figure 3: Hydrology Summary
CA04a 33 / 74 Basin ID 10-yr/100-yr flows (cfs)
Hydrologic Subbasins
70 / 176 Design Flow (10-yr / 100-yr) in cfs
Flow Arrows
1' Contour
5' Index Contour
0 300 600 1,200 Feet
1 inch = 600 feet
N
ATKINS
Stewart Ave
Ogden Ave
Ash Ave
Marlin Ave
Elm Ave
Poplar Ave
Cedar Ave
Isabelle Ave
Sunrise Ave
Charleston Blvd
Builders Ave
Olive St
Clifford Ave
Houston Dr
Maple Ave
Eastern Ave
Bruce St
Tower St
Fremont St
Earl St
Spencer St
Circle Dr
15th St
16th St
17th St
20th St
21st St
23rd St
26th St
28th St
29th St
30th St
Atlantic St
Boulder Hwy
Mojave Rd
Palm St
Pecos St
Pearl Ave
Spectrum Blvd
Pecos Rd
95

RECOMMENDATIONS

Using the peak flows developed in the hydrologic analysis, the project area was reviewed to develop preliminary facility sizes and recommendations along Stewart Avenue and Pecos Road. The recommended facilities for each of these systems are described below. An assessment of the Cedar Avenue Channel capacity in the existing, interim, and ultimate condition is also included. The recommended facilities in this PDM are conceptual in nature and were sized using normal depth calculations. They are subject to revision as more detailed hydraulic analysis is performed.

Stewart Avenue System

The 100-year ultimate condition flow impacting the intersection of Stewart Ave and Eastern Ave is 176 cfs and the 10-year flow is 70 cfs. Moving downstream to the east, the 100-year ultimate condition flow increases to 641 cfs and the 10-year flow increases to 271 cfs at Stewart Ave and Mohave Rd. These ultimate condition peak flows along Stewart Ave are essentially the same as the interim and existing condition flows since the watershed is nearly fully developed. The proposed regional storm drain (already included in the scope) from Mohave Rd to Pecos Rd has been preliminarily sized as a 14' x 4' RCB to convey the 100-year flow.

Upstream on Stewart Ave (between Mohave Rd and Eastern Ave), it is recommended to install a 48" RCP (currently out of scope). This facility will alleviate flooding at the intersection of Eastern Ave and Stewart Ave. It will collect flow from the west side of Eastern Avenue and south side of Stewart Ave and convey it to the larger 14' x 4' RCB downstream. Based on discussions with CLV and CCRFCD at a project progress meeting on April 23, 2014, this facility was sized to convey the 10-year flow which will meet the dry lane criteria in Stewart Ave. Continued discussion and coordination will be needed with the City and CCRFCD to finalize the recommendation and proposed facility plan for this section of Stewart Ave. The peak flows impacting Stewart Ave and the recommended facility plan is shown in **Figure 4**.

Pecos Road System

Atkins reviewed the drainage patterns and topography and determined that Pecos Rd is only impacted by minor surface runoff from relatively small tributary areas. The majority of the flow in the area is already conveyed in the existing 66" RCP in Pecos Road and in local, on-site storm drains that convey flow through parking lots and commercial areas immediately west of Pecos Rd. Thus, Atkins recommends that the existing facilities be left in place in Pecos Rd because they are adequate to convey the 100-year flow in ultimate condition. This recommendation takes advantage of existing storm drain facilities in the area and minimizes utility conflicts and construction costs.

The 100-year ultimate condition flow in the storm drain in Pecos Rd is approximately 174 cfs, while the remaining flow on the surface of the road will be approximately 91 cfs just south of Stewart Avenue. In the interim condition, the flow in the Pecos Rd storm drain will be greater at 217 cfs but the flow on the surface streets will be the same. Atkins recommends that the 100-year ultimate condition surface flow be collected in new drop inlets on the west side of Pecos Rd south of Stewart Ave and conveyed in the drainage easement west of Pecos Rd in a 42" RCP. Flow in the 42" RCP will then be conveyed north across Stewart Avenue in a proposed 5' x 4' RCB where it will connect with the proposed facility in Stewart Avenue. All of the combined flow will then be conveyed north in Pecos Road to the Cedar Avenue Channel in a proposed 14' x 6' RCB. The peak flows impacting Pecos Rd and the recommended facility plan is shown in **Figure 5**.

Cedar Avenue Channel Proposed Facility Sizes

- 42" RCP
- 48" RCP
- 5' x 4' RCB
- 14' x 4' RCB
- 14' x 6' RCB
- Cedar Avenue Channel

CEDAR AVE
WARDELLE ST
30TH ST
MARLIN AVE
95
14x6 RCB
0 (70)
106 (70)
0 (99)
148 (99)
18
44
0 (282)
379 (282)
21
47
0 (334)
0 (774)
48" RCP
14x4 RCB
STEWART AVE
5x4 RCB
42" RCP
35
90
35
86
29
71
18
41
147
329
31
66
N 23RD ST
FLOWER AVE
EASTERN AVE
N 28TH ST
N MOJAVE RD
TECHNOLOGY CT
SUNRISE AVE
SPECTRUM BLVD
PECOS RD
VALLEY ST
N 27TH ST
30TH ST

Las Vegas Wash Central
Cedar Avenue Channel

Figure 4: Stewart Avenue System

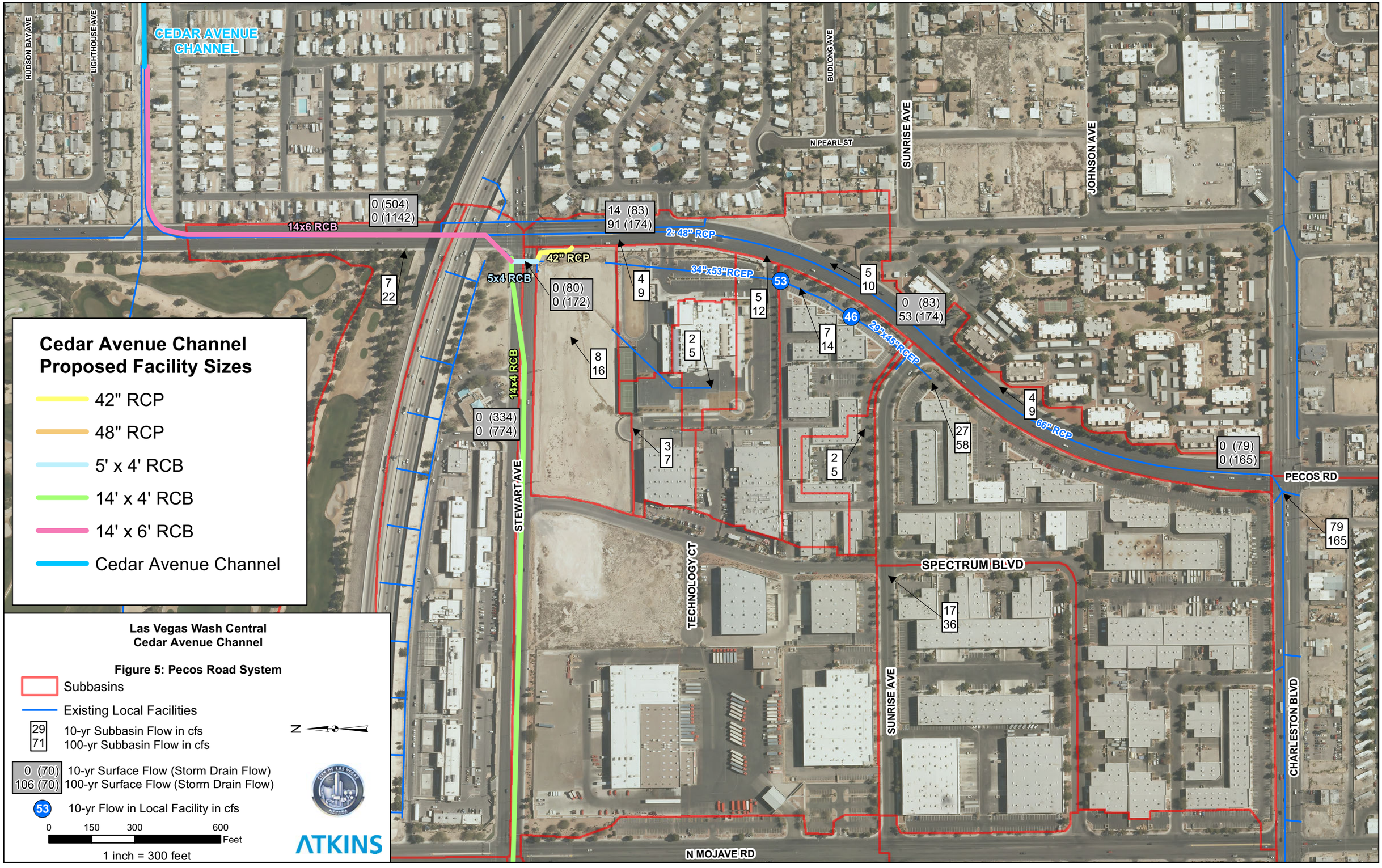
- Subbasins
- Existing Local Facilities
- 29 / 71 — 10-yr Subbasin Flow in cfs / 100-yr Subbasin Flow in cfs
- 0 (70) — 10-yr Surface Flow (Storm Drain Flow)
- 106 (70) — 100-yr Surface Flow (Storm Drain Flow)

N

0 200 400 800 Feet

1 inch = 400 feet

ATKINS


CEDAR AVENUE CHANNEL
HUDSON BAY AVE
LIGHTHOUSE AVE
BUDLONG AVE
N PEARL ST
SUNRISE AVE
JOHNSON AVE
0 (504)
0 (1142)
14x6 RCB
14 (83)
91 (174)
2: 48" RCP
42" RCP
5x4 RCB
34"x53" RCEP
53
46
29"x45" RCEP
66" RCP
0 (80)
0 (172)
0 (83)
53 (174)
0 (334)
0 (774)
14x4 RCB
0 (79)
0 (165)
PECOS RD
STEWART AVE
TECHNOLOGY CT
SPECTRUM BLVD
SUNRISE AVE
CHARLESTON BLVD
N MOJAVE RD
Cedar Avenue Channel
Proposed Facility Sizes
42" RCP
48" RCP
5' x 4' RCB
14' x 4' RCB
14' x 6' RCB
Cedar Avenue Channel
Las Vegas Wash Central
Cedar Avenue Channel
Figure 5: Pecos Road System
Subbasins
Existing Local Facilities
10-yr Subbasin Flow in cfs
100-yr Subbasin Flow in cfs
10-yr Surface Flow (Storm Drain Flow)
100-yr Surface Flow (Storm Drain Flow)
10-yr Flow in Local Facility in cfs
0 150 300 600
Feet
1 inch = 300 feet
N
ATKINS

Cedar Avenue Channel

As mentioned previously, a qualitative assessment of the existing/interim/ultimate condition flow in the Cedar Avenue Channel has been performed for planning purposes and to get a general understanding of potential project impacts downstream. Atkins reviewed the peak flows at two locations in the Cedar Avenue Channel: (1) at the outlet for this project just east of Pecos Rd (i.e., the upstream end of the Cedar Avenue Channel) and (2) at the Lamb Blvd culvert crossing farther downstream. The 100-year peak flows at these locations are shown below in **Table 1**.

Table 1: Cedar Avenue Channel Existing/Interim/Ultimate Condition Flow

	100-year Peak Flow (cfs)		
Location	**Existing**	**Interim**	**Ultimate**
Project Outlet	763	1356	1170
Lamb Crossing	980	1573	1387

For qualitative purposes of this PDM, the **existing condition** flows in the table above were derived from storm drain plans or based on full-flow, normal depth capacity of the existing storm drain facilities discharging to the Cedar Avenue Channel today. The **ultimate condition** flow was based on the 2013 MPU, and the **interim condition** flow was derived by quantifying the differences between the interim and ultimate condition. In general the interim and ultimate condition flow in Cedar Avenue Channel are fairly similar; however, there are two locations where the interim condition flow will be greater than the ultimate condition flow as described below.

The first location is at Bonanza Rd and Pecos Rd. Currently at this location, there is a 60" RCP storm drain that conveys flow south from Bonanza Rd along Pecos Rd until discharging to the Cedar Avenue Channel. In the ultimate condition, a proposed regional facility in Bonanza Rd will convey the entire 100-year flow east in Bonanza Rd, thereby cutting off the flow that is currently conveyed south along Pecos Rd to the Cedar Avenue Channel. For the purpose of this analysis, it was assumed that the storm drain in Pecos Road is flowing full at a capacity of 143 cfs. Thus, the peak flow coming from the north in Pecos Road will be **143** cfs higher in the interim condition.

The second location where interim condition flow is greater than the ultimate condition flow is at the intersection of Charleston Blvd and Fremont St. Currently, flow is conveyed east along Charleston Blvd to Pecos Road where flow turns north in a 54" RCP. The CNS estimates the current 100-year flow in the Pecos Rd storm drain to be 208 cfs. However, in the ultimate condition, a proposed regional facility in Charleston Blvd will cut off 100-year flows from upstream areas and convey it southeast along Boulder Highway, thereby reducing the flow in the Pecos Road storm drain from 208 cfs to 165 cfs. The flow conveyed north at Pecos Rd towards the CAC project will be **43** cfs higher in the interim condition than in the ultimate condition.

These two differences result in a total increase of 186 cfs in the interim condition compared to the ultimate condition in the Cedar Avenue Channel. Thus, if the ultimate condition flow (based on MPU) is 1,170 cfs and 1,387 cfs at the project outlet and at Lamb Blvd, respectively, then the interim condition flow at these same locations is 1,356 cfs and 1,573 cfs.

For preliminary analysis purposes, normal depth calculations were performed for the Cedar Avenue Channel at the project outlet (upstream end of channel) and at Lamb Blvd just upstream of the culvert. The culvert crossing at Lamb Blvd was analyzed using HY-8. The analysis included existing, interim, and ultimate condition peak flows for comparison purposes. The resulting depths at each location are shown in **Figure 6**, **Figure 7**, and **Figure 8**.

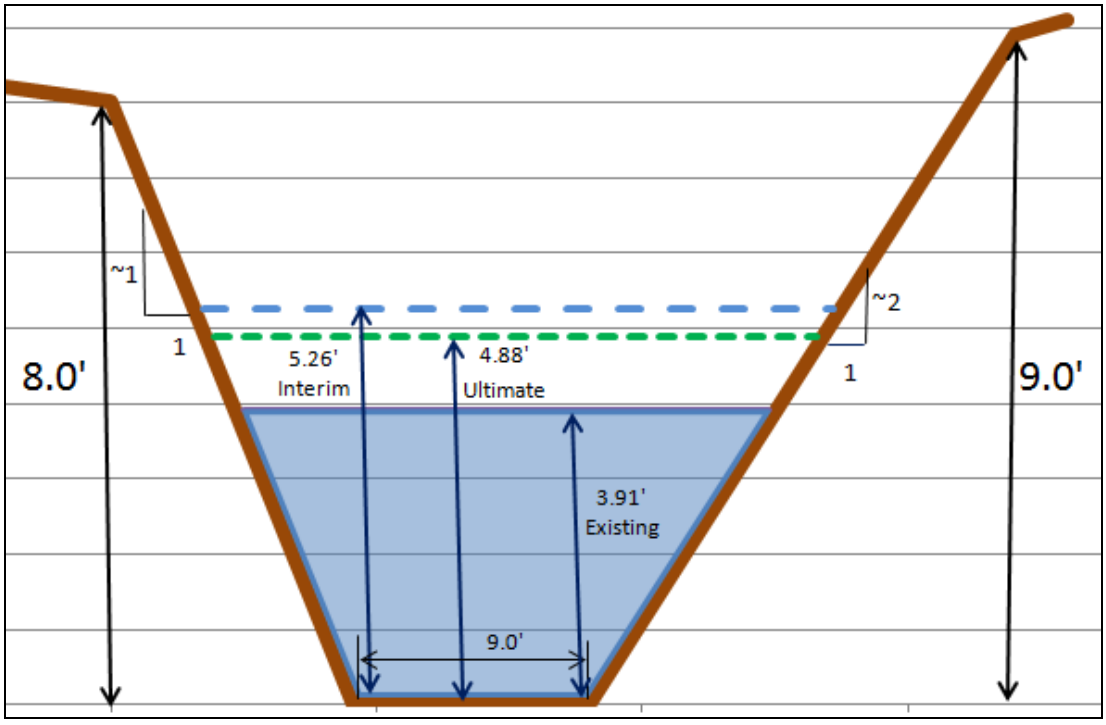


Figure 6: Normal Depth Analysis, Cedar Avenue Channel at Project Outlet (Upstream End)

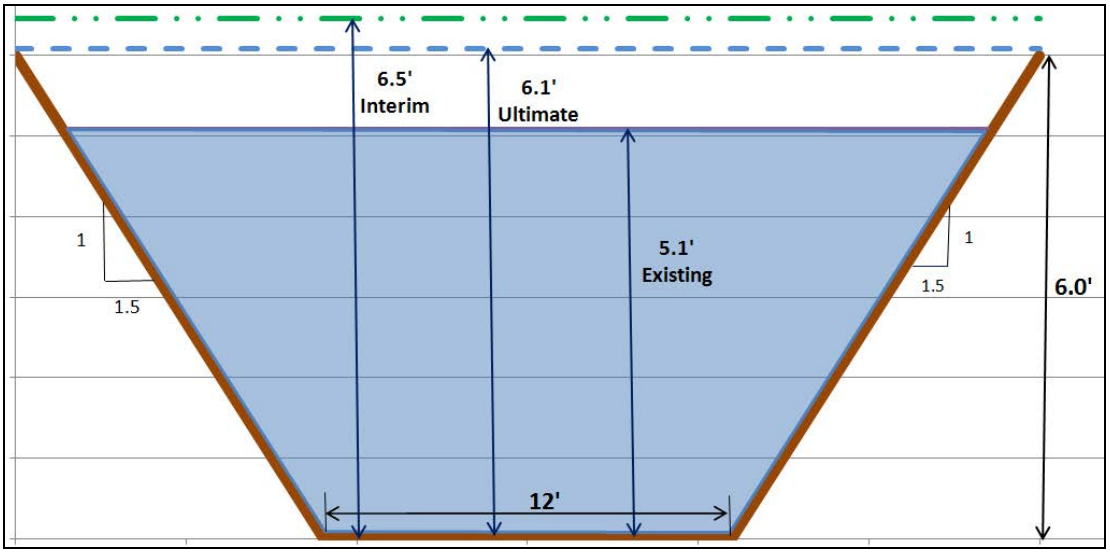


Figure 7: Normal Depth Analysis, Cedar Avenue Channel, Just Upstream of Lamb Blvd

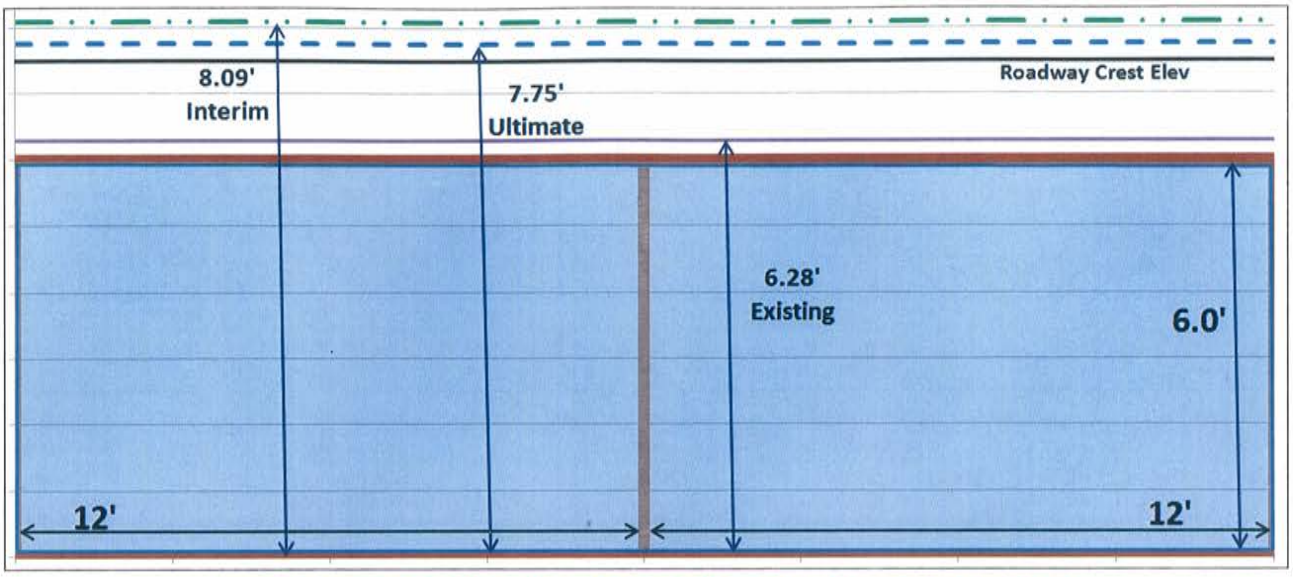


Figure 8: Normal Depth Analysis, 2: 12' x 6' RCB Culvert Crossing at Lamb Blvd

The preliminary normal depth and HY-8 results above indicate that the Cedar Avenue Channel does not have adequate capacity or freeboard to convey the interim or ultimate condition flow without overtopping the channel near the Lamb Blvd crossing (and perhaps other locations). The interim condition flow discharging to Cedar Avenue Channel is greater than the existing condition by more than 500 cfs because new, ultimate storm drain facilities completed with this project will collect and convey more flow to the channel than the existing facilities. Atkins believes this warrants additional, detailed hydrologic/hydraulic analysis of the Cedar Avenue Channel from the upstream end to the Las Vegas Wash outlet. Detailed analysis would refine the qualitative flows identified in this PDM and provide the City with an accurate assessment of channel capacity and an understanding of impacts from this project on adjacent private properties, bridges, or crossings.

Following review of this PDM and upon determination of the preferred alternative and facility plan, the City and Atkins will re-evaluate the scope of services make modifications accordingly. Please feel free to contact us if you have any questions.

Sincerely,

PROFESSIONAL ENGINEER-STATE OF NEVADA
BRIAN J. ROWLEY
Exp: 12/31/15
CIVIL
No. 19586
5/5/2014

Harshal Desai, P.E.
Project Manager

Brian Rowley, P.E.
Associate Project Manager

Cedar Avenue Channel Capacity Analysis
Technical Memorandum

To:	Rosa Cortez, P.E., City of Las Vegas
From:	Harshal Desai, P.E. and Brian Rowley, P.E., Atkins
Date:	June 13, 2014
Subject:	Cedar Avenue Channel Capacity Analysis

BACKGROUND AND PURPOSE

Atkins is working with the City of Las Vegas (City) on the Las Vegas Wash Central, Cedar Avenue Channel project. This project encompasses the design of regional storm drain facilities CACN 0001, CACN 0035, and CNST 0000 as described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU). These facilities are proposed in Stewart Ave and Pecos Rd and will discharge to the Cedar Avenue Channel at the downstream end of the project (see **Figure 1**).

Atkins previously completed a qualitative, normal-depth analysis of the capacity of the Cedar Avenue Channel at the downstream end of the project as summarized in the Preliminary Drainage Memorandum. Preliminary results indicated that the channel likely does not have adequate capacity to convey the interim and ultimate condition 100-year flow from the project. As a result, the City requested that Atkins complete field survey and hydrologic/hydraulic analysis of the Cedar Avenue Channel in order to determine the channel conveyance capacity and to understand potential project impacts on the downstream channel and adjacent properties.

This Technical Memorandum has been prepared to summarize the Cedar Avenue Channel hydrologic/hydraulic analysis results. This memo and the content herein will need to be reviewed by and discussed further with the City and CCRFCD in order to determine how best to proceed with the proposed project.

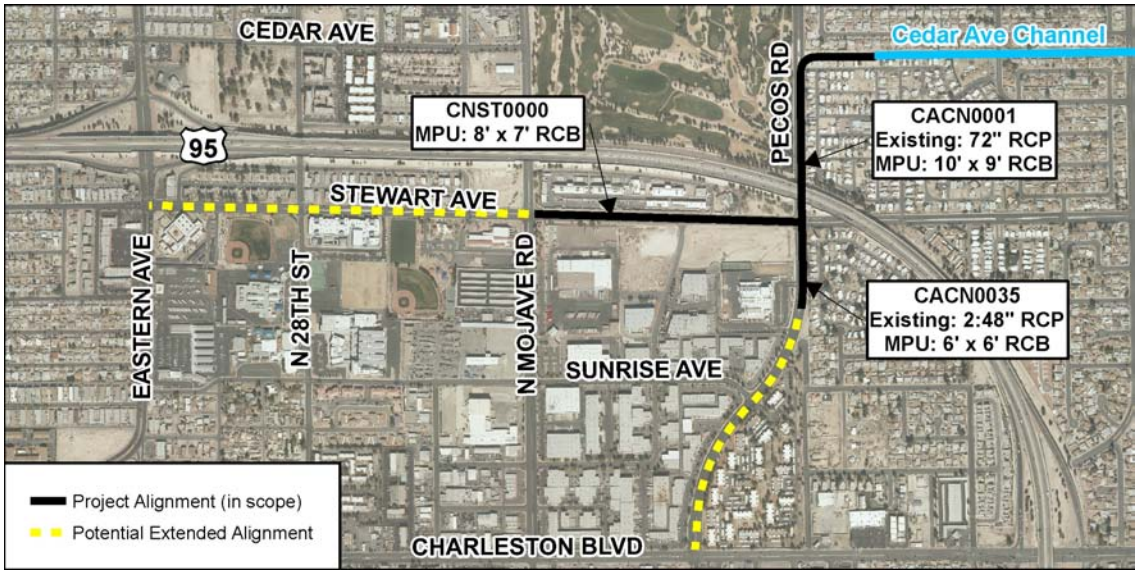


Figure 1: Cedar Avenue Channel Project Vicinity

HYDROLOGIC ANALYSIS

Atkins performed hydrologic analysis to determine the peak 100-year flow in the Cedar Avenue Channel in the existing, interim, and ultimate condition flow. The **ultimate** condition is a future scenario when the project watershed is fully developed and all proposed regional facilities are built and functioning. The **interim** condition is a future scenario where the proposed Cedar Avenue Channel project is complete but prior to full build out of all proposed regional facilities. The **existing** condition is the current watershed condition today.

Interim Condition

The interim condition hydrologic analysis was based on the HEC-1 model that was previously completed for project during the development of the Preliminary Drainage Memorandum. The analysis was updated and extended to account for flow entering the channel downstream of the proposed project between Pecos Rd and the Las Vegas Wash. It was also updated to account for flow that enters the Cedar Avenue Channel from a local storm drain on the Desert pines Golf Course. This facility was assumed to be flowing full at a capacity of 310 cfs.

Ultimate Condition

The ultimate condition flow in Cedar Avenue Channel is similar to the interim condition flow; however, there are two locations where the interim condition flow is greater than the ultimate condition flow as described below.

The first location is at Bonanza Rd and Pecos Rd. Currently at this location, there is a 60" RCP storm drain that conveys flow south from Bonanza Rd along Pecos Rd until discharging to the Cedar Avenue Channel. In the ultimate condition, a proposed regional facility in Bonanza Rd will convey the entire 100-year flow east in Bonanza Rd, thereby cutting off the flow that is currently conveyed south along Pecos Rd to the Cedar Avenue Channel. For the purpose of this analysis, it was assumed that the storm drain in Pecos Road is flowing full at a capacity of 202 cfs in the interim condition.

The second location where interim condition flow is greater than the ultimate condition flow is at the intersection of Charleston Blvd and Fremont St. Currently, flow is conveyed east along Charleston Blvd to Pecos Road where flow turns north in a 54" RCP. However, in the ultimate condition, a proposed regional facility in Charleston Blvd will cut off 100-year flows from upstream areas and convey it southeast along Boulder Highway, thereby reducing the flow in the Pecos Road storm drain.

These differences above result in a total decrease of about 140 cfs in ultimate condition flow compared to the interim condition in the Cedar Avenue Channel.

Existing Condition

The existing condition flows were derived from storm drain plans or based on full-flow, normal depth capacity of the existing storm drain facilities discharging to the Cedar Avenue Channel today. For the purpose of this analysis, it was assumed that the existing storm drain facility in Pecos Road that conveys flow to the Cedar Avenue Channel from Stewart Avenue has a capacity of 310 cfs (based on design plans). The other local storm drain facilities (at Desert Pines Golf Course and in Pecos Road from the north) were assumed to have the same flow as described above.

Results

The resultant peak flows in the Cedar Avenue Channel from the HEC-1 model and from the assumptions described above are summarized in **Table 1**. This table also includes MPU Flows from the 2013 MPU for comparison purposes.

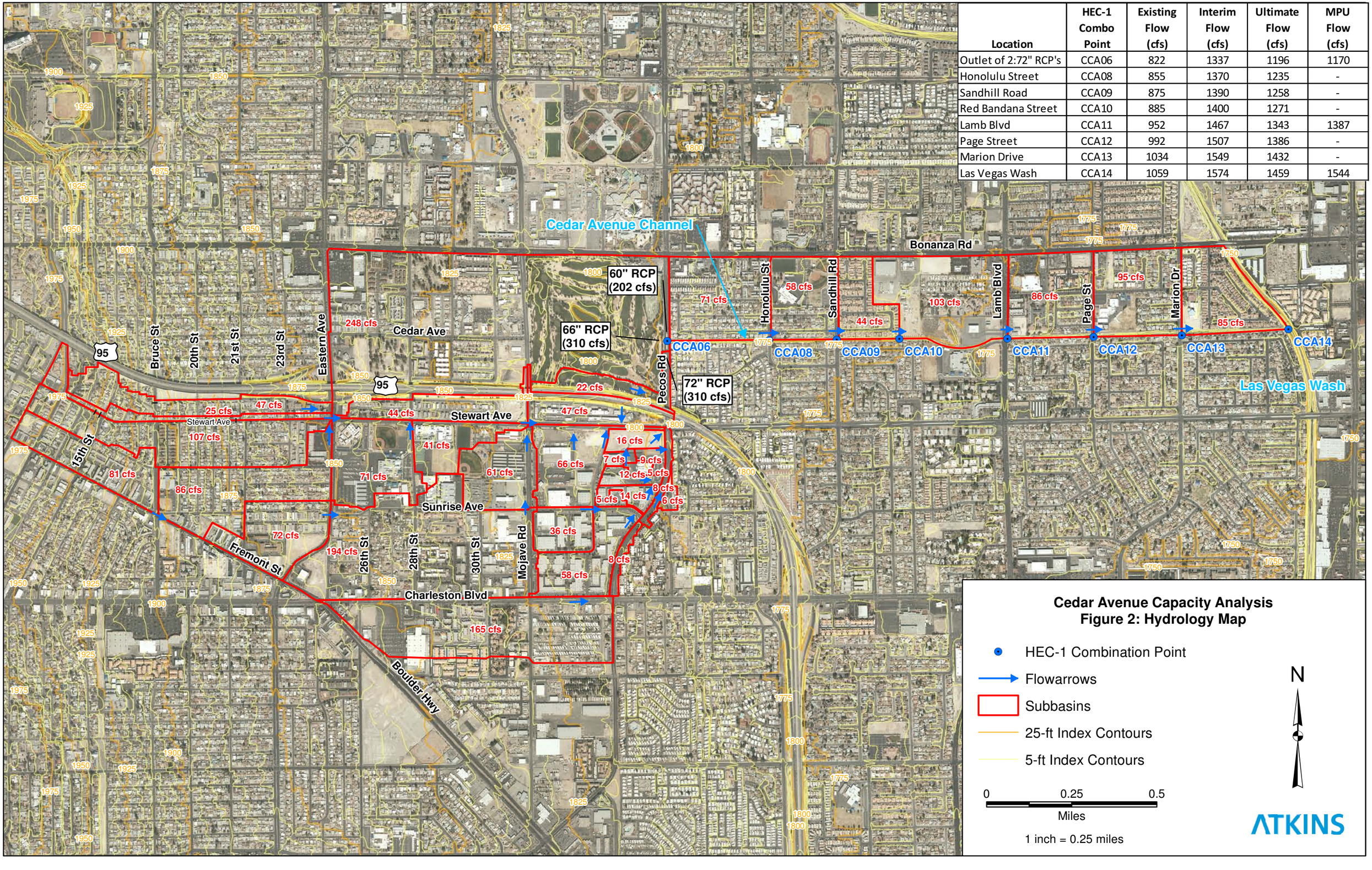
Table 1: Cedar Avenue Channel Existing/Interim/Ultimate Condition Flow

Location	HEC-1 Combo Point	Existing Flow (cfs)	Interim Flow (cfs)	Ultimate Flow (cfs)	MPU Flow (cfs)
Outlet of 2:72" RCP's	CCA06	822	1337	1196	1170
Honolulu Street	CCA08	855	1370	1235	-
Sandhill Road	CCA09	875	1390	1258	-
Red Bandana Street	CCA10	885	1400	1271	-
Lamb Blvd	CCA11	952	1467	1343	1387
Page Street	CCA12	992	1507	1386	-
Marion Drive	CCA13	1034	1549	1432	-
Las Vegas Wash	CCA14	1059	1574	1459	1544

As shown above, the existing condition 100-year peak flow entering the upstream end of the Cedar Avenue Channel is approximately 820 cfs. In the interim condition, the 100-year peak flow entering the channel is approximately 1,340 cfs or about 520 cfs higher. In the ultimate condition, the 100-year peak flow entering the channel is approximately 1,200 cfs or about 140 cfs lower than the interim condition.

The subbasins, topography, project watershed, flow patterns and hydrologic results are shown in **Figure 2.**

Location	HEC-1 Combo Point	Existing Flow (cfs)	Interim Flow (cfs)	Ultimate Flow (cfs)	MPU Flow (cfs)
Outlet of 2:72" RCP's	CCA06	822	1337	1196	1170
Honolulu Street	CCA08	855	1370	1235	-
Sandhill Road	CCA09	875	1390	1258	-
Red Bandana Street	CCA10	885	1400	1271	-
Lamb Blvd	CCA11	952	1467	1343	1387
Page Street	CCA12	992	1507	1386	-
Marion Drive	CCA13	1034	1549	1432	-
Las Vegas Wash	CCA14	1059	1574	1459	1544



Cedar Avenue Capacity Analysis
Figure 2: Hydrology Map

- HEC-1 Combination Point
- Flowarrows
- Subbasins
- 25-ft Index Contours
- 5-ft Index Contours

N

0 0.25 0.5
Miles

1 inch = 0.25 miles

ATKINS

HYDRAULIC ANALYSIS

Atkins used the peak flow rates determined in the hydrologic analysis to analyze the capacity of the Cedar Avenue Channel in HEC-RAS for the existing, interim, and ultimate condition. The modeled reach extends 1.85 miles from the upstream end of the channel just east of Pecos Rd to the Las Vegas Wash at the downstream end. This channel reach also includes 5 bridge crossings at Honolulu St, Sandhill Rd, Lamb Blvd, Page St, and Marion Dr (from upstream to downstream). The model reach is shown in blue in **Figure 3**.

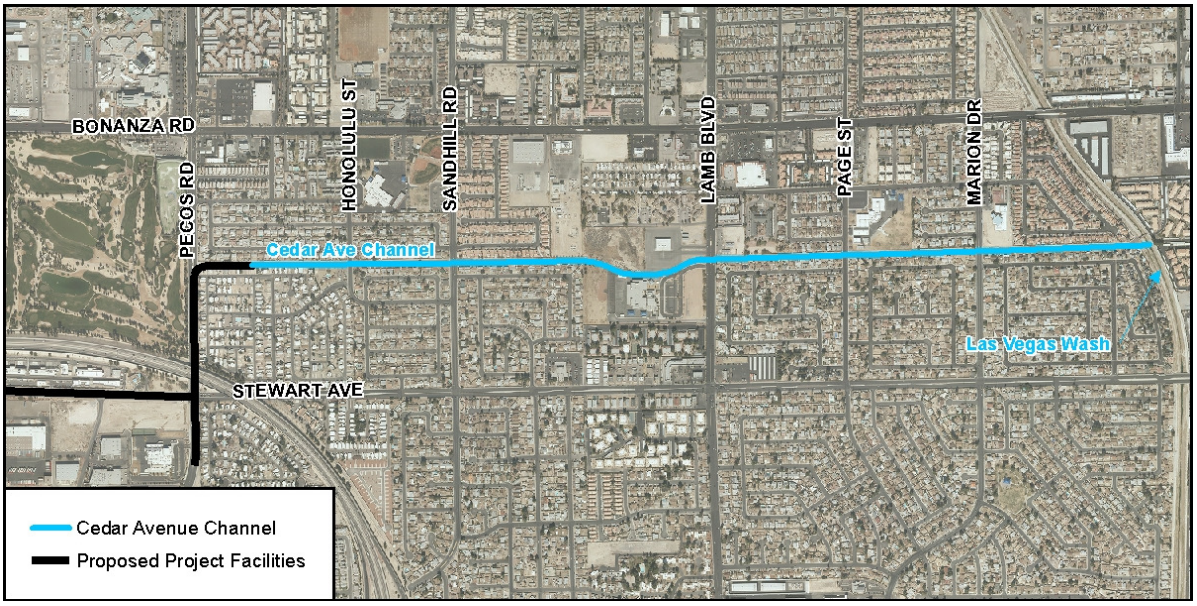


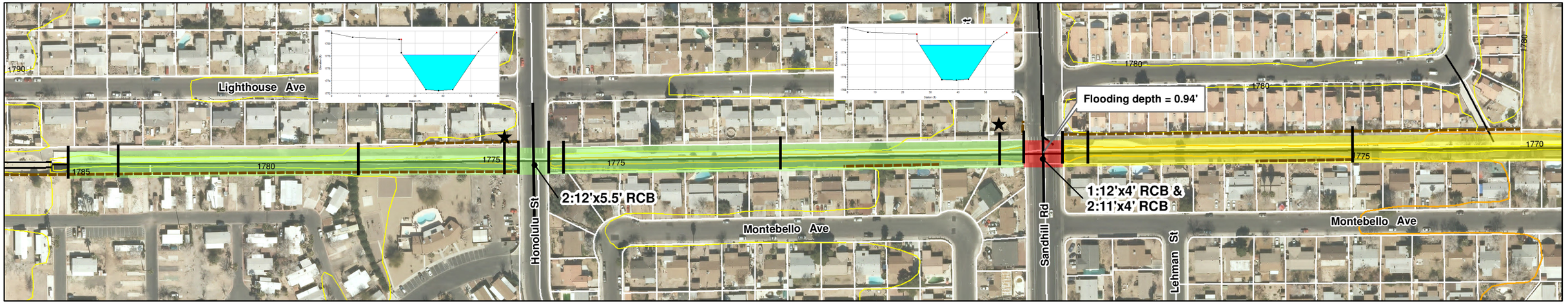
Figure 3 – Cedar Avenue Channel HEC-RAS Model Extents

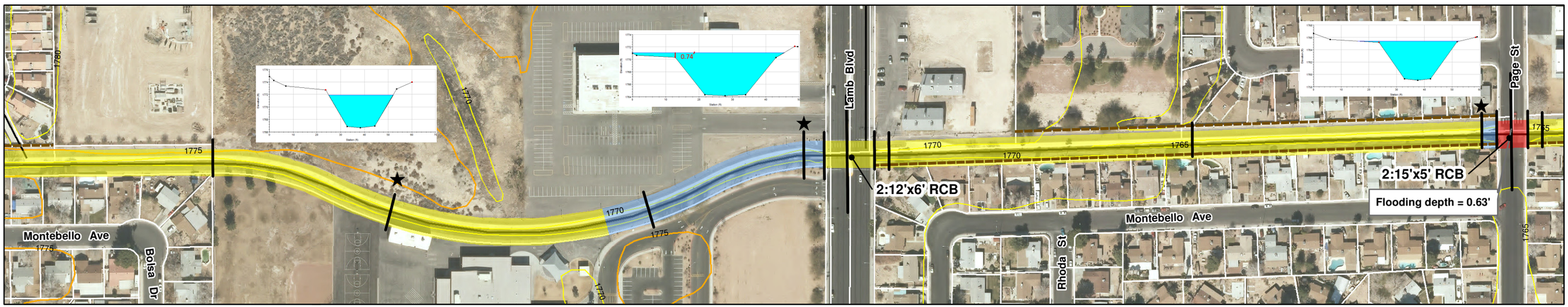
Detailed field survey was obtained by Atkins at several channel cross sections as well as upstream and downstream of all of the crossings. Photographs were also taken during the field work and are included as **Attachment A** at the end of this memo.

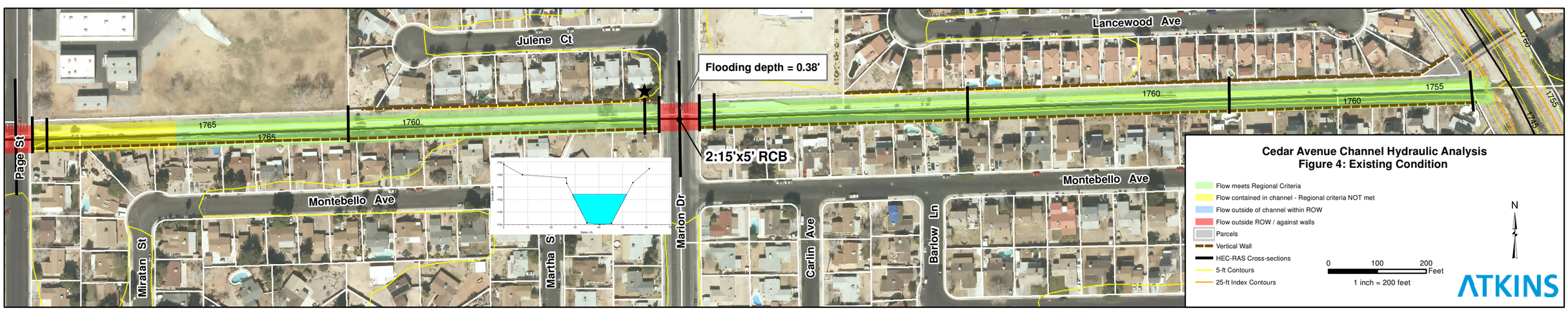
After the model was developed, the existing/interim/ultimate condition scenarios were analyzed, and the results were plotted on three figures that were color coded to show problem locations where the flow is not contained in the channel and/or overtops the crossings. These results are shown on **Figure 4**, **Figure 5**, and **Figure 6**. A profile plot showing the water surface elevation for all scenarios is also included in **Figure 7**.

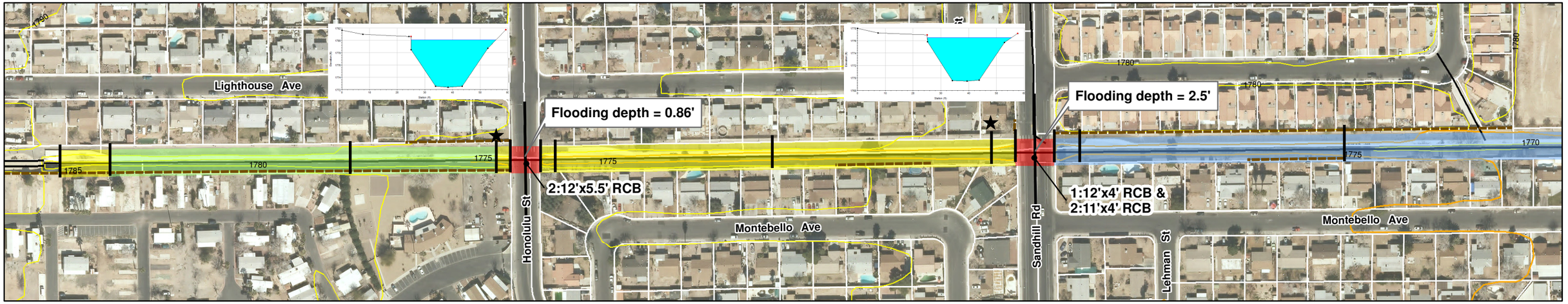
The results show that the 5 bridge crossings along the channel are undersized and do not have conveyance capacity to convey the existing, interim, or ultimate condition flow. The interim/ultimate condition flows at all 5 crossings overtop and leave the channel. The existing condition is slightly better at Honolulu St (most upstream crossing), but the other crossings are all undersized.

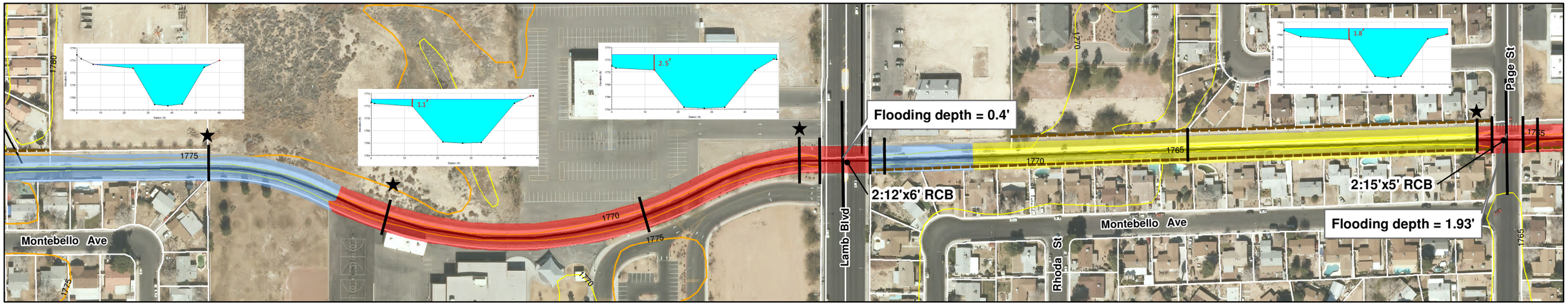
The channel has more capacity to convey the 100-year flow compared to the bridge crossings, and most of the channel sections contain the flow (although with minimal freeboard). The exception is the channel reach upstream of Lamb Blvd and downstream of Sandhill Rd where the flow is not contained in the channel in the interim or ultimate condition.

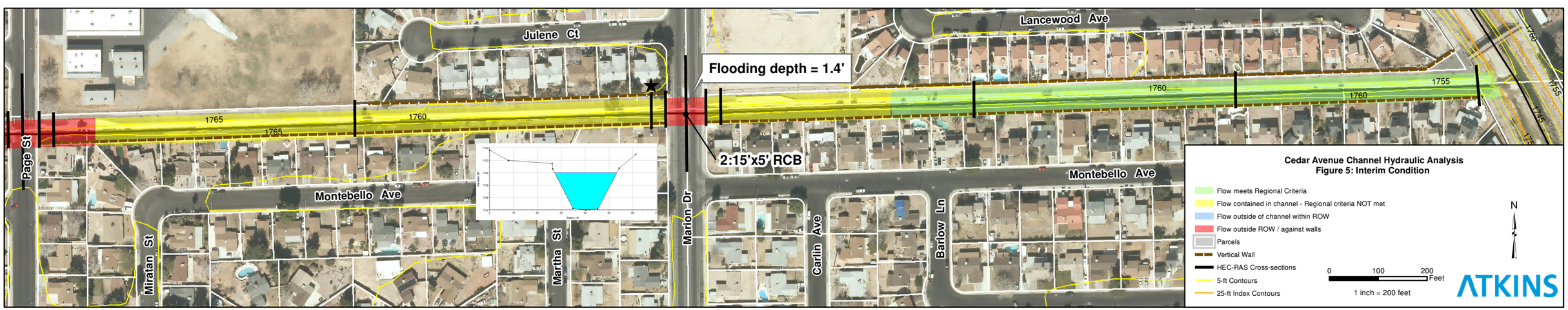

Lighthouse Ave
1790
1785
1780
1775
1770
Honolulu St
2:12'x5.5' RCB
Montebello Ave
Sandhill Rd
Flooding depth = 0.94'
1:12'x4' RCB &
2:11'x4' RCB
Lehman St
Montebello Ave

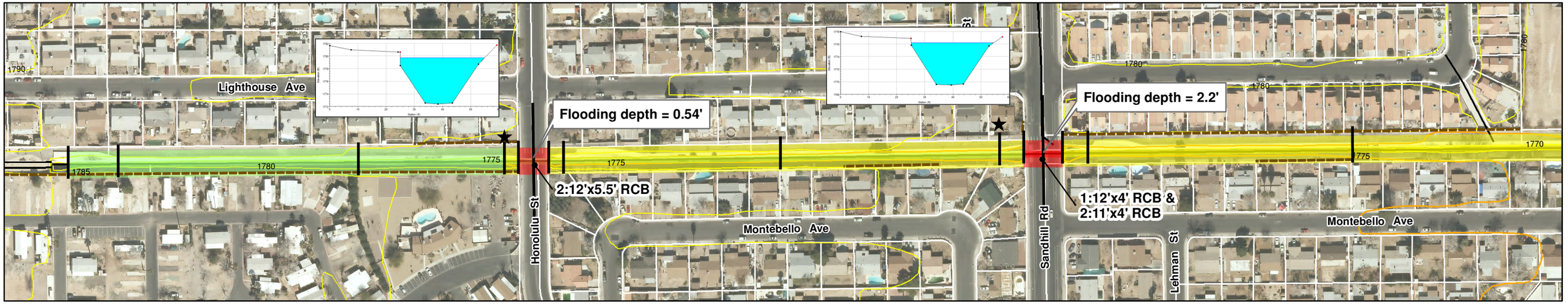

1780
1775
1770
Montebello Ave
Bolsa Dr
Lamb Blvd
2:12'x6' RCB
1765
Rhoda St
2:15'x5' RCB
Flooding depth = 0.63'
Page St

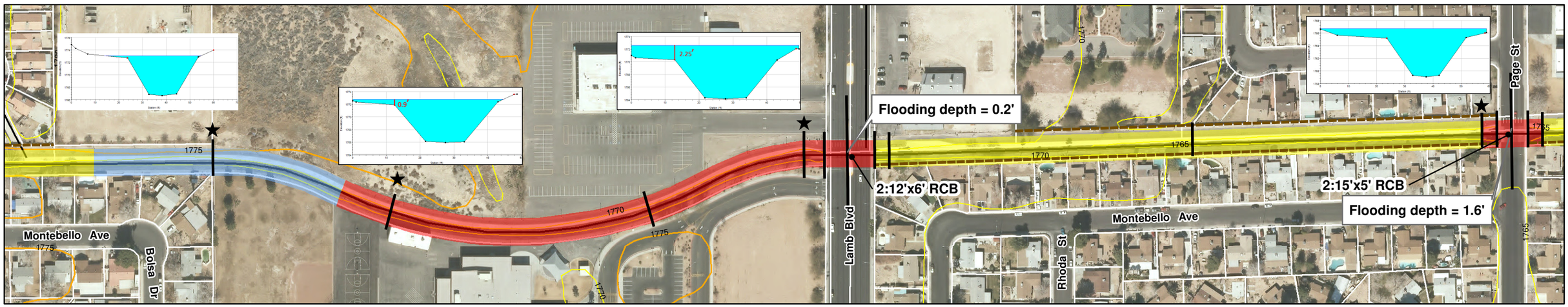

Julene Ct
Flooding depth = 0.38'
Lancewood Ave
1765
1760
1755
Page St
Montebello Ave
Miratan St
Martha St
Marion Dr
2:15'x5' RCB
Carlin Ave
Barlow Ln
Cedar Avenue Channel Hydraulic Analysis
Figure 4: Existing Condition
Flow meets Regional Criteria
Flow contained in channel - Regional criteria NOT met
Flow outside of channel within ROW
Flow outside ROW / against walls
Parcels
Vertical Wall
HEC-RAS Cross-sections
5-ft Contours
25-ft Index Contours
N
0
100
200
Feet
1 inch = 200 feet
ATKINS


Lighthouse Ave
Flooding depth = 0.86'
2:12'x5.5' RCB
Honolulu St
Montebello Ave
Sandhill Rd
Flooding depth = 2.5'
1:12'x4' RCB &
2:11'x4' RCB
Lehman St
Montebello Ave
1785
1780
1775
1770


Montebello Ave
1775
1770
Flooding depth = 0.4'
2:12'x6' RCB
Lamb Blvd
Rhoda St
Montebello Ave
Flooding depth = 1.93'
2:15'x5' RCB
Page St
1765
1770


Julene Ct
Flooding depth = 1.4'
2:15'x5' RCB
Lancewood Ave
Page St
Montebello Ave
Miratan St
Martha St
Marion Dr
Carlin Ave
Barlow Ln
Montebello Ave
1765
1760
1755
Cedar Avenue Channel Hydraulic Analysis
Figure 5: Interim Condition
Flow meets Regional Criteria
Flow contained in channel - Regional criteria NOT met
Flow outside of channel within ROW
Flow outside ROW / against walls
Parcels
Vertical Wall
HEC-RAS Cross-sections
5-ft Contours
25-ft Index Contours
N
0 100 200 Feet
1 inch = 200 feet
ATKINS


Lighthouse Ave
Flooding depth = 0.54'
2:12'x5.5' RCB
Honolulu St
Montebello Ave
Sandhill Rd
Flooding depth = 2.2'
1:12'x4' RCB &
2:11'x4' RCB
Lehman St
Montebello Ave


Montebello Ave
Boise Dr
Flooding depth = 0.2'
2:12'x6' RCB
Lamb Blvd
Rhoda St
Montebello Ave
2:15'x5' RCB
Flooding depth = 1.6'
Page St

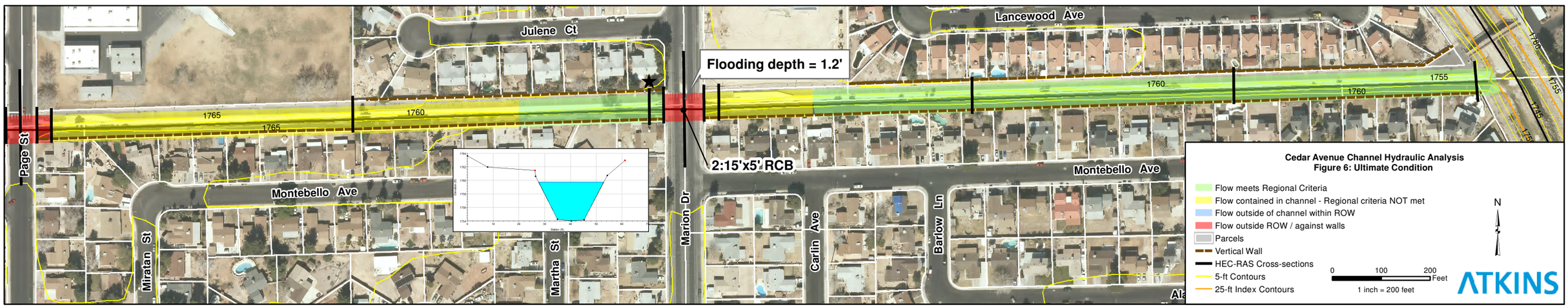
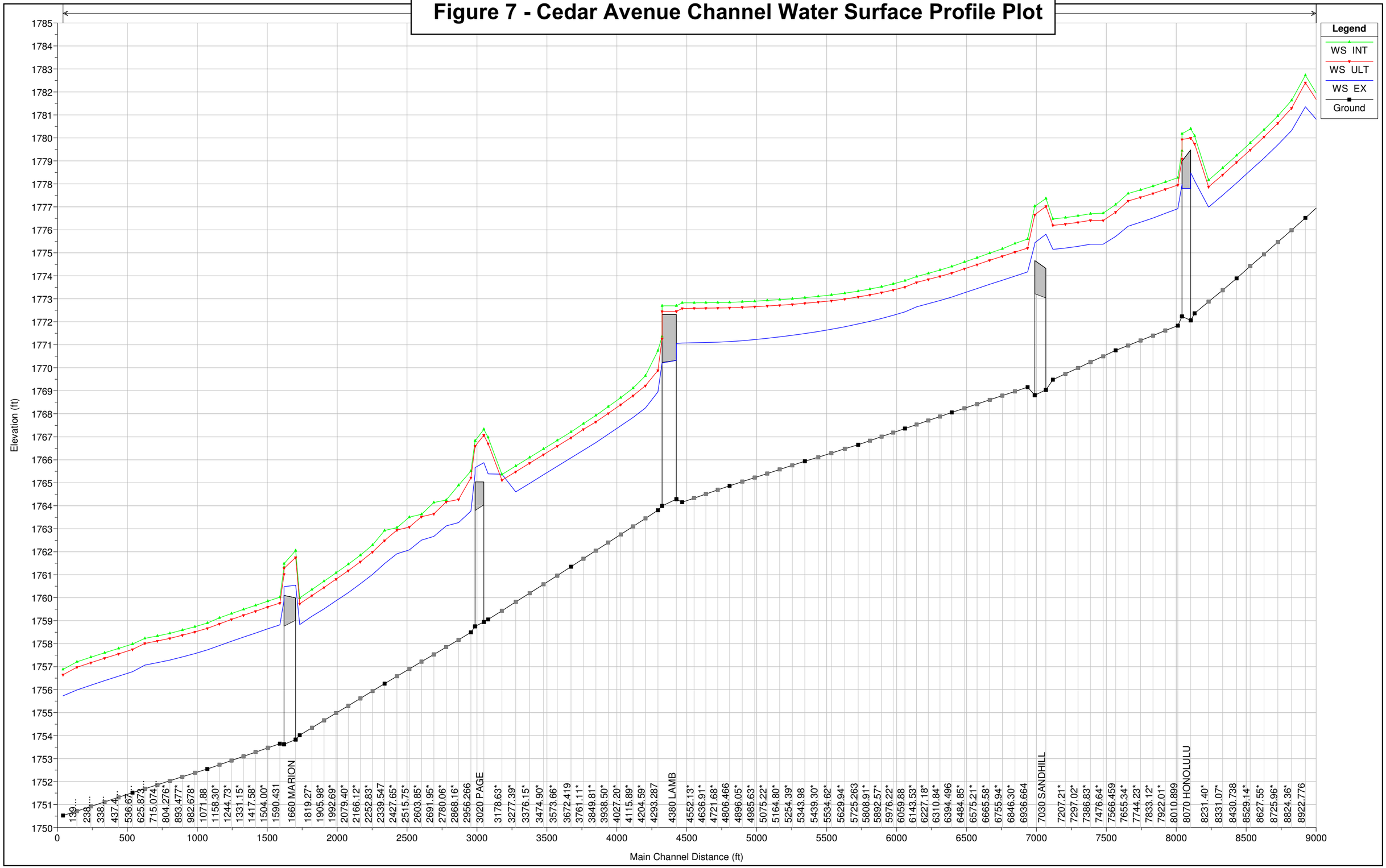

Julene Ct
Page St
Montebello Ave
Miratan St
Martha St
Flooding depth = 1.2'
2:15'x5' RCB
Marion Dr
Lancewood Ave
Montebello Ave
Carlin Ave
Bariow Ln
Cedar Avenue Channel Hydraulic Analysis
Figure 6: Ultimate Condition
Flow meets Regional Criteria
Flow contained in channel - Regional criteria NOT met
Flow outside of channel within ROW
Flow outside ROW / against walls
Parcels
Vertical Wall
HEC-RAS Cross-sections
5-ft Contours
25-ft Index Contours
N
0 100 200 Feet
1 inch = 200 feet
ATKINS

Figure 7 - Cedar Avenue Channel Water Surface Profile Plot



CONCLUSIONS AND RECOMMENDATIONS

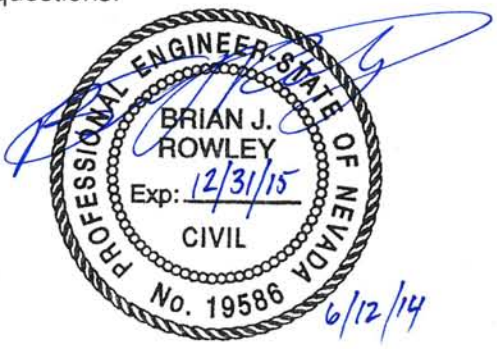
The hydrologic/hydraulic analysis presented in this memo shows that the Cedar Avenue Channel does not have adequate capacity or freeboard to convey the existing, interim, or ultimate condition flow. When the proposed project is complete upstream, new storm drain will collect and convey more flow (approximately 500 cfs more) to the channel than what is currently conveyed in the existing condition. The limited channel capacity combined with increased flows from the proposed project has the potential to cause flooding and adversely impact nearby residential areas.

Atkins believes that the bridge crossings are undersized and are the primary restriction on channel conveyance. The geometry and size of the channel sections are better suited to convey project flows than the crossings. There are also abrupt channel transitions upstream and downstream of each crossing that result in backwater and hydraulic losses at the crossings. Possible enhancements to the bridge crossings could include adding additional barrels or reconfiguring the bridge geometry. The channels could be improved by extending the transition reaches upstream and downstream of the crossings or by adding flood walls to increase channel conveyance capacity and protect adjacent residences.

In a project progress meeting held on June 2, 2014, the City stated that the areas further downstream (east) of the project along Stewart Avenue experience flooding issues already. The option of picking up less flow in this project and collecting it downstream in Stewart was mentioned during the meeting, but Atkins and the City agreed that it would be much more expensive to build a new, long regional facility in Stewart Avenue compared to the cost of fixing the Cedar Avenue Channel crossings. In addition, even with a new regional facility in Stewart Avenue, the Cedar Avenue Channel would still need to be fixed to adequately convey the existing condition flow.

Following review of this technical memorandum, further coordination will be required between the City, CCRFCD, and Atkins to re-evaluate the scope of services and develop an action plan to continue with the project and address the downstream capacity limitations in Cedar Avenue Channel. Atkins recommends that the 30% design effort and scope of services be increased to cover not only the original project extents but also the downstream Cedar Avenue Channel improvements. This would provide the City with a complete set of 30% plans and an understanding of needed improvements and project costs. The project schedule and budget could be reviewed following the 30% design phase to determine how to best use remaining project funds (i.e., build a portion of the improvements, use a phased project approach, authorize additional services, etc.).

Please feel free to contact us if you have any questions.



Harshal Desai, P.E.
Project Manager

Brian Rowley, P.E.
Associate Project Manager

Attachment A: Photo Library



Photo 1: Looking at the upstream end of the channel at the two (2) 72-inch RCP's



Photo 2: Looking east at the trail along the Cedar Channel

Attachment A: Photo Library



Photo 3: Looking east at the Cedar channel upstream of Honolulu Street crossing



Photo 4: Looking east at the upstream face of Honolulu Street crossing

Attachment A: Photo Library



Photo 5: Looking west at the downstream face of Honolulu Street crossing



Photo 6: Looking east at the Cedar channel downstream of Honolulu Street crossing

Attachment A: Photo Library



Photo 7: Looking east at the Cedar channel upstream of Sandhill Road crossing



Photo 8: Looking east at the upstream face of Sandhill Road crossing

Attachment A: Photo Library



Photo 9: Looking west at the downstream face of Sandhill Road crossing



Photo 10: Looking east at the Cedar channel downstream of Sandhill Road crossing

Attachment A: Photo Library



Photo 11: Looking east at the Cedar channel upstream of Lamb Boulevard crossing



Photo 12: Looking east at the upstream face of Lamb Boulevard crossing

Attachment A: Photo Library



Photo 13: Looking west at the downstream face of Lamb Boulevard crossing



Photo 14: Looking east at the upstream face of Marion Street crossing

Attachment A: Photo Library



Photo 15: Looking west at the downstream face of Marion Street crossing



Photo 16: Looking east at the upstream face of Page Street crossing

Attachment A: Photo Library



Photo 17: Looking west at the downstream face of Page Street crossing

GEOTECHNICAL DATA REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

DRAFT

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 10, 2015
Project No. 303710001

April 10, 2015
Project No. 303710001

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074-7755

Subject: Geotechnical Data Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith are the data results of Ninyo & Moore's geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide our findings. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

DRAFT

Naik Banavathu, P.E.
Principal Engineer

Brad L. Olsen, PE
Principal Engineer

NB/BLO/dh

Distribution: (1) Addressee (via e-mail)

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1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment. This report presents the findings of our subsurface exploration, results of our background review and laboratory testing.

This study was performed concurrently with a hydrogeologic study, also performed by Ninyo & Moore. A report presenting the results of our hydrogeologic study will be submitted under separate cover.

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. This evaluation included preparation of a geotechnical interpretive report. Data from this report, including two exploratory borings (B-108 and B-109) that were performed along Pecos Road approximately between Stewart Avenue and Bonanza Road, were used to the extent possible for this evaluation.

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2. SCOPE OF SERVICES

The scope of our services included the following:

- Review of pertinent background data listed in the References section of this report. The data reviewed included drawings, in-house geotechnical and soils data, aerial photographs, and published soils and geologic maps and literature.
- Coordination and mobilization for subsurface exploration. Markout of existing utilities in areas of our exploratory borings was conducted through Underground Service Alert (USA).
- Drilling, logging, and sampling of 20 exploratory borings, which were advanced to depths ranging from approximately 10 to 25 feet. The borings were performed to evaluate subsurface conditions along the proposed alignment and to obtain soil samples for laboratory testing.

- Performance of laboratory tests on selected soil samples obtained from the exploratory borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts).
- Compilation and analysis of accumulated data.
- Preparation of this data report presenting results of our background review, subsurface exploration and laboratory testing.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

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4. GENERAL ALIGNMENT CONDITIONS

The proposed alignment will extend along portions of Pecos Road and existing Cedar Avenue Channel ROW. At the time of our geotechnical reconnaissance, Pecos Road extended in a north-to-south direction and was generally bordered by residential properties to the east and a golf course to the west. The existing concrete-lined trapezoidal channel extended in an east-to-west

direction and was generally bordered by residential properties to the north and south. An elementary school was located to the south of the channel near the Lamb Boulevard crossing and north of the channel near Page Street crossing. Chain-link fencing and concrete block screen walls were located on the north and south sides of the channel.

The existing channel was up to approximately 30 feet wide and up to approximately 10 feet deep. An asphalt-concrete paved trail, up to approximately 15 feet wide, was located to the north of the existing channel. The existing trail is at an elevation of approximately 1,792 feet above mean sea level (AMSL) near Pecos Road and at an elevation of approximately 1,760 feet AMSL near Las Vegas Wash. Water, several inches deep, was observed flowing in the channel bottom. The existing channel crosses under numerous streets, including Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive. At the time of our geotechnical reconnaissance, all these streets were paved with asphalt concrete and extended in a north-south direction. All these streets in the vicinity of the project alignment were fully improved with curb, gutter, and sidewalks. Honolulu Street and Page Street included one lane each way, Marion Drive and Sandhill Road included one lane each way with a turn lane, and Lamb Boulevard included three lanes each way with a two-way left turn lane

Indications of underground utilities observed in the vicinity of the alignment included gas, water, storm drain, and electric lines. Other underground utilities may be present in the vicinity of the project.

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5. GEOLOGY

Based on our field observations, subsurface exploration, and review of referenced geologic and soils data, the project alignment is underlain primarily by relatively shallow fill, which is in turn underlain by Quaternary-age alluvium (native soil). Ninyo & Moore's findings regarding the geologic setting, potential geologic hazards and problematic soils, and ground motions are provided in the following sections.

5.1. Geologic Setting

The project alignment is located in the eastern portion of Las Vegas Valley, which lies in the southwestern portion of the Great Basin, within the Basin and Range physiographic province. Las Vegas Valley is a naturally formed structural basin as a result of block faulting, a fundamental characteristic of the Basin and Range physiographic province.

Las Vegas Valley extends in a northwest-southeast direction and drains generally toward the southeast through Las Vegas Wash into Lake Mead. Bordering the alluvium-filled valley are relatively steep mountain ranges, including the Spring Mountains to the west; the Desert, Sheep, and Las Vegas ranges to the north; the McCullough Range to the south; and Sunrise Mountain, Frenchman Mountain, and River Mountains to the east.

Las Vegas Valley is underlain at depth by Proterozoic-age igneous and metamorphic basement rock, which is overlain by thick layers of Paleozoic- and Mesozoic-age sedimentary rock, and Tertiary-age volcanic rock. The lower lying areas of Las Vegas Valley generally contain relatively fine-grained alluvial, aeolian, and playa deposits. Extending outward into the valley from the bordering mountain fronts, are sloping alluvial aprons, or fans, comprised primarily of poorly sorted gravel and sand deposits with cobbles and boulders. The soils are up to approximately 5,000 feet thick in some areas of the valley.

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5.2. Potential Geologic Hazards and Problematic Soils

Ninyo & Moore's geotechnical study included an evaluation of the possible presence of geologic hazards, such as faults and ground fissures, in the project alignment area. This evaluation included visual observation of the alignment for indications of adverse geologic features and review of published geologic and soils maps and literature, and other data listed in the References section of this report. Referenced geologic data were also reviewed to evaluate seismic activity levels, and associated potential earthquake hazards, for faults in the alignment vicinity. It should be noted that the fault seismic activity levels provided in this section were obtained/interpreted primarily from United States Geological Survey (USGS, 2015b) data.

Review of referenced geologic data indicates that the nearest active fault (i.e., a fault that has experienced ground surface rupture within the past 11,000 years) to the alignment is the Black Hills fault. The Frenchman Mountain fault and the Eglington fault, which are considered potentially active (i.e., faults that have experienced ground surface rupture within the past 1.6 million years) are also located in the alignment vicinity. The distances from the alignment to these active and potentially active faults are provided in Table 1.

Review of referenced geologic data also indicates that an unnamed Las Vegas Valley fault extends through the western portion of the alignment (Figure 2). Referenced USGS data indicate that this fault is of uncertain origin and that its seismic activity level has not been established. During our geologic field reconnaissance along the project alignment, surficial indications of previous faulting were not observed. The origin of this geologic feature, and other similar features in southern Nevada, which have been previously referred to as "compaction faults." Differing proposed origins for these faults include:

- Differential consolidation or compaction over time of the thick alluvial and lakebed sediments in valley areas.
- Tectonic factors associated with faults that may extend into the basement bedrock beneath the valley sediment.
- A combination of differential consolidation and tectonic factors.

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Table 1 – Faults in Project Alignment Vicinity

Fault Name	Seismic Activity Level *	Approximate Distance From Project Alignment to Fault (miles)
Black Hills fault	Active	16
Eglington fault	Potentially Active	8
Frenchman Mountain fault	Potentially Active	3
Unnamed Las Vegas Valley fault	Not Established	Extends through alignment (see Figure 2)
*From United States Geological Survey (USGS, 2015b) data.		

Ground fissures, generally believed to be caused by erosion and differential stress resulting from regional subsidence due primarily to withdrawal of groundwater, are known to occur near faults in southern Nevada. Review of the referenced geologic data does not indicate the

presence of ground fissures along the project alignment and no ground fissures were observed during our field activities. However, it should be noted that the ground surface had been disturbed/obscured by previous development.

As part of this study, Ninyo & Moore evaluated whether the project alignment is located in a Special Geotechnical Considerations Area, as shown on the referenced Clark County Soil Guidelines Map (Clark County Building Department, 1998). This map indicates important aspects of near-surface soils and geologic features in the Las Vegas Valley. Review of the Clark County Soil Guidelines Map indicates that the portion of the project alignment between Stewart Avenue and Sandhill Road is located in a *Special Geotechnical Considerations Area - Subsidence and 2,000-Foot Compaction or Seismic Fault Buffer Zone*. This buffer zone is considered to contain 90 percent of mapped ground fissures. These potential ground fissure areas extend approximately 1,000 feet to each side of faults. The portion of the project alignment between Sandhill Road and Marion Drive is located in a *Special Geotechnical Considerations Area - Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*: This area is indicative of potentially moisture-sensitive and corrosive soils. The portion of the alignment located between Marion Drive and Las Vegas Wash is located in a *Special Geotechnical Considerations Area - Potential Drainage Areas or Recent Sediment Deposits, which may also have Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*. This area is in the vicinity of major drainages and may also contain potentially moisture-sensitive and corrosive soils.

The Clark County Expansive Soil Guidelines Map (Clark County Development Services Department, 2006) indicates general trends of near-surface soils in the Las Vegas Valley. This map shows areas of the valley where previous geotechnical studies have indicated the presence of moderately, highly, and critically expansive soils. Based on review of this map, the portion of the project alignment between Stewart Avenue and Honolulu Street is located in an area prone to moderately expansive soil and the remaining portion of the alignment is located in an area prone to highly expansive soil.

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5.3. Ground Motions

Using the referenced United States Geological Survey database (USGS, 2015a), estimated maximum considered earthquake spectral response accelerations for short (0.2 second) and long (1.0 second) periods were obtained for the project alignment, which is located at approximately 36.1699 degrees north latitude and -115.0891 degrees west longitude. Based on the referenced International Building Code (ICC, 2012) and due to a detailed seismic site class evaluation not being performed for the project, Seismic Site Class D is appropriate for the project alignment and the parameters in the following table are characteristic of the project alignment for design purposes.

Table 2 – Seismic Design Parameters

Parameters	Value		Reference (ICC, 2012)
	Short Period	Long Period	
Mapped Maximum Considered Earthquake Spectral Response Acceleration, S_S and S_1	0.495g	0.164g	Figure 1613.3.1 and referenced database (USGS, 2015a)
Site Coefficient, F_a and F_v	1.40	2.14	Table 1613.3.3
Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Class Effects, S_{MS} and S_{M1}	0.695g	0.352g	Equations 16-37 and 16-38
Design Spectral Response Acceleration, S_{DS} and S_{D1}	0.463g	0.235g	Equations 16-39 and 16-40

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6. FIELD EXPLORATION, LABORATORY TESTING, AND SUBSURFACE CONDITIONS

Ninyo & Moore's subsurface exploration along the project alignment was performed from March 5 through March 16, 2015. This exploration consisted of drilling, logging, and sampling of 20 small-diameter exploratory borings. The borings were advanced to depths ranging from approximately 10 to 25 feet with a truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The purpose of the borings was to evaluate subsurface conditions along the project alignment, as well as to collect bulk and relatively undisturbed soil samples for laboratory testing. The approximate locations of the borings along with the pertinent borings from the other study previously discussed are shown on Figure 2.

Laboratory tests were performed on representative soil samples collected from the borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts). The results of the in-place moisture content and dry density tests are provided on the boring logs in Appendix A. Ground surface elevations at boring locations surveyed by Atkins personnel are also provided on the boring logs. Descriptions of the laboratory testing procedures utilized and the other test results are presented in Appendix B and Appendix C.

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6.1. Subsurface Soils Encountered

Generalized descriptions of the subsurface soils (fill and native soil) encountered in the exploratory borings are provided in the following sections.

6.1.1. Fill

Fill material, up to approximately 1.8 feet deep, was encountered in our exploratory borings. In addition, fill material approximately 7.0 feet deep was encountered in boring B-17. The encountered fill soils were comprised primarily of medium dense to dense, silty gravel with sand. A dense, clayey sand with gravel layer was also encountered in boring B-17. Much of the fill encountered in our borings was likely associated with channel sidewall backfill and/or roadway fill material.

Asphalt concrete pavement and underlying aggregate base material was penetrated in all of our 20 borings drilled during our subsurface evaluation for the subject project. The approximate thicknesses of asphalt concrete and underlying aggregate base material encountered in these borings are summarized in the following table.

Table 3 – Existing Asphalt Concrete Pavement and Aggregate Base Thicknesses

Boring	Approximate Thickness of Asphalt Concrete (inches)	Approximate Thickness of Aggregate Base Material (inches)
B-1	9-1/8	12 to 13
B-2	2	3-1/2
B-3	2	4-1/2
B-4	2-1/2	5-1/2
B-5	1-1/2	5-1/2
B-6	1-7/8	5
B-7	2-1/2	4
B-8	2-1/2	4
B-9	2-3/4	4
B-10	2-1/2	5-1/2
B-11	3	4
B-12	2-7/8	5-1/2
B-13	2-3/4	4-1/2
B-14	2-5/8	4-3/4
B-15	2-1/2	11
B-16	2-1/2	12 to 13
B-17	2-5/8	12 to 13
B-18	3-1/2	12 to 13
B-19	3	12 to 13
B-20	3-1/4	8-1/2
B-108*	8-3/4	5
B-109*	8-1/4	7
* Boring from previous evaluation		

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6.1.2. Native Soil

Native soil was encountered beneath the noted fill and extended to the total depths of our exploratory borings. The encountered native soil consisted primarily of firm to very stiff lean clay and fat clay with varying amounts of sand and gravel. An approximately 5-foot thick layer of stiff to very stiff silt with sand was encountered at a depth of approximately 12 and 15 feet in borings B-19 and B-20, respectively.

Layers of hard to very hard, strongly cemented soil (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Caliche is a naturally occurring cemented soil with rock-like characteristics. The following describes typical properties of caliche encountered in southern Nevada.

- Generally occurs in layers a few inches to several feet thick.

- Layers typically vary significantly in thickness, degree of cementation, and hardness over relatively short distances.
- Varies in composition from primarily fine-grained material to primarily coarse-grained material.
- Moderately hard, moderately cemented caliche can generally be gouged with a knife with difficulty and broken with a few hammer blows.
- Hard and very hard, strongly cemented caliche is difficult to scratch with a knife and breaks with difficulty with repeated hammer blows.
- Impedes earthwork operations, including grading and utility line trenching. Rock excavation methods are generally needed.

Laboratory tests were performed on representative samples of native soil obtained from the exploratory borings. Results of these tests are summarized in the following table.

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Table 4 – Summary of Laboratory Test Results

Test Type	Test Results	Remarks
Atterberg Limits Liquid Limit Plastic Limit Plasticity Index	 24 to 64 16 to 32 7 to 42	Low to high plasticity
Expansion Index	41 to 140	Low to very high
Sodium Sulfate Content	0.03 to 0.70 percent	Negligible to moderate chemical heave (salt heave) potential
Sodium Content	0.03 to 0.42 percent	--
Sulfate Content	0.02 to 0.47 percent	Negligibly to severely deleterious to concrete
Total Salts (Solubility)	0.15 to 1.86 percent	Low to high solubility potential

6.2. Selected and Granular Backfill Suitability

As a part of this study, Ninyo & Moore evaluated the suitability of encountered soils for use as trench backfill material. Clark County gradation and plasticity requirements (Clark County, 2003) for Selected and Granular Backfill (USSPWC Sections 207.02.01 and 207.02.02, respectively), along with the results of gradation and Atterberg limits tests performed by Ninyo & Moore, are presented in the following table.

Table 5 – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-1 5.0-6.5	B-3 2.0-3.5	B-5 2.0-3.5	B-6 5.0-6.5	B-9 5.0-6.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	82	100	100	100
No. 16	--	25-100	100	73	100	100	100
No. 200	--	5-15	86.1	61.6	88.8	84.3	93.8
Plasticity Index	15 max	15 max.	42	34	31	23	17
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

Table 5 (continued) – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-12 5.0-6.5	B-14 5.0-6.5	B-17 5.0-6.5	B-18 10.0-11.5	B-20 15.0-16.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	100	58	99	100
No. 16	--	25-100	98	100	41	99	100
No. 200	--	5-15	95.0	96.6	19.0	82.3	81.8
Plasticity Index	15 max	15 max.	8	12	14	7	20
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

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6.3. Groundwater

Groundwater was encountered in 12 of our 20 exploratory borings. Borings B-1, B-2, B-6, and B-20 were converted to temporary monitoring wells for the hydrogeologic study. The approximate depths to groundwater levels measured in the exploratory borings are presented in the following table. Depths to groundwater are also included on the boring logs in Appendix A.

Table 6 – Measured Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Approximate Time Measured After Drilling (days)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)
B-1	1,795.4	3	12.2	1,783.2
B-2	1,791.6	4	12.7	1,778.9
B-3	1,783.9	1	8.2	1,775.7
B-4	1,781.9	1	8.4	1,773.5
B-5	1,779.6	4	6.9	1,772.7
B-6	1,778.2	4	8.4	1,769.8
B-10	1,772.5	4	13.6	1,758.9
B-16	1,764.1	4	13.6	1,750.5
B-17	1,761.7	4	15.4	1,746.3
B-18	1,762.3	1	18.4	1,743.9
B-19	1,761.7	3	18.7	1,743.0
B-20	1760.5	3	18.4	1,742.1

*Measured from top of ground surface (top of channel bank) adjacent to boring.

Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this study.

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7. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical data report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the findings presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that

our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for data purposes only. It does not provide sufficient data to prepare an accurate bid by some contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

If geotechnical conditions different from those described in this report are encountered, our office should be notified. It should be understood that the conditions along the project alignments could change with time as a result of natural processes or the activities of man along the subject alignments or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings of this report by parties other than the client is undertaken at said parties' sole risk.

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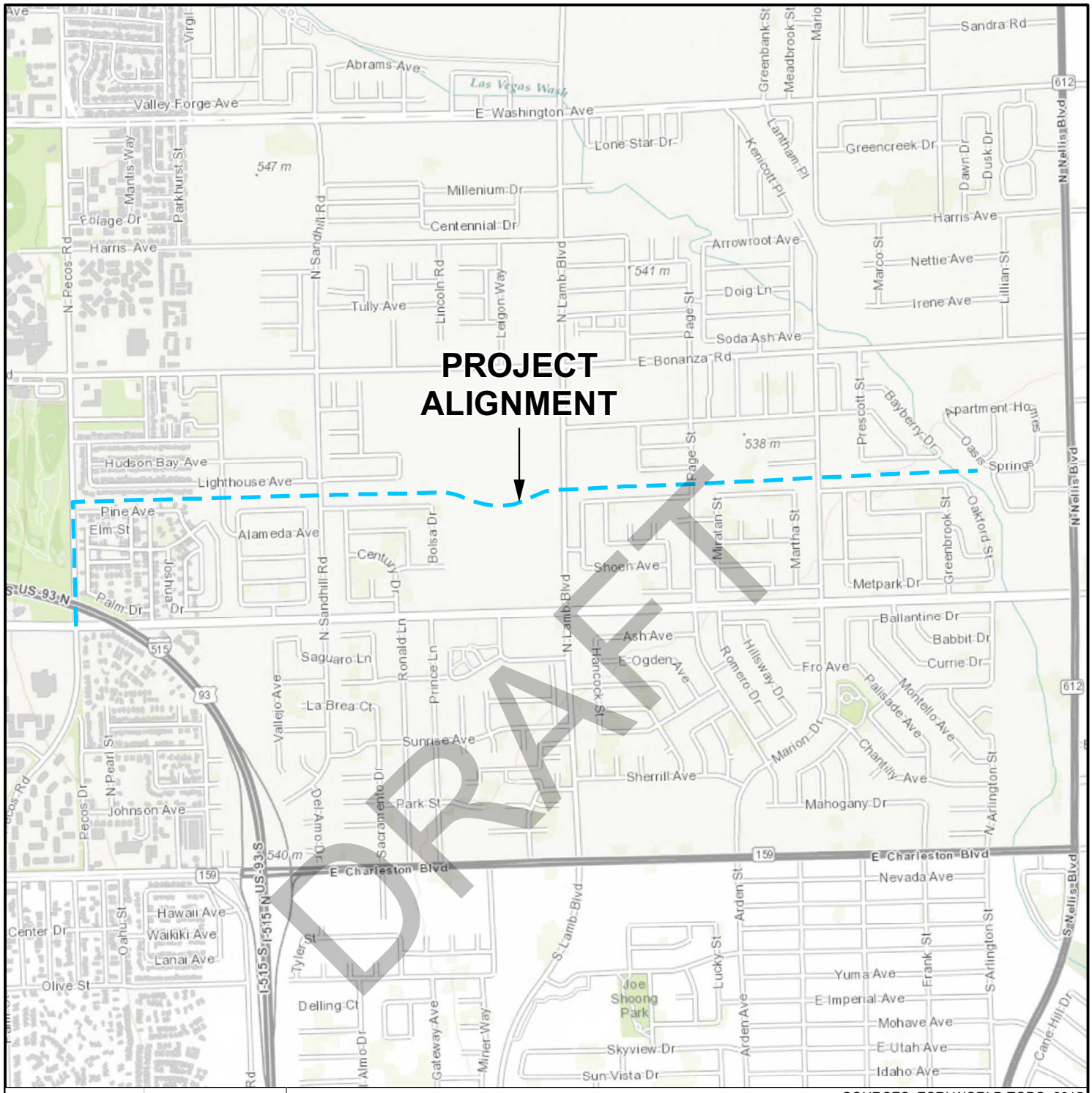
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SOURCES: ESRI WORLD TOPO, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710001_SL.mxd 4/7/2015 3:32:13 PM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2
303710001	4/15		

2_303710001_BL.mxd 4/10/2015 JDL

APPENDIX A

EXPLORATORY BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory excavations. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

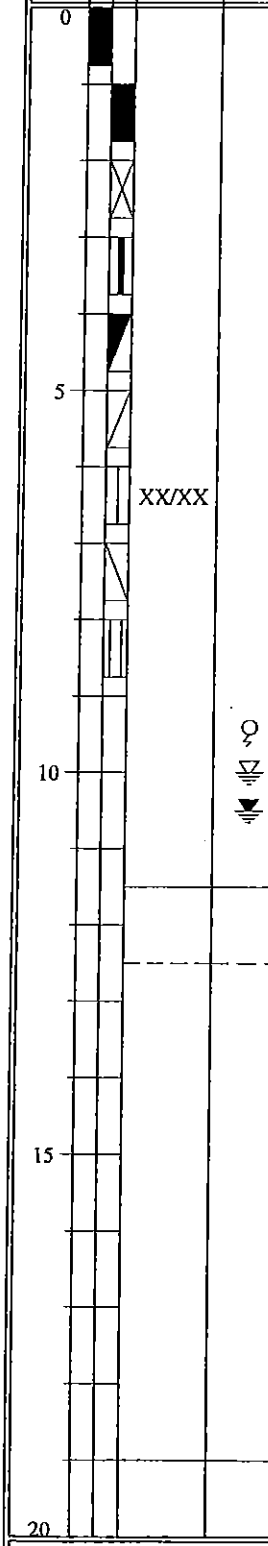
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586 and the blow counts were recorded. Soil samples were observed and removed from the sampler, bagged, sealed, and transported to the laboratory for testing.

Field Procedure for the Collection of Ring-lined Samples

Ring-lined soil samples were obtained in the field using a Modified Split-Barrel Drive Sampler. The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer of thin general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows during driving are presented on the excavation logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

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BORING LOG EXPLANATION SHEET



Bulk sample.

Modified split-barrel drive sampler.

No recovery with modified split-barrel drive sampler.

Sample retained by others.

Standard Penetration Test (SPT).

No recovery with a SPT.

Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.

No recovery with Shelby tube sampler.

Continuous Push Sample.

Seepage.

Groundwater encountered during drilling.

Groundwater measured after drilling.

SM

MAJOR MATERIAL TYPE (SOIL):
Solid line denotes unit change.

CL

Dashed line denotes material change.

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Shear Bedding Surface

The total depth line is a solid line that is drawn at the bottom of the boring.

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BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE
	Rev. 11/11	

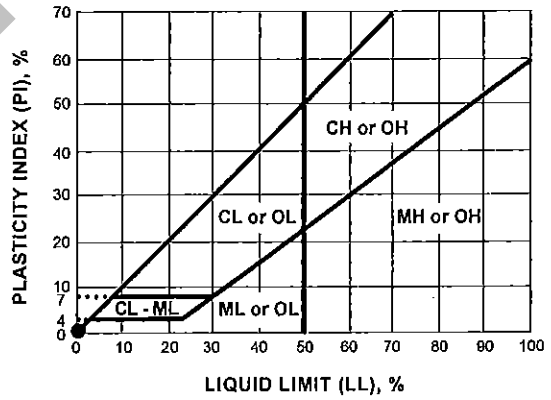
SOIL CLASSIFICATION CHART PER ASTM D 2488

PRIMARY DIVISIONS			SECONDARY DIVISIONS	
			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	GRAVEL more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with clay
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	SILT and CLAY liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

PLASTICITY CHART



APPARENT DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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USCS METHOD OF SOIL CLASSIFICATION

Explanation of USCS Method of Soil Classification

PROJECT NO.	DATE	FIGURE

DATE DRILLED 3/13/15 BORING NO. B-1

GROUND ELEVATION 1,795.4'± (MSL) SHEET 1 OF 2

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 9-1/8 inches thick.
						GM	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		9/6" 7/6" 7/6"	7.9	110.5		CL	NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; few sand.
5		4/6" 5/6" 8/6"	32.1	80.8		CH	Light brown, moist, stiff to very stiff, fat CLAY; few sand.
							Trace gravel.
10		7/6" 14/6" 16/6"	32.3	80.7			Very stiff.
			▼				Wet.
15		4/6" 8/6" 40/6"	21.1	102.3			With gravel.
							Few gravel.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-1

DATE DRILLED 3/13/15 BORING NO. B-1

GROUND ELEVATION 1,795.4'± (MSL) SHEET 2 OF 2

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		25/6" 50/2"	26.2	99.6		CH	NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, fat CLAY with gravel; few sand.
							Few gravel.
25		7/6" 11/6" 14/6"	27.2	91.2			Gray to light brown; with gravel.
							Total Depth = 26.5 feet. Groundwater was measured at a depth of approximately 12.2 feet about 72 hours after drilling. Backfilled and patched on 3/24/15.
							NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
30							
35							
40							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-2

DATE DRILLED 3/5/15 BORING NO. B-2

GROUND ELEVATION 1,791.6'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2 inches thick.
						CL	FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 3-1/2 inches thick.
		12/6" 11/6" 13/6"					NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; few sand; few gravel.
						CH	Light brown, moist, very stiff, sandy fat CLAY with gravel.
5		6/6" 13/6" 23/6"	24.6	86.7			
							A layer of silty gravel a few inches thick.
10		4/6" 6/6" 8/6"	29.4	77.5			Few gravel.
			▼				Wet.
15		1/6" 2/6" 3/6"	54.2	64.6			Firm.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-3

DATE DRILLED 3/5/15 BORING NO. B-2

GROUND ELEVATION 1,791.6±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			7/6" 14/6" 9/6"				CH	NATIVE SOIL (CONTINUED): Light brown, very stiff, sandy fat CLAY with gravel.
								Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 12.7 feet about 96 hours after drilling. Backfilled and patched on 3/9/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
25								
30								
35								
40								

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-4

DATE DRILLED 3/5/15 BORING NO. B-3

GROUND ELEVATION 1,783.9'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2 inches thick.
						CH	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4-1/2 inches thick.
		5/6" 9/6' 11/6"	15.7	82.6			NATIVE SOIL: Dark brown, moist, very stiff, sandy fat CLAY with gravel.
5		9/6" 30/6" 41/6"	22.0	95.8			A layer of gravel a few inches thick.
							Trace gravel.
			▼				Wet.
10		4/6" 6/6" 8/6"	31.8	89.2			
15		12/6" 7/6" 18/6"					Few gravel.
							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.2 feet about 24 hours after drilling. Backfilled and patched on 3/6/15.
							NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-5

DATE DRILLED 3/5/15 BORING NO. B-4

GROUND ELEVATION 1,781.9'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CH	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		7/6" 14/6" 16/6"	25.1	92.8			NATIVE SOIL: Dark brown, moist, very stiff, sandy fat CLAY with gravel.
5		4/6" 12/6" 21/6"	24.1	89.4			Trace gravel.
							Wet.
10		21/6" 22/6" 11/6"	32.3	88.9			A moderately hard, moderately cemented layer, a few inches thick. Few gravel.
15		3/6" 9/6" 12/6"					
20							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.4 feet about 24 hours after drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-6

DATE DRILLED 3/11/15 BORING NO. B-5

GROUND ELEVATION 1,779.6'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 1-1/2 inches thick.
						CH	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		6/6" 8/6" 9/6"	29.8	83.9			NATIVE SOIL: Brown, moist, very stiff, fat CLAY; few sand.
							Few gravel.
5		5/6" 12/6" 25/6"	33.0	78.8			Light brown; wet; trace gravel.
10		4/6" 4/6" 5/6"	35.1	81.3			Gray; stiff.
15		4/6" 12/6" 14/6"	23.5	99.8			Very stiff.
20							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 6.9 feet about 96 hours after drilling. Backfilled and patched on 3/24/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-7

DATE DRILLED 3/5/15 BORING NO. B-6

GROUND ELEVATION 1,778.2'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 1-7/8 inches thick.
						CL	FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5 inches thick.
		2/6" 3/6" 4/6"					NATIVE SOIL: Dark brown, moist, stiff, lean CLAY with sand.
5		4/6" 9/6" 9/6"	24.6	91.3			Very stiff.
						CH	Light brown, very stiff, fat CLAY with sand; trace gravel.
			▼				Wet.
10		3/6" 6/6" 8/6"	41.8	74.2			Few gravel.
15		5/6" 13/6" 13/6"	29.6	90.9			
							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.4 feet about 96 hours after drilling. Backfilled and patched on 3/9/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-8

DATE DRILLED 3/5/15 BORING NO. B-7

GROUND ELEVATION 1,775.7'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		6/6" 5/6" 5/6"	15.1	85.3			NATIVE SOIL: Brown, moist, stiff, lean CLAY with sand. Trace gravel.
5		3/6" 3/6" 5/6"	23.7	90.7			
10		6/6" 18/6" 38/6"	17.5	102.2			Very stiff.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-9

DATE DRILLED 3/5/15 BORING NO. B-8

GROUND ELEVATION 1,774.6'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		5/6" 5/6" 8/6"	16.6	93.8			NATIVE SOIL: Brown, moist, stiff to very stiff, lean CLAY; few sand; few gravel.
5		3/6" 4/6" 6/6"	23.1	93.4			Stiff.
10		4/6" 9/6" 26/6"	22.1	89.6			Very stiff.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-10

DATE DRILLED 3/5/15 BORING NO. B-9

GROUND ELEVATION 1,773.6'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-3/4 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		3/6" 4/6" 4/6"	19.5	93.5			NATIVE SOIL: Dark brown, moist, stiff, lean CLAY; few sand.
5		2/6" 4/6" 5/6"	26.0	88.7			Trace gravel.
10		4/6" 8/6" 9/6"	26.8	89.7			Very stiff.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-11

DATE DRILLED 3/5/15 BORING NO. B-10

GROUND ELEVATION 1,772.5'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		2/6" 3/6" 3/6"	25.7	88.6			NATIVE SOIL: Dark brown, moist, firm to stiff, lean CLAY; few sand.
							Trace gravel.
5		3/6" 6/6" 8/6"	20.7	97.1			Very stiff.
							Few gravel.
10						CH	Brown, moist, firm, fat CLAY; few sand; trace gravel.
		2/6" 2/6" 2/6"	34.3	78.2			
			▼				Wet.
15		4/6" 8/6" 11/6"	31.2	79.3			Very stiff.
							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 13.6 feet about 96 hours after drilling. Backfilled and patched on 3/9/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-12

DATE DRILLED 3/5/15 BORING NO. B-11

GROUND ELEVATION 1,771.5'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		4/6" 4/6" 6/6"					NATIVE SOIL: Dark brown, moist, stiff, lean CLAY; few sand.
5		2/6" 5/6" 6/6"	21.9	93.3			Trace gravel.
10		2/6" 4/6" 5/6"	26.5	85.9			Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-13

DATE DRILLED 3/5/15 BORING NO. B-12

GROUND ELEVATION 1,770.5'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-7/8 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		5/6" 6/6" 6/6"	20.7	97.8			NATIVE SOIL: Brown, moist, stiff, lean CLAY; trace sand.
5		2/6" 4/6" 7/6"	19.6	97.8			Trace gravel. Few gravel.
10		2/6" 4/6" 4/6"	22.8	88.3			
15		1/6" 2/6" 3/6"	38.0	80.7			Firm.
							Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-14

DATE DRILLED 3/11/15 BORING NO. B-13

GROUND ELEVATION 1,769'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 2-3/4 inches thick.
						GM	
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4-1/2 inches thick.
		12/6" 8/6" 8/6"	14.6	91.2			NATIVE SOIL: Light brown, moist, very stiff, lean CLAY; trace sand.
							Dark brown; few gravel.
5		7/6" 4/6" 4/6"	13.4	99.9			Stiff.
10		5/6" 5/6" 7/6"	25.2	89.9			Light brown; trace gravel.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/12/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-15

DATE DRILLED 3/11/15 BORING NO. B-14

GROUND ELEVATION 1,766.7'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-5/8 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4-3/4 inches thick.
		8/6" 6/6" 9/6"	10.4	107.1			NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; trace sand.
							Trace gravel.
5		4/6" 3/6" 5/6"	20.6	94.3			Stiff; few gravel.
10		3/6" 3/6" 5/6"	25.0	91.4			Light brown.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/12/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-16

DATE DRILLED 3/11/15 BORING NO. B-15

GROUND ELEVATION 1,765.2'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 11 inches thick.
		10/6" 7/6" 6/6"	18.7	83.7			NATIVE SOIL: Brown, moist, stiff to very stiff, lean CLAY; few sand.
							Light brown.
5		6/6" 6/6" 6/6"	21.6	87.6			Dark brown; stiff.
							Few gravel.
10		3/6" 2/6" 2/6"					Light brown; firm.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/12/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-17

DATE DRILLED 3/11/15 BORING NO. B-16

GROUND ELEVATION 1,764.1'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		6/6" 4/6" 6/6"	24.5	87.1			NATIVE SOIL: Brown, moist, stiff, sandy lean CLAY; trace gravel.
							With gravel.
5		4/6" 7/6" 8/6"	16.7	92.9			Very stiff.
							Few gravel.
10		4/6" 4/6" 3/6"	26.1	88.0			Stiff; trace gravel.
							Few gravel.
			▼				Wet.
15		2/6" 1/6" 2/6"	33.5	78.5			Light brown; soft to firm.
							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 13.6 feet about 96 hours after drilling. Backfilled and patched on 3/15/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-18

DATE DRILLED 3/11/15 BORING NO. B-17

GROUND ELEVATION 1,761.7'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-5/8 inches thick.
						SC	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		24/6" 29/6" 23/6"	7.6	115.5			Dark brown, moist, dense, clayey SAND with gravel.
							A layer of silty gravel, a few inches thick.
							Light brown.
5		10/6" 11/6" 12/6"	7.5	100.1		GM	Light brown, moist, medium dense, silty GRAVEL with sand.
						CL	NATIVE SOIL: Dark brown, moist, stiff, sandy lean CLAY with gravel.
10		2/6" 3/6" 4/6"	33.2	84.4			Light brown; trace gravel.
15		4/6" 4/6" 6/6"	▼ 38.2	81.0			Wet.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-19

DATE DRILLED 3/11/15 BORING NO. B-17

GROUND ELEVATION 1,761.7'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			5/6" 6/6" 10/6"	34.7	85.8		SC	NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, sandy lean CLAY; trace gravel.
								Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 15.4 feet about 96 hours after drilling. Backfilled and patched on 3/15/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-20

DATE DRILLED 3/16/15 BORING NO. B-18

GROUND ELEVATION 1,762.3'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3-1/2 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		18/6" 22/6" 43/6"					NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY with gravel. A layer of silty gravel, a few inches thick.
5		5/6" 4/6" 4/6"	26.2	89.0			Light brown; stiff; few gravel.
10		4/6" 4/6" 5/6"	24.0	87.9		CL-ML	Light brown, moist, stiff, silty CLAY with sand; trace gravel.
15		6/6" 5/6" 6/6"	21.4	96.6			Dark brown.
			▼				Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-21

DATE DRILLED 3/16/15 BORING NO. B-18

GROUND ELEVATION 1,762.3'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		7/6" 12/6" 12/6"				CL	NATIVE SOIL (CONTINUED): Dark brown, wet, very stiff, sandy lean CLAY; few gravel.
							Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 18.4 feet about 24 hours after drilling. Backfilled and patched on 3/17/15.
							NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-22

DATE DRILLED 3/16/15 BORING NO. B-19

GROUND ELEVATION 1,761.7'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		7/6" 8/6" 8/6"	17.2	97.0			NATIVE SOIL: Brown, moist, very stiff, sandy lean CLAY; trace gravel.
							Dark brown; few gravel.
5		3/6" 2/6" 6/6"	23.4	90.4			Light brown; stiff.
10		3/6" 4/6" 9/6"	15.0	99.0			Stiff to very stiff.
						ML	Light brown, moist, stiff, SILT with sand; trace gravel.
15		6/6" 17/6" 29/6"	19.3	98.6			Very stiff.
						CL	Light brown, moist, stiff to very stiff, sandy lean CLAY; trace gravel.
			▼				Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-23

DATE DRILLED 3/16/15 BORING NO. B-19

GROUND ELEVATION 1,761.7'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		5/6" 5/6" 24/6"	35.4	78.6		CL	NATIVE SOIL (CONTINUED): Brown, wet, very stiff, sandy lean CLAY with gravel.
25		14/6" 44/6" 50/5"	37.2	80.7			Light brown; moderately hard, moderately cemented layer.
							Total Depth = 26.4 feet. Groundwater was measured at a depth of approximately 18.7 feet about 72 hours after drilling. Backfilled and patched on 3/19/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-24

DATE DRILLED 3/16/15 BORING NO. B-20

GROUND ELEVATION 1,760.5'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3-1/4 inches thick.
						CL	FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 8-1/2 inches thick.
		7/6" 11/6" 10/6"					NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY; trace gravel.
5		6/6" 5/6" 5/6"	18.2	100.2			Stiff.
							Few gravel.
10		3/6" 3/6" 4/6"	22.8	95.1			Light brown; trace gravel.
15		5/6" 9/6" 18/6"	29.3	81.9		ML	Light brown, moist, very stiff, SILT with sand.
							Few gravel.
							Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-25

DATE DRILLED 3/16/15 BORING NO. B-20

GROUND ELEVATION 1,760.5'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		4/6" 9/6" 9/6"	51.5	69.2		CL	NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, sandy lean CLAY; few gravel.
25		6/6" 32/6" 50/4"	35.3	81.4			Few gravel; moderately hard, moderately cemented layer.
30							Total Depth = 26.3 feet. Groundwater was measured at a depth of approximately 18.4 feet about 72 hours after drilling. Backfilled and patched on 3/19/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
35							
40							

DRAFT

Ninyo & Moore

BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-26

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory excavations in Appendix A.

In-Place Moisture and Density

The moisture content and dry density of ring-lined samples obtained from the exploratory excavations were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory excavations in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. These test results were utilized in evaluating the soil classifications in accordance with the USCS. The grain-size distribution curves are shown on Figure B-1 through Figure B-10.

Atterberg Limits

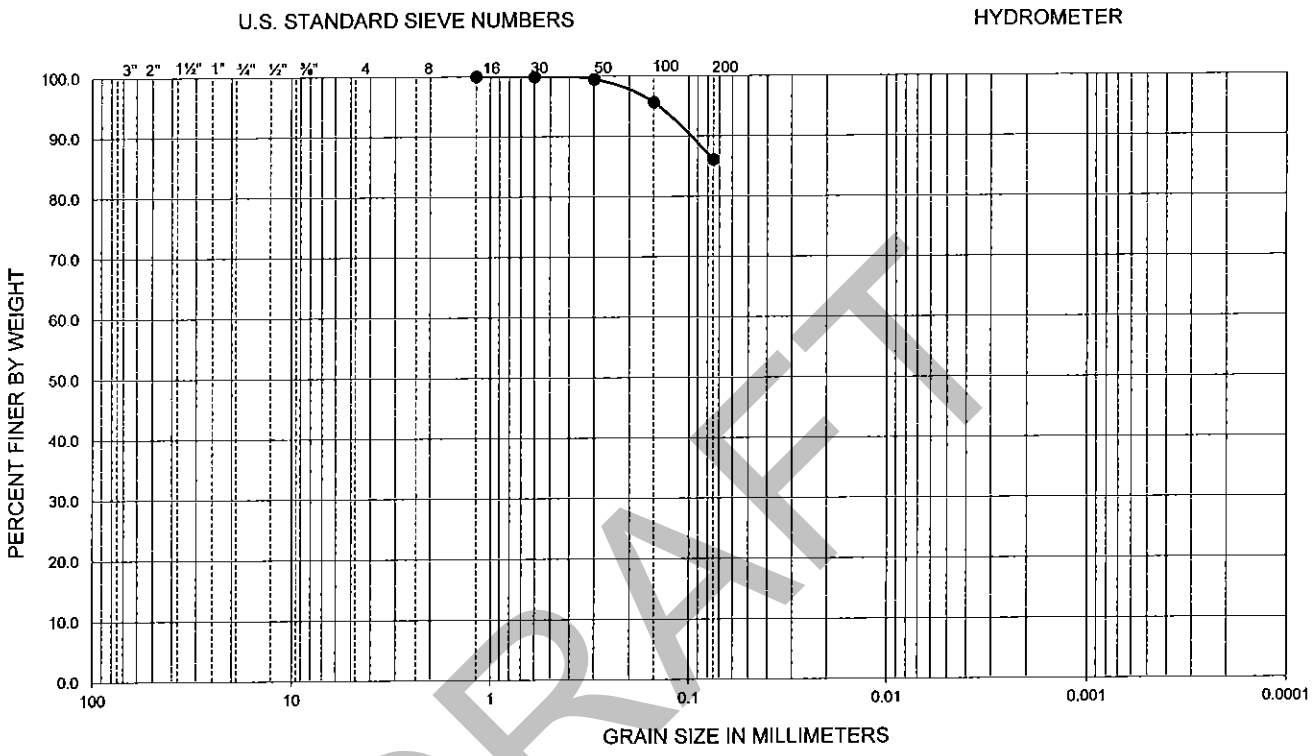
Tests were performed on selected representative soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. These test results were utilized to evaluate soil classification in accordance with the USCS. The test results and classifications are shown on Figure B-11 and Figure B-12.

Expansion Index

The expansion index of selected materials was evaluated in general accordance with ASTM D 4829. Specimens were molded under a specified compactive energy at approximately 50 percent saturation. The prepared 1-inch thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The results of these tests are presented on Figure B-13.

DRAFT

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-1	5.0-6.5	64	22	42	--	--	--	--	--	86.1	CH

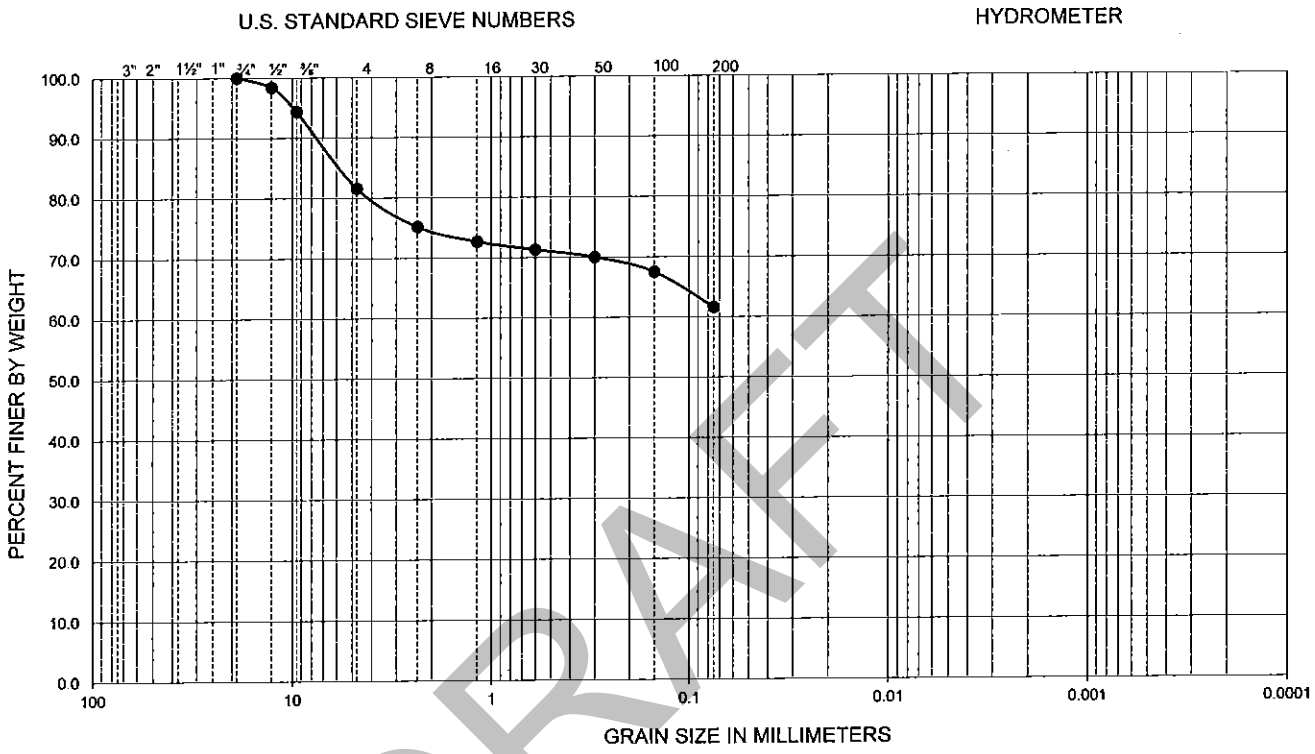
Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Fat CLAY
0.0	13.9	86.1	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-1
303710001 / 4/15		

B-1 (303710001 SV B-1@5.0-6.5)

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-3	2.0-3.5	52	18	34	--	--	--	--	--	61.6	CH

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Sandy fat CLAY with gravel
18.4	20.0	61.6	

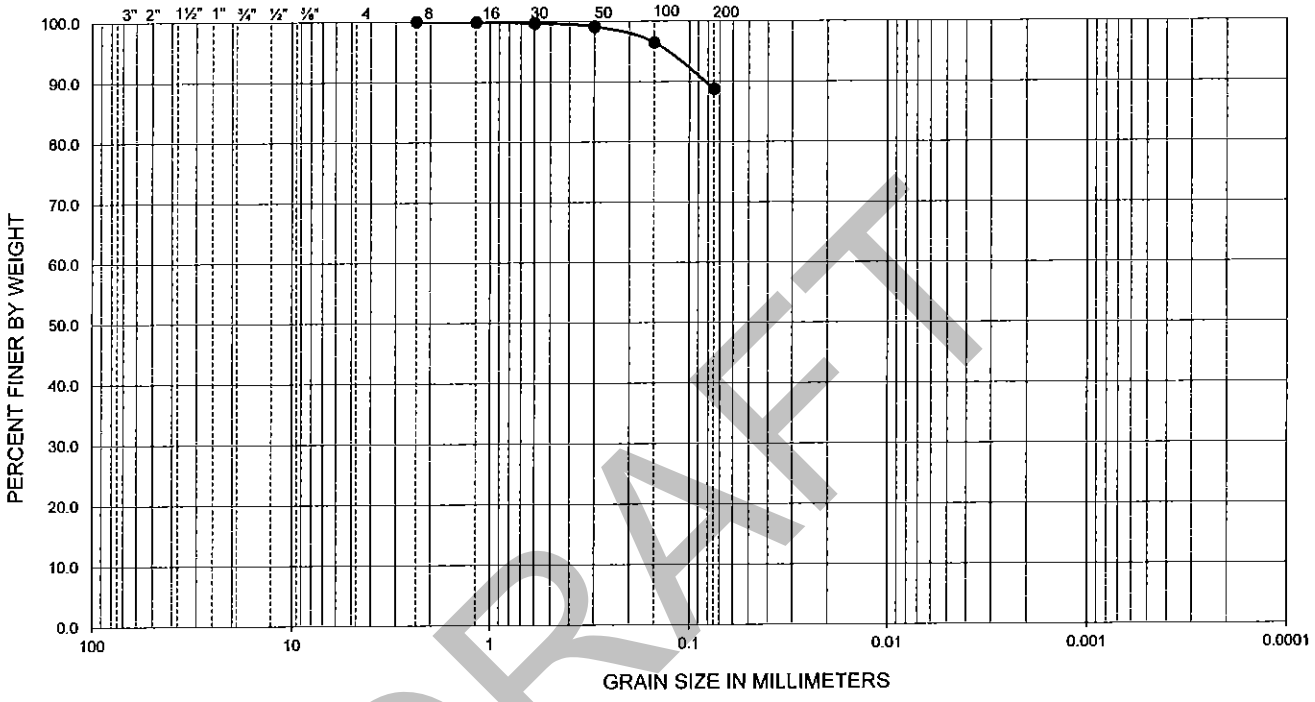
NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-2
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-5	2.0-3.5	58	27	31	--	--	--	--	--	88.8	CH

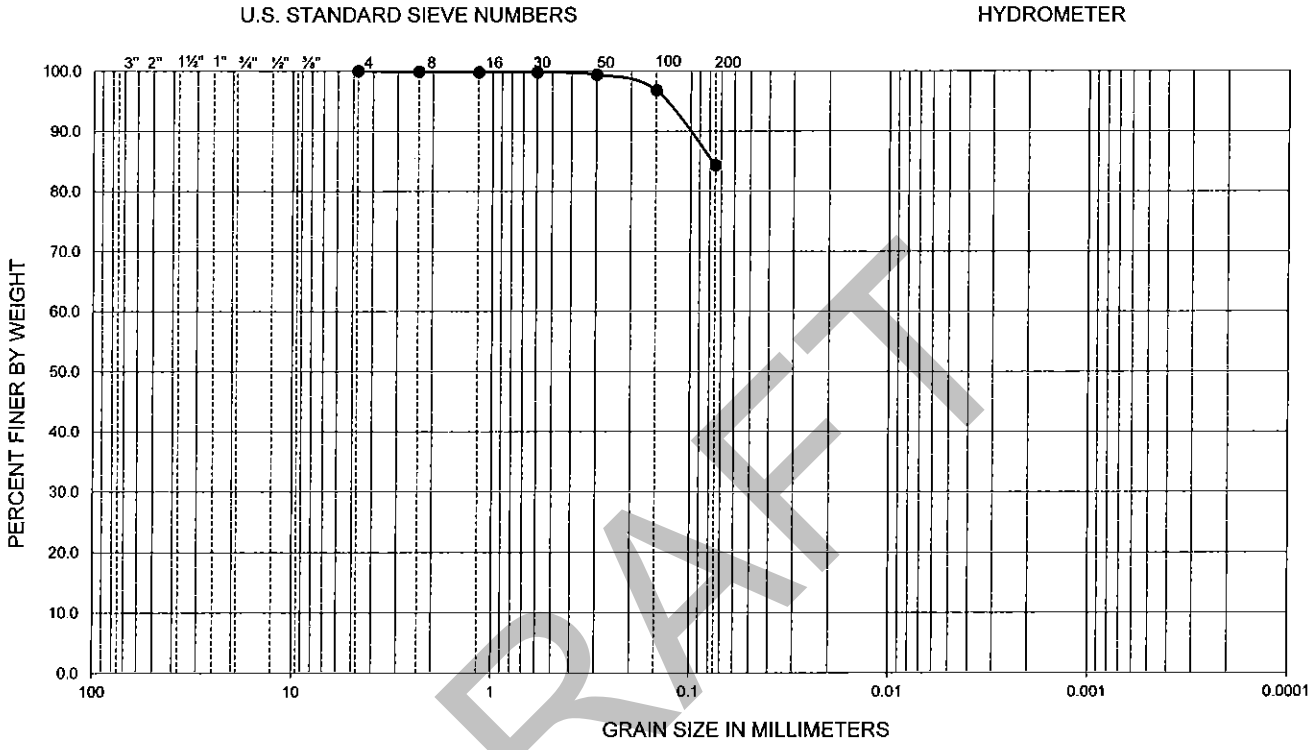
Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Fat CLAY
0.0	11.2	88.8	

NOTE:

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-3
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

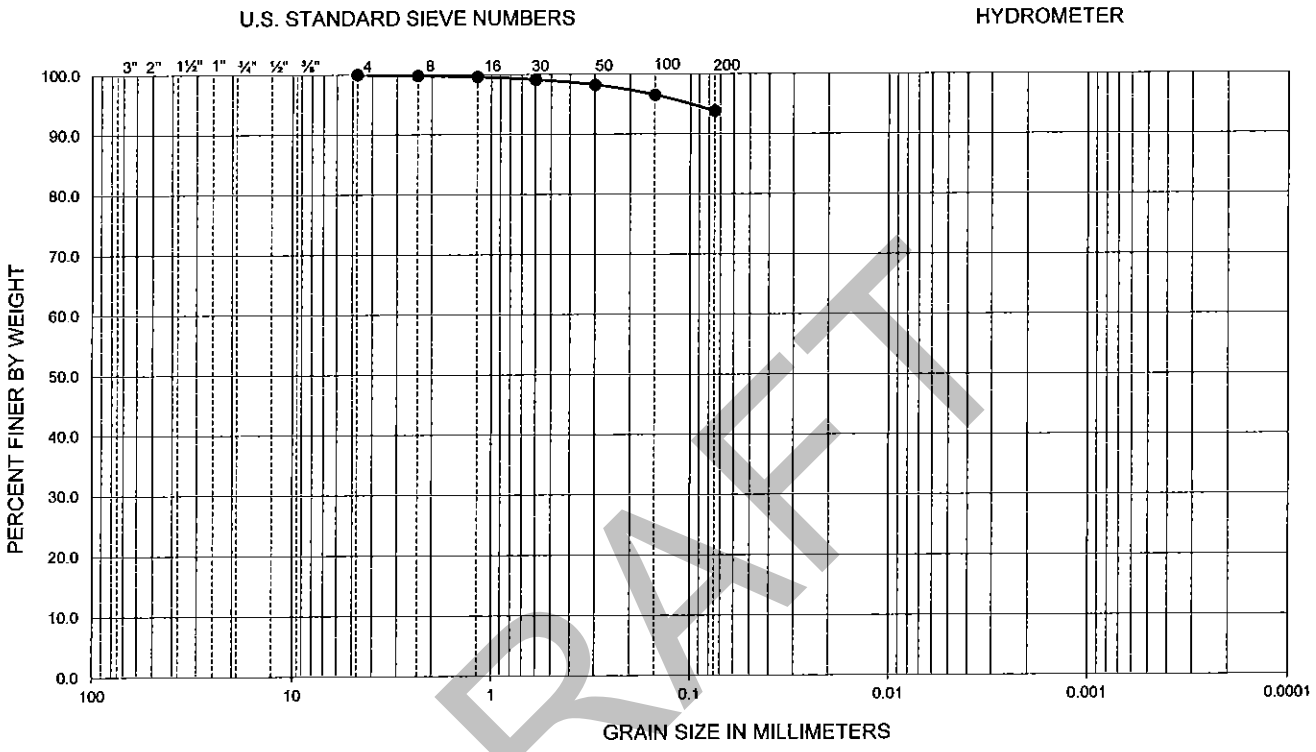
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-6	5.0-6.5	43	20	23	--	--	--	--	--	84.3	CL

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY with sand
0.0	15.7	84.3	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-4
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

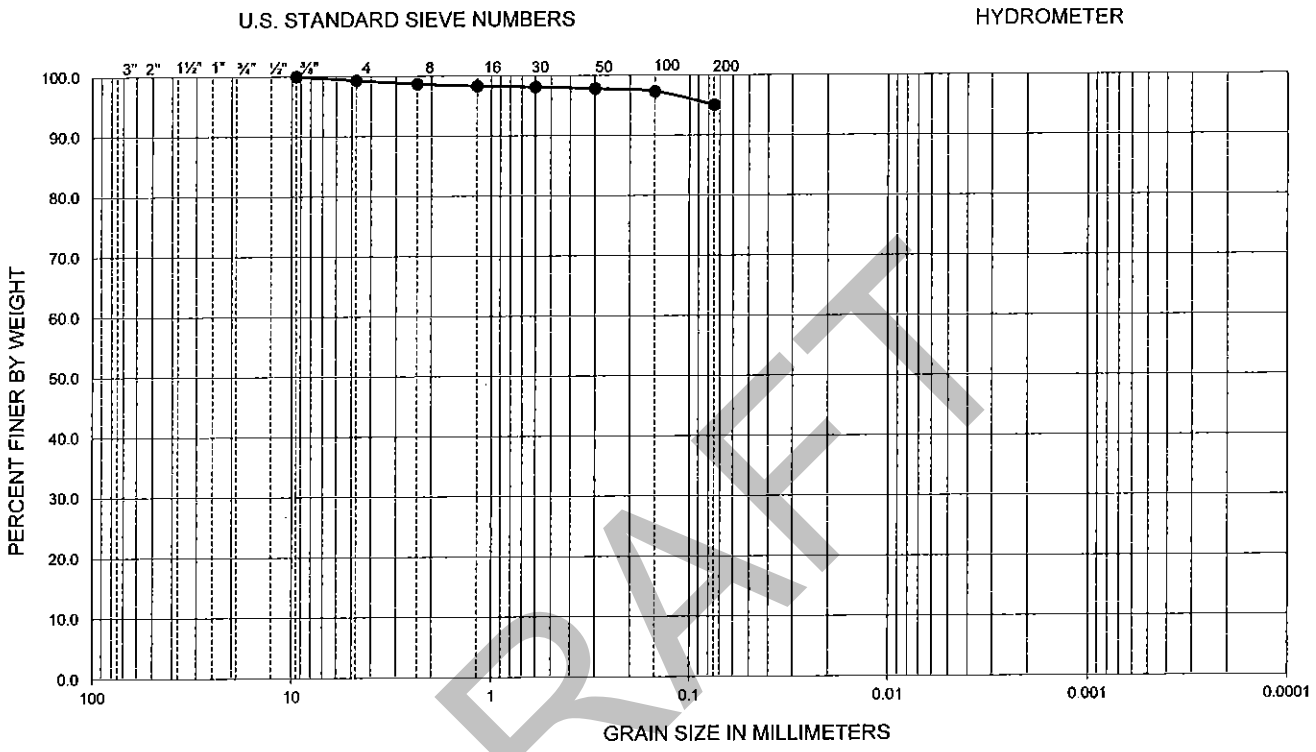
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-9	5.0-6.5	38	21	17	--	--	--	--	--	93.8	CL

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY
0.0	6.2	93.8	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-5
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-12	5.0-6.5	24	16	8	--	--	--	--	--	95.0	CL

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY
0.7	4.3	95.0	

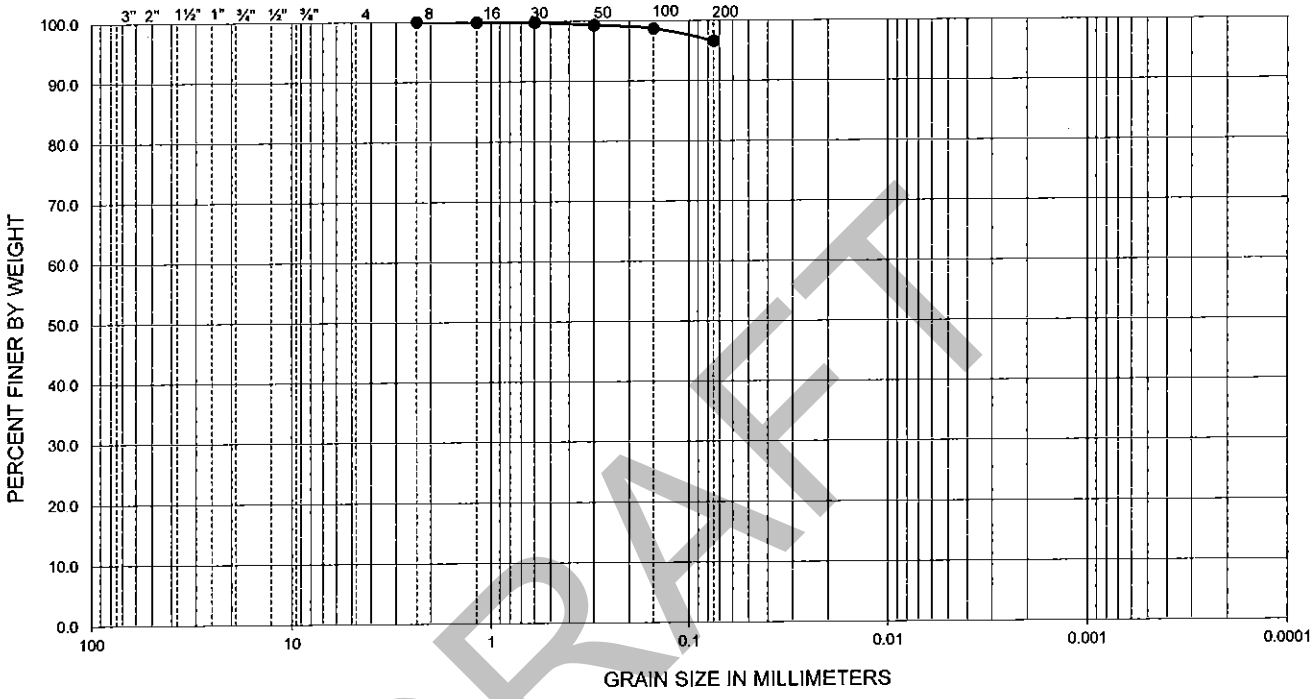
NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-6
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-14	5.0-6.5	31	19	12	--	--	--	--	--	96.6	CL

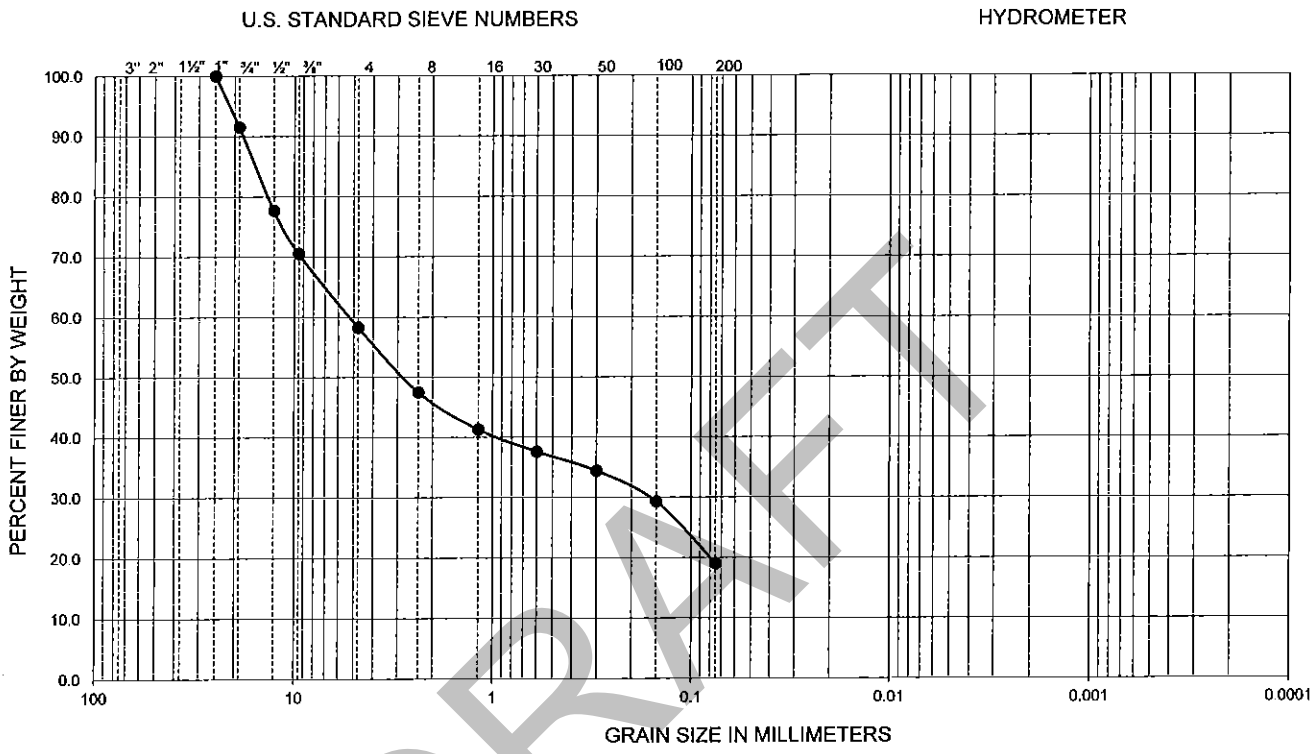
Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY
0.0	3.4	96.6	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-7
303710001 / 4/15		

B-7 (303710001 SV B-14@5.0-6.5)

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

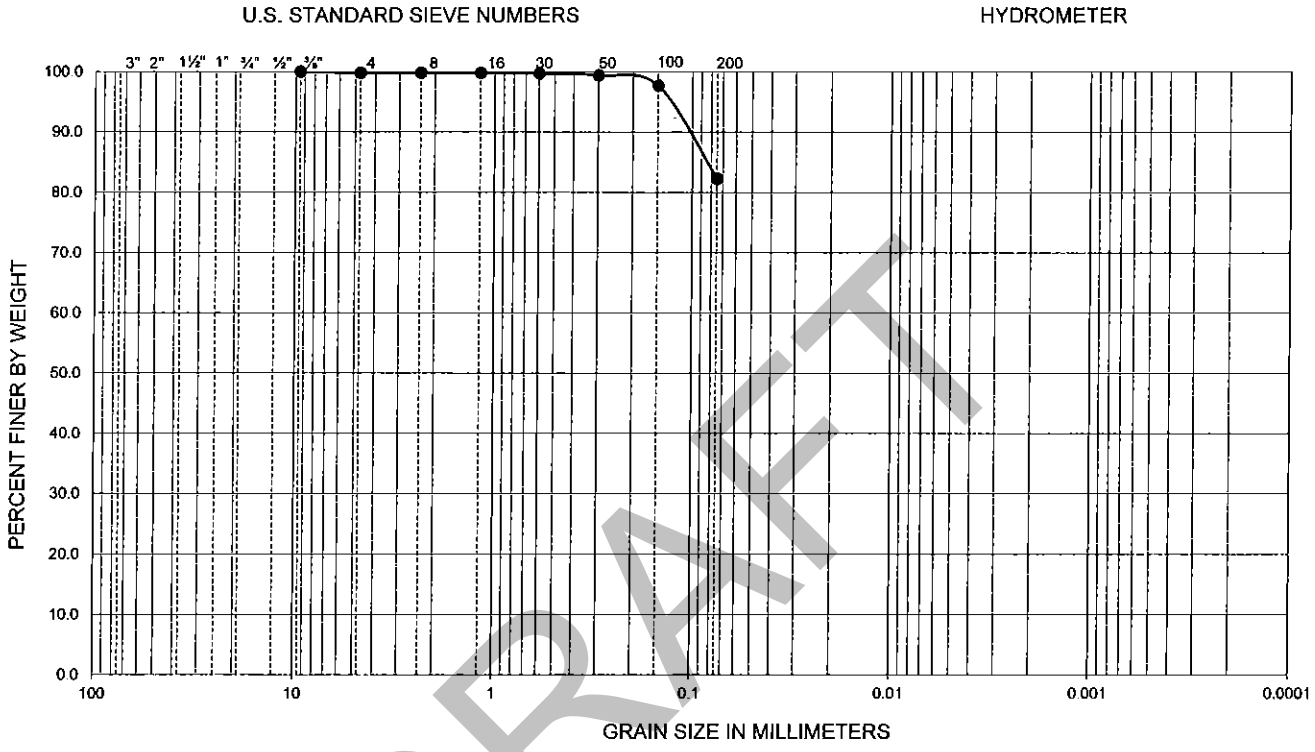
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-17	5.0-6.5	46	32	14	--	0.16	5.23	--	--	19.0	GM

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Silty GRAVEL with sand
41.7	39.3	19.0	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-8

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

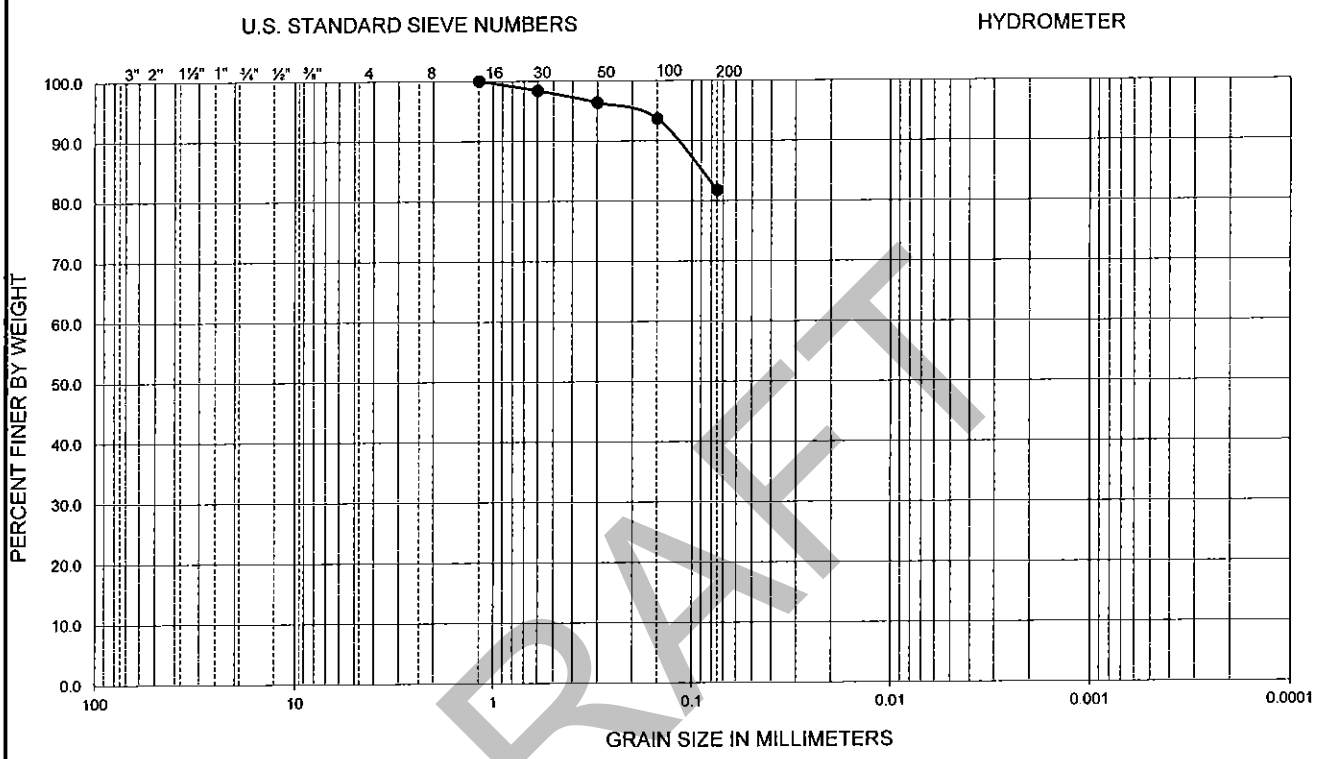
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-18	10.0-11.5	27	20	7	--	--	--	--	--	82.3	CL-ML

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Silty CLAY with sand
0.2	17.5	82.3	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-9
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-20	15.0-16.5	48	28	20	--	--	--	--	--	81.8	ML

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	SILT with sand
0.0	18.2	81.8	

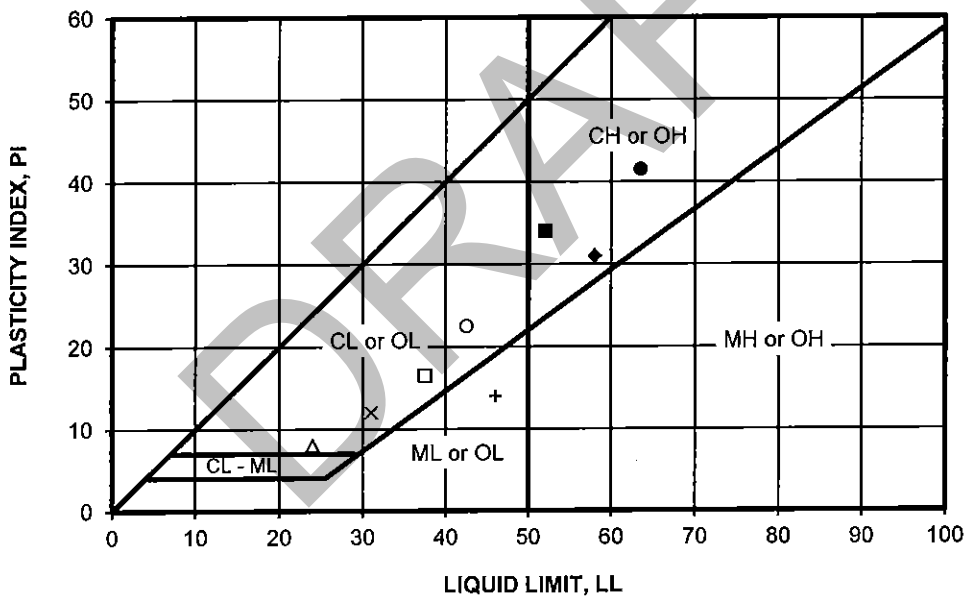
NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-10

B-10 (303710001 SV B-20@15.0-16.5)

SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-1	5.0-6.5	64	22	42	CH	CH
■	B-3	2.0-3.5	52	18	34	CH	CH
◆	B-5	2.0-3.5	58	27	31	CH	CH
○	B-6	5.0-6.5	43	20	23	CL	CL
□	B-9	5.0-6.5	38	21	17	CL	CL
△	B-12	5.0-6.5	24	16	8	CL	CL
X	B-14	5.0-6.5	31	19	12	CL	CL
+	B-17	5.0-6.5	46	32	14	ML	GM

NP - INDICATES NON-PLASTIC



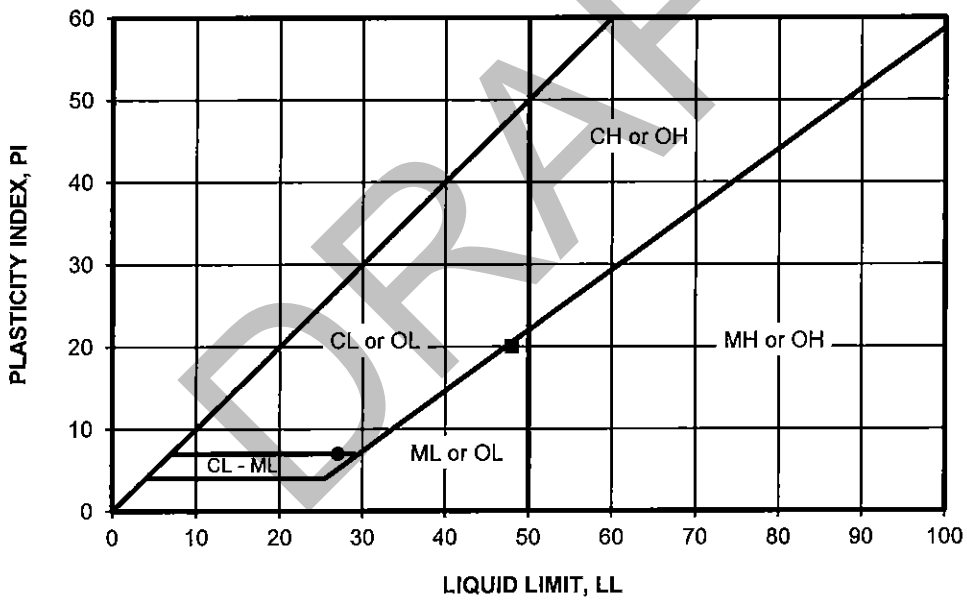
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

DRAFT

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-11

SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-18	10.0-11.5	27	20	7	CL-ML	CL-ML
■	B-20	15.0-16.5	48	28	20	ML	ML

NP - INDICATES NON-PLASTIC



DRAFT

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-12

SAMPLE LOCATION	SAMPLE DEPTH (FT)	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (PCF)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (IN)	EXPANSION INDEX	POTENTIAL EXPANSION
B-1	5.0-6.5	13.0	97.6	37.4	0.140	140	Very High
B-3	2.0-3.5	11.0	106.0	32.6	0.130	130	High
B-6	5.0-6.5	13.0	97.4	31.0	0.086	86	Medium
B-9	5.0-6.5	11.5	103.2	27.8	0.075	75	Medium
B-12	5.0-6.5	13.0	97.9	19.3	0.054	54	Medium
B-16	5.0-6.5	11.0	104.3	23.0	0.041	41	Low
B-18	10.0-11.5	12.0	103.4	23.7	0.042	42	Low
B-20	15.0-16.5	14.5	94.1	37.9	0.083	83	Medium

PERFORMED IN GENERAL ACCORDANCE WITH ☐ UBC STANDARD 18-2 ☐ ASTM D 4829

DRAFT

Ninyo & Moore	EXPANSION INDEX TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-13

APPENDIX C

CHEMICAL TEST RESULTS

The results of chemical tests performed are provided in this appendix.

DRAFT

SilverState Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-1A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-1 @ 10.0-11.5'

Analysis	Result	Unit	Method
Sodium	0.05	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.02	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.03	%	Calculation
Total Salts (Solubility)	0.35	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-2A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-3 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.03	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.02	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.03	%	Calculation
Total Salts (Solubility)	0.15	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-3A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-5 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.04	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.03	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.04	%	Calculation
Total Salts (Solubility)	0.18	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

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Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-4A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-8 @ 2.0-3.5'

Analysis	Result	Unit	Method
Sodium	0.26	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.20	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.30	%	Calculation
Total Salts (Solubility)	1.24	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-5A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-10 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.42	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.47	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.70	%	Calculation
Total Salts (Solubility)	1.86	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-6A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-13 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.41	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.24	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.35	%	Calculation
Total Salts (Solubility)	1.69	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-7A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-15 @ 2.0-3.5'

Analysis	Result	Unit	Method
Sodium	0.26	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.32	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.47	%	Calculation
Total Salts (Solubility)	1.55	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-8A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-17 @ 2.0-3.5'

Analysis	Result	Unit	Method
Sodium	0.07	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.23	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.23	%	Calculation
Total Salts (Solubility)	0.92	%	SM2540B

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NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-9A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-20 @ 10.0-11.5'

Analysis	Result	Unit	Method
Sodium	0.19	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.15	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.22	%	Calculation
Total Salts (Solubility)	0.90	%	SM2540B

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NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

APPENDIX D

EXPLORATORY BORING LOGS FROM OUR PREVIOUS EVALUATION

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. The pertinent boring logs (borings B-108 and B-109) from this evaluation are presented in this appendix.

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DATE DRILLED 6/28/13 BORING NO. B-108

GROUND ELEVATION Not Measured SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lb (auto. trip hammer) DROP 30"

SAMPLED BY RDB LOGGED BY RDB REVIEWED BY BLO

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOW COUNTS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8-3/4 to 9 inches thick.
						GP-GM	FILL MATERIAL: Brown, damp, medium dense, poorly graded GRAVEL with silt and sand (Base Material);
						SP-SM	unit is approximately 5 inches thick.
						CL	Brown, damp, medium dense, poorly graded SAND with silt and gravel.
		9/6" 12/6" 14/6"	19.7	100.8			NATIVE SOIL: Brown, moist, very stiff, sandy lean CLAY; slightly gypsiferous.
5		7/6" 13/6" 22/6"	29.0	90.5			
						GC	Light brown, moist, dense, clayey GRAVEL; few sand; slightly gypsiferous.
10		11/6" 12/6" 18/6"	37.9	78.2			
15		10/6" 9/6" 9/6"	35.0	79.9			Few white caliche nodules.
20							Total depth = 16.5 feet. Groundwater not encountered during drilling. Backfilled and patched on 06/28/13.

NOTE:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

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BORING LOG

BONANZA-MOJAVE REUSE PIPELINE, FREEDOM PARK TO SLOAN LANE
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303599001	10/13	A-8

DATE DRILLED 6/19/13 BORING NO. B-109

GROUND ELEVATION Not Measured SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lb (auto. trip hammer) DROP 30"

SAMPLED BY RDB LOGGED BY RDB REVIEWED BY BLO

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOW COUNTS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8-1/4 to 8-1/2 inchest thick.
						GP-GM	FILL MATERIAL: Brown, damp, medium dense, poorly graded GRAVEL with silt and sand (Base Material); unit is approximately 7 inches thick.
						SP-SM	Brown, damp, medium dense, poorly graded SAND with silt and gravel.
		10/6" 5/6" 10/6"	25.5	94.7		CL	NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY.
5		3/6" 4/6" 6/6"	30.5	87.6			Stiff.
						GC	Light brown; moist; medium dense, clayey GRAVEL; few sand.
10		3/6" 5/6" 8/6"	16.2	103.8			
15		7/6" 10/6" 10/6"	17.8	106.4			Dense.
							Total depth = 16.5 feet. Groundwater not encountered during drilling. Backfilled and patched on 06/19/13.
20							NOTE: Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other fators as discussed in the report.

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Ninyo & Moore

BORING LOG

BONANZA-MOJAVE REUSE PIPELINE, FREEDOM PARK TO SLOAN LANE
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303599001	10/13	A-9

GEOTECHNICAL INTERPRETIVE REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

DRAFT

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 10, 2015
Project No. 303710001

April 10, 2015
Project No. 303710001

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074-7755

Subject: Geotechnical Interpretive Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith is the Geotechnical Interpretive Report, which is based on the results of Ninyo & Moore's geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide design and construction recommendations regarding geotechnical aspects of the project. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

DRAFT

Naik Banavathu, P.E.
Principal Engineer

Brad L. Olsen, PE
Principal Engineer

NB/BLO/dh

Distribution: (1) Addressee (via e-mail)

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Appendix A – Exploratory Boring Logs
Appendix B – Laboratory Testing
Appendix C – Chemical Test Results
Appendix D – Exploratory Boring logs From Our Previous Evaluation

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1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide design and construction recommendations regarding geotechnical aspects of the project. This report presents the findings of our subsurface exploration, results of our laboratory testing, conclusions regarding the subsurface soil conditions along the alignment, and geotechnical recommendations for the design and construction of this project.

This study was performed concurrently with a hydrogeologic study, also performed by Ninyo & Moore. A report presenting the results of our hydrogeologic study will be submitted under separate cover.

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. This evaluation included preparation of a geotechnical interpretive report. Data from this report, including two exploratory borings (B-108 and B-109) that were performed along Pecos Road approximately between Stewart Avenue and Bonanza Road, were used to the extent possible for this evaluation.

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2. SCOPE OF SERVICES

The scope of our services included the following:

- Review of pertinent background data listed in the References section of this report. The data reviewed included drawings, in-house geotechnical and soils data, aerial photographs, and published soils and geologic maps and literature.
- Coordination and mobilization for subsurface exploration. Markout of existing utilities in areas of our exploratory borings was conducted through Underground Service Alert (USA).

- Drilling, logging, and sampling of 20 exploratory borings, which were advanced to depths ranging from approximately 10 to 25 feet. The borings were performed to evaluate subsurface conditions along the proposed alignment and to obtain soil samples for laboratory testing.

- Performance of laboratory tests on selected soil samples obtained from the exploratory borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts).

- Compilation and analysis of accumulated data.

- Preparation of this geotechnical interpretive report presenting our findings, conclusions, and recommendations regarding the subject project.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

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4. GENERAL ALIGNMENT CONDITIONS

The proposed alignment will extend along portions of Pecos Road and existing Cedar Avenue Channel ROW. At the time of our geotechnical reconnaissance, Pecos Road extended in a north-to-south direction and was generally bordered by residential properties to the east and a golf course to the west. The existing concrete-lined trapezoidal channel extended in an east-to-west direction and was generally bordered by residential properties to the north and south. An elementary school was located to the south of the channel near the Lamb Boulevard crossing and north of the channel near Page Street crossing. Chain-link fencing and concrete block screen walls were located on the north and south sides of the channel.

The existing channel was up to approximately 30 feet wide and up to approximately 10 feet deep. An asphalt-concrete paved trail, up to approximately 15 feet wide, was located to the north of the existing channel. The existing trail is at an elevation of approximately 1,792 feet above mean sea level (AMSL) near Pecos Road and at an elevation of approximately 1,760 feet AMSL near Las Vegas Wash. Water, several inches deep, was observed flowing in the channel bottom. The existing channel crosses under numerous streets, including Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive. At the time of our geotechnical reconnaissance, all these streets were paved with asphalt concrete and extended in a north-south direction. All these streets in the vicinity of the project alignment were fully improved with curb, gutter, and sidewalks. Honolulu Street and Page Street included one lane each way, Marion Drive and Sandhill Road included one lane each way with a turn lane, and Lamb Boulevard included three lanes each way with a two-way left turn lane

Indications of underground utilities observed in the vicinity of the alignment included gas, water, storm drain, and electric lines. Other underground utilities may be present in the vicinity of the project.

5. GEOLOGY

Based on our field observations, subsurface exploration, and review of referenced geologic and soils data, the project alignment is underlain primarily by relatively shallow fill, which is in turn

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underlain by Quaternary-age alluvium (native soil). Ninyo & Moore's findings regarding the geologic setting, potential geologic hazards and problematic soils, and ground motions are provided in the following sections.

5.1. Geologic Setting

The project alignment is located in the eastern portion of Las Vegas Valley, which lies in the southwestern portion of the Great Basin, within the Basin and Range physiographic province. Las Vegas Valley is a naturally formed structural basin as a result of block faulting, a fundamental characteristic of the Basin and Range physiographic province.

Las Vegas Valley extends in a northwest-southeast direction and drains generally toward the southeast through Las Vegas Wash into Lake Mead. Bordering the alluvium-filled valley are relatively steep mountain ranges, including the Spring Mountains to the west; the Desert, Sheep, and Las Vegas ranges to the north; the McCullough Range to the south; and Sunrise Mountain, Frenchman Mountain, and River Mountains to the east.

Las Vegas Valley is underlain at depth by Proterozoic-age igneous and metamorphic basement rock, which is overlain by thick layers of Paleozoic- and Mesozoic-age sedimentary rock, and Tertiary-age volcanic rock. The lower lying areas of Las Vegas Valley generally contain relatively fine-grained alluvial, aeolian, and playa deposits. Extending outward into the valley from the bordering mountain fronts, are sloping alluvial aprons, or fans, comprised primarily of poorly sorted gravel and sand deposits with cobbles and boulders. The soils are up to approximately 5,000 feet thick in some areas of the valley.

5.2. Potential Geologic Hazards and Problematic Soils

Ninyo & Moore's geotechnical study included an evaluation of the possible presence of geologic hazards, such as faults and ground fissures, in the project alignment area. This evaluation included visual observation of the alignment for indications of adverse geologic features and review of published geologic and soils maps and literature, and other data listed in the References section of this report. Referenced geologic data were also reviewed to evaluate seismic activity levels, and

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associated potential earthquake hazards, for faults in the alignment vicinity. It should be noted that the fault seismic activity levels provided in this section were obtained/interpreted primarily from United States Geological Survey (USGS, 2015b) data.

Review of referenced geologic data indicates that the nearest active fault (i.e., a fault that has experienced ground surface rupture within the past 11,000 years) to the alignment is the Black Hills fault. The Frenchman Mountain fault and the Eglington fault, which are considered potentially active (i.e., faults that have experienced ground surface rupture within the past 1.6 million years) are also located in the alignment vicinity. The distances from the alignment to these active and potentially active faults are provided in Table 1.

Review of referenced geologic data also indicates that an unnamed Las Vegas Valley fault extends through the western portion of the alignment (Figure 2). Referenced USGS data indicate that this fault is of uncertain origin and that its seismic activity level has not been established. During our geologic field reconnaissance along the project alignment, surficial indications of previous faulting were not observed. The origin of this geologic feature, and other similar features in southern Nevada, which have been previously referred to as "compaction faults." Differing proposed origins for these faults include:

- Differential consolidation or compaction over time of the thick alluvial and lakebed sediments in valley areas.
- Tectonic factors associated with faults that may extend into the basement bedrock beneath the valley sediment.
- A combination of differential consolidation and tectonic factors.

Table 1 – Faults in Project Alignment Vicinity

Fault Name	Seismic Activity Level *	Approximate Distance From Project Alignment to Fault (miles)
Black Hills fault	Active	16
Eglington fault	Potentially Active	8
Frenchman Mountain fault	Potentially Active	3
Unnamed Las Vegas Valley fault	Not Established	Extends through alignment (see Figure 2)
*From United States Geological Survey (USGS, 2015b) data.		

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Ground fissures, generally believed to be caused by erosion and differential stress resulting from regional subsidence due primarily to withdrawal of groundwater, are known to occur near faults in southern Nevada. Review of the referenced geologic data does not indicate the presence of ground fissures along the project alignment and no ground fissures were observed during our field activities. However, it should be noted that the ground surface had been disturbed/obscured by previous development.

As part of this study, Ninyo & Moore evaluated whether the project alignment is located in a Special Geotechnical Considerations Area, as shown on the referenced Clark County Soil Guidelines Map (Clark County Building Department, 1998). This map indicates important aspects of near-surface soils and geologic features in the Las Vegas Valley. Review of the Clark County Soil Guidelines Map indicates that the portion of the project alignment between Stewart Avenue and Sandhill Road is located in a *Special Geotechnical Considerations Area - Subsidence and 2,000-Foot Compaction or Seismic Fault Buffer Zone*. This buffer zone is considered to contain 90 percent of mapped ground fissures. These potential ground fissure areas extend approximately 1,000 feet to each side of faults. The portion of the project alignment between Sandhill Road and Marion Drive is located in a *Special Geotechnical Considerations Area - Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*: This area is indicative of potentially moisture-sensitive and corrosive soils. The portion of the alignment located between Marion Drive and Las Vegas Wash is located in a *Special Geotechnical Considerations Area - Potential Drainage Areas or Recent Sediment Deposits, which may also have Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*. This area is in the vicinity of major drainages and may also contain potentially moisture-sensitive and corrosive soils.

The Clark County Expansive Soil Guidelines Map (Clark County Development Services Department, 2006) indicates general trends of near-surface soils in the Las Vegas Valley. This map shows areas of the valley where previous geotechnical studies have indicated the presence of moderately, highly, and critically expansive soils. Based on review of this map, the portion of the project alignment between Stewart Avenue and Honolulu Street is located

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in an area prone to moderately expansive soil and the remaining portion of the alignment is located in an area prone to highly expansive soil.

5.3. Ground Motions

Using the referenced United States Geological Survey database (USGS, 2015a), estimated maximum considered earthquake spectral response accelerations for short (0.2 second) and long (1.0 second) periods were obtained for the project alignment, which is located at approximately 36.1699 degrees north latitude and -115.0891 degrees west longitude. Based on the referenced International Building Code (ICC, 2012) and due to a detailed seismic site class evaluation not being performed for the project, Seismic Site Class D is appropriate for the project alignment and the parameters in the following table are characteristic of the project alignment for design purposes.

Table 2 – Seismic Design Parameters

Parameters	Value		Reference (ICC, 2012)
	Short Period	Long Period	
Mapped Maximum Considered Earthquake Spectral Response Acceleration, S_S and S_1	0.495g	0.164g	Figure 1613.3.1 and referenced database (USGS, 2015a)
Site Coefficient, F_a and F_v	1.40	2.14	Table 1613.3.3
Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Class Effects, S_{MS} and S_{M1}	0.695g	0.352g	Equations 16-37 and 16-38
Design Spectral Response Acceleration, S_{DS} and S_{D1}	0.463g	0.235g	Equations 16-39 and 16-40

6. FIELD EXPLORATION, LABORATORY TESTING, AND SUBSURFACE CONDITIONS

Ninyo & Moore's subsurface exploration along the project alignment was performed from March 5 through March 16, 2015. This exploration consisted of drilling, logging, and sampling of 20 small-diameter exploratory borings. The borings were advanced to depths ranging from approximately 10 to 25 feet with a truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The purpose of the borings was to evaluate subsurface conditions

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along the project alignment, as well as to collect bulk and relatively undisturbed soil samples for laboratory testing. The approximate locations of the borings along with the pertinent borings from the other study previously discussed are shown on Figure 2.

Laboratory tests were performed on representative soil samples collected from the borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts). The results of the in-place moisture content and dry density tests are provided on the boring logs in Appendix A. Ground surface elevations at boring locations surveyed by Atkins personnel are also provided on the boring logs. Descriptions of the laboratory testing procedures utilized and the other test results are presented in Appendix B and Appendix C.

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6.1. Subsurface Soils Encountered

Generalized descriptions of the subsurface soils (fill and native soil) encountered in the exploratory borings are provided in the following sections.

6.1.1. Fill

Fill material, up to approximately 1.8 feet deep, was encountered in our exploratory borings. In addition, fill material approximately 7.0 feet deep was encountered in boring B-17. The encountered fill soils were comprised primarily of medium dense to dense, silty gravel with sand. A dense, clayey sand with gravel layer was also encountered in boring B-17. Much of the fill encountered in our borings was likely associated with channel sidewall backfill and/or roadway fill material.

Asphalt concrete pavement and underlying aggregate base material was penetrated in all of our 20 borings drilled during our subsurface evaluation for the subject project. The approximate thicknesses of asphalt concrete and underlying aggregate base material encountered in these borings are summarized in the following table.

Table 3 – Existing Asphalt Concrete Pavement and Aggregate Base Thicknesses

Boring	Approximate Thickness of Asphalt Concrete (inches)	Approximate Thickness of Aggregate Base Material (inches)
B-1	9-1/8	12 to 13
B-2	2	3-1/2
B-3	2	4-1/2
B-4	2-1/2	5-1/2
B-5	1-1/2	5-1/2
B-6	1-7/8	5
B-7	2-1/2	4
B-8	2-1/2	4
B-9	2-3/4	4
B-10	2-1/2	5-1/2
B-11	3	4
B-12	2-7/8	5-1/2
B-13	2-3/4	4-1/2
B-14	2-5/8	4-3/4
B-15	2-1/2	11
B-16	2-1/2	12 to 13
B-17	2-5/8	12 to 13
B-18	3-1/2	12 to 13
B-19	3	12 to 13
B-20	3-1/4	8-1/2
B-108*	8-3/4	5
B-109*	8-1/4	7
* Boring from previous evaluation		

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6.1.2. Native Soil

Native soil was encountered beneath the noted fill and extended to the total depths of our exploratory borings. The encountered native soil consisted primarily of firm to very stiff lean clay and fat clay with varying amounts of sand and gravel. An approximately 5-foot thick layer of stiff to very stiff silt with sand was encountered at a depth of approximately 12 and 15 feet in borings B-19 and B-20, respectively.

Layers of hard to very hard, strongly cemented soil (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Caliche is a naturally occurring cemented soil with rock-like characteristics. The following describes typical properties of caliche encountered in southern Nevada.

- Generally occurs in layers a few inches to several feet thick.

- Layers typically vary significantly in thickness, degree of cementation, and hardness over relatively short distances.
- Varies in composition from primarily fine-grained material to primarily coarse-grained material.
- Moderately hard, moderately cemented caliche can generally be gouged with a knife with difficulty and broken with a few hammer blows.
- Hard and very hard, strongly cemented caliche is difficult to scratch with a knife and breaks with difficulty with repeated hammer blows.
- Impedes earthwork operations, including grading and utility line trenching. Rock excavation methods are generally needed.

Laboratory tests were performed on representative samples of native soil obtained from the exploratory borings. Results of these tests are summarized in the following table.

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Table 4 – Summary of Laboratory Test Results

Test Type	Test Results	Remarks
Atterberg Limits Liquid Limit Plastic Limit Plasticity Index	 24 to 64 16 to 32 7 to 42	Low to high plasticity
Expansion Index	41 to 140	Low to very high
Sodium Sulfate Content	0.03 to 0.70 percent	Negligible to moderate chemical heave (salt heave) potential
Sodium Content	0.03 to 0.42 percent	--
Sulfate Content	0.02 to 0.47 percent	Negligibly to severely deleterious to concrete
Total Salts (Solubility)	0.15 to 1.86 percent	Low to high solubility potential

6.2. Selected and Granular Backfill Suitability

As a part of this study, Ninyo & Moore evaluated the suitability of encountered soils for use as trench backfill material. Clark County gradation and plasticity requirements (Clark County, 2003) for Selected and Granular Backfill (USSPWC Sections 207.02.01 and 207.02.02, respectively), along with the results of gradation and Atterberg limits tests performed by Ninyo & Moore, are presented in the following table.

Table 5 – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-1 5.0-6.5	B-3 2.0-3.5	B-5 2.0-3.5	B-6 5.0-6.5	B-9 5.0-6.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	82	100	100	100
No. 16	--	25-100	100	73	100	100	100
No. 200	--	5-15	86.1	61.6	88.8	84.3	93.8
Plasticity Index	15 max	15 max.	42	34	31	23	17
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

Table 5 (continued) – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-12 5.0-6.5	B-14 5.0-6.5	B-17 5.0-6.5	B-18 10.0-11.5	B-20 15.0-16.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	100	58	99	100
No. 16	--	25-100	98	100	41	99	100
No. 200	--	5-15	95.0	96.6	19.0	82.3	81.8
Plasticity Index	15 max	15 max.	8	12	14	7	20
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

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6.3. Groundwater

Groundwater was encountered in 12 of our 20 exploratory borings. Borings B-1, B-2, B-6, and B-20 were converted to temporary monitoring wells for the hydrogeologic study. The approximate depths to groundwater levels measured in the exploratory borings are presented in the following table. Depths to groundwater are also included on the boring logs in Appendix A.

Table 6 – Measured Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Approximate Time Measured After Drilling (days)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)
B-1	1,795.4	3	12.2	1,783.2
B-2	1,791.6	4	12.7	1,778.9
B-3	1,783.9	1	8.2	1,775.7
B-4	1,781.9	1	8.4	1,773.5
B-5	1,779.6	4	6.9	1,772.7
B-6	1,778.2	4	8.4	1,769.8
B-10	1,772.5	4	13.6	1,758.9
B-16	1,764.1	4	13.6	1,750.5
B-17	1,761.7	4	15.4	1,746.3
B-18	1,762.3	1	18.4	1,743.9
B-19	1,761.7	3	18.7	1,743.0
B-20	1760.5	3	18.4	1,742.1

*Measured from top of ground surface (top of channel bank) adjacent to boring.

Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this study.

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7. FINDINGS AND CONCLUSIONS

Based on the findings of this study, there are no known geotechnical or geologic conditions that would preclude construction of the proposed project, provided the recommendations presented herein are implemented and appropriate construction practices are followed. Geotechnical design and construction considerations for the proposed project include the following:

- Based on the results of our field and laboratory evaluation, it is our opinion that proposed improvements may be founded on medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils).

- Groundwater was measured at relatively shallow depths in our borings. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Therefore, potentially unstable and pumping subgrade conditions should be anticipated in excavation bottoms.

- Based on the results of our subsurface evaluation, we anticipate that groundwater will be encountered at or above the invert elevation along the project alignment. Accordingly, dewatering utilizing sump pumps, well points, and/or other appropriate dewatering methods will likely be needed to facilitate construction operations. During dewatering, existing structures within the limits of the resulting drawdown may be at risk of experiencing settlement. Therefore, existing structures should be monitored for possible movement associated with the dewatering operations.

- Fill material was encountered to a depth of up to approximately 1.8 feet in the exploratory borings. In addition, approximately 7 feet of fill encountered was encountered in boring B-17. This fill material is likely associated with channel sidewall backfill material. Contractors for this project should anticipate that fill will be encountered during excavation operations. The full depth of any undocumented fill material, and any loose, disturbed, or otherwise unsuitable soil should be removed from beneath proposed improvement areas and replaced with structural fill and/or appropriate backfill.

- The findings of our study indicate that some of the native soils encountered in our exploratory borings should generally be suitable for use as structural fill and backfill material for the project. However, our laboratory test results indicated that some of the on-site soils have very high expansion potential and a high solubility potential. These soils will not be suitable for use as structural fill and backfill. Additional soil sampling and laboratory testing should be performed during earthwork operations to evaluate whether on-site soils meet recommendations provided in this report for use as structural fill/backfill.

- Chemical test results performed on selected soil samples from the exploratory borings indicate that some of the on-site soils should be considered severely deleterious to concrete.

- Review of referenced geologic data indicates that a previously mapped fault traverses the western portion of the alignment (Figure 2). Published geologic data does not provide an activity level for this fault. During our field activities, surficial indications of previous faulting were not observed. A qualified geologist/geotechnical consultant should be present during trenching and excavation operations in the area of the mapped fault to assess subsurface conditions and provide recommendations as needed.

- Water, several inches deep, was observed flowing in the channel bottom. In addition, flash flooding is known to occur in Las Vegas Valley. Accordingly, the contractor for this project should be aware of the potential for adverse affects of flash flooding on construction activities and take adequate precautions.

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- Layers of hard to very hard, strongly cemented soils (caliche) were not encountered in our exploratory borings performed along the project alignment. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Due to its variable nature, caliche may be encountered in areas between and beyond our boring locations during earthwork operations. Grading activities and excavations may be impeded due to the presence of cemented soils. Rock excavation techniques should be anticipated during grading and excavation operations.

- As indicated in the referenced International Building Code, the seismic parameters provided in Table 2 are characteristic of the alignment and may be considered where appropriate in the design of structures.

8. RECOMMENDATIONS

We anticipate that the Clark County Regional Flood Control District, Hydrological Criteria and Drainage Design Manual (CCRFCD, 1999) will be used in design of the proposed channel improvements for this project. The following sections provide geotechnical recommendations for design and construction of proposed project improvements.

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8.1. Construction Dewatering

Groundwater was encountered in 12 of our 20 exploratory borings. The depths below the existing ground surface of the measured groundwater levels are provided on Table 6. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Accordingly, dewatering of excavations should be anticipated during earthwork operations. The purpose of dewatering is to improve excavation wall and bottom stability, as well as subgrade stability, and to allow installation of subsurface improvements and compaction of structural fill, trench backfill, and RCB and channel bottoms. Dewatering measures may include installation of well points, deep wells, and other devices. Disposal of groundwater should be performed in accordance with guidelines of the Nevada Division of Environmental Protection (NDEP).

Existing structures within the limits of groundwater drawdown resulting from dewatering may be at risk of experiencing settlement. The amount of settlement, if it occurs, will depend primarily on the amount and duration of the dewatering and subsurface soil conditions.

Consideration should be given to monitoring nearby structures for possible movement and associated damage during dewatering operations. If significant movement/damage occurs, dewatering operations should be temporarily suspended and the project's geotechnical consultant/owner's representative should be informed. Recommendations for mitigating settlement and associated distress should be provided by the geotechnical consultant/owner's representative.

8.2. Earthwork

Specifications for construction materials to be used and construction practices to be followed when excavating and backfilling trenches within paved and unpaved ROW are provided in the referenced USSPWC. The following subsections provide additional earthwork recommendations for the project including RCB and channel excavation, subgrade stabilization, mapped fault considerations, structural fill and backfill, import soils, and stability of temporary excavations.

8.2.1. RCB and Channel Excavation

Prior to excavation, the existing concrete for the trapezoidal channel side slopes should be removed and any ground surface along the proposed channel excavation areas should be cleared of any surface and subsurface obstructions, debris, organics (including vegetation), and other deleterious material. Materials generated from clearing operations should be removed from the project area and disposed of at a legal landfill.

Fill material, including existing channel sidewall backfill material was encountered to a depth of up to approximately 7 feet in the exploratory borings. Contractors for this project should anticipate that fill will be encountered during excavation operations, particularly below or behind existing channel side slopes. The full depth of any undocumented fill material, and any loose, disturbed, or otherwise unsuitable soil should be removed from beneath proposed improvement areas and replaced with structural fill and/or appropriate backfill.

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The proposed channel and RCB excavations for the proposed project should extend to the full depth and width, as specified in the project plans, or to a greater depth or width where needed, as evaluated in the field by the project's geotechnical consultant. Excavations should be deep enough to provide an approximately 8-inch thick layer of aggregate base beneath concrete channel and RCB bottoms. Excavations should be wide enough to provide an adequate work zone and trenching for the proposed structures should provide a 12-inch or more clearance on either side of the RCB for structural fill material placement and compaction. The 12-inch side clearance should be the clear distance between the RCB and shoring system where present.

Care should be taken not to overexcavate trench/channel bottoms. In the event that overexcavation occurs, the overexcavated area should be backfilled with Type II Aggregate Base compacted to 90 percent relative compaction, as evaluated by ASTM D 1557 or Controlled Low-Strength Material (CLSM) as described in the referenced USSPWC Section 208.02.07. Excavated bottoms should be cleaned of loose material generated by the excavation process. If the exposed surficial soils at the base of the excavations are loose, soft, or disturbed by excavation operations, these soils should be scarified to a depth of approximately 6 inches, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557. When the bottom of the excavation contains rocks larger than 6 inches nominal diameter, protruding above the bottom of the excavation, these protrusions should be removed and the area leveled prior to the compaction of the subgrade and placement of structural fill materials.

Consideration should be given to existing buried pipeline utilities running parallel to the planned excavation. Trench excavations within two pipe diameters of existing pipelines and extending below the springline of, and running parallel to, existing pipeline utilities may need to be supported by properly designed trench shoring and bracing to prevent damage to existing pipeline facilities.

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Layers of hard to very hard, strongly cemented soils (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Due to the highly variable nature of caliche, this rock-like cemented soil may be encountered along the project alignment in areas between and beyond our exploratory boring locations. If caliche is encountered, rock excavation techniques, such as use of heavy-duty ripping equipment, heavy-duty backhoe, headache ball, hoe-ram, rock bits, etc., should be anticipated during earthwork operations. The contractor should be aware of the potential for (and take adequate precautions to reduce the potential for) vibrational damage to adjacent or nearby structures, and take appropriate precautions, when using heavy impact equipment during removal of caliche.

Some shrinkage should be anticipated when on-site soils are excavated, processed, and compacted. For planning purposes, an estimated shrinkage factor of approximately 25 percent may be used for native soils.

8.2.2. Subgrade Stabilization

As previously indicated, groundwater was measured at relatively shallow depths in some of our exploratory borings. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Accordingly, pumping subgrade should be anticipated during excavation and earthwork operations. Subgrade stabilization will be needed where pumping subgrade conditions are encountered.

Stabilization methods should be provided by the grading contractor, as needed, and may include the use of a geogrid, such as Tensar TX160, or a woven geotextile fabric, such as Mirafi 600X, placed on unstable subgrade and overlain by 12 inches of crushed rock in accordance with Section 704.03.06 of Uniform Standard Specifications for Public Works Construction (USSPWC) or Type II Aggregate Base (USSPWC 704.03.04). Pushing oversized angular rock, up to approximately 6 inches in nominal diameter, into

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exposed unstable subgrade soils may also be an appropriate stabilization alternative. The volume of rock needed will vary based upon factors including the moisture content of the native soil, soil type, depth to groundwater, and total affected area. Placement of angular rock should continue until the area exhibits a relatively non-yielding behavior as observed or tested by the geotechnical consultant.

If conditions (e.g. excavations extending below groundwater) are observed that indicate additional stabilization efforts may be needed, a combination of overexcavation, rock fill, and geogrid placement should be considered. Dewatering and use of relatively light or tracked equipment may also be needed. The geotechnical consultant/engineer during construction should evaluate proposed subgrade stabilization methods prior to their implementation.

8.2.3. Mapped Fault Considerations

As previously mentioned, a mapped fault transects the western portion of the project alignment. The approximate location of this fault is shown on Figure 2. Review of referenced USGS data does not provide an activity level for this fault. Published geologic data and our professional experience in the project area indicate that previous subsurface evaluation, such as fault trenching, has not been performed to confirm the fault's location, activity level, or whether it is in the mapped location. During excavation operations for this project, indications of faulting, such as off-set or deformation of soil layers, may or may not be observed. Ninyo & Moore recommends that a qualified geologist/geotechnical consultant be present during trenching/excavation operations in the area of the mapped fault to assess subsurface conditions and provide recommendations for fault mitigation as needed.

If indications of faulting, or associated potential instability, are encountered, mitigation measures may include vertical overexcavation of the trench, placement of geofabric and gravel, or a layer of geogrid across the fault prior to placement of structural fill.

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8.2.4. Structural Fill and Backfill

Structural fill soils should not contain organic matter, debris, other deleterious matter, or rocks or hard chunks larger than approximately 3 inches nominal diameter. These soils should have a low solubility potential of 1.0 percent or less, as evaluated by Technical Guideline TG-19-2007 (Clark County Development Services Department, 2007), and a very low to low expansion potential (EI less than 50, as evaluated by ASTM D 4829).

Soils used as structural fill or backfill should be moisture-conditioned to approximately optimum moisture content and placed and compacted in uniform horizontal lifts to a relative compaction of 90 percent, as evaluated by ASTM D 1557. The optimal lift thickness of fill will depend on the type of soil and compaction equipment used, but should generally not exceed approximately 8 inches in loose thickness. Placement and compaction of structural fill should be performed in accordance with the referenced USSPWC (Clark County, 2003).

Earthwork operations should be observed and compaction of structural fill materials should be tested by the project's geotechnical consultant. Typically, one field test should be performed per lift for each approximately 500 cubic yards of fill placement in structural areas. Additional field tests may also be performed in structural and non-structural areas at the discretion of the geotechnical consultant.

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8.2.5. Import Soils

Import soil for backfill or structural fill should consist of coarse-grained material (50 percent or more retained on the No. 200 sieve), with a low solubility potential of 1.0 percent or less, as evaluated by Technical Guideline TG-19-2007 (Clark County Development Services Department, 2007), a low sulfate content (less than 0.1 percent), and a very low to low expansion potential (EI less than 50, as evaluated by ASTM D 4829). Import soil should not contain organic matter, debris, other deleterious matter, or rocks or hard chunks larger than approximately 3 inches nominal diameter. We further recommend that proposed import material be evaluated by the project's

geotechnical consultant at the borrow source for its suitability prior to importation to the project site. Import soil should be moisture-conditioned and placed and compacted in accordance with the recommendations set forth in the previous section.

8.2.6. Stability of Temporary Excavations

Temporary excavations should be performed in accordance with the requirements and recommendations of the referenced Occupational Safety and Health Administration's Construction Industry Regulations (OSHA, 2005). Excavations deeper than 5 feet should be appropriately shored or laid back at a slope no steeper than 1:1 (horizontal to vertical) per OSHA recommendations. On-site safety of personnel is the responsibility of the contractor. Worker protection, such as trench boxes, may be needed for protection against rolling or falling particles.

Excavations for the proposed RCB and channel are anticipated to be up to approximately 15 feet deep. Spoils from excavations, heavy construction equipment, and other surcharge loads should not be placed above the excavations within a 1:1 (horizontal to vertical) plane extending up and back from the base of the excavation. In addition, surface drainage should be channeled away from the top edge of excavations and traffic should be routed as far away from the excavation as practicable during construction.

As an alternative to laying back the sides of the excavations, temporary excavations may be rigidly braced. Temporary earth retaining systems will be subjected to lateral loads resulting from earth pressures. As a guideline, lateral earth pressures presented in this report may be used in the design of internally braced excavation shoring for temporary excavations. A structural engineer experienced in retaining systems for temporary excavations should be consulted by the contractor during the design of the shoring system. The project's geotechnical engineer should review the design plans for a temporary retaining system prior to its implementation.

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8.3. Vertical Loads and RCB Foundations

For calculation of overburden loads, Type II Aggregate Base and trench backfill soils, when placed and compacted as specified, may be assumed to have a unit weight of approximately 130 pounds per cubic foot (pcf). This value is based on soils being compacted to a relative compaction of 90 percent of the maximum dry density, as evaluated by ASTM D 1557. We have assumed that CLSM used as pipe zone and trench backfill material will have a unit weight of approximately 120 pcf.

The base of RCB sections should be founded on 8 inches or more of Type II Aggregate Base overlying medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils). The Type II Aggregate Base should be in conformance with referenced USSPWC Subsection 704.03.04, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557. An allowable bearing pressure of 2,000 pounds per square foot (psf) may be used for RCB/structure foundations. The allowable bearing capacity, which was developed considering a factor of safety of 2.5, may be increased by one-third for short duration loads, such as seismic.

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8.4. Concrete-Lined Channel Invert Slabs and Sidewalls

We recommend that concrete channel walls, invert slabs-on-grade and access ramps be founded on 8 inches or more of Type II Aggregate Base overlying medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils). The Type II Aggregate Base should be in conformance with referenced USSPWC Subsection 704.03.04, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557.

We recommend that the concrete channel lining be provided with construction joints in accordance with Section 705.7.1.3 of the Clark County Regional Flood Control District, Hydrological Criteria and Drainage Design Manual (CCRFCD, 1999). For continuously reinforced concrete channel construction, we recommend that longitudinal and transverse

cutoff walls be constructed in accordance with Section 705.7.1.12 of the CCRFCD design manual. Slab reinforcement should be in accordance with Section 705.7.1.6 of the CCRFCD design manual. Additional reinforcement and control joint recommendations may be provided by a qualified structural engineer. Recommendations regarding concrete utilized for construction of the proposed channel are provided in Section 8.7.

In order to drain accumulated water below invert slabs, we recommend that 3-inch diameter weep holes be installed in the channel bottom approximately 1 foot upstream of transverse cutoff walls and at the approximate midpoint between cutoff walls. These weep holes should be protected against clogging by installation of 1 square-foot of non-woven geotextile fabric such as Trevira 1135 (or approved equivalent) between weep holes and underlying aggregate base.

In order to reduce the potential for build-up of hydrostatic pressures and to drain possible accumulated water behind concrete channel sidewalls, 3-inch diameter weep holes should be installed in the channel sidewalls at a spacing of approximately 10 feet on-center and approximately 3 inches from the channel bottom. Drainage measures should also include the placement of free-draining granular backfill over weep hole areas encased in a non-woven filter fabric such as Trevira 1135 (or approved equivalent).

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8.5. Lateral Earth Pressures

Below grade walls that are not restrained from movement at the top and having level backfill behind the wall may be designed using an "active" lateral earth pressure as indicated on Figure 3. Restrained subsurface walls having a horizontal ground surface behind the wall, may be designed using an "at-rest" lateral earth pressure as indicated on Figure 4. These lateral earth pressure values assume compaction within about 5 feet of the wall will be accomplished with relatively light compaction equipment and that very low to low expansive backfill will be placed behind the wall. These values also assume that below grade walls will have a height of approximately 15 feet or less.

We understand that dynamic lateral earth pressures induced from a seismic event may be considered in the design of subsurface structures along the alignment. Ninyo & Moore has evaluated the "active" and "at-rest" seismic earth pressure coefficient based on the Mononobe-Okabe equation for an active driving wedge. Based on our calculations, Ninyo & Moore recommends that below grade walls, which are not restrained from movement at the top, be designed using an additional inverted triangular "active" equivalent fluid unit weight as indicated on Figure 3, where appropriate. Subsurface walls, which are restrained from movement at the top, be designed using an additional inverted triangular "at-rest" equivalent fluid unit weight as indicated on Figure 4.

Below grade walls should also be designed to resist an "active" and "at-rest" surcharge pressure as shown on Figure 3 and Figure 4. The value for "q" represents the pressure induced by adjacent light loads, uniform slab, or traffic loads plus any adjacent footing loads.

Measures should be taken so that hydrostatic pressure does not build up behind retaining walls. Drainage measures, as indicated on Figure 5, should include free-draining granular backfill material and perforated drain pipes, or weepholes lined with polyvinyl chloride (PVC) pipe. Drain pipes should outlet away from structures and retaining walls should be waterproofed in accordance with the recommendations of a qualified civil engineer or architect.

For passive resistance to lateral loads, we recommend that a passive lateral earth pressure of 300 psf/ft above groundwater and 130 psf/ft below groundwater be used up to a value of 2,000 psf. This value assumes that the ground surface is horizontal for a distance of 10 feet, or three times the height generating the passive pressure, whichever is more. We recommend that the upper 12 inches of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance. For frictional resistance to lateral loads, we recommend that a coefficient of friction of 0.53 be used between soil and soil contacts and/or between soil and cast-against-grade concrete contacts. A coefficient of friction of 0.35 may be used between soil and formed concrete contacts. Passive and frictional resistances may be used in combination, provided the passive resistance does not exceed one-half of the total allowable resistance.

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8.6. Pavement Replacement

Pavement patching in trench areas for this project should be performed in accordance with the USSPWC (Clark County, 2003), which provides specifications for thickness of pavement and underlying aggregate base/CLSM depending on the width of the roadway ROW. The existing asphalt concrete pavement thickness measured in our exploratory borings is provided in Section 6.1.

In areas of pavement removal and patching, pavement saw-cuts should be linear and vertical. The pavement should be saw-cut a few inches beyond the soil excavation as shown on Drawing No. 503AF of the referenced Uniform Standard Drawings for Public Works Construction (Clark County, 2001). Saw-cuts should be adequately cleaned and then coated with an appropriate tack-coat prior to placement of new pavement.

8.7. Concrete and Corrosion Considerations

The corrosion potential of on-site soils to concrete was evaluated in the laboratory using representative samples obtained from the exploratory borings. Laboratory testing was performed to assess the effects of sulfate content on concrete. Results of these tests are presented in Appendix C. Recommendations regarding concrete to be utilized in construction of proposed improvements and for buried metal pipes are provided in the following sections.

8.7.1. Concrete

Chemical tests performed on selected samples of on-site soils indicated sulfate contents ranging from 0.02 to 0.47 percent by weight. Based on review of the referenced International Building Code (ICC, 2012) and American Concrete Institute manual (ACI, 2005), the tested soil is considered negligibly to severely deleterious to concrete. Accordingly, we recommend that concrete in contact with on-site soils, along with subsurface walls up to 12 inches above finished grade, contain Type V cement and have a design compressive strength of 4,500 pounds per square inch (psi). In accordance with Section 501 of the referenced USSPWC, concrete in contact with on-site soils should

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have a water-cement ratio of 0.45 by weight. In addition, it is recommended that reinforcing bars in cast-against-grade concrete be covered by approximately 3 inches or more of concrete. Concrete should be placed with an approximate 4-inch slump and good densification procedures should be used during placement to reduce the potential for honeycombing. Concrete samples should be obtained, as indicated by ACI manual Section 318 (ACI, 2005), and the slump should be tested at the site by the project's geotechnical consultant. Structural concrete should be placed in accordance with American Concrete Institute (ACI, 2005) and project specifications.

8.7.2. Buried Metal Pipes

Ninyo & Moore recommends that corrosion reduction methods be implemented for this project for buried metal pipes. These corrosion reduction methods may include utilization of protective coatings, pipe sleeving, and/or appropriate cathodic protection as recommended by a qualified corrosion engineer. Where permitted by jurisdictional building codes, the use of plastic pipes for buried utilities should also be considered.

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9. PLAN REVIEW

The recommendations presented in this report are based on preliminary design information for the proposed project, as provided by Atkins personnel, and on the findings of our geotechnical evaluation. When finished, project plans and specifications should be reviewed by the geotechnical consultant prior to submitting the plans and specifications for bid. Additional field exploration and laboratory testing may be needed upon review of the project design plans.

10. PRE-CONSTRUCTION MEETING

We recommend that a pre-construction meeting be held. The owner or the owner's representative, the civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the plans and the project.

11. OBSERVATION AND TESTING

A qualified geotechnical consultant should perform appropriate observation and testing services during earthwork and construction operations. These services should include observation of removal of soft, loose, or otherwise unsuitable soils, evaluation of subgrade conditions where soil removals are performed, and performance of observation and testing services during placement and compaction of structural fill and backfill soils. The geotechnical consultant should also perform observation and testing services during placement of concrete, mortar, grout, asphalt concrete, and steel reinforcement.

12. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

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This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent

evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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13. REFERENCES

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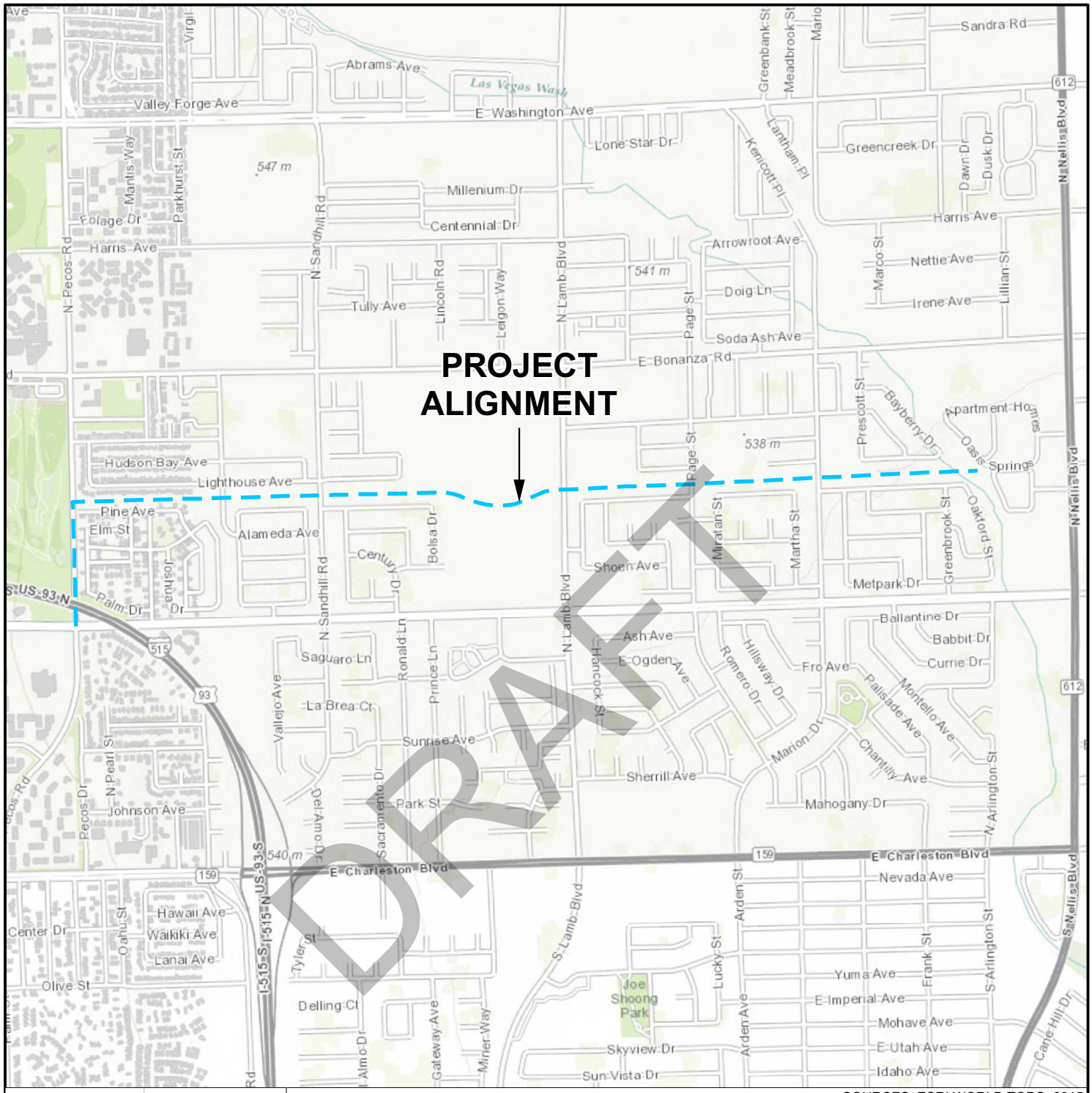
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SOURCES: ESRI WORLD TOPO, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

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SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

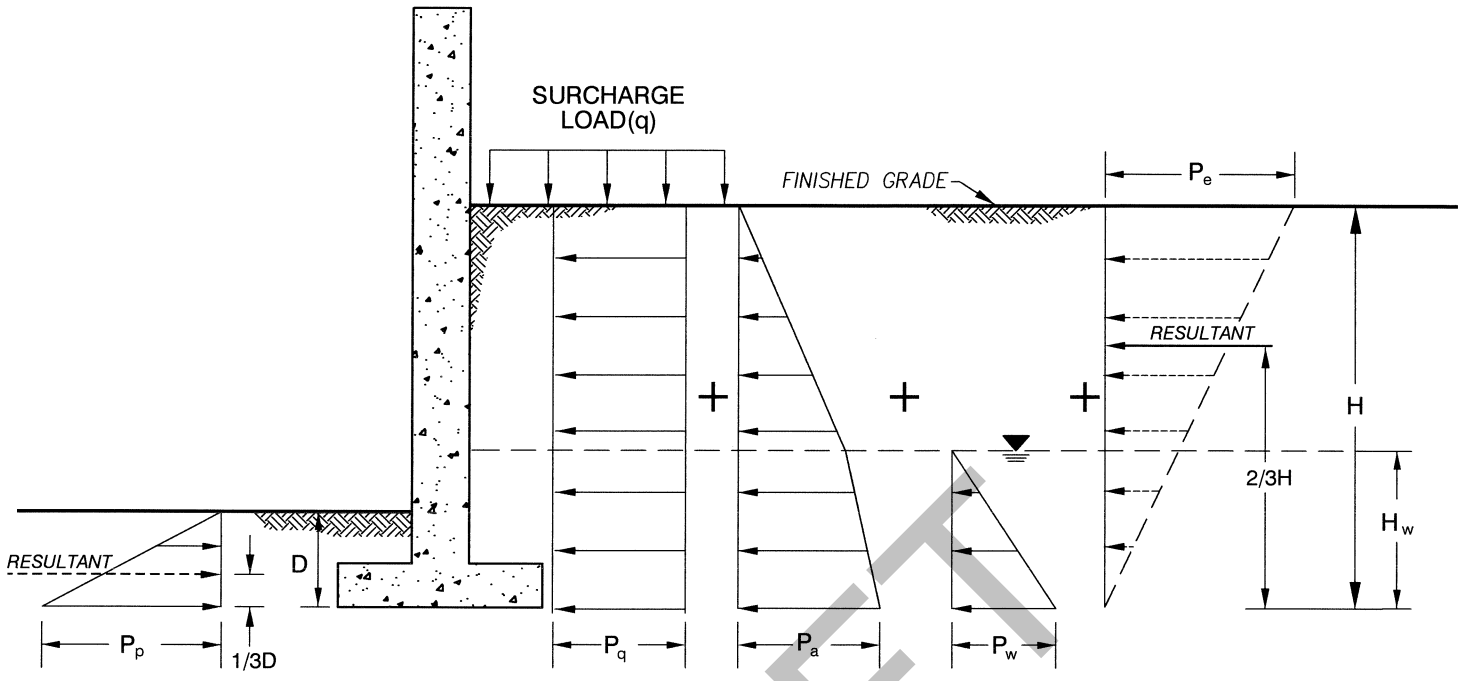
NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2
303710001	4/15		

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NOTES:

1. ASSUMES NON-EXPANSIVE BACKFILL MATERIALS
2. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON AN EFFECTIVE PEAK GROUND ACCELERATOR OF 0.20g
3. H, H_w, AND D ARE IN FEET

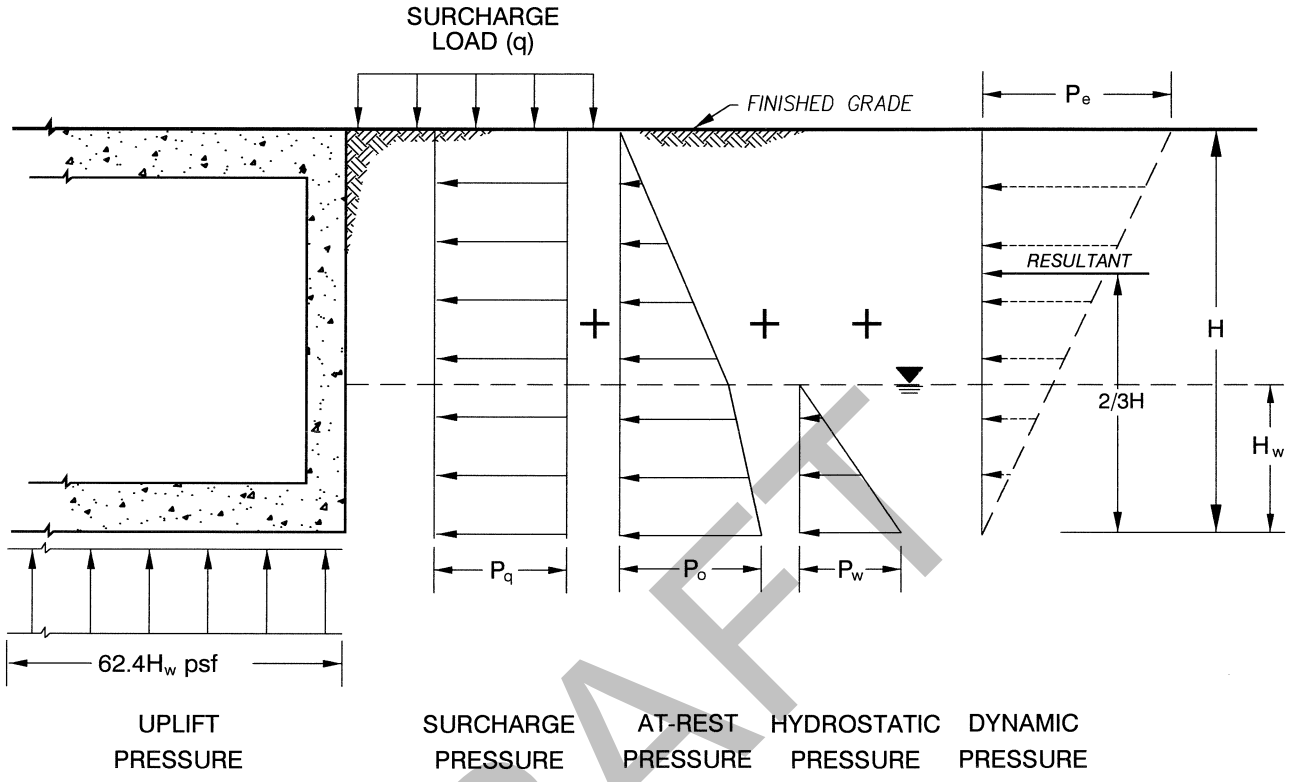
RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

Lateral Earth Pressure	Equivalent Fluid Pressure (psf/ft)	
	Level Backfill with Granular Soils	Below Groundwater
P_p	300D	130D
P_q	0.36q	0.36q
P_a	43H	$43(H-H_w)+21H_w$
P_w	--	$62.4H_w$
Resultant	Force per unit of wall	
P_e	8H	8H

NOT TO SCALE

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Ninyo & Moore	LATERAL EARTH PRESSURES FOR YIELDING RETAINING WALLS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	3



DRAFT

NOTES:

1. ASSUMES NON-EXPANSIVE BACKFILL MATERIALS
2. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON AN EFFECTIVE PEAK GROUND ACCELERATOR OF 0.20g
3. H, H_w, AND D ARE IN FEET

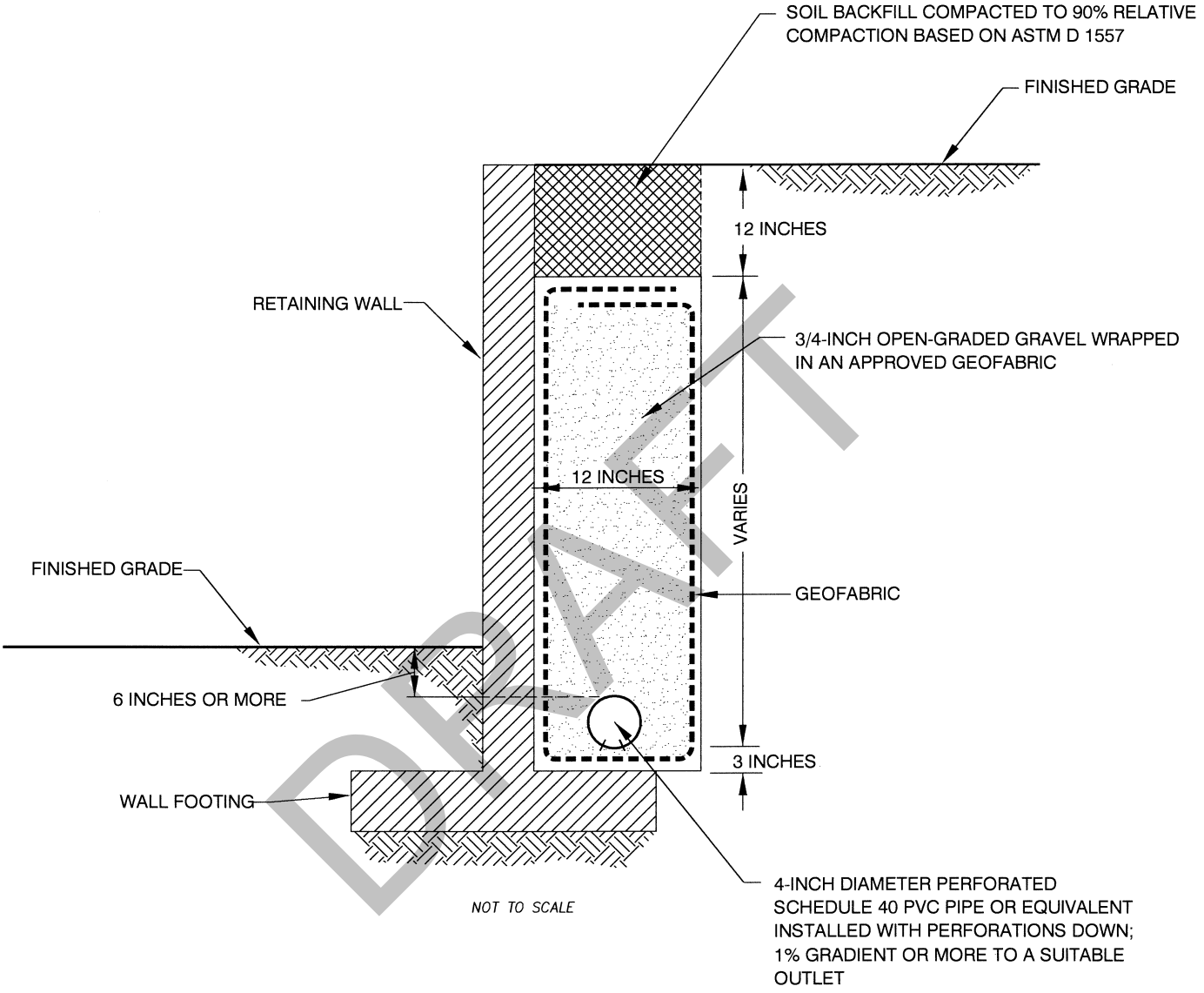
RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

Lateral Earth Pressure	Equivalent Fluid Pressure (psf/ft)	
	Level Backfill with Granular Soils	Below Groundwater
P_p	300D	130D
P_q	0.53q	0.53q
P_o	64H	$64(H-H_w)+31H_w$
P_w	--	$62.4H_w$
Resultant	Force per unit of wall	
P_e	18H	18H

NOT TO SCALE

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Ninyo & Moore		LATERAL EARTH PRESSURES FOR RESTRAINED RETAINING WALLS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	4
303710001	4/15		



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NOTES: AS AN ALTERNATIVE, AN APPROVED GEOCOMPOSITE DRAIN SYSTEM MAY BE USED.

AS AN ALTERNATIVE TO USE OF 4" DIAMETER PVC BACKDRAINAGE PIPES, WEEP HOLES CAN BE CORED THROUGH THE WALL AND LINED WITH PVC PIPE. WEEP HOLES SHOULD BE 3" DIAMETER AND PLACED APPROXIMATELY 3" ABOVE THE LOWEST ADJACENT FINISHED GRADE AT APPROXIMATELY 10' ON-CENTER.

Ninyo & Moore	RETAINING WALL DRAINAGE DETAIL	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	5

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APPENDIX A

EXPLORATORY BORING LOGS

Field Procedure for the Collection of Disturbed Samples

Disturbed soil samples were obtained in the field using the following methods.

Bulk Samples

Bulk samples of representative earth materials were obtained from the exploratory excavations. The samples were bagged and transported to the laboratory for testing.

The Standard Penetration Test (SPT) Sampler

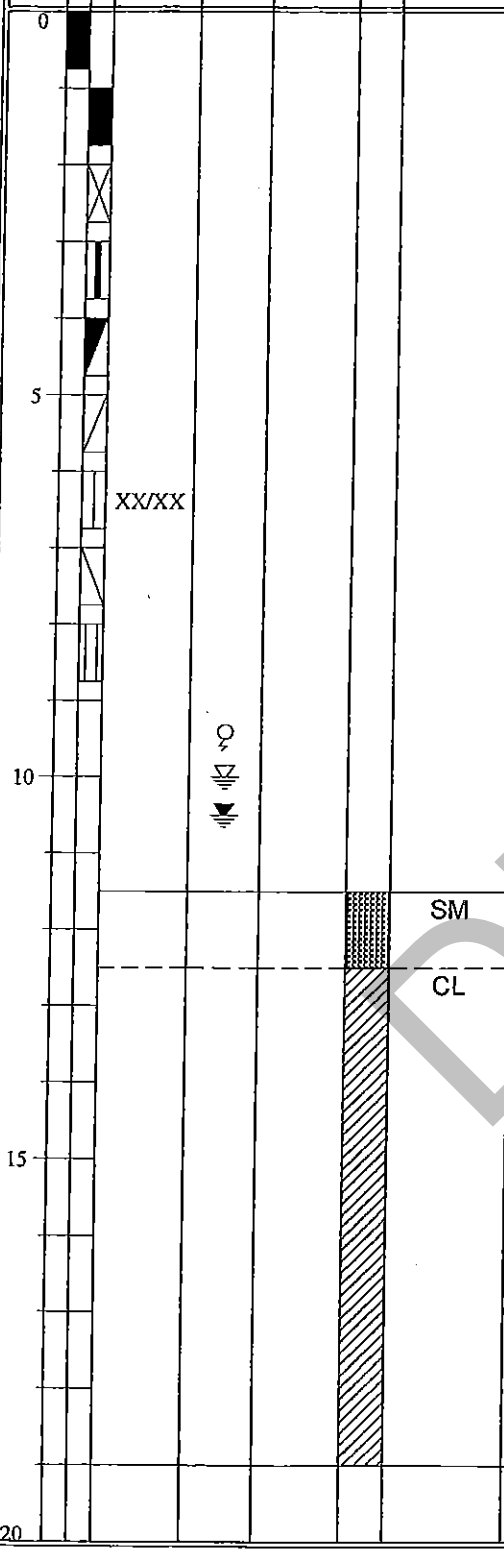
Disturbed drive samples of earth materials were obtained by means of a Standard Penetration Test sampler. The sampler is composed of a split barrel with an external diameter of 2 inches and an unlined internal diameter of 1-3/8 inches. The sampler was driven into the ground with a 140-pound hammer free-falling from a height of 30 inches in general accordance with ASTM D 1586 and the blow counts were recorded. Soil samples were observed and removed from the sampler, bagged, sealed, and transported to the laboratory for testing.

Field Procedure for the Collection of Ring-lined Samples

Ring-lined soil samples were obtained in the field using a Modified Split-Barrel Drive Sampler. The sampler, with an external diameter of 3.0 inches, was lined with 1-inch long, thin brass rings with inside diameters of 2.4 inches. The sample barrel was driven into the ground with the weight of a hammer of thin general accordance with ASTM D 3550. The driving weight was permitted to fall freely. The approximate length of the fall, the weight of the hammer, and the number of blows during driving are presented on the excavation logs as an index to the relative resistance of the materials sampled. The samples were removed from the sample barrel in the brass rings, sealed, and transported to the laboratory for testing.

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BORING LOG EXPLANATION SHEET



Bulk sample.

Modified split-barrel drive sampler.

No recovery with modified split-barrel drive sampler.

Sample retained by others.

Standard Penetration Test (SPT).

No recovery with a SPT.

Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.

No recovery with Shelby tube sampler.

Continuous Push Sample.

Seepage.
Groundwater encountered during drilling.
Groundwater measured after drilling.

MAJOR MATERIAL TYPE (SOIL):
Solid line denotes unit change.
Dashed line denotes material change.

Attitudes: Strike/Dip
b: Bedding
c: Contact
j: Joint
f: Fracture
F: Fault
cs: Clay Seam
s: Shear
bss: Basal Slide Surface
sf: Shear Fracture
sz: Shear Zone
sbs: Shear Bedding Surface

The total depth line is a solid line that is drawn at the bottom of the boring.

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BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE
	Rev. 11/11	

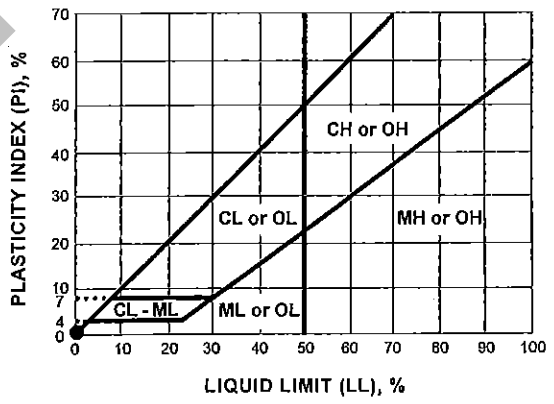
SOIL CLASSIFICATION CHART PER ASTM D 2488

PRIMARY DIVISIONS			SECONDARY DIVISIONS	
			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	GRAVEL more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with clay
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	SILT and CLAY liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
Highly Organic Soils			PT	Peat

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

PLASTICITY CHART



APPARENT DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

CONSISTENCY - FINE-GRAINED SOIL

CONSIS-TENCY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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USCS METHOD OF SOIL CLASSIFICATION

Explanation of USCS Method of Soil Classification

PROJECT NO.	DATE	FIGURE

DATE DRILLED 3/13/15 BORING NO. B-1

GROUND ELEVATION 1,795.4'± (MSL) SHEET 1 OF 2

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 9-1/8 inches thick.
						GM	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		9/6" 7/6" 7/6"	7.9	110.5		CL	NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; few sand.
5		4/6" 5/6" 8/6"	32.1	80.8		CH	Light brown, moist, stiff to very stiff, fat CLAY; few sand.
							Trace gravel.
10		7/6" 14/6" 16/6"	32.3	80.7			Very stiff.
							Wet.
15		4/6" 8/6" 40/6"	21.1	102.3			With gravel.
							Few gravel.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-1

DATE DRILLED 3/13/15 BORING NO. B-1

GROUND ELEVATION 1,795.4'± (MSL) SHEET 2 OF 2

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		25/6" 50/2"	26.2	99.6		CH	NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, fat CLAY with gravel; few sand. Few gravel.
25		7/6" 11/6" 14/6"	27.2	91.2			Gray to light brown; with gravel.
30							Total Depth = 26.5 feet. Groundwater was measured at a depth of approximately 12.2 feet about 72 hours after drilling. Backfilled and patched on 3/24/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
35							
40							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-2

DATE DRILLED 3/5/15 BORING NO. B-2

GROUND ELEVATION 1,791.6'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2 inches thick.
						CL	FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 3-1/2 inches thick.
		12/6" 11/6" 13/6"					NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; few sand; few gravel.
						CH	Light brown, moist, very stiff, sandy fat CLAY with gravel.
5		6/6" 13/6" 23/6"	24.6	86.7			
							A layer of silty gravel a few inches thick.
10		4/6" 6/6" 8/6"	29.4	77.5			
							Few gravel.
			▼				Wet.
15		1/6" 2/6" 3/6"	54.2	64.6			Firm.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-3

DATE DRILLED 3/5/15 BORING NO. B-2

GROUND ELEVATION 1,791.6'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		7/6" 14/6" 9/6"				CH	NATIVE SOIL (CONTINUED): Light brown, very stiff, sandy fat CLAY with gravel.
							Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 12.7 feet about 96 hours after drilling. Backfilled and patched on 3/9/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
25							
30							
35							
40							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-4

DATE DRILLED 3/5/15 BORING NO. B-3

GROUND ELEVATION 1,783.9'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2 inches thick.
						CH	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4-1/2 inches thick.
		5/6" 9/6' 11/6"	15.7	82.6			NATIVE SOIL: Dark brown, moist, very stiff, sandy fat CLAY with gravel.
5		9/6" 30/6" 41/6"	22.0	95.8			A layer of gravel a few inches thick.
							Trace gravel.
							Wet.
10		4/6" 6/6" 8/6"	31.8	89.2			
15		12/6" 7/6" 18/6"					Few gravel.
20							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.2 feet about 24 hours after drilling. Backfilled and patched on 3/6/15.

NOTE:
Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-5

DATE DRILLED 3/5/15 BORING NO. B-4

GROUND ELEVATION 1,781.9'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CH	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		7/6" 14/6" 16/6"	25.1	92.8			NATIVE SOIL: Dark brown, moist, very stiff, sandy fat CLAY with gravel.
5		4/6" 12/6" 21/6"	24.1	89.4			Trace gravel.
			▼				Wet.
10		21/6" 22/6" 11/6"	32.3	88.9			A moderately hard, moderately cemented layer, a few inches thick. Few gravel.
15		3/6" 9/6" 12/6"					
20							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.4 feet about 24 hours after drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-6

DATE DRILLED 3/11/15 BORING NO. B-5

GROUND ELEVATION 1,779.6'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 1-1/2 inches thick.
						CH	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		6/6" 8/6" 9/6"	29.8	83.9			NATIVE SOIL: Brown, moist, very stiff, fat CLAY; few sand.
							Few gravel.
5		5/6" 12/6" 25/6"	33.0	78.8			Light brown; wet; trace gravel.
10		4/6" 4/6" 5/6"	35.1	81.3			Gray; stiff.
15		4/6" 12/6" 14/6"	23.5	99.8			Very stiff.
20							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 6.9 feet about 96 hours after drilling. Backfilled and patched on 3/24/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-7

DATE DRILLED 3/5/15 BORING NO. B-6

GROUND ELEVATION 1,778.2'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 1-7/8 inches thick.
						CL	FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5 inches thick.
		2/6" 3/6" 4/6"					NATIVE SOIL: Dark brown, moist, stiff, lean CLAY with sand.
5		4/6" 9/6" 9/6"	24.6	91.3			Very stiff.
						CH	Light brown, very stiff, fat CLAY with sand; trace gravel.
			▼				Wet.
10		3/6" 6/6" 8/6"	41.8	74.2			Few gravel.
15		5/6" 13/6" 13/6"	29.6	90.9			
							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.4 feet about 96 hours after drilling. Backfilled and patched on 3/9/15.
							NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-8

DATE DRILLED 3/5/15 BORING NO. B-7

GROUND ELEVATION 1,775.7'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		6/6" 5/6" 5/6"	15.1	85.3			NATIVE SOIL: Brown, moist, stiff, lean CLAY with sand. Trace gravel.
5		3/6" 3/6" 5/6"	23.7	90.7			
10		6/6" 18/6" 38/6"	17.5	102.2			Very stiff.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-9

DATE DRILLED 3/5/15 BORING NO. B-8

GROUND ELEVATION 1,774.6'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		5/6" 5/6" 8/6"	16.6	93.8			NATIVE SOIL: Brown, moist, stiff to very stiff, lean CLAY; few sand; few gravel.
5		3/6" 4/6" 6/6"	23.1	93.4			Stiff.
10		4/6" 9/6" 26/6"	22.1	89.6			Very stiff.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-10

DATE DRILLED 3/5/15 BORING NO. B-9

GROUND ELEVATION 1,773.6'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-3/4 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		3/6" 4/6" 4/6"	19.5	93.5			NATIVE SOIL: Dark brown, moist, stiff, lean CLAY; few sand.
5		2/6" 4/6" 5/6"	26.0	88.7			Trace gravel.
10		4/6" 8/6" 9/6"	26.8	89.7			Very stiff.
15							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-11

DATE DRILLED 3/5/15 BORING NO. B-10

GROUND ELEVATION 1,772.5'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		2/6" 3/6" 3/6"	25.7	88.6			NATIVE SOIL: Dark brown, moist, firm to stiff, lean CLAY; few sand.
							Trace gravel.
5		3/6" 6/6" 8/6"	20.7	97.1			Very stiff.
							Few gravel.
10		2/6" 2/6" 2/6"	34.3	78.2		CH	Brown, moist, firm, fat CLAY; few sand; trace gravel.
			▼				Wet.
15		4/6" 8/6" 11/6"	31.2	79.3			Very stiff.
20							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 13.6 feet about 96 hours after drilling. Backfilled and patched on 3/9/15.
							NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.

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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-12

DATE DRILLED 3/5/15 BORING NO. B-11

GROUND ELEVATION 1,771.5'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4 inches thick.
		4/6" 4/6" 6/6"					NATIVE SOIL: Dark brown, moist, stiff, lean CLAY; few sand.
5		2/6" 5/6" 6/6"	21.9	93.3			Trace gravel.
10		2/6" 4/6" 5/6"	26.5	85.9			Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-13

DATE DRILLED 3/5/15 BORING NO. B-12

GROUND ELEVATION 1,770.5'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-7/8 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5-1/2 inches thick.
		5/6" 6/6" 6/6"	20.7	97.8			NATIVE SOIL: Brown, moist, stiff, lean CLAY; trace sand.
5		2/6" 4/6" 7/6"	19.6	97.8			Trace gravel. Few gravel.
10		2/6" 4/6" 4/6"	22.8	88.3			
15		1/6" 2/6" 3/6"	38.0	80.7			Firm.
20							Total Depth = 16.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/6/15. NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-14

DATE DRILLED 3/11/15 BORING NO. B-13

GROUND ELEVATION 1,769'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 2-3/4 inches thick.
						GM / CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4-1/2 inches thick.
		12/6" 8/6" 8/6"	14.6	91.2			NATIVE SOIL: Light brown, moist, very stiff, lean CLAY; trace sand.
							Dark brown; few gravel.
5		7/6" 4/6" 4/6"	13.4	99.9			Stiff.
10		5/6" 5/6" 7/6"	25.2	89.9			Light brown; trace gravel.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/12/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-15

DATE DRILLED 3/11/15 BORING NO. B-14

GROUND ELEVATION 1,766.7'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-5/8 inches thick.
						CL	FILL: Brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 4-3/4 inches thick.
		8/6" 6/6" 9/6"	10.4	107.1			NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; trace sand.
							Trace gravel.
5		4/6" 3/6" 5/6"	20.6	94.3			Stiff; few gravel.
10		3/6" 3/6" 5/6"	25.0	91.4			Light brown.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/12/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-16

DATE DRILLED 3/11/15 BORING NO. B-15

GROUND ELEVATION 1,765.2'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 11 inches thick.
		10/6" 7/6" 6/6"	18.7	83.7			NATIVE SOIL: Brown, moist, stiff to very stiff, lean CLAY; few sand.
							Light brown.
5		6/6" 6/6" 6/6"	21.6	87.6			Dark brown; stiff.
							Few gravel.
10		3/6" 2/6" 2/6"					Light brown; firm.
							Total Depth = 11.5 feet. Groundwater was not encountered during drilling. Backfilled and patched on 3/12/15.
							NOTE: Groundwater, though not encountered, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-17

DATE DRILLED 3/11/15 BORING NO. B-16

GROUND ELEVATION 1,764.1'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-1/2 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		6/6" 4/6" 6/6"	24.5	87.1			NATIVE SOIL: Brown, moist, stiff, sandy lean CLAY; trace gravel.
							With gravel.
5		4/6" 7/6" 8/6"	16.7	92.9			Very stiff.
							Few gravel.
10		4/6" 4/6" 3/6"	26.1	88.0			Stiff; trace gravel.
							Few gravel.
		▼					Wet.
15		2/6" 1/6" 2/6"	33.5	78.5			Light brown; soft to firm.
							Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 13.6 feet about 96 hours after drilling. Backfilled and patched on 3/15/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-18

DATE DRILLED 3/11/15 BORING NO. B-17

GROUND ELEVATION 1,761.7'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 2-5/8 inches thick.
						SC	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		24/6" 29/6" 23/6"	7.6	115.5			Dark brown, moist, dense, clayey SAND with gravel. A layer of silty gravel, a few inches thick. Light brown.
5		10/6" 11/6" 12/6"	7.5	100.1		GM	Light brown, moist, medium dense, silty GRAVEL with sand.
						CL	NATIVE SOIL: Dark brown, moist, stiff, sandy lean CLAY with gravel.
10		2/6" 3/6" 4/6"	33.2	84.4			Light brown; trace gravel.
15		4/6" 4/6" 6/6"	▼ 38.2	81.0			Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-19

DATE DRILLED 3/11/15 BORING NO. B-17

GROUND ELEVATION 1,761.7'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		5/6" 6/6" 10/6"	34.7	85.8		SC	NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, sandy lean CLAY; trace gravel.
							Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 15.4 feet about 96 hours after drilling. Backfilled and patched on 3/15/15.
							NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-20

DATE DRILLED 3/16/15 BORING NO. B-18

GROUND ELEVATION 1,762.3'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3-1/2 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		18/6" 22/6" 43/6"					NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY with gravel. A layer of silty gravel, a few inches thick.
5		5/6" 4/6" 4/6"	26.2	89.0			Light brown; stiff; few gravel.
10		4/6" 4/6" 5/6"	24.0	87.9		CL-ML	Light brown, moist, stiff, silty CLAY with sand; trace gravel.
15		6/6" 5/6" 6/6"	21.4	96.6			Dark brown.
			▼				Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-21

DATE DRILLED 3/16/15 BORING NO. B-18

GROUND ELEVATION 1,762.3'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		7/6" 12/6" 12/6"				CL	NATIVE SOIL (CONTINUED): Dark brown, wet, very stiff, sandy lean CLAY; few gravel.
							Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 18.4 feet about 24 hours after drilling. Backfilled and patched on 3/17/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-22

DATE DRILLED 3/16/15 BORING NO. B-19

GROUND ELEVATION 1,761.7'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3 inches thick.
						CL	FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		7/6" 8/6" 8/6"	17.2	97.0			NATIVE SOIL: Brown, moist, very stiff, sandy lean CLAY; trace gravel.
							Dark brown; few gravel.
5		3/6" 2/6" 6/6"	23.4	90.4			Light brown; stiff.
10		3/6" 4/6" 9/6"	15.0	99.0			Stiff to very stiff.
						ML	Light brown, moist, stiff, SILT with sand; trace gravel.
15		6/6" 17/6" 29/6"	19.3	98.6			Very stiff.
						CL	Light brown, moist, stiff to very stiff, sandy lean CLAY; trace gravel.
			▼				Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-23

DATE DRILLED 3/16/15 BORING NO. B-19

GROUND ELEVATION 1,761.7'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20		5/6" 5/6" 24/6"	35.4	78.6		CL	NATIVE SOIL (CONTINUED): Brown, wet, very stiff, sandy lean CLAY with gravel.
25		14/6" 44/6" 50/5"	37.2	80.7			Light brown; moderately hard, moderately cemented layer.
30							Total Depth = 26.4 feet. Groundwater was measured at a depth of approximately 18.7 feet about 72 hours after drilling. Backfilled and patched on 3/19/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-24

DATE DRILLED 3/16/15 BORING NO. B-20

GROUND ELEVATION 1,760.5'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0						GM	ASPHALT CONCRETE: Approximately 3-1/4 inches thick.
						CL	FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 8-1/2 inches thick.
		7/6" 11/6" 10/6"					NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY; trace gravel.
5		6/6" 5/6" 5/6"	18.2	100.2			Stiff.
							Few gravel.
10		3/6" 3/6" 4/6"	22.8	95.1			Light brown; trace gravel.
15		5/6" 9/6" 18/6"	29.3	81.9		ML	Light brown, moist, very stiff, SILT with sand.
							Few gravel.
		▼					Wet.
20							

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BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-25

DATE DRILLED 3/16/15 BORING NO. B-20

GROUND ELEVATION 1,760.5'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
20			4/6" 9/6" 9/6"	51.5	69.2		CL	NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, sandy lean CLAY; few gravel.
25			6/6" 32/6" 50/4"	35.3	81.4			Few gravel; moderately hard, moderately cemented layer.
30								Total Depth = 26.3 feet. Groundwater was measured at a depth of approximately 18.4 feet about 72 hours after drilling. Backfilled and patched on 3/19/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
35								
40								

DRAFT

Ninyo & Moore

BORING LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710001	4/15	A-26

APPENDIX B

LABORATORY TESTING

Classification

Soils were visually and texturally classified in accordance with the Unified Soil Classification System (USCS) in general accordance with ASTM D 2488. Soil classifications are indicated on the logs of the exploratory excavations in Appendix A.

In-Place Moisture and Density

The moisture content and dry density of ring-lined samples obtained from the exploratory excavations were evaluated in general accordance with ASTM D 2937. The test results are presented on the logs of the exploratory excavations in Appendix A.

Gradation Analysis

Gradation analysis tests were performed on selected representative soil samples in general accordance with ASTM D 422. These test results were utilized in evaluating the soil classifications in accordance with the USCS. The grain-size distribution curves are shown on Figure B-1 through Figure B-10.

Atterberg Limits

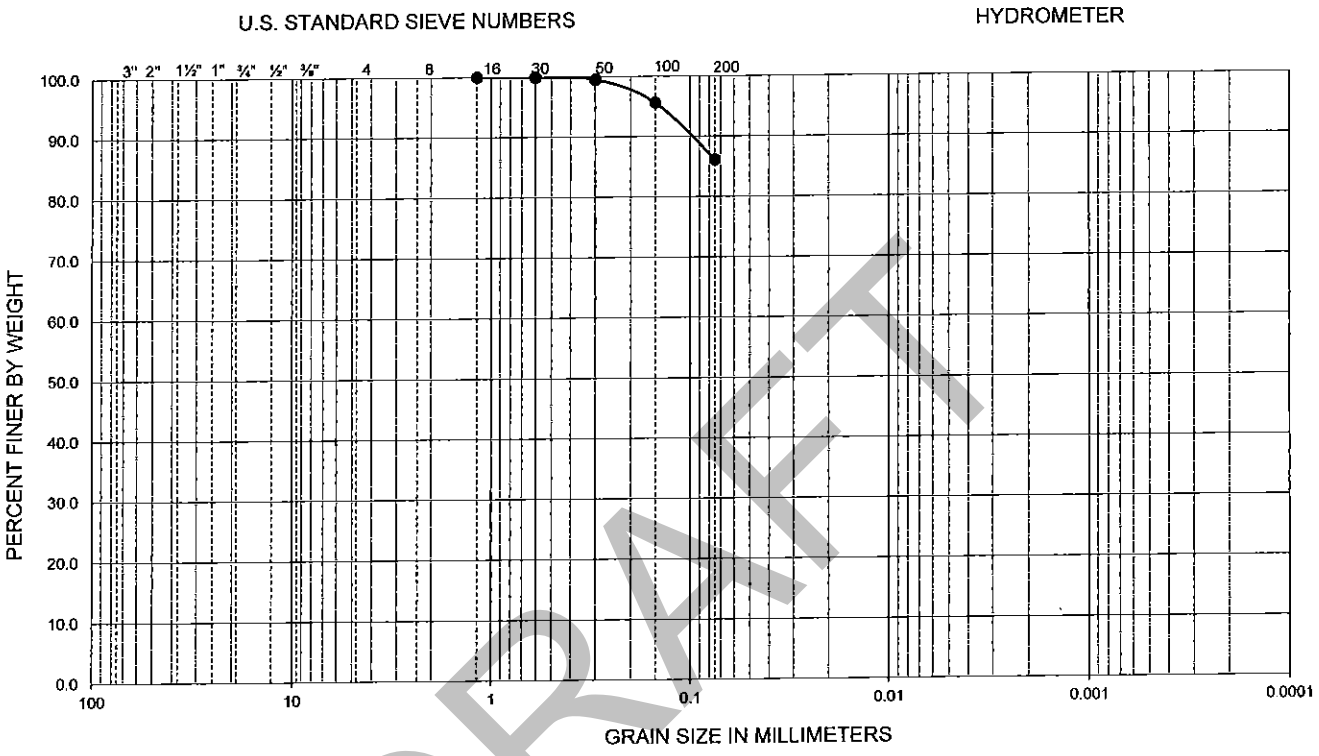
Tests were performed on selected representative soil samples to evaluate the liquid limit, plastic limit, and plasticity index in general accordance with ASTM D 4318. These test results were utilized to evaluate soil classification in accordance with the USCS. The test results and classifications are shown on Figure B-11 and Figure B-12.

Expansion Index

The expansion index of selected materials was evaluated in general accordance with ASTM D 4829. Specimens were molded under a specified compactive energy at approximately 50 percent saturation. The prepared 1-inch thick by 4-inch diameter specimens were loaded with a surcharge of 144 pounds per square foot and were inundated with tap water. Readings of volumetric swell were made for a period of 24 hours. The results of these tests are presented on Figure B-13.

DRAFT

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-1	5.0-6.5	64	22	42	--	--	--	--	--	86.1	CH

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Fat CLAY
0.0	13.9	86.1	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

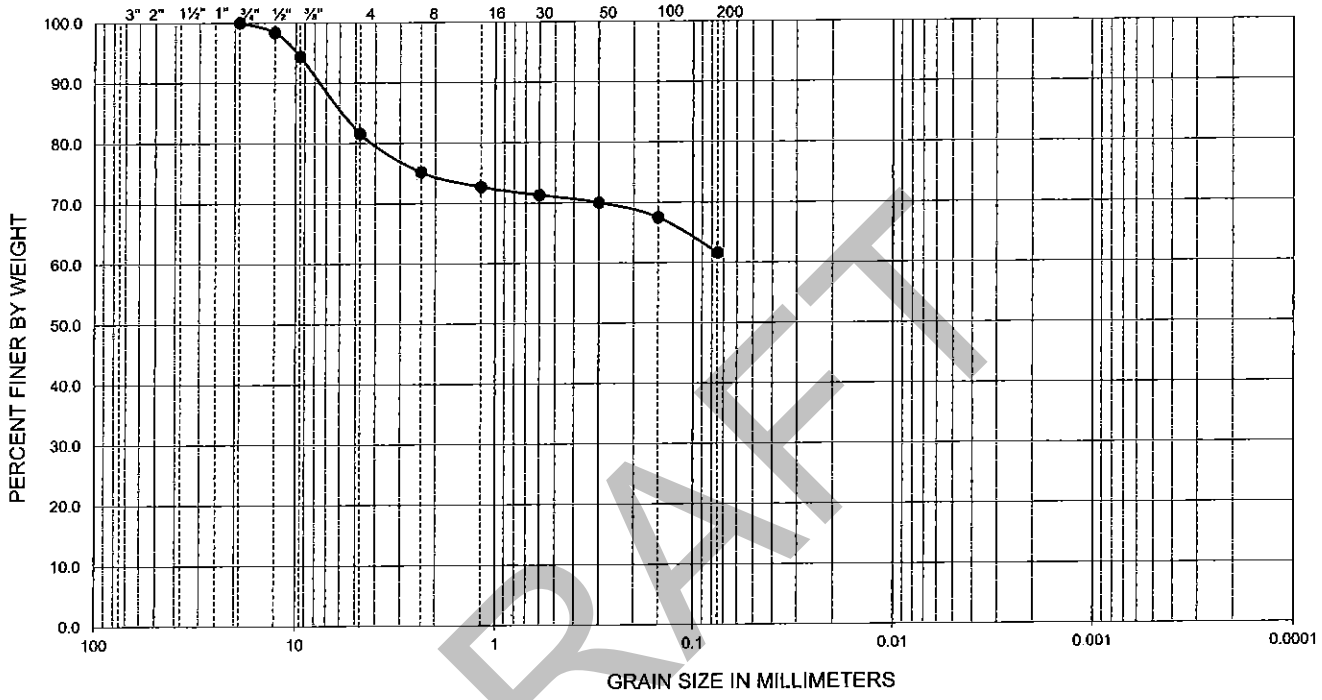
Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-1
303710001 / 4/15		

B-1 (303710001 SV B-1@5.0-6.5)

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-3	2.0-3.5	52	18	34	--	--	--	--	--	61.6	CH

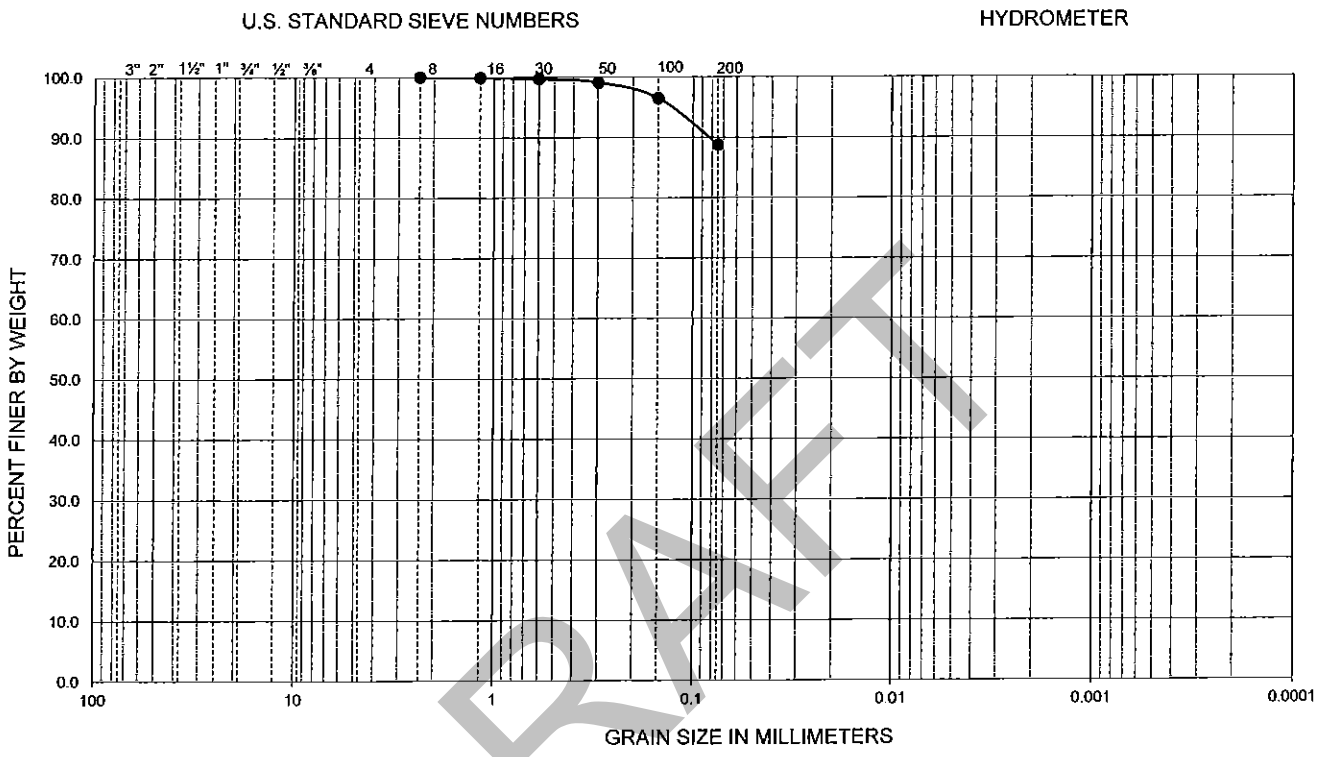
Material Percent by Weight			Soil Type
Gravel	Sand	Fines	
18.4	20.0	61.6	Sandy fat CLAY with gravel

NOTE:

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-2
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

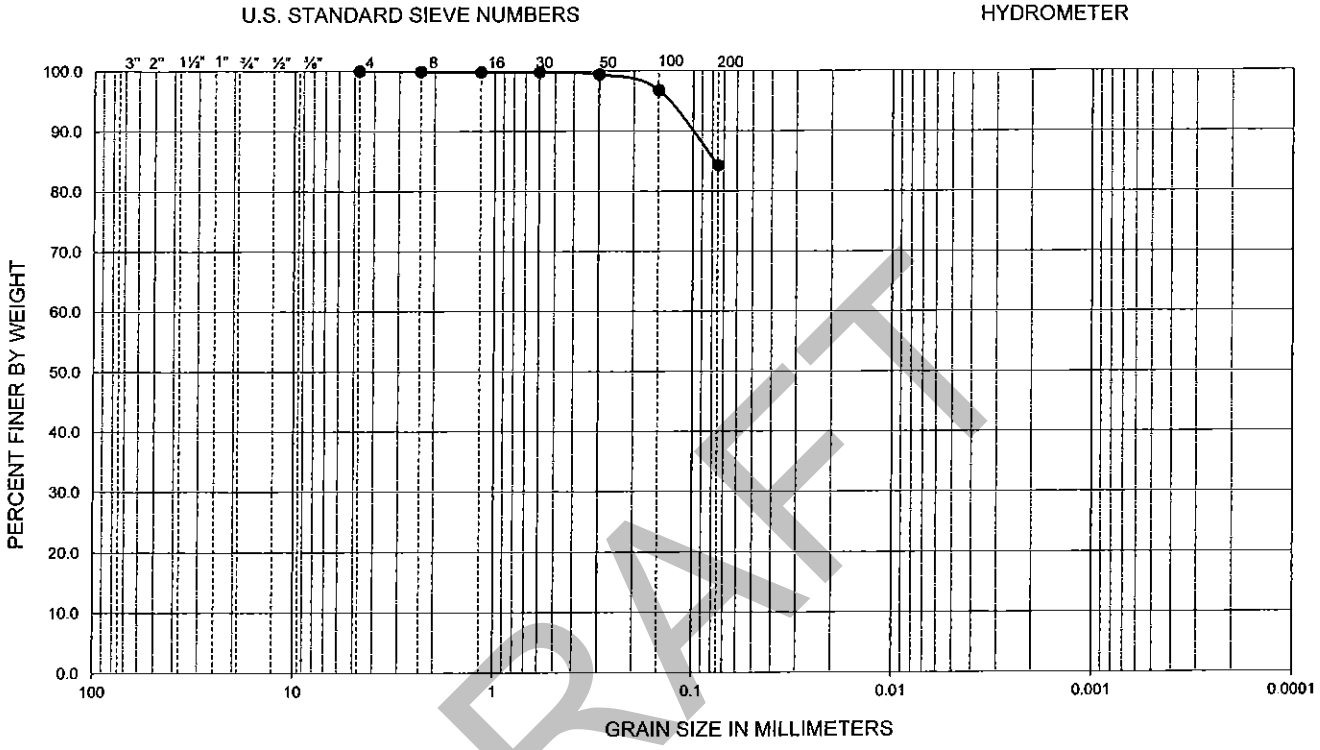
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-5	2.0-3.5	58	27	31	--	--	--	--	--	88.8	CH

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Fat CLAY
0.0	11.2	88.8	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-3
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

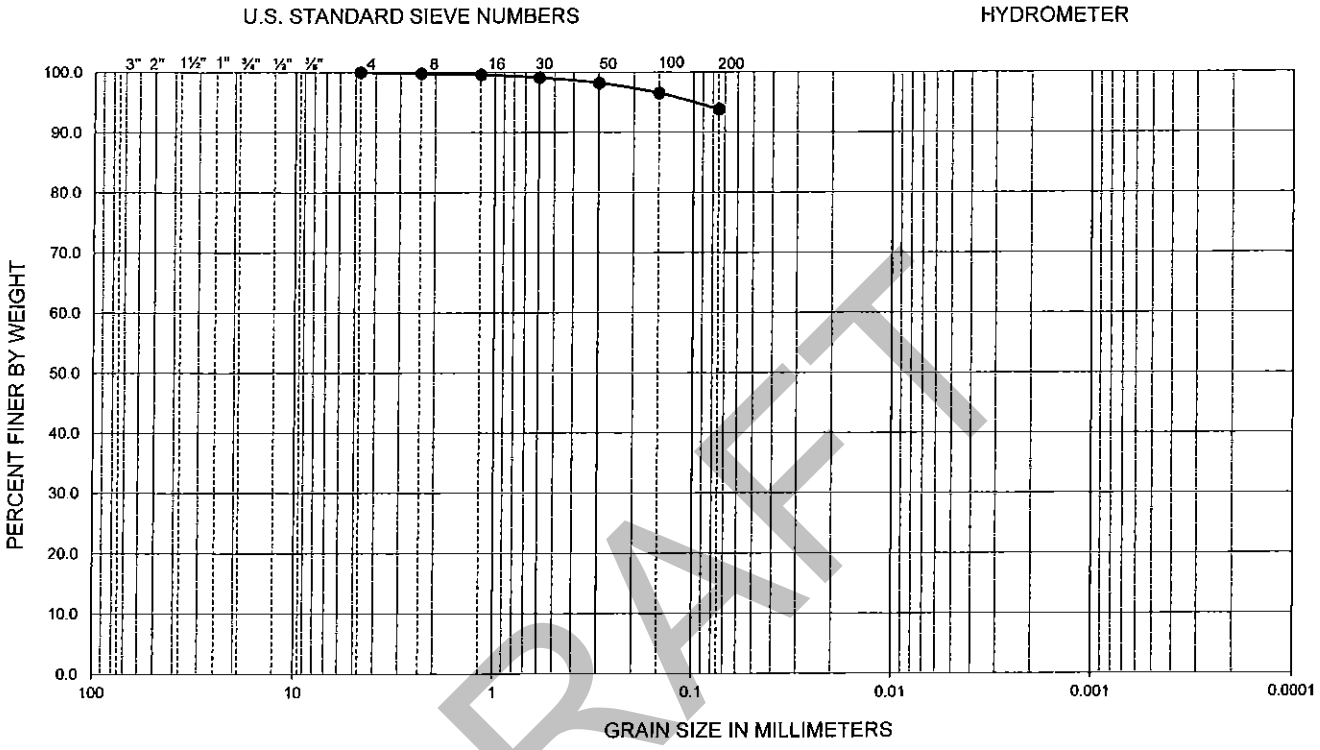
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-6	5.0-6.5	43	20	23	--	--	--	--	--	84.3	CL

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY with sand
0.0	15.7	84.3	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-4
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-9	5.0-6.5	38	21	17	--	--	--	--	--	93.8	CL

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY
0.0	6.2	93.8	

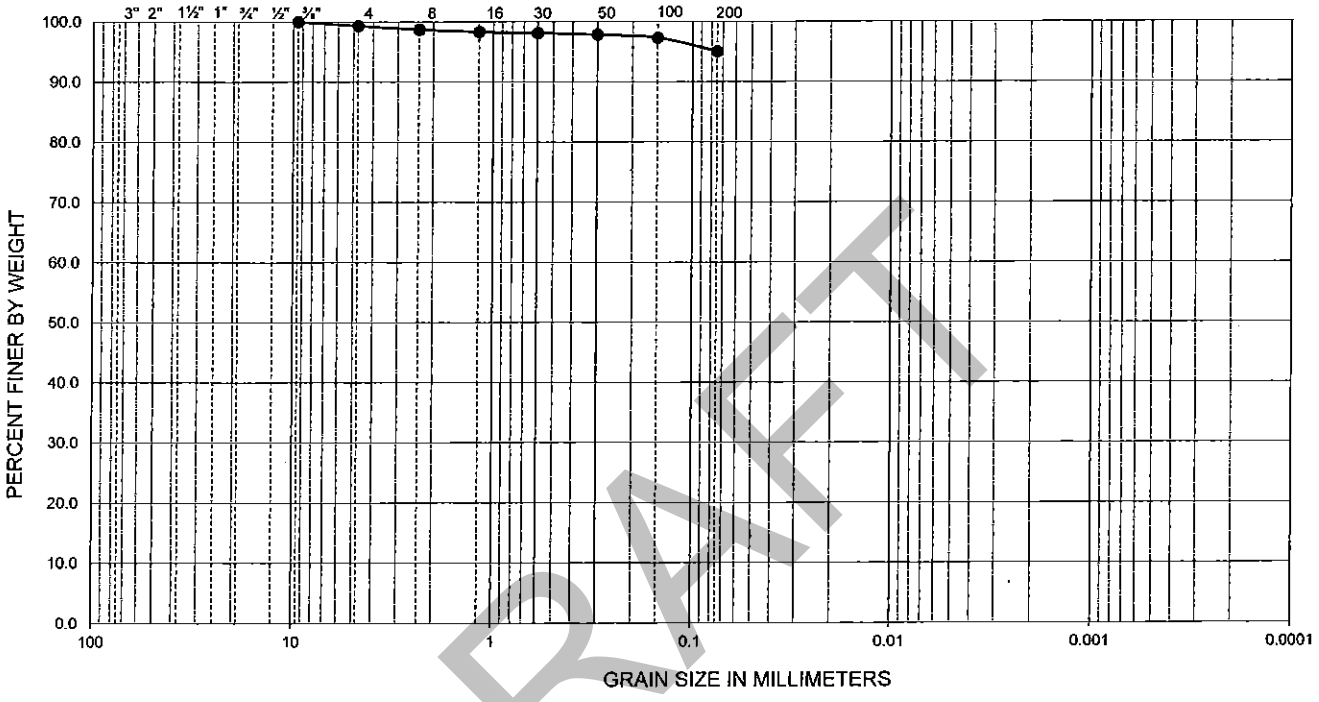
NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-5
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-12	5.0-6.5	24	16	8	--	--	--	--	--	95.0	CL

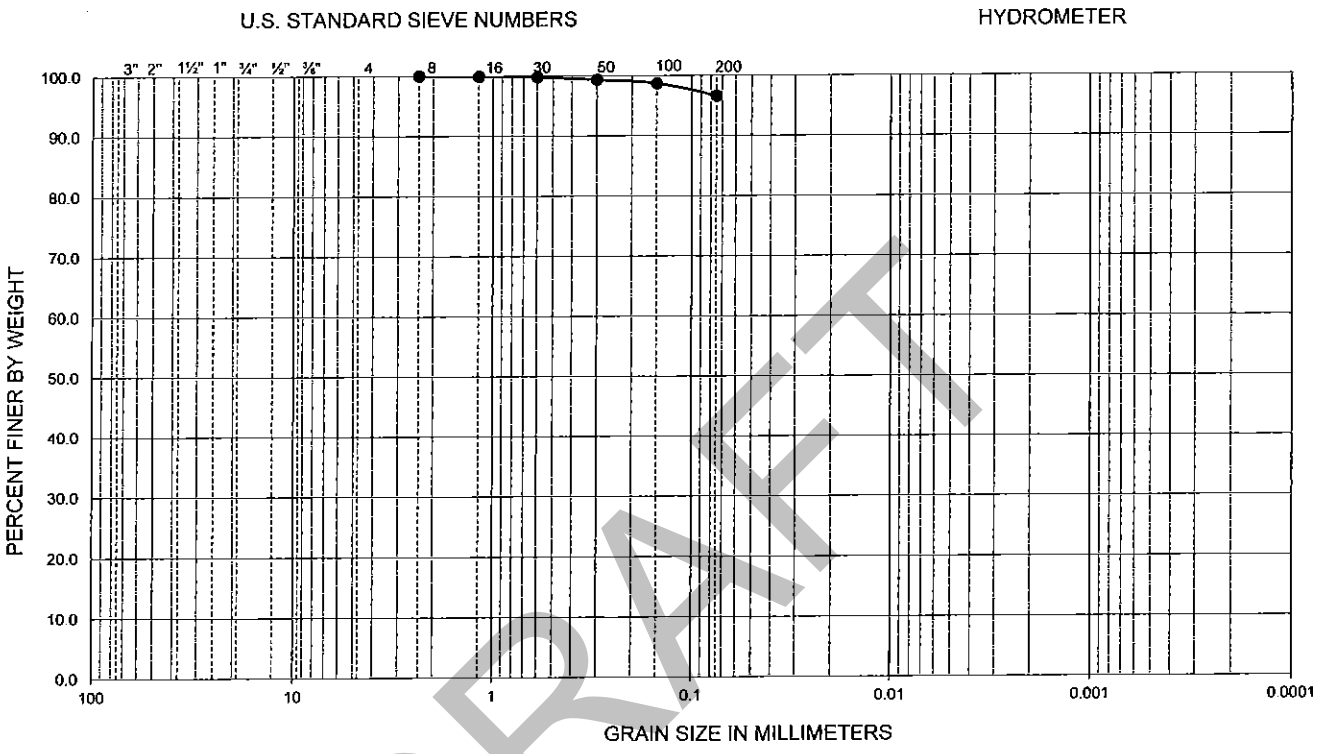
Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Lean CLAY
0.7	4.3	95.0	

NOTE:

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-6
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

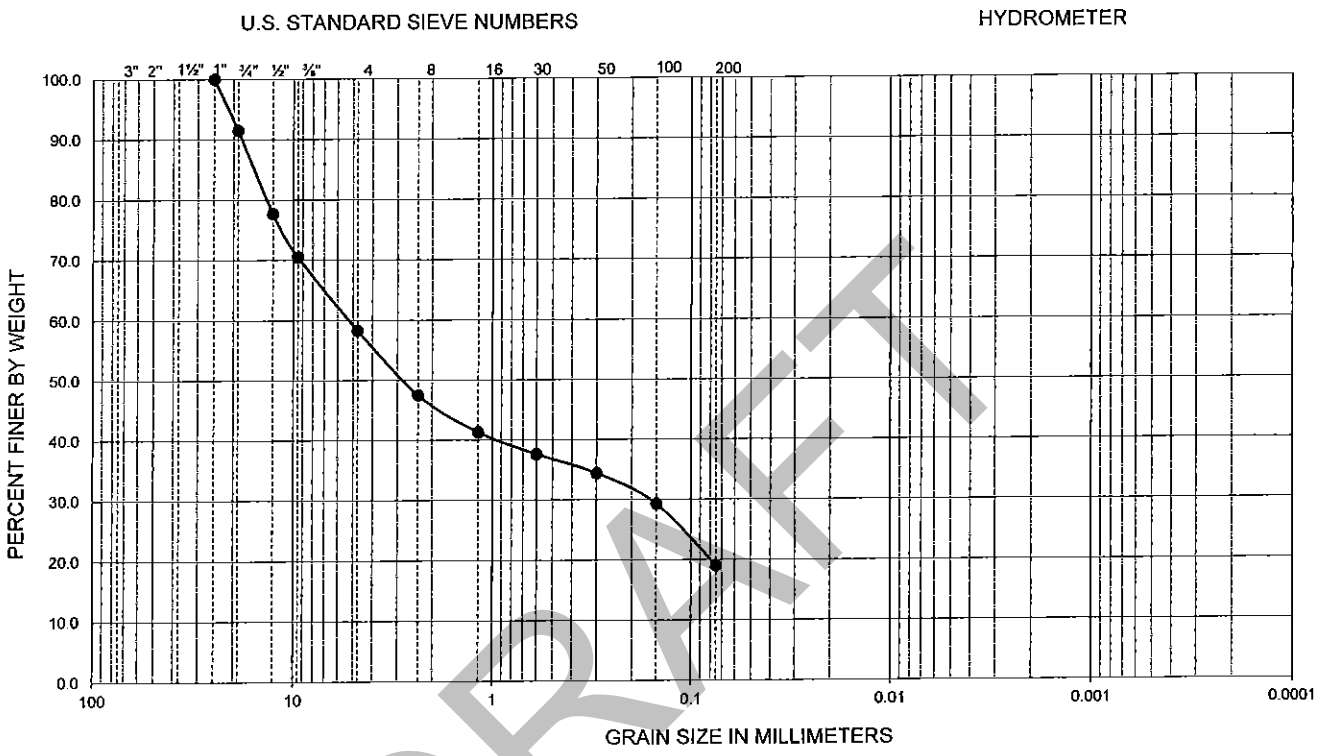
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-14	5.0-6.5	31	19	12	--	--	--	--	--	96.6	CL

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	
0.0	3.4	96.6	Lean CLAY

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-7
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-17	5.0-6.5	46	32	14	--	0.16	5.23	--	--	19.0	GM

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Silty GRAVEL with sand
41.7	39.3	19.0	

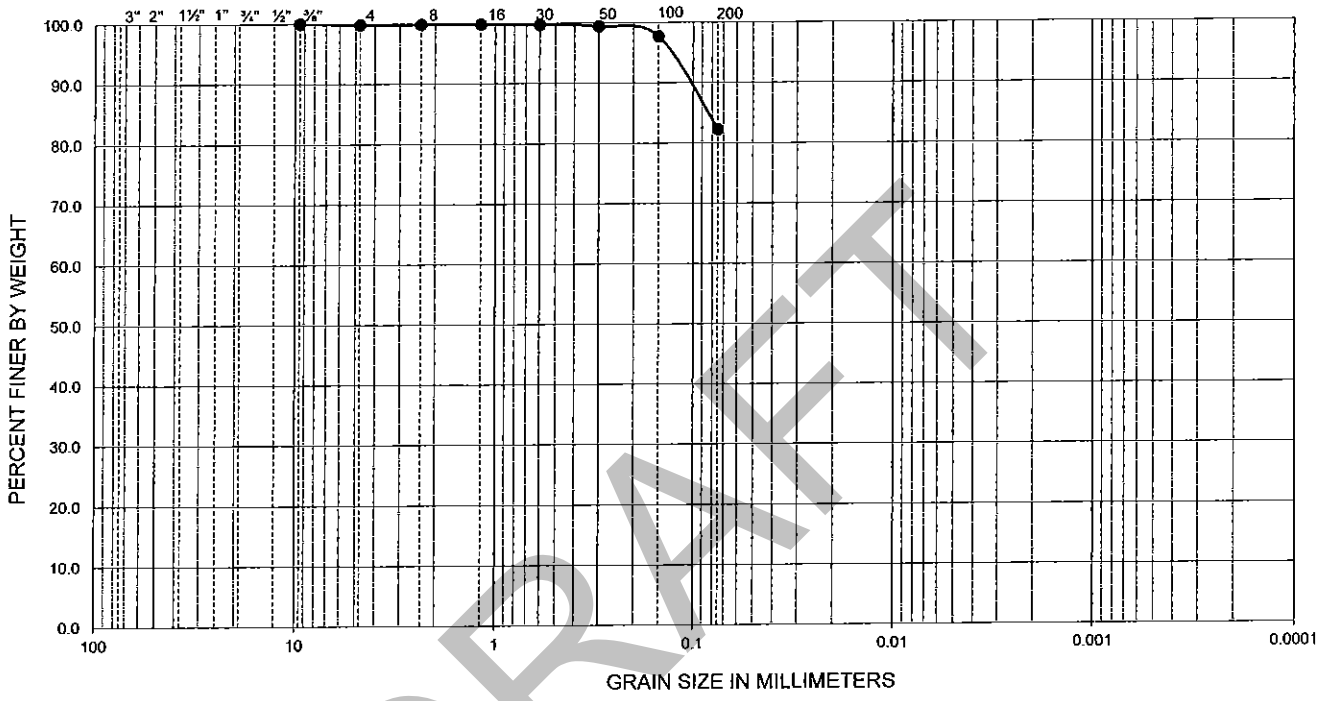
NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-8
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY

U.S. STANDARD SIEVE NUMBERS

HYDROMETER



DRAFT

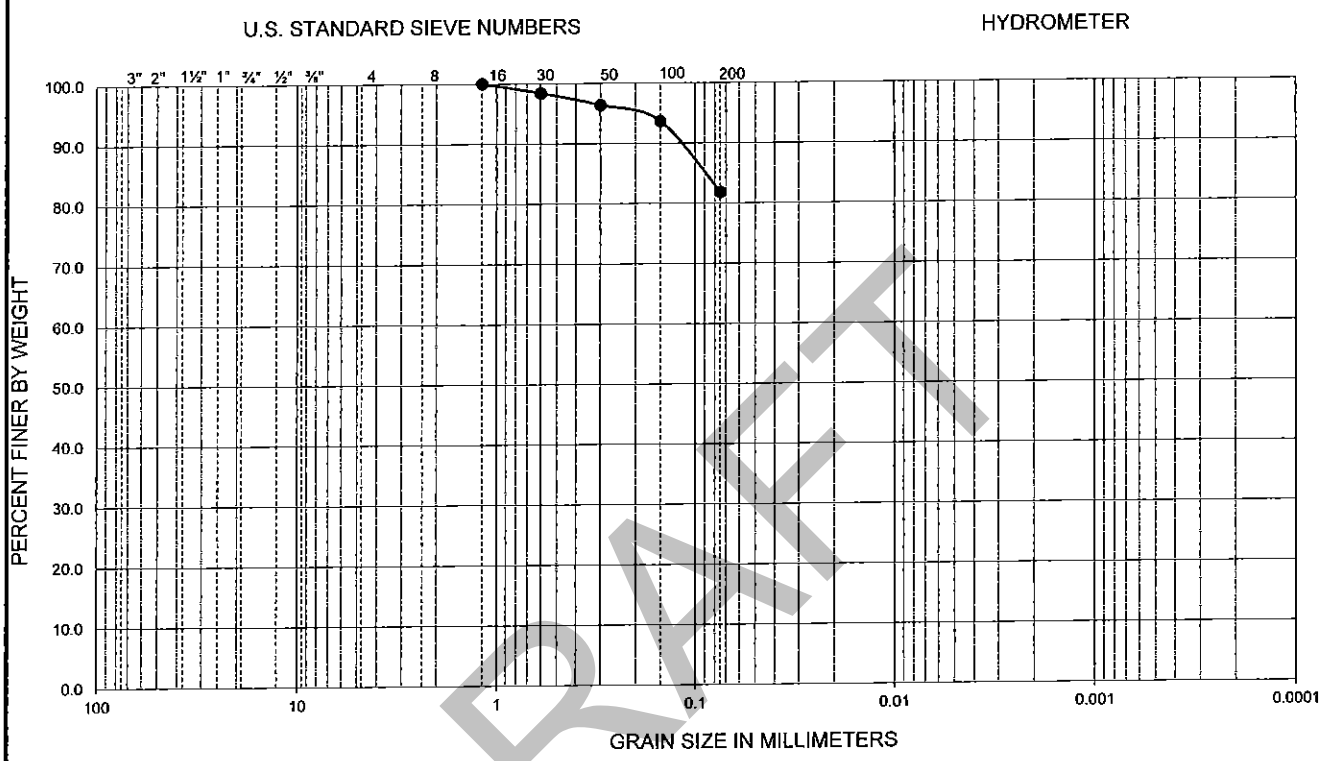
Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-18	10.0-11.5	27	20	7	--	--	--	--	--	82.3	CL-ML

Material Percent by Weight			Soil Type
Gravel	Sand	Fines	Silty CLAY with sand
0.2	17.5	82.3	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-9
303710001 / 4/15		

GRAVEL		SAND			FINES	
Coarse	Fine	Coarse	Medium	Fine	SILT	CLAY



DRAFT

Symbol	Sample Location	Depth (ft)	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	Passing No. 200 (%)	U.S.C.S
●	B-20	15.0-16.5	48	28	20	--	--	--	--	--	81.8	ML

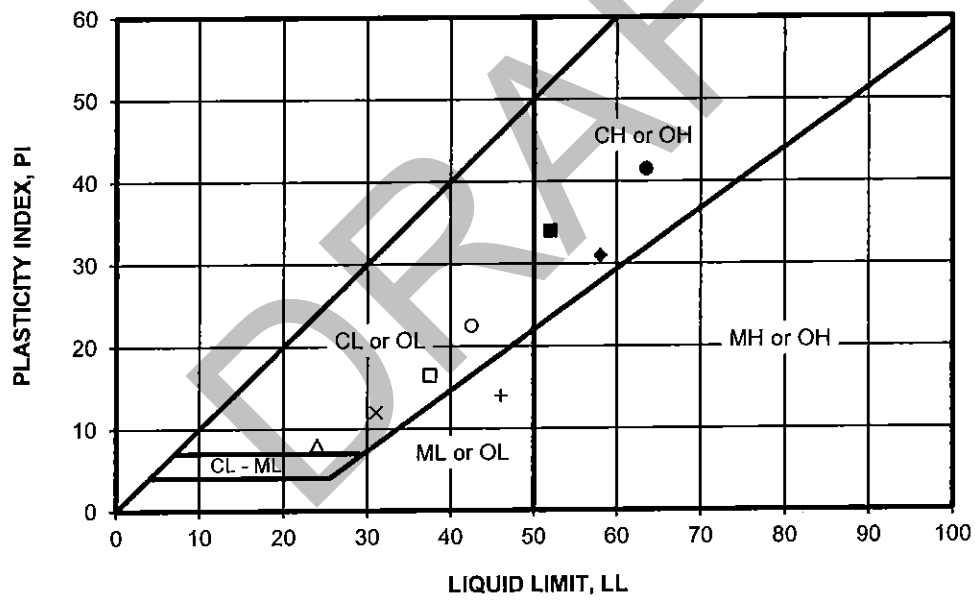
Material Percent by Weight			Soil Type
Gravel	Sand	Fines	SILT with sand
0.0	18.2	81.8	

NOTE:
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 422

Ninyo & Moore	GRADATION TEST RESULTS	FIGURE
PROJECT NO. / DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-10
303710001 / 4/15		

SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-1	5.0-6.5	64	22	42	CH	CH
■	B-3	2.0-3.5	52	18	34	CH	CH
◆	B-5	2.0-3.5	58	27	31	CH	CH
○	B-6	5.0-6.5	43	20	23	CL	CL
□	B-9	5.0-6.5	38	21	17	CL	CL
△	B-12	5.0-6.5	24	16	8	CL	CL
X	B-14	5.0-6.5	31	19	12	CL	CL
+	B-17	5.0-6.5	46	32	14	ML	GM

NP - INDICATES NON-PLASTIC



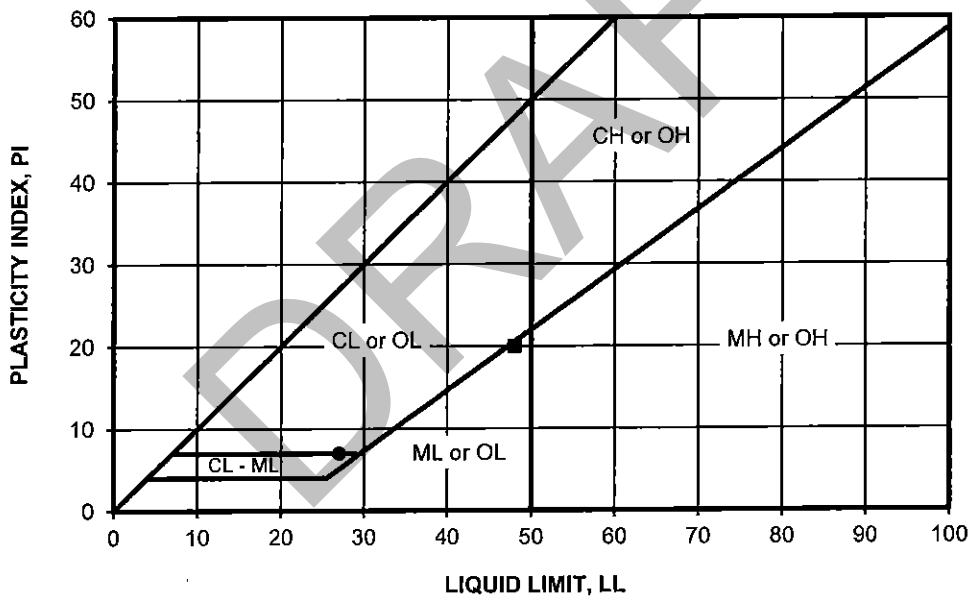
PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

DRAFT

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-11

SYMBOL	LOCATION	DEPTH (FT)	LIQUID LIMIT, LL	PLASTIC LIMIT, PL	PLASTICITY INDEX, PI	USCS CLASSIFICATION (Fraction Finer Than No. 40 Sieve)	USCS (Entire Sample)
●	B-18	10.0-11.5	27	20	7	CL-ML	CL-ML
■	B-20	15.0-16.5	48	28	20	ML	ML

NP - INDICATES NON-PLASTIC



DRAFT

PERFORMED IN GENERAL ACCORDANCE WITH ASTM D 4318

Ninyo & Moore	ATTERBERG LIMITS TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-12

SAMPLE LOCATION	SAMPLE DEPTH (FT)	INITIAL MOISTURE (%)	COMPACTED DRY DENSITY (PCF)	FINAL MOISTURE (%)	VOLUMETRIC SWELL (IN)	EXPANSION INDEX	POTENTIAL EXPANSION
B-1	5.0-6.5	13.0	97.6	37.4	0.140	140	Very High
B-3	2.0-3.5	11.0	106.0	32.6	0.130	130	High
B-6	5.0-6.5	13.0	97.4	31.0	0.086	86	Medium
B-9	5.0-6.5	11.5	103.2	27.8	0.075	75	Medium
B-12	5.0-6.5	13.0	97.9	19.3	0.054	54	Medium
B-16	5.0-6.5	11.0	104.3	23.0	0.041	41	Low
B-18	10.0-11.5	12.0	103.4	23.7	0.042	42	Low
B-20	15.0-16.5	14.5	94.1	37.9	0.083	83	Medium

PERFORMED IN GENERAL ACCORDANCE WITH ☐ UBC STANDARD 18-2 ☐ ASTM D 4829

DRAFT

Ninyo & Moore	EXPANSION INDEX TEST RESULTS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	B-13

APPENDIX C

CHEMICAL TEST RESULTS

The results of chemical tests performed are provided in this appendix.

DRAFT

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-1A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-1 @ 10.0-11.5'

Analysis	Result	Unit	Method
Sodium	0.05	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.02	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.03	%	Calculation
Total Salts (Solubility)	0.35	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-2A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-3 @ 5.0-6.5'

DRAFT

Analysis	Result	Unit	Method
Sodium	0.03	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.02	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.03	%	Calculation
Total Salts (Solubility)	0.15	%	SM2540B

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-3A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-5 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.04	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.03	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.04	%	Calculation
Total Salts (Solubility)	0.18	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY: _____

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-4A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-8 @ 2.0-3.5'

Analysis	Result	Unit	Method
Sodium	0.26	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.20	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.30	%	Calculation
Total Salts (Solubility)	1.24	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA:NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-5A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-10 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.42	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.47	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.70	%	Calculation
Total Salts (Solubility)	1.86	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-6A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-13 @ 5.0-6.5'

Analysis	Result	Unit	Method
Sodium	0.41	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.24	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.35	%	Calculation
Total Salts (Solubility)	1.69	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-7A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: --
Time Sampled: --

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-15 @ 2.0-3.5'

Analysis	Result	Unit	Method
Sodium	0.26	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.32	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.47	%	Calculation
Total Salts (Solubility)	1.55	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-8A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-17 @ 2.0-3.5'

Analysis	Result	Unit	Method
Sodium	0.07	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.23	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.23	%	Calculation
Total Salts (Solubility)	0.92	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: April 02, 2015

LABORATORY NO: 15-1718-9A

CLIENT: Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

PAGE: 1 of 1

CLIENT PROJECT: 303710001

CLIENT PO #:

ANALYST: SW/ET

Sampled By: Client
Date Sampled: –
Time Sampled: –

Date Received: 04/02/15
Time Received: 0915

Sample ID: B-20 @ 10.0-11.5'

Analysis	Result	Unit	Method
Sodium	0.19	%	ASTM D2791
Water Soluble Sulfate (SO_4)	0.15	%	SM4500E
Total Available Water Soluble Sodium Sulfate (Na_2SO_4)	0.22	%	Calculation
Total Salts (Solubility)	0.90	%	SM2540B

DRAFT

NOTES: The results for each constituent denote the percentage (%) for that particular element which is soluble in a 1:5 (soil to water) extraction ratio and corrected for dilution.

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 Las Vegas, NV 89120
Tel: 702-873-4478 Fax: 702-873-7967 www.ssalabs.com

APPENDIX D

EXPLORATORY BORING LOGS FROM OUR PREVIOUS EVALUATION

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. The pertinent boring logs (borings B-108 and B-109) from this evaluation are presented in this appendix.

DRAFT

DATE DRILLED 6/28/13 BORING NO. B-108

GROUND ELEVATION Not Measured SHEET 1 OF 1

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lb (auto. trip hammer) DROP 30"

SAMPLED BY RDB LOGGED BY RDB REVIEWED BY BLO

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOW COUNTS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8-3/4 to 9 inches thick.
						GP-GM	FILL MATERIAL: Brown, damp, medium dense, poorly graded GRAVEL with silt and sand (Base Material); unit is approximately 5 inches thick.
						SP-SM	Brown, damp, medium dense, poorly graded SAND with silt and gravel.
		9/6" 12/6" 14/6"	19.7	100.8		CL	NATIVE SOIL: Brown, moist, very stiff, sandy lean CLAY; slightly gypsiferous.
5		7/6" 13/6" 22/6"	29.0	90.5			
						GC	Light brown, moist, dense, clayey GRAVEL; few sand; slightly gypsiferous.
10		11/6" 12/6" 18/6"	37.9	78.2			
15		10/6" 9/6" 9/6"	35.0	79.9			Few white caliche nodules.
20							Total depth = 16.5 feet. Groundwater not encountered during drilling. Backfilled and patched on 06/28/13.

NOTE:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other factors as discussed in the report.

DRAFT

Ninyo & Moore

BORING LOG

BONANZA-MOJAVE REUSE PIPELINE, FREEDOM PARK TO SLOAN LANE
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303599001	10/13	A-8

DATE DRILLED 6/19/13 BORING NO. B-109

GROUND ELEVATION Not Measured SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lb (auto. trip hammer) DROP 30"

SAMPLED BY RDB LOGGED BY RDB REVIEWED BY BLO

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOW COUNTS	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	DESCRIPTION/INTERPRETATION
0							ASPHALT CONCRETE: Approximately 8-1/4 to 8-1/2 inchest thick.
						GP-GM	FILL MATERIAL: Brown, damp, medium dense, poorly graded GRAVEL with silt and sand (Base Material); unit is approximately 7 inches thick.
						SP-SM	Brown, damp, medium dense, poorly graded SAND with silt and gravel.
		10/6" 5/6" 10/6"	25.5	94.7		CL	NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY.
5		3/6" 4/6" 6/6"	30.5	87.6			Stiff.
						GC	Light brown; moist; medium dense, clayey GRAVEL; few sand.
10		3/6" 5/6" 8/6"	16.2	103.8			
15		7/6" 10/6" 10/6"	17.8	106.4			Dense.
20							Total depth = 16.5 feet. Groundwater not encountered during drilling. Backfilled and patched on 06/19/13.

NOTE:
Groundwater, though not encountered at the time of drilling, may rise to a higher level due to seasonal variations in precipitation and several other fators as discussed in the report.

DRAFT

Ninyo & Moore

BORING LOG

BONANZA-MOJAVE REUSE PIPELINE, FREEDOM PARK TO SLOAN LANE
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303599001	10/13	A-9

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

HYDROGEOLOGIC AQUIFER TESTING REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 15, 2015
Project No. 303710002

April 15, 2015
Project No. 303710002

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

Subject: Hydrogeologic Aquifer Testing Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith are the results of Ninyo & Moore's hydrogeologic aquifer testing for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purpose of this testing was to estimate the hydrogeologic conditions present along the project alignment which will be utilized in preparation of a National Pollutant Discharge Elimination System (NPDES) discharge permit application for proposed dewatering associated with the project. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

Courtney J. Brooks, CEM
Senior Hydrogeologist

Robert M. Troisi, CEM
Managing Principal
Environmental Sciences Division

CB/NB/RMT/dh

Distribution: (1) Addressee (via e-mail)

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Appendix A – Monitoring Well Logs
Appendix B – Laboratory Reports and Chain-of-Custody Records
Appendix C – Hydrogeologic Aquifer Test Analyses and Modeling

1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed preliminary hydrogeologic testing for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purpose of this testing was to estimate the hydrogeologic conditions present along the project alignment which will be utilized in preparation of a National Pollutant Discharge Elimination System (NPDES) discharge permit application for proposed dewatering associated with the project. This report presents the methodologies, findings, opinions, conclusions, and recommendations regarding the hydrogeologic conditions along the project alignment.

This study was performed concurrently with a geotechnical evaluation, also performed by Ninyo & Moore. A report presenting the results of the geotechnical evaluation (Ninyo & Moore, 2015) was submitted under separate cover.

2. SCOPE OF SERVICES

In accordance with our approved scope of work, Ninyo & Moore performed the following tasks.

- Coordinated the installation and development of four temporary groundwater monitoring wells collocated in geotechnical borings B-1, B-2, B-6, and B-20 advanced along the project alignment.
- Collected groundwater samples from temporary monitoring wells to measure groundwater quality. The water samples were submitted to an NDEP-certified analytical laboratory in accordance with chain-of-custody procedures.
- The groundwater samples were analyzed for the following NDEP Profile I parameters and General *DeMinimis* groundwater discharge application Category 4 parameters, as well as perchlorate and fecal coliform bacteria.
- Multiple falling head and rising head tests were performed in the temporary monitoring wells to estimate the aquifer conditions at each location. The aquifer test data was analyzed to estimate the hydraulic conductivity values in the vicinity of the proposed excavations.
- Hydrogeologic data derived from this study was utilized to create multiple finite difference groundwater models, which simulated various well configurations and pumping scenarios to estimate the expected pumping rates capable of dewatering the excavations to target levels.

- The hydrogeologic data and groundwater model output from this study may be utilized to prepare an NDEP NPDES discharge permit application for the proposed dewatering program.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

4. FINDINGS

Ninyo & Moore performed hydrogeologic testing to obtain information to prepare a General *DeMinimus* groundwater discharge permit application for submittal to the NDEP. Our findings are summarized in the sections below.

4.1. Monitoring Well Installation

Beginning on March 6, 2015, Ninyo & Moore observed the installation of four temporary groundwater monitoring wells collocated in geotechnical borings B-1, B-2, B-6 and B-20. The monitoring well boring depths ranged from approximately 15 to 25 feet below existing

grade with truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The temporary groundwater monitoring wells consist of 2-inch diameter, 0.02-inch factory-machine slotted screens flush-threaded to 2-inch diameter schedule 40 polyvinyl chloride blank casing to the existing grade. Clean silica sand filter material was placed in the annulus around the perforated section of each casing. Upon completion, Ninyo & Moore staff utilized a submersible development pump with clean, dedicated tubing to remove the fine materials from the well casings and filter packs. The temporary monitoring wells were abandoned upon completion of testing. The approximate locations of the temporary monitoring wells are shown on Figure 2.

It is anticipated that the target of dewatering will be to lower the groundwater level to approximately 3 feet below the estimated maximum design depth of the planned channel excavations. Based on preliminary design specifications and our conversations with Atkins personnel, it is our understanding that the channel invert elevations along the alignment will range from approximately 1,745.5 feet above mean sea level (AMSL) near B-20 to 1,780 feet AMSL near B-1.

Subsurface geotechnical and hydrologic conditions observed as part of Ninyo & Moore's geotechnical study (Ninyo & Moore, 2015), which was submitted under separate cover, were reviewed as part of this study.

4.2. Groundwater

Groundwater was encountered in 12 of 20 exploratory borings advanced as part of Ninyo & Moore's geotechnical evaluation for the subject project. Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, surface water seepage through expansion joints in the existing channel, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this

study. Table 1 summarizes the groundwater and invert elevations observed in our borings performed as part of Ninyo & Moore's geotechnical evaluation for the subject project.

4.3. Groundwater Sampling and Analysis

Following development and purging, the temporary monitoring well was sampled utilizing clean disposable polyethylene bailers. The groundwater samples were placed in clean, laboratory-supplied containers and labeled according to the sample location, date, analysis requested, and the name of the person collecting the sample. The samples were stored in an insulated cooler, preserved on ice, and delivered under chain-of-custody protocol to an NDEP-certified laboratory for water quality analysis. The groundwater samples were analyzed for NDEP Profile I and General DeMinimis groundwater discharge Category 4 parameters, as well as for fecal coliform bacteria and perchlorate by EPA Method 331.

Tables 2 through Table 4 summarize the sample analytical results for the parameters. The analyte concentrations are printed in bold for samples that are reported above the NDEP Profile 1 and/or Category 4 recommended discharge limits. These include Sulfate and Total Dissolved Solids (TDS) in B-1, B-2, B-6 and B-20, and Chloride in B-1 and B-20. Copies of the complete laboratory report and chain-of-custody record are presented in Appendix B.

4.4. Hydrogeologic Aquifer Testing

Multiple hydraulic displacement (slug) tests were performed in the temporary monitoring well to estimate aquifer characteristics in the vicinity of the proposed excavations. The procedure involved the sudden introduction of a mechanical slug into (falling head), or the sudden removal of the mechanical slug from (rising head) the well casing. These actions caused the groundwater level to rise or fall, respectively. The water level displacement and subsequent rate of recovery was recorded and later analyzed utilizing the hydrogeologic software, Aqtesolv™, to estimate the hydraulic conditions of the aquifer in the vicinity of the monitoring well. The data analysis included the Hvorslev method (1951) and the Bouwer and Rice method (1976 and 1989), two comparable techniques for estimating the hydraulic

conductivity (K) from slug displacement test data (rising and falling head) in unconfined aquifers.

The displacement test analyses for the temporary monitoring wells, which are summarized in Appendix C, ranged from 0.8 feet per day (ft/d) to 33.2 ft/d. Data for the full hydrogeologic analysis is presented in Appendix C.

It is our understanding that the target dewatering depth for the channel excavations is approximately 3 feet below the deepest expected invert depth along the alignment.

4.4.1. Assumptions

It is assumed that no more than 500 linear feet of excavation will be open at one time during construction operations. It is expected that groundwater discharged from the dewatering systems will be pumped to one or more settling tanks, as necessary, prior to discharge to the same wash down gradient from the dewatering operations.

4.4.2. Finite Modeling

The hydraulic conductivity values were incorporated into numerical, finite difference, groundwater models to simulate the expected water level changes caused by various pumping scenarios under the modeled conditions.

The groundwater model processing platform, Groundwater Vistas, was utilized to create groundwater simulations utilizing the Modflow method (2007). Computerized finite difference groundwater models were set out on a grid with uniform 10 feet row and column spacings. The models assume that homogeneous and isotropic aquifer conditions exist horizontally across the grid similar to those ascertained from lithologic drill log and aquifer tests obtained from the temporary monitoring wells. The models' general head boundaries create a slight west to east trending water table gradient, mimicking the regional gradient across that portion of the Las Vegas Valley. The models were run until steady-state groundwater conditions were achieved. Multiple simulations

were performed with varying numbers and configurations of wells to estimate the desired water-table changes.

Groundwater was measured in our geotechnical borings at elevations ranging from approximately 1,742.1 to 1,783.2 feet AMSL, which is approximately 3.6 to 5.8 feet above the anticipated target dewatering depths in the western portion of the alignment. As the water in the lined channel could possibly be feeding the shallow alluvial aquifer due to seepage via expansion joints, depth to groundwater may decrease with closer proximity to the existing channel base, thereby increasing the potential need for additional dewatering during construction of the proposed channel improvements. However, this study cannot confirm this assumption. . In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, it is not likely to require dewatering of more than 3 feet. Ninyo & Moore prepared three groundwater models to simulate the effect of 6 dewatering wells set at 100-foot intervals along a 500-foot transect near B-1, B-6, and B-20 which simulate 500-linear foot cut and fill trenches.

The simulated wells in each model were assumed to be 10 inches in diameter and screened to 10 feet below the target dewatering elevations. The wells were programmed to pump at a constant rate for the duration of each simulation until steady state conditions were achieved.

Based on the hydrogeologic conditions and assumptions described above, the model simulations were performed utilizing the highest estimated hydraulic conductivity values for each end of the proposed excavation (near Pecos Road and near Las Vegas Wash). Based on our hydrogeologic analysis, a combined flow rate ranging from approximately 6 gallons per minute (gpm) to 18 gpm could be expected to lower the water table approximately 5 to 6 feet within an adjacent 500 linear foot trench in the western portion of the alignment. In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, a flow rate of approximately 120 gpm could be expected to lower the water

table approximately 3 feet within an adjacent 500 linear foot trench. These combined flow rates would be less than the 250 gpm threshold limit for a *DeMinimis* discharge permit.

Due to the very limited number of field tests relative to the length of the proposed alignment, the predicted dewatering flow rates should be treated as estimates only and not considered a dewatering design plan. Aquifer conditions may vary across the approximately 10,400 linear feet alignment where hydrogeologic testing was not performed. The hydrogeologic aquifer testing and analyses and modeling are summarized in Appendix C.

5. SUMMARY

A summary of our findings are presented as follows:

- Groundwater was measured in our geotechnical borings at elevations ranging from approximately 1,742.1 to 1,783.2 feet AMSL, which is approximately 3.6 to 5.8 feet above the anticipated target dewatering depths along the western portion of the project alignment. Ninyo & Moore recommends that the client apply for a *DeMinimis* discharge permit.

- As the water in the existing lined channel could possibly be feeding the shallow alluvial aquifer in the area, depth to groundwater may decrease with closer proximity to the channel base, thereby increasing the potential need for additional dewatering during construction of proposed channel improvements.

- Based on our hydrogeologic analysis, a combined flow rate ranging from approximately 6 gpm to 18 gpm could be expected to lower the water table approximately 5 to 6 feet within an adjacent 500 linear foot trench in the western portion of the alignment. In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, a flow rate of approximately 120 gpm could be expected to lower the water table approximately 3 feet within an adjacent 500 linear foot trench. These flow rates would be less than the 250 gpm threshold limit for a *DeMinimis* discharge permit. Due to the relatively tight hydraulic conditions measured during this study, a modeled interval of 100-feet between wells was modeled instead of the typical 50-feet interval. If field conditions are found to require a more robust pumping operation, additional wells set at a shorter interval may be necessary.

- Based upon a review of the laboratory results for the groundwater samples collected from the temporary monitoring wells B-1, B-2, B-6 and B-20, the following parameters reported

concentrations above the NDEP recommended discharge limits: Sulfate and Total Dissolved Solids (TDS) in B-1, B-2, B-6 and B-20, and Chloride in B-1 and B-20. Treatment of the discharge waters would not likely be required for a *DeMinimis* permit.

6. OPERATIONAL MONITORING RESPONSIBILITIES

Ninyo & Moore recommends that the following bulleted list of issues be considered prior to commencing with the proposed dewatering operation:

- The NDEP General *DeMinimis* discharge permits, when approved, will be issued to the owner, along with a list of limitations and a compliance reporting schedule. Ninyo & Moore recommends that the owner require the dewatering contractor to fully comply with permit conditions, and be responsible for any violations and penalties incurred due to non-compliance.

- Based on the results of this study, to adequately dewater the proposed excavations as planned, the discharge rate is not likely to exceed the 250 gpm limit for a NDEP *DeMinimis* discharge permit for each outfall.

- During the planned construction, the operation of the dewatering wells should be closely monitored to ensure that all compliance monitoring and testing are performed, as will be required by the NDEP General *DeMinimis* groundwater discharge permit.

- Existing structures within the limits of groundwater drawdown resulting from dewatering may be at risk of experiencing settlement. The amount of settlement, if it occurs, would depend primarily on the depth and duration of the dewatering, as well as subsurface soil conditions. It is recommended that survey points be installed and monitored to evaluate potential settlement of nearby structures and that a photographic survey of the adjacent structures be conducted to monitor evidence of distress prior to the beginning of dewatering operations. If significant movement/damage occurs, dewatering operations should be temporarily suspended and the project's geotechnical consultant/owner's representative should be informed. Recommendations for mitigating settlement and associated distress should be provided by the geotechnical consultant/owner's representative.

- There is a potential for hydrogeologic conditions to be encountered that might require additional dewatering wells, deeper dewatering wells, and/or increased groundwater pumping and increased discharge rates to achieve the dewatering goal for the planned excavations. If an increased discharge rate is required, the NDEP might require from 6 to 9 months for issuing a new permanent NPDES permit for an increased discharge rate for this project.

7. LIMITATIONS

The dewatering discharge estimates provided in this report have been estimated from limited hydrogeologic testing performed at one location. The estimates presented in this report should be used for initial planning purposes and completion of the discharge permit only. The estimates are not presented, nor should they be construed, as a dewatering design plan.

The environmental and hydrological services described in this report have been conducted in general accordance with current regulatory guidelines and the standard of care exercised by consultants performing similar work in the project area. No other warranty, expressed or implied, is made regarding the professional opinions presented in this report. Please note that this study is based on a limited scope of work, and it did not include an extensive evaluation of geotechnical conditions or potential geologic hazards.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires any additional information or has questions regarding the content, interpretations presented, or completeness of this document.

The findings, opinions, and conclusions are based on an analysis of the observed site conditions and the referenced literature. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control. Ninyo & Moore cannot warrant or guarantee that not finding indicators of any particular hazardous material means that this particular hazardous material or any other hazardous materials do not exist in the groundwater below the site. Additional research, including additional chemical and hydrological testing, can reduce the uncertainty, but no techniques now commonly employed can eliminate the uncertainty altogether.

8. NEVADA CERTIFIED ENVIRONMENTAL MANAGER

In accordance with the Nevada Revised Statutes 459.500, Section 1, a holder of a certificate who is responsible for a service requiring certification shall ensure that each document relating to the service includes the following language:

> *I, Robert M. Troisi, hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state, and local statutes, regulations, and ordinances.*

Robert M. Troisi, CEM
Certified Environmental Manager
No. 1247
Expires: January 15, 2017

4/15/15
Date

9. REFERENCES

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Ninyo & Moore, proprietary in-house data.

TABLES

Table 1 –Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Invert Elevation (feet-amsl)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)	Dewatering Target Depth below Static Groundwater (feet)
B-1	1795.4	1,780.4	12.2	1,783.2	5.8
B-2	1791.6	1,776.6	12.7	1,778.9	5.3
B-3	1783.9	1,773.9	8.2	1,775.7	4.8
B-4	1781.9	1,771.9	8.4	1,773.5	4.6
B-5	1779.6	1,771.6	6.9	1,772.7	4.1
B-6	1778.2	1,769.2	8.4	1,769.8	3.6
B-10	1772.5	1,764.5	13.6	1,758.9	0
B-16	1764.1	1,755.1	13.6	1,750.5	0
B-17	1761.7	1,752.7	15.4	1,746.3	0
B-18	1762.3	1,748.3	18.4	1,743.9	0
B-19	1761.7	1,748.7	18.7	1,743.0	0
B-20	1760.5	1,745.5	18.4	1,742.1	0

*Measured from top of ground surface adjacent to borings.

Table 2 - Groundwater Analytical Results - Metals							
Analyte						Groundwater Standards	
	B-1	B-2	B-6	B-20	Reporting Limit	Federal	RSL
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Alluminum	3.2	0.12	<0.25	<0.25	0.25		
Antimony	<.0005	<.0005	<.0005	<.0005	0.0005	0.006	0.015
Arsenic	0.0064	0.0047	0.0058	0.0019	0.0001	0.010	0.000045
Barium	0.12	0.012	0.0057	<0.001	0.0010	2	2.6
Beryllium	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.004	0.073
Boron	2.2	0.4	0.78	1.7	0.05		7.3
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.005	0.018
Calcium	310	140	230	260	0.5		
Chromium	0.0047	0.0011	0.0012	<0.001	0.0010	0.1	55
Copper	<0.001	<0.001	<0.001	<0.001	0.0010	1.3	1.5
Iron	1.3	<0.5	<0.5	<0.0005	0.0005	0.30	26
Lead	<0.005	<0.001	<0.001	<0.001	0.001	0.015	
Manganese	0.039	<0.0005	<0.0005	0.0068	0.0005	0.05	0.88
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.002	0.011
Magnesium	370	200	290	410	0.1		
Molybdenum	0.005	0.012	0.0022	0.094	0.0005		0.18
Nickel	0.0019	<0.001	<0.001	<0.001	0.0010		0.73
Potassium	61	19	39	50	5		
Selenium	0.0068	0.0021	0.0075	0.024	0.001	0.05	0.18
Silver	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.1	0.18
Sodium	320	110	220	390	25		
Thallium	<0.0025	<0.0005	<0.0005	<0.0005	0.0005	0.002	0.0024
Zinc	<0.01	<0.01	<0.01	<0.01	0.010	5	11
Chloride	**480**	94	240	**390**	50	250	
Fluoride	1.3	0.96	1.4	2.4	0.5	4	2.20
Nitrogen, Nitrite (as N)	<0.5	<0.5	<0.5	<0.5	0.5	1	1
Nitrogen, Nitrate (as N)	4.5	1	4.4	6.3	0.5	10	10
Sulfate	**2400**	**880**	**1400**	**2200**	200	250	
Sulfur	820	370	630	920	50		
Hardness, Calcium (As $CaCO_3$)	780	340	580	650	0.5		
Hardness, Total	2300	1200	1800	2300	1		
pH (pH units)	7.6	7.6	7.6	7.4			
Suspended Solids (Residue-Non Filterable)	260	21	15	19	10		
Total Disolved Solids (Residue, Filterable)	**4400**	**1700**	**2700**	**4200**	33	500	
Phosphorus, Total	0.047	<0.02	<0.02	0.048	0.020		
Alkalinity, Bicarbonate (As $CaCO_3$)	440	230	240	290	5		
Alkalinity, Carbonate (As $CaCO_3$)	<5	<5	<5	<5	5		
Alkalinity, Hydroxide (As $CaCO_3$)	<5	<5	<5	<5	5		
Alkalinity, Total (As $CaCO_3$)	440	230	240	290	5		
Bio.Oxygen Demand (BOD) - field measurement	2.31	6.24	6.12	0.96			

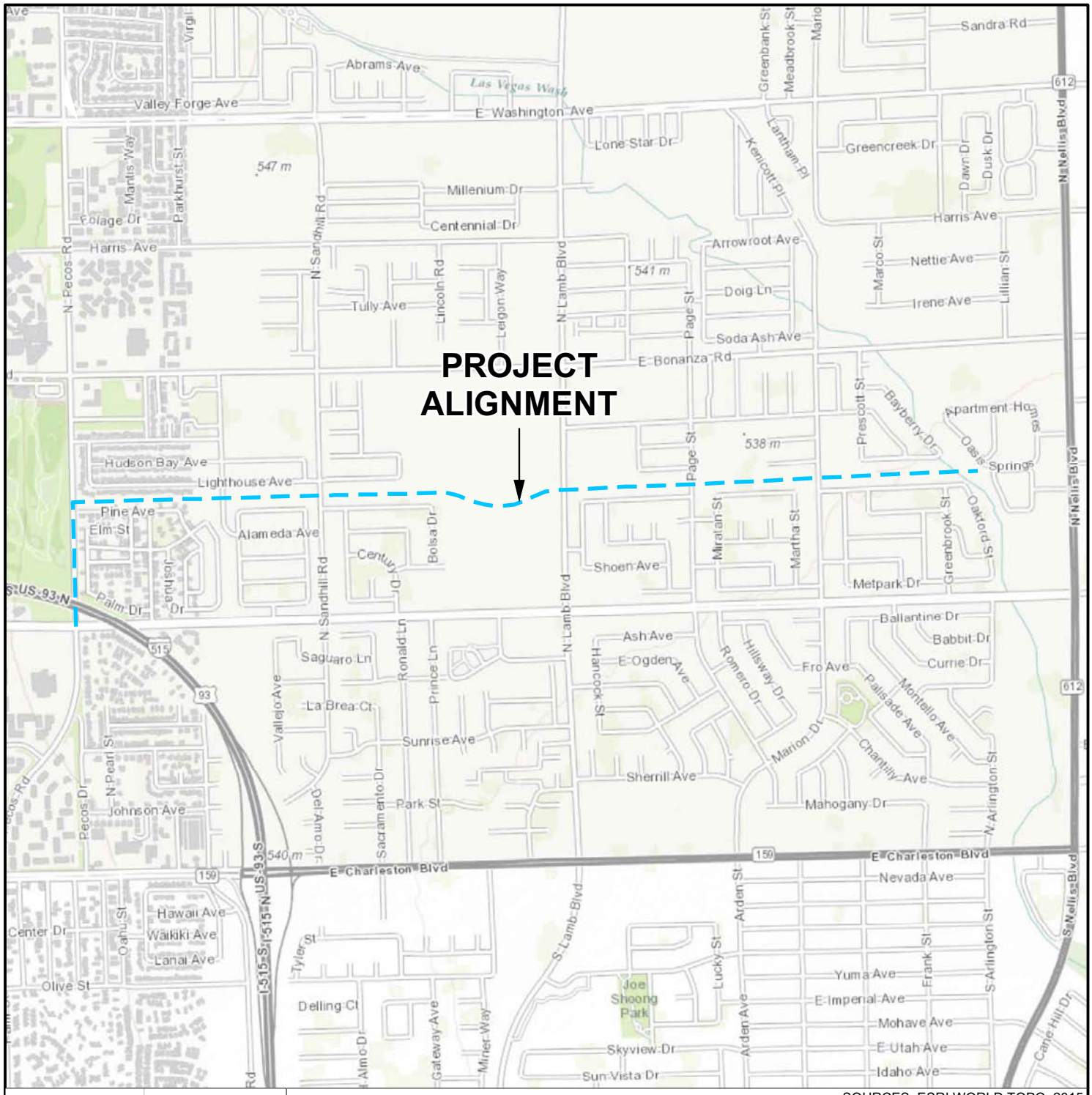
Notes:
RSL - Regional Screening Level

Table 3 - Groundwater Analytical Results - Organics and Biological							
Analyte						Groundwater Standards	
	B-1 (µg/L)	B-2 (µg/L)	B-6 (µg/L)	B-20 (µg/L)	Reporting Limit (µg/L)	Federal (µg/L)	MCL (µg/L)
Benzene	<0.50	<0.50	<0.50	<0.50	0.50	0.39	5.0
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	0.50	1.3	700
m,p-Xylene	<1.0	<1.0	<1.0	<1.0	1.0	190	
Methylene chloride	<2.0	<2.0	<2.0	<2.0	2.0	9.9	5.0
MTBE	<0.50	<0.50	<0.50	<0.50	0.50	12	
o-Xylene	<0.50	<0.50	<0.50	<0.50	0.50	190	
Xylenes, Total	<1.5	<1.5	<1.5	<1.5	1.50		
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	0.50		
Toluene	<0.50	<0.50	<0.50	<0.50	0.50	860.00	1,000
Trichloroethene	<0.50	<0.50	<0.50	<0.50	0.50		

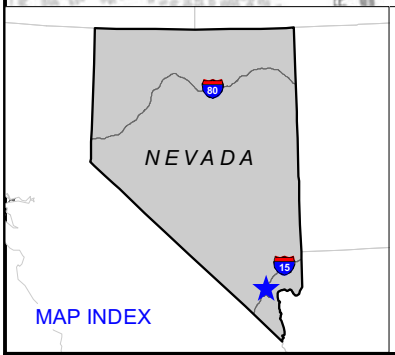
Table 4 - Organochlorine Pesticides and Herbicides							
Analyte						Groundwater Standards	
	B-1	B-2	B-6	B-20	Reporting Limit	Federal	MCL
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
4,4'-DDD (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.027	
4,4'-DDE (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.2	
4,4'-DDT (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.2	
Aldrin (1)	<0.027	<0.027	<0.027	<0.027	0.027	0.004	
alpha-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
alpha-Chlordane (1)	<0.027	<0.027	<0.027	<0.027	0.027		
beta-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Chlordane (1)	<0.27	<0.27	<0.27	<0.27	0.27	0.19	2.0
delta-BHD (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Dieldrin (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.0015	
Endosulfan I (1)	<0.027	<0.027	<0.027	<0.027	0.027	78	
Endosulfan II (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endosulfane sulfate (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endrin (1)	<0.053	<0.053	<0.053	<0.053	0.053	1.7	2.0
Endrin aldehyde (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endrin ketone (1)	<0.053	<0.053	<0.053	<0.053	0.053		
gamma-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
gamma-Chlordane (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Heptachlor (1)	<0.027	<0.027	<0.027	<0.027	0.027	0.0018	0.4
Heptachlor epoxide (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Methoxychlor (1)	<0.27	<0.27	<0.27	<0.27	0.27	27	40
Toxaphene (1)	<2.7	<2.7	<2.7	<2.7	2.7	0.013	3.0
Azinphos-methyl	<2.0	<2.0	<2.0	<2.0	2		
Bulstar (Sulfprofos)	<1.0	<1.0	<1.0	<1.0	1		
Chloropyrifos	<1.0	<1.0	<1.0	<1.0	1	6.200	
Coumaphos	<2.0	<2.0	<2.0	<2.0	2		
Demeton-O & S	<1.0	<1.0	<1.0	<1.0	1		
Diazinon	<1.0	<1.0	<1.0	<1.0	1	7.900	
Dichlorvos	<1.0	<1.0	<1.0	<1.0	1	0.230	
Disulfoton	<1.0	<1.0	<1.0	<1.0	1	0.380	
Ethoprop	<1.0	<1.0	<1.0	<1.0	1		
Fensulfothion	<1.0	<1.0	<1.0	<1.0	1		
Fenthion	<1.0	<1.0	<1.0	<1.0	1		
Malathion	<1.0	<1.0	<1.0	<1.0	1	300.000	
Merphos	<1.0	<1.0	<1.0	<1.0	1		
Methyl parathion	<1.0	<1.0	<1.0	<1.0	1	3.400	
Mevinphos	<2.0	<2.0	<2.0	<2.0	2		
Naled	<2.0	<2.0	<2.0	<2.0	2	31.000	
Phorate	<1.0	<1.0	<1.0	<1.0	1	2.300	
Ronnel	<1.0	<1.0	<1.0	<1.0	1	300.000	
Tetrachlor0vinphos	<1.0	<1.0	<1.0	<1.0	1		
Tokuthion	<1.0	<1.0	<1.0	<1.0	1		
Trichloronate	<1.0	<1.0	<1.0	<1.0	1		

Notes:
(1) - EPA Method 8081A
MCL - Maximum Contaminant Level

FIGURES



SOURCES: ESRI WORLD TOPO, 2015



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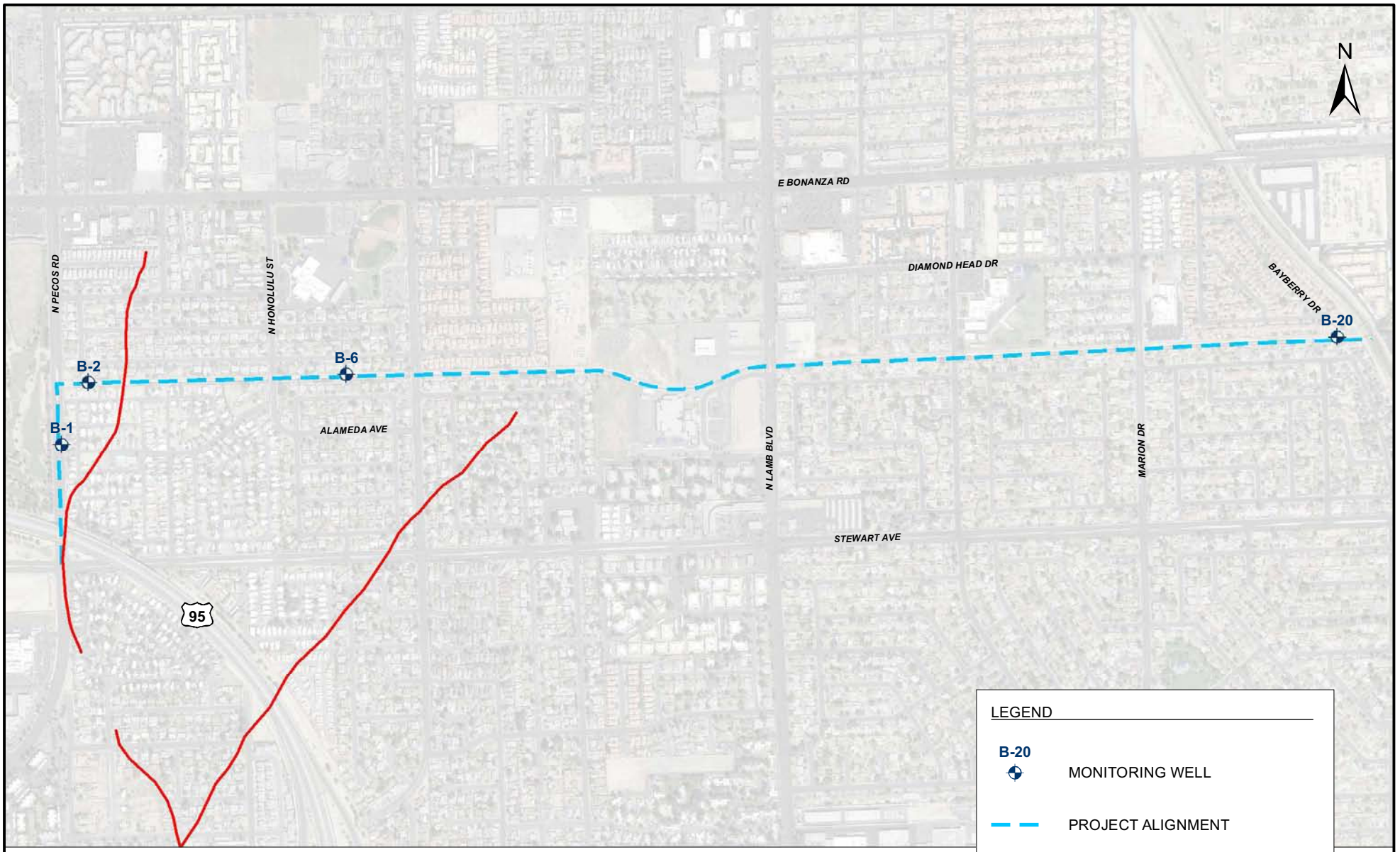
SCALE IN FEET

0 1,500 3,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710002 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710002_SL.mxd 4/14/2015 10:25:03 AM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore	MONITORING WELL LOCATIONS	FIGURE
PROJECT NO. 303710002 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2

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APPENDIX A

MONITORING WELL LOGS

BORING LOG EXPLANATION SHEET

DEPTH (feet)	SAMPLES: Bulk	SAMPLES: Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	SYMBOL	CLASSIFICATION U.S.C.S.	
0								Bulk sample.
								Modified split-barrel drive sampler.
								No recovery with modified split-barrel drive sampler.
								Sample retained by others.
								Standard Penetration Test (SPT).
5								No recovery with a SPT.
			XX/XX					Shelby tube sample. Distance pushed in inches/length of sample recovered in inches.
								No recovery with Shelby tube sampler.
								Continuous Push Sample.
				♀				Seepage.
10				▽				Groundwater encountered during drilling.
				▼				Groundwater measured after drilling.
							SM	MAJOR MATERIAL TYPE (SOIL): Solid line denotes unit change.
							CL	Dashed line denotes material change.
								Attitudes: Strike/Dip b: Bedding c: Contact j: Joint f: Fracture F: Fault cs: Clay Seam s: Shear bss: Basal Slide Surface sf: Shear Fracture sz: Shear Zone sbs: Shear Bedding Surface
15								
								The total depth line is a solid line that is drawn at the bottom of the boring.
20								

Ninyo & Moore

BORING LOG

Explanation of Boring Log Symbols

PROJECT NO.	DATE	FIGURE
	Rev. 11/11	

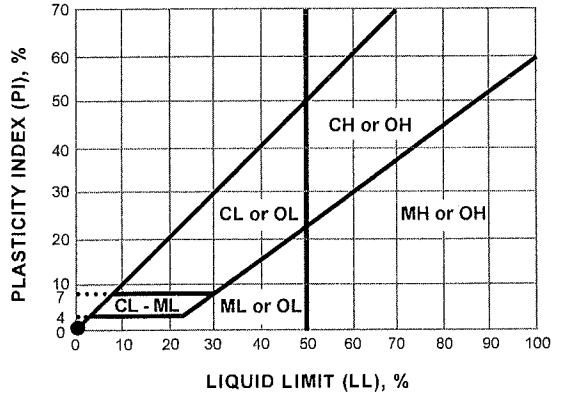
SOIL CLASSIFICATION CHART PER ASTM D 2488

PRIMARY DIVISIONS			SECONDARY DIVISIONS	
			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS more than 50% retained on No. 200 sieve	**GRAVEL** more than 50% of coarse fraction retained on No. 4 sieve	CLEAN GRAVEL less than 5% fines	GW	well-graded GRAVEL
			GP	poorly graded GRAVEL
		GRAVEL with DUAL CLASSIFICATIONS 5% to 12% fines	GW-GM	well-graded GRAVEL with silt
			GP-GM	poorly graded GRAVEL with silt
			GW-GC	well-graded GRAVEL with clay
			GP-GC	poorly graded GRAVEL with clay
		GRAVEL with FINES more than 12% fines	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND 50% or more of coarse fraction passes No. 4 sieve	CLEAN SAND less than 5% fines	SW	well-graded SAND
			SP	poorly graded SAND
		SAND with DUAL CLASSIFICATIONS 5% to 12% fines	SW-SM	well-graded SAND with silt
			SP-SM	poorly graded SAND with silt
			SW-SC	well-graded SAND with clay
			SP-SC	poorly graded SAND with clay
		SAND with FINES more than 12% fines	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS 50% or more passes No. 200 sieve	**SILT and CLAY** liquid limit less than 50%	INORGANIC	CL	lean CLAY
			ML	SILT
			CL-ML	silty CLAY
		ORGANIC	OL (PI > 4)	organic CLAY
			OL (PI < 4)	organic SILT
	SILT and CLAY liquid limit 50% or more	INORGANIC	CH	fat CLAY
			MH	elastic SILT
		ORGANIC	OH (plots on or above "A"-line)	organic CLAY
			OH (plots below "A"-line)	organic SILT
	Highly Organic Soils		PT	Peat

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		> 12"	> 12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	Coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	Fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	Coarse	#10 - #4	0.079 - 0.19"	Rock-salt-sized to pea-sized
	Medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock-salt-sized
	Fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized
Fines		Passing #200	< 0.0029"	Flour-sized and smaller

PLASTICITY CHART



APPARENT DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Loose	≤ 4	≤ 8	≤ 3	≤ 5
Loose	5 - 10	9 - 21	4 - 7	6 - 14
Medium Dense	11 - 30	22 - 63	8 - 20	15 - 42
Dense	31 - 50	64 - 105	21 - 33	43 - 70
Very Dense	> 50	> 105	> 33	> 70

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPOOLING CABLE OR CATHEAD		AUTOMATIC TRIP HAMMER	
	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)	SPT (blows/foot)	MODIFIED SPLIT BARREL (blows/foot)
Very Soft	< 2	< 3	< 1	< 2
Soft	2 - 4	3 - 5	1 - 3	2 - 3
Firm	5 - 8	6 - 10	4 - 5	4 - 6
Stiff	9 - 15	11 - 20	6 - 10	7 - 13
Very Stiff	16 - 30	21 - 39	11 - 20	14 - 26
Hard	> 30	> 39	> 20	> 26

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USCS METHOD OF SOIL CLASSIFICATION

Explanation of USCS Method of Soil Classification

PROJECT NO.	DATE	FIGURE

DATE DRILLED 3/13/15 BORING NO. B-1

GROUND ELEVATION 1,795.4'± (MSL) SHEET 1 OF 2

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
0									ASPHALT CONCRETE: Approximately 9-1/8 inches thick.
							GM		FILL: Light brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 12 to 13 inches thick.
		9/6" 7/6" 7/6"	7.9	110.5			CL		NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; few sand.
5		4/6" 5/6" 8/6"	32.1	80.8			CH		Light brown, moist, stiff to very stiff, fat CLAY; few sand.
									Trace gravel.
10		7/6" 14/6" 16/6"	32.3	80.7					Very stiff.
									Wet.
15		4/6" 8/6" 40/6"	21.1	102.3					With gravel.
									Few gravel.
20									

Ninyo & Moore

MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-1

DATE DRILLED 3/13/15 BORING NO. B-1

GROUND ELEVATION 1,795.4'± (MSL) SHEET 2 OF 2

METHOD OF DRILLING Mobile B-57 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
20		25/6" 50/2"	26.2	99.6			CH		NATIVE SOIL (CONTINUED): Light brown, wet, very stiff, fat CLAY with gravel; few sand.
									Few gravel.
25		7/6" 11/6" 14/6"	27.2	91.2					Gray to light brown; with gravel.
									Total Depth = 26.5 feet. Groundwater was measured at a depth of approximately 12.2 feet about 72 hours after drilling. Backfilled and patched on 3/24/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
30									
35									
40									

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MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-2

DATE DRILLED 3/5/15 BORING NO. B-2

GROUND ELEVATION 1,791.6'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
0							GM		ASPHALT CONCRETE: Approximately 2 inches thick.
							CL		FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 3-1/2 inches thick.
		12/6" 11/6" 13/6"							NATIVE SOIL: Dark brown, moist, very stiff, lean CLAY; few sand; few gravel.
							CH		Light brown, moist, very stiff, sandy fat CLAY with gravel.
5		6/6" 13/6" 23/6"	24.6	86.7					
									A layer of silty gravel a few inches thick.
10		4/6" 6/6" 8/6"	29.4	77.5					
									Few gravel.
			▼						Wet.
15		1/6" 2/6" 3/6"	54.2	64.6					Firm.
20									

Ninyo & Moore

MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-3

DATE DRILLED 3/5/15 BORING NO. B-2

GROUND ELEVATION 1,791.6'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
20			7/6" 14/6" 9/6"					CH		NATIVE SOIL (CONTINUED): Light brown, very stiff, sandy fat CLAY with gravel.
										Total Depth = 21.5 feet. Groundwater was measured at a depth of approximately 12.7 feet about 96 hours after drilling. Backfilled and patched on 3/9/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
25										
30										
35										
40										

Ninyo & Moore

MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-4

DATE DRILLED 3/5/15 BORING NO. B-6

GROUND ELEVATION 1,778.2'±(MSL) SHEET 1 OF 1

METHOD OF DRILLING CME 75 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
0							GM		ASPHALT CONCRETE: Approximately 1-7/8 inches thick.
							CL		FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 5 inches thick.
		2/6" 3/6" 4/6"							NATIVE SOIL: Dark brown, moist, stiff, lean CLAY with sand.
5		4/6" 9/6" 9/6"	24.6	91.3					Very stiff.
							CH		Light brown, very stiff, fat CLAY with sand; trace gravel.
			▼						Wet.
10		3/6" 6/6" 8/6"	41.8	74.2					Few gravel.
15		5/6" 13/6" 13/6"	29.6	90.9					
									Total Depth = 16.5 feet. Groundwater was measured at a depth of approximately 8.4 feet about 96 hours after drilling. Backfilled and patched on 3/9/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
20									

Ninyo & Moore

MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-5

DATE DRILLED 3/16/15 BORING NO. B-20

GROUND ELEVATION 1,760.5'±(MSL) SHEET 1 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES (Bulk / Driven)	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
0							GM		ASPHALT CONCRETE: Approximately 3-1/4 inches thick.
							CL		FILL: Dark brown, moist, medium dense to dense, silty GRAVEL with sand (base material); unit is approximately 8-1/2 inches thick.
		7/6" 11/6" 10/6"							NATIVE SOIL: Dark brown, moist, very stiff, sandy lean CLAY; trace gravel.
5		6/6" 5/6" 5/6"	18.2	100.2					Stiff.
									Few gravel.
10		3/6" 3/6" 4/6"	22.8	95.1					Light brown; trace gravel.
15		5/6" 9/6" 18/6"	29.3	81.9			ML		Light brown, moist, very stiff, SILT with sand.
									Few gravel.
									Wet.
20									

Ninyo & Moore

MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-6

DATE DRILLED 3/16/15 BORING NO. B-20

GROUND ELEVATION 1,760.5'±(MSL) SHEET 2 OF 2

METHOD OF DRILLING CME 55 hollow-stem auger drill rig

DRIVE WEIGHT 140 lbs. (auto trip) DROP 30"

SAMPLED BY RPM LOGGED BY RPM REVIEWED BY BDB

DEPTH (feet)	SAMPLES Bulk	SAMPLES Driven	BLOWS/FOOT	MOISTURE (%)	DRY DENSITY (PCF)	PID READING (PPM)	SYMBOL	CLASSIFICATION U.S.C.S.	WELL CONSTRUCTION	DESCRIPTION/INTERPRETATION
20			4/6" 9/6" 9/6"	51.5	69.2			CL		Light brown, wet, very stiff, sandy lean CLAY; few gravel. NATIVE SOIL (CONTINUED):
25			6/6" 32/6" 50/4"	35.3	81.4					Few gravel; moderately hard, moderately cemented layer.
30										Total Depth = 26.3 feet. Groundwater was measured at a depth of approximately 18.4 feet about 72 hours after drilling. Backfilled and patched on 3/19/15. NOTE: Groundwater may rise to a level higher than that measured in borehole due to relatively slow rate of seepage in clay and silt, and several other factors as discussed in the report.
35										
40										

Ninyo & Moore

MONITORING WELL LOG

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PROJECT NO.	DATE	FIGURE
303710002	4/15	A-7

APPENDIX B

LABORATORY REPORTS AND CHAIN-OF-CUSTODY RECORDS

Ninyo & Moore

Groundwater Sampling Field Data Sheet

Project Name: CEDAR WASH
Project No.:
Monitoring Well ID: R-1

Date: 3/24/13
Weather/Site Conditions: SUNNY 80°
Site Location: PECOS N. OF STEWART

By: C BROOKS

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ Other ____
Casing Material: ☒ SCH 40-PVC ☐ Other: S. Steel
Total Depth (ft-TOC): 18
Depth to Water (ft-TOC): 12.1
LNAPL Observed: ☐ Yes ☒ No
LNAPL Thickness:
LNAPL Observed: ☐ Yes ☒ No
LNAPL Thickness:
Water Column Height (feet): 6' x 2"/8¼" = 0.16 / 4"/10¼" = 0.65 g/ft = ____ x 3 - 5 = ____
Approx. Min. Purge Vol. (gallons)

Water Level Measurement Equip.:
Cleaned:
Purging Method/Equipment:
Cleaned:
Pump Lines/Bailer Ropes-New or Cleaned?:

TIME	PURGE VOL. (gallons)	pH	COND. (µS/cm)	TURBIDITY DO mg/L	TEMP. ~~(µS/cm)~~ °C	COMMENTS: ORP ~~(color, odor, sheen, etc.)~~
1200	15	6.64	3069	2.04	24.31	121.6
1215	30	6.60	3058	2.04	24.24	123.5
1230	45	6.59	3052	2.21	24.39	124.9

TIME	DEPTH TO WATER (ft)	RESIDUAL DRAWDOWN (ft)	PERCENT RECOVERY

Total Vol. Purged (gal):
Max. Drawdown:
Depth to Water After Purging (ft)
Time Finished Purging:

Sampling Method/Equipment:
Bailer Rope-New or Cleaned?:
Sampled By:
Sample Time:
Sample ID:
Replicate ID (if appl.)
Laboratory:
Comments:

PARAMETER	USEPA METHOD	CONTAINERS/VOLUME/ TYPE (Voa/Glass/Plastic)	PRES.

Groundwater Sampling Field Data Sheet

Ninyo & Moore

Project Name: Atkins/Cedar Ave
Project No.: 303710002
Monitoring Well ID: B-2
Date: 3-9-15
By: CJE
Weather/Site Conditions: Sunny
Site Location:

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ Other
Casing Material: ☒ SCH 40-PVC ☐ Other: S. Steel
Total Depth (ft ~~TOC~~): Surface 18.00
Depth to Water (ft ~~TOC~~): Grade 12.73
LNAPL Observed: ☐ Yes ☒ No
LNAPL Thickness:
LNAPL Observed: ☐ Yes ☒ No
LNAPL Thickness:
Water Column Height (feet): 5.27 x (2"/8¼" = 0.16, 4"/10¼" = 0.65 g/ft) = ____ x 3 - 5 = ____
Approx. Min. Purge Vol. (gallons)

Water Level Measurement Equip.: Solinst model 101
Cleaned: Yes
Purging Method/Equipment: Pump
Cleaned: Yes
Pump Lines/Bailer Ropes-New or Cleaned?: New

TIME	PURGE VOL. (gallons)	pH	~~mS~~ COND. (~~mS~~/cm)	TURBIDITY D.O	TEMP. (µS/cm)	COMMENTS: ORP (color, odor, sheen, etc.)
10:35	2	7.67	2.2	6.51	25.67	119
10:40	4.5	7.69	2.2	6.68	25.22	115
10:45	6.5	7.70	2.2	6.63	25.00	111
10:51	8.5	7.71	2.2	6.62	24.89	107
10:56	10.5	7.72	2.2	6.53	24.87	104
11:02	12.5	7.73	2.2	6.34	24.83	99
11:08	15.0	7.73	2.2	6.36	24.83	97
11:15	18.0	7.74	2.2	6.29	24.82	95
11:22	20.5	7.74	2.2	6.24	24.84	94

TIME	DEPTH TO WATER (ft)	RESIDUAL DRAWDOWN (ft)	PERCENT RECOVERY

Total Vol. Purged (gal): 51
Depth to Water After Purging (ft)
Max. Drawdown:
Time Finished Purging:

Sampling Method/Equipment: pump
Bailer Rope-New or Cleaned?: New
Sampled By: CJE
Sample Time: 11:25
Sample ID: B-2
Replicate ID (if appl.)
Laboratory:
Comments:

PARAMETER	USEPA METHOD	CONTAINERS/VOLUME/ TYPE (Voa/Glass/Plastic)	PRES.

Ninyo & Moore

Groundwater Sampling Field Data Sheet

Project Name: Atkins / Cedar Ave Date: 3-9-15 By: CJE
Project No.: 303741002 Weather/Site Conditions: Sunny
Monitoring Well ID: B-6 Site Location:

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ Other ____ Casing Material: ☒ SCH 40-PVC ☐ Other: S. Steel
Total Depth (ft-~~TOC~~): Surface 14.10 LNAPL Observed: ☐ Yes ☒ No LNAPL Observed: ☐ Yes ☒ No
Depth to Water (~~ft-TOC~~): Grade 8.44 LNAPL Thickness: LNAPL Thickness:
Water Column Height (feet): 5.66 x (2"/8¼" = 0.16, 4"/10¼" = 0.65 g/ft) = ____ x 3 - 5 = ____ Approx. Min. Purge Vol. (gallons)

Water Level Measurement Equip.: Solinst model 101 Cleaned: yes
Purging Method/Equipment: pump Cleaned: yes
Pump Lines/Bailer Ropes-New or Cleaned?: New

TIME	PURGE VOL. (gallons)	pH	COND. (µS/cm)	TURBIDITY 0.0	TEMP. (µS/cm)	COMMENTS: (color, odor, sheen, etc.)
12:20	3.0	7.89	3.4	6.27	22.30	100
12:25	7.0	7.86	3.4	6.19	21.45	95
12:30	10.5	7.87	3.4	6.16	21.27	91
12:34	15.0	7.87	3.4	6.13	21.18	87
12:38	18.5	7.88	3.4	6.14	21.14	85
12:42	21.0	7.88	3.4	6.12	21.13	83

TIME	DEPTH TO WATER (ft)	RESIDUAL DRAWDOWN (ft)	PERCENT RECOVERY

Total Vol. Purged (gal): 56 Max. Drawdown: ____
Depth to Water After Purging (ft) ____ Time Finished Purging: ____

Sampling Method/Equipment: ____
Bailer Rope-New or Cleaned?: New
Sampled By: CJE
Sample Time: 12:48
Sample ID: B-6
Replicate ID (if appl.) ____
Laboratory: ____
Comments: ____

PARAMETER	USEPA METHOD	CONTAINERS/VOLUME/ TYPE (Voa/Glass/Plastic)	PRES.

Ninyo & Moore — Groundwater Sampling Field Data Sheet

Project Name: Atkins / Cedar
Project No.: 303718002
Monitoring Well ID: B-20
Date: 3-17-15
By: CJE
Weather/Site Conditions: Sunny
Site Location:

Casing Diameter: ☒ 2" ☐ 4" ☐ 6" ☐ Other ___
Casing Material: ☒ SCH 40-PVC ☐ Other: S. Steel
Total Depth (ft-TOC): 24.05
Depth to Water (ft-TOC): 19.20
LNAPL Observed: ☐ Yes ☒ No
LNAPL Thickness:
LNAPL Observed: ☐ Yes ☒ No
LNAPL Thickness:
Water Column Height (feet): ___ x 2"/8¼" = 0.16, 4"/10¼" = 0.65 g/ft = ___ x 3 - 5 = ___
Approx. Min. Purge Vol. (gallons)

Water Level Measurement Equip.: Solinst Model 101
Cleaned: yes
Purging Method/Equipment: pump
Cleaned: yes
Pump Lines/Bailer Ropes-New or Cleaned?: New

TIME	PURGE VOL. (gallons)	pH	COND. (µS/cm)	TURBIDITY 0.0	TEMP. (µS/cm)	COMMENTS: O.R.P (color, odor, sheen, etc.)
10:45	3	6.67	4795	1.40	23.97	350.4
10:50	6	6.68	4787	1.27	23.95	332.5
10:55	9	6.67	4778	1.17	23.93	317.5
11:00	12	6.66	4770	1.08	23.92	304.9
11:05	15	6.67	4760	0.96	23.91	294.8
11:10	18	6.66	4759	0.96	23.91	290.2

TIME	DEPTH TO WATER (ft)	RESIDUAL DRAWDOWN (ft)	PERCENT RECOVERY

Total Vol. Purged (gal): 48
Depth to Water After Purging (ft) ___
Max. Drawdown: ___
Time Finished Purging: ___

Sampling Method/Equipment: ___
Bailer Rope-New or Cleaned?: New
Sampled By: CJE
Sample Time: 11:15
Sample ID: B-20
Replicate ID (if appl.)
Laboratory:
Comments:

PARAMETER	USEPA METHOD	CONTAINERS/VOLUME/ TYPE (Voa/Glass/Plastic)	PRES.

April 06, 2015

Courtney Brooks
Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

TEL: (702) 433-0330
FAX: (702) 227-2051

CA-ELAP No.:2676
NV Cert. No.:NV-00922

Workorder No.: N015089

RE: CEDAR WASH, 303710602

Attention: Courtney Brooks

Enclosed are the results for sample(s) received on March 24, 2015 by ASSET Laboratories . The sample(s) are tested for the parameters as indicated in the enclosed chain of custody in accordance with the applicable laboratory certifications.

This is an amended report. Please disregard all previous documentation that corresponds to the page(s) enclosed.

Thank you for the opportunity to service the needs of your company.

Please feel free to call me at (702) 307-2659 if I can be of further assistance to your company.

Sincerely,

Nancy Litucas for

Glen Gesmundo
QA Manager

The cover letter is an integral part of this analytical report. This Laboratory Report cannot be reproduced in part or in its entirety without written permission from the client and Advanced Technology Laboratories - Las Vegas.

ASSET Laboratories **Date:** *06-Apr-15*

CLIENT: Ninyo & Moore
Project: CEDAR WASH, 303710602
Lab Order: N015089

CASE NARRATIVE

SAMPLE RECEIVING/GENERAL COMMENTS:

Samples were received intact with proper chain of custody documentation.

Cooler temperature and sample preservation were verified upon receipt of samples if applicable.

Information on sample receipt conditions including discrepancies can be found in attached Sample Receipt Checklist Form.

Samples were analyzed within method holding time except for pH. pH testing is specified to be performed in the field within 15 minutes of sampling;sample was received and analyzed past the regulatory holding time.

Subcontracted Analyses:

TKN and Sulfur were subcontracted to Western Environmental Testing Laboratory- Las Vegas,NV.

Fecal Coliform , E.Coli and Residual Chlorine were subcontracted to Silver State Analytical Laboratory- Las Vegas,NV.

Perchlorate by EPA 331.0 was subcontracted to Eurofins Eaton Analytical- Monrovia,CA.

Analytical Comments for EPA 200.7:

Matrix Spike Duplicate (MSD) is outside recovery criteria for some analytes possibly due to matrix interference. The associated Laboratory Control Sample (LCS) recovery was acceptable.

Analytical Comments for EPA 200.8:

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) are outside recovery criteria for some analytes possibly due to matrix interference. The associated Laboratory Control Sample (LCS) recovery was acceptable.

Dilution was necessary on some analytes due to associated internal standard not meeting method criteria possibly due to matrix interference. Sample was analyzed with dilution and internal standard met method criteria. Affected analytes for this failed internal standard were reported at dilution that meet



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internal standard recovery limit.

Analytical Comments for EPA 300.0:

Dilution was necessary due to precipitation of sample upon the addition of eluent.

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ASSET Laboratories

Date: *06-Apr-15*

CLIENT: Ninyo & Moore
Project: CEDAR WASH, 303710602
Lab Order: N015089
Contract No:

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Matrix	Collection Date	Date Received	Date Reported
N015089-001A	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001B	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001C	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001D	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001E	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001F	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001G	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001H	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001I	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001J	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001K	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015
N015089-001L	B-1	Groundwater	3/24/2015 1:00:00 PM	3/24/2015	4/6/2015

CLIENT:	Ninyo & Moore	**Client Sample ID:**	B-1
Lab Order:	N015089	**Collection Date:**	3/24/2015 1:00:00 PM
Project:	CEDAR WASH, 303710602	**Matrix:**	GROUNDWATER
Lab ID:	N015089-001		

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PH						
			SM4500-H+B			
RunID: WETCHEM_150324C	QC Batch: R99610			PrepDate:		Analyst: **LR**
pH	7.6	0.10	H	pH Units	1	3/24/2015 06:30 PM
Temp. at time of pH Analysis	25	0.10	H	°C	1	3/24/2015 06:30 PM
TOTAL FILTERABLE RESIDUE						
			SM2540C			
RunID: WETCHEM_150326A	QC Batch: 50052			PrepDate:	3/26/2015	Analyst: **LR**
Total Dissolved Solids (Residue, Filterable)	4400	33		mg/L	1	3/26/2015 03:37 PM
TOTAL NON-FILTERABLE RESIDUE						
			SM2540D			
RunID: WETCHEM_150325D	QC Batch: 50033			PrepDate:	3/25/2015	Analyst: **LR**
Suspended Solids (Residue, Non-Filterable)	260	10		mg/L	1	3/25/2015 09:47 AM
TURBIDITY						
			EPA 180.1			
RunID: WETCHEM_150324B	QC Batch: R99609			PrepDate:		Analyst: **LR**
Turbidity	440	0.10		NTU	1	3/24/2015 07:00 PM
ALKALINITY, SPECIATED						
			SM 2320 B			
RunID: WETCHEM_150327C	QC Batch: R99660			PrepDate:		Analyst: **QBM**
Alkalinity, Bicarbonate (As CaCO3)	440	5.0		mg/L	1	3/27/2015
Alkalinity, Carbonate (As CaCO3)	ND	5.0		mg/L	1	3/27/2015
Alkalinity, Hydroxide (As CaCO3)	ND	5.0		mg/L	1	3/27/2015
Alkalinity, Total (As CaCO3)	440	5.0		mg/L	1	3/27/2015
TOTAL PHOSPHORUS						
			EPA 365.3			
RunID: WETCHEM_150401C	QC Batch: 50065			PrepDate:	3/30/2015	Analyst: **QBM**
Phosphorus, Total (As P)	0.047	0.020		mg/L	1	4/1/2015
VOLATILE ORGANIC COMPOUNDS BY GC/MS						
			EPA 8260B			
RunID: MS5_150329A	QC Batch: P15VW055			PrepDate:		Analyst: **QBM**
Benzene	ND	0.50		µg/L	1	3/29/2015 02:00 PM
Ethylbenzene	ND	0.50		µg/L	1	3/29/2015 02:00 PM
m,p-Xylene	ND	1.0		µg/L	1	3/29/2015 02:00 PM

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Lab Order: N015089
Project: CEDAR WASH, 303710602
Lab ID: N015089-001

Client Sample ID: B-1
Collection Date: 3/24/2015 1:00:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS BY GC/MS				**EPA 8260B**		
RunID: MS5_150329A	QC Batch: P15VW055			PrepDate:		Analyst: **QBM**
MTBE	ND	0.50		µg/L	1	3/29/2015 02:00 PM
o-Xylene	ND	0.50		µg/L	1	3/29/2015 02:00 PM
Tetrachloroethene	ND	0.50		µg/L	1	3/29/2015 02:00 PM
Toluene	ND	0.50		µg/L	1	3/29/2015 02:00 PM
Trichloroethene	ND	0.50		µg/L	1	3/29/2015 02:00 PM
Xylenes, Total	ND	1.5		µg/L	1	3/29/2015 02:00 PM
Surr: 1,2-Dichloroethane-d4	98.1	78-125		%REC	1	3/29/2015 02:00 PM
Surr: 4-Bromofluorobenzene	99.6	80-120		%REC	1	3/29/2015 02:00 PM
Surr: Dibromofluoromethane	99.1	80-122		%REC	1	3/29/2015 02:00 PM
Surr: Toluene-d8	98.3	80-120		%REC	1	3/29/2015 02:00 PM
DIESEL & MOTOR OIL RANGE ORGANICS BY GC/FID						
EPA 3510C				**EPA 8015B**		
RunID: GC1_150326B	QC Batch: 50038			PrepDate: 3/26/2015		Analyst: **MDM**
DRO	ND	0.21		mg/L	1	3/27/2015 01:54 AM
ORO	ND	0.21		mg/L	1	3/27/2015 01:54 AM
Surr: p-Terphenyl	80.3	48-133		%REC	1	3/27/2015 01:54 AM
GASOLINE RANGE ORGANICS BY GC/FID						
				EPA 8015B		
RunID: GC4_150330A	QC Batch: E15VW021			PrepDate:		Analyst: **QBM**
GRO	ND	0.050		mg/L	1	3/30/2015 11:07 AM
Surr: Chlorobenzene - d5	103	73-132		%REC	1	3/30/2015 11:07 AM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150324A	QC Batch: R99605			PrepDate:		Analyst: **QBM**
Chloride	480	50		mg/L	100	3/24/2015 05:28 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150324A	QC Batch: R99605			PrepDate:		Analyst: **QBM**
Fluoride	1.3	0.50		mg/L	5	3/24/2015 04:44 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150324A	QC Batch: R99605			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrite	ND	0.50		mg/L	5	3/24/2015 04:44 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N015089
Project: CEDAR WASH, 303710602
Lab ID: N015089-001

Client Sample ID: B-1
Collection Date: 3/24/2015 1:00:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150324A	QC Batch: R99605			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrate (As N)	4.5	0.50		mg/L	5	3/24/2015 04:44 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150324A	QC Batch: R99605			PrepDate:		Analyst: **QBM**
Sulfate	2400	200		mg/L	200	3/24/2015 07:14 PM
DISSOLVED MERCURY BY COLD VAPOR TECHNIQUE						
				EPA 245.1		
RunID: AA1_150326A	QC Batch: 50036			PrepDate:	3/26/2015	Analyst: **CEI**
Mercury	ND	0.20		µg/L	1	3/26/2015 10:08 AM
DISSOLVED METALS BY ICP						
				EPA 200.7		
RunID: ICP2_150331A	QC Batch: 50060			PrepDate:	3/30/2015	Analyst: **CEI**
Calcium	310	0.50		mg/L	1	3/31/2015 11:31 AM
Iron	1.3	0.50		mg/L	1	3/31/2015 11:31 AM
Magnesium	370	0.10		mg/L	1	3/31/2015 11:31 AM
DISSOLVED METALS BY ICP						
				EPA 200.7		
RunID: ICP2_150331B	QC Batch: 50060			PrepDate:	3/30/2015	Analyst: **CEI**
Potassium	61	2.5		mg/L	5	3/31/2015 01:16 PM
Sodium	320	12		mg/L	25	3/31/2015 01:24 PM
HARDNESS BY CALCULATION						
				SM 2340 B		
RunID: ICP2_150331A	QC Batch: 50060			PrepDate:	3/30/2015	Analyst: **CEI**
Hardness, Calcium (As CaCO3)	780	0.50		mg/L	1	3/31/2015
Total Hardness (As CaCO3)	2300	1.0		mg/L	1	3/31/2015
DISSOLVED METALS BY ICPMS						
				EPA 200.8		
RunID: ICP7_150330B	QC Batch: 50051			PrepDate:	3/27/2015	Analyst: **CEI**
Aluminum	3200	1200		µg/L	25	3/30/2015 06:24 PM
Antimony	ND	0.50		µg/L	1	3/27/2015 07:09 PM
Arsenic	6.4	0.10		µg/L	1	3/27/2015 07:09 PM
Barium	120	1.0		µg/L	1	3/27/2015 07:09 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N015089
Project: CEDAR WASH, 303710602
Lab ID: N015089-001

Client Sample ID: B-1
Collection Date: 3/24/2015 1:00:00 PM
Matrix: GROUNDWATER

DISSOLVED METALS BY ICPMS

EPA 200.8

RunID: ICP7_150330B | QC Batch: 50051 | PrepDate: 3/27/2015 | Analyst: **CEI**

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
Beryllium	ND	0.50		µg/L	1	3/27/2015 07:09 PM
Boron	2200	250		µg/L	5	3/27/2015 07:15 PM
Cadmium	ND	0.50		µg/L	1	3/27/2015 07:09 PM
Chromium	4.7	1.0		µg/L	1	3/27/2015 07:09 PM
Copper	ND	1.0		µg/L	1	3/27/2015 07:09 PM
Lead	ND	5.0		µg/L	5	3/27/2015 07:15 PM
Manganese	39	0.50		µg/L	1	3/27/2015 07:09 PM
Molybdenum	50	0.50		µg/L	1	3/27/2015 07:09 PM
Nickel	1.9	1.0		µg/L	1	3/30/2015 06:49 PM
Selenium	6.8	0.50		µg/L	1	3/27/2015 07:09 PM
Silver	ND	0.50		µg/L	1	3/27/2015 07:09 PM
Thallium	ND	2.5		µg/L	5	3/27/2015 07:15 PM
Zinc	ND	10		µg/L	1	3/27/2015 07:09 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 150.1_4500H+B_W

Sample ID **N015079-001B DUP** SampType: **DUP** TestCode: **150.1_4500H** Units: **pH Units** Prep Date: RunNo: **99610**
Client ID: **ZZZZZZ** Batch ID: **R99610** TestNo: **SM4500-H+B** Analysis Date: **3/24/2015** SeqNo: **1963902**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
pH	7.820	0.10						7.860	0.510	10	H
Temp. at time of pH Analysis	25.600	0.10						25.70	0.390	10	H

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 160.1_2540C_W

Sample ID **MB-50052**	SampType: **MBLK**	TestCode: **160.1_2540C**	Units: **mg/L**	Prep Date: **3/26/2015**	RunNo: **99654**
Client ID: **PBW**	Batch ID: **50052**	TestNo: **SM2540C**		Analysis Date: **3/26/2015**	SeqNo: **1965895**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	ND	10									

Sample ID **LCS-50052**	SampType: **LCS**	TestCode: **160.1_2540C**	Units: **mg/L**	Prep Date: **3/26/2015**	RunNo: **99654**
Client ID: **LCSW**	Batch ID: **50052**	TestNo: **SM2540C**		Analysis Date: **3/26/2015**	SeqNo: **1965896**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	999.000	10	1000	0	99.9	80	120				

Sample ID **N015089-001E DUP**	SampType: **DUP**	TestCode: **160.1_2540C**	Units: **mg/L**	Prep Date: **3/26/2015**	RunNo: **99654**
Client ID: **ZZZZZZ**	Batch ID: **50052**	TestNo: **SM2540C**		Analysis Date: **3/26/2015**	SeqNo: **1965898**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	4346.667	33						4433	1.97	5	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 160.2_2540D_W

Sample ID	MB-50033	SampType:	MBLK	TestCode:	160.2_2540D	Units:	mg/L	Prep Date:	3/25/2015	RunNo:	99621
Client ID:	PBW	Batch ID:	50033	TestNo:	SM2540D			Analysis Date:	3/25/2015	SeqNo:	1964102

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	ND	10									

Sample ID	LCS-50033	SampType:	LCS	TestCode:	160.2_2540D	Units:	mg/L	Prep Date:	3/25/2015	RunNo:	99621
Client ID:	LCSW	Batch ID:	50033	TestNo:	SM2540D			Analysis Date:	3/25/2015	SeqNo:	1964103

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	911.000	10	1000	0	91.1	80	120				

Sample ID	LCSD-50033	SampType:	LCSD	TestCode:	160.2_2540D	Units:	mg/L	Prep Date:	3/25/2015	RunNo:	99621
Client ID:	LCSS02	Batch ID:	50033	TestNo:	SM2540D			Analysis Date:	3/25/2015	SeqNo:	1964104

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	907.000	10	1000	0	90.7	80	120				

Sample ID	N015089-001EDUP	SampType:	DUP	TestCode:	160.2_2540D	Units:	mg/L	Prep Date:	3/25/2015	RunNo:	99621
Client ID:	ZZZZZZ	Batch ID:	50033	TestNo:	SM2540D			Analysis Date:	3/25/2015	SeqNo:	1964107

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	271.000	10						263.0	3.00	5	

Qualifiers:

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- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 180.1_W

Sample ID **N015079-001B DUP** SampType: **DUP** TestCode: **180.1_W** Units: **NTU** Prep Date: RunNo: **99609**
Client ID: **ZZZZZZ** Batch ID: **R99609** TestNo: **EPA 180.1** Analysis Date: **3/24/2015** SeqNo: **1963899**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	0.350	0.10						0.3400	2.90	30	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD

Sample ID	MB-50060	SampType:	MBLK	TestCode:	200.7_WD	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99697
Client ID:	PBW	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968209

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	0.065	0.50									
Iron	0.002	0.50									
Magnesium	ND	0.10									

Sample ID	LCS-50060	SampType:	LCS	TestCode:	200.7_WD	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99697
Client ID:	LCSW	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968210

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	9.858	0.50	10.00	0	98.6	85	115				
Iron	9.939	0.50	10.00	0	99.4	85	115				
Magnesium	10.093	0.10	10.00	0	101	85	115				

Sample ID	N015079-001A-MS	SampType:	MS	TestCode:	200.7_WD	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99697
Client ID:	ZZZZZZ	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968214

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	85.639	0.50	10.00	73.96	117	75	125				
Iron	10.181	0.50	10.00	0.06195	101	75	125				
Magnesium	35.650	0.10	10.00	25.04	106	75	125				

Sample ID	N015079-001A-MSD	SampType:	MSD	TestCode:	200.7_WD	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99697
Client ID:	ZZZZZZ	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968215

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	84.779	0.50	10.00	73.96	108	75	125	85.64	1.01	20	
Iron	10.158	0.50	10.00	0.06195	101	75	125	10.18	0.230	20	
Magnesium	35.737	0.10	10.00	25.04	107	75	125	35.65	0.244	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD1

Sample ID	MB-50060	SampType:	MBLK	TestCode:	200.7_WD1	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99709
Client ID:	PBW	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968306

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	ND	0.50									
Sodium	ND	0.50									

Sample ID	LCS2-50060	SampType:	LCS	TestCode:	200.7_WD1	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99709
Client ID:	LCSW	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968307

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	19.793	0.50	20.00	0	99.0	85	115				
Sodium	19.711	0.50	20.00	0	98.6	85	115				

Sample ID	N015089-001J-MS2	SampType:	MS	TestCode:	200.7_WD1	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99709
Client ID:	ZZZZZZ	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968313

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	80.097	2.5	20.00	61.33	93.9	75	125				

Sample ID	N015089-001J-MSD	SampType:	MSD	TestCode:	200.7_WD1	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99709
Client ID:	ZZZZZZ	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968314

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	88.741	2.5	20.00	61.33	137	75	125	80.10	10.2	20	S

Sample ID	N015089-001J-MS2	SampType:	MS	TestCode:	200.7_WD1	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99709
Client ID:	ZZZZZZ	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968320

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sodium	340.103	12	20.00	323.7	82.1	75	125				

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD1

Sample ID	N015089-001J-MSD	SampType:	MSD	TestCode:	200.7_WD1	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99709
Client ID:	ZZZZZZ	Batch ID:	50060	TestNo:	EPA 200.7			Analysis Date:	3/31/2015	SeqNo:	1968321

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sodium	378.230	12	20.00	323.7	273	75	125	340.1	10.6	20	S

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 2320_W_SP

Sample ID **LCS-R99660** SampType: **LCS** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99660**
Client ID: **LCSW** Batch ID: **R99660** TestNo: **SM 2320 B** Analysis Date: **3/27/2015** SeqNo: **1965971**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	99.576	5.0	100.0	0	99.6	85	115				
Alkalinity, Total (As CaCO3)	101.695	5.0	100.0	0	102	85	115				

Sample ID **MB-R99660** SampType: **MBLK** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99660**
Client ID: **PBW** Batch ID: **R99660** TestNo: **SM 2320 B** Analysis Date: **3/27/2015** SeqNo: **1965972**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	ND	5.0									
Alkalinity, Carbonate (As CaCO3)	ND	5.0									
Alkalinity, Hydroxide (As CaCO3)	ND	5.0									
Alkalinity, Total (As CaCO3)	ND	5.0									

Sample ID **N015017-003BDUP** SampType: **DUP** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99660**
Client ID: **ZZZZZZ** Batch ID: **R99660** TestNo: **SM 2320 B** Analysis Date: **3/27/2015** SeqNo: **1965974**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	21.186	5.0						21.19	0	30	H
Alkalinity, Carbonate (As CaCO3)	ND	5.0						0	0	30	H
Alkalinity, Hydroxide (As CaCO3)	ND	5.0						0	0	30	H
Alkalinity, Total (As CaCO3)	21.186	5.0						21.19	0	30	H

Sample ID **N015017-003BMS** SampType: **MS** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99660**
Client ID: **ZZZZZZ** Batch ID: **R99660** TestNo: **SM 2320 B** Analysis Date: **3/27/2015** SeqNo: **1965975**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	119.703	5.0	100.0	21.19	98.5	75	125				H
Alkalinity, Total (As CaCO3)	119.703	5.0	100.0	21.19	98.5	75	125				H

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 2320_W_SP

Sample ID **N015017-003BMSD**	SampType: **MSD**	TestCode: **2320_W_SP**	Units: **mg/L**	Prep Date:	RunNo: **99660**
Client ID: **ZZZZZZ**	Batch ID: **R99660**	TestNo: **SM 2320 B**		Analysis Date: **3/27/2015**	SeqNo: **1965976**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	118.644	5.0	100.0	21.19	97.5	75	125	119.7	0.889	20	H
Alkalinity, Total (As CaCO3)	118.644	5.0	100.0	21.19	97.5	75	125	119.7	0.889	20	H

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 245.1_WD

Sample ID	MB-50036	SampType:	MBLK	TestCode:	245.1_WD	Units:	µg/L	Prep Date:	3/26/2015	RunNo:	99638
Client ID:	PBW	Batch ID:	50036	TestNo:	EPA 245.1			Analysis Date:	3/26/2015	SeqNo:	1965174

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.20									

Sample ID	LCS-50036	SampType:	LCS	TestCode:	245.1_WD	Units:	µg/L	Prep Date:	3/26/2015	RunNo:	99638
Client ID:	LCSW	Batch ID:	50036	TestNo:	EPA 245.1			Analysis Date:	3/26/2015	SeqNo:	1965175

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	4.276	0.20	5.000	0	85.5	85	115				

Sample ID	N015000-001J-MS	SampType:	MS	TestCode:	245.1_WD	Units:	µg/L	Prep Date:	3/26/2015	RunNo:	99638
Client ID:	ZZZZZZ	Batch ID:	50036	TestNo:	EPA 245.1			Analysis Date:	3/26/2015	SeqNo:	1965176

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	3.836	0.20	5.000	0	76.7	75	125				

Sample ID	N015000-001J-MSD	SampType:	MSD	TestCode:	245.1_WD	Units:	µg/L	Prep Date:	3/26/2015	RunNo:	99638
Client ID:	ZZZZZZ	Batch ID:	50036	TestNo:	EPA 245.1			Analysis Date:	3/26/2015	SeqNo:	1965177

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	4.491	0.20	5.000	0	89.8	75	125	3.836	15.7	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_CL

Sample ID	MB-R99605_CL	SampType:	MBLK	TestCode:	300_W_CL	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	PBW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963243

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	ND	0.50									

Sample ID	LCS-R99605_CL	SampType:	LCS	TestCode:	300_W_CL	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	LCSW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963244

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	2.368	0.50	2.500	0	94.7	90	110				

Sample ID	N015079-001BDUP	SampType:	DUP	TestCode:	300_W_CL	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963246

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	90.920	10						94.52	3.88	20	

Sample ID	N015079-001BMS	SampType:	MS	TestCode:	300_W_CL	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963247

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	146.340	10	50.00	94.52	104	80	120				

Sample ID	N015079-001BMSD	SampType:	MSD	TestCode:	300_W_CL	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963248

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	144.480	10	50.00	94.52	99.9	80	120	146.3	1.28	20	

Qualifiers:

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- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_F

Sample ID	MB-R99605_F	SampType:	MBLK	TestCode:	300_W_F	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	PBW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963211

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	ND	0.10									

Sample ID	LCS-R99605_F	SampType:	LCS	TestCode:	300_W_F	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	LCSW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963212

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	2.369	0.10	2.500	0	94.8	90	110				

Sample ID	N015066-003CDUP	SampType:	DUP	TestCode:	300_W_F	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963218

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	0.580	0.50						0.6650	13.7	20	

Sample ID	N015066-003CMS	SampType:	MS	TestCode:	300_W_F	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963219

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	13.435	0.50	12.50	0.6650	102	80	120				

Sample ID	N015066-003CMSD	SampType:	MSD	TestCode:	300_W_F	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963220

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	13.180	0.50	12.50	0.6650	100	80	120	13.44	1.92	20	

Qualifiers:

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- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_NO2

Sample ID	MB-R99605_NO2	SampType:	MBLK	TestCode:	300_W_NO2	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	PBW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963265

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	ND	0.10									

Sample ID	LCS-R99605_NO2	SampType:	LCS	TestCode:	300_W_NO2	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	LCSW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963266

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	2.335	0.10	2.500	0	93.4	90	110				

Sample ID	N015066-003CDUP	SampType:	DUP	TestCode:	300_W_NO2	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963268

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	0.145	0.50						0.1550	0	20	

Sample ID	N015066-003CMS	SampType:	MS	TestCode:	300_W_NO2	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963269

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	13.555	0.50	12.50	0.1550	107	80	120				

Sample ID	N015066-003CMSD	SampType:	MSD	TestCode:	300_W_NO2	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963270

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	13.360	0.50	12.50	0.1550	106	80	120	13.56	1.45	20	

Qualifiers:

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- H Holding times for preparation or analysis exceeded
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CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_NO3

Sample ID	MB-R99605_NO3	SampType:	MBLK	TestCode:	300_W_NO3	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	PBW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963276

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	ND	0.10									

Sample ID	LCS-R99605_NO3	SampType:	LCS	TestCode:	300_W_NO3	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	LCSW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963277

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	2.336	0.10	2.500	0	93.4	90	110				

Sample ID	N015066-003CDUP	SampType:	DUP	TestCode:	300_W_NO3	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963279

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	5.410	0.50						5.475	1.19	20	

Sample ID	N015066-003CMS	SampType:	MS	TestCode:	300_W_NO3	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963280

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	18.625	0.50	12.50	5.475	105	80	120				

Sample ID	N015066-003CMSD	SampType:	MSD	TestCode:	300_W_NO3	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963281

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	18.280	0.50	12.50	5.475	102	80	120	18.62	1.87	20	

Qualifiers:

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- H Holding times for preparation or analysis exceeded
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CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_SO4

Sample ID	MB-R99605_SO4	SampType:	MBLK	TestCode:	300_W_SO4	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	PBW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963284

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	ND	1.0									

Sample ID	LCS-R99605_SO4	SampType:	LCS	TestCode:	300_W_SO4	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	LCSW	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963285

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	4.705	1.0	5.000	0	94.1	90	110				

Sample ID	N015079-001BDUP	SampType:	DUP	TestCode:	300_W_SO4	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963287

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	237.080	20						241.3	1.78	20	

Sample ID	N015079-001BMS	SampType:	MS	TestCode:	300_W_SO4	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963288

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	345.040	20	100.0	241.3	104	80	120				

Sample ID	N015079-001BMSD	SampType:	MSD	TestCode:	300_W_SO4	Units:	mg/L	Prep Date:		RunNo:	99605
Client ID:	ZZZZZZ	Batch ID:	R99605	TestNo:	EPA 300.0			Analysis Date:	3/24/2015	SeqNo:	1963289

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	337.360	20	100.0	241.3	96.0	80	120	345.0	2.25	20	

Qualifiers:

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- DO Surrogate Diluted Out
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- H Holding times for preparation or analysis exceeded
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CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 365.3_W_T

Sample ID	LCS-50065	SampType:	LCS	TestCode:	365.3_W_T	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99714
Client ID:	LCSW	Batch ID:	50065	TestNo:	EPA 365.3			Analysis Date:	4/1/2015	SeqNo:	1968448

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.385	0.020	0.4000	0	96.2	80	120				

Sample ID	MB-50065	SampType:	MBLK	TestCode:	365.3_W_T	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99714
Client ID:	PBW	Batch ID:	50065	TestNo:	EPA 365.3			Analysis Date:	4/1/2015	SeqNo:	1968449

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	ND	0.020									

Sample ID	N015089-001I-MS	SampType:	MS	TestCode:	365.3_W_T	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99714
Client ID:	ZZZZZZ	Batch ID:	50065	TestNo:	EPA 365.3			Analysis Date:	4/1/2015	SeqNo:	1968452

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.433	0.020	0.4000	0.04700	96.5	80	120				

Sample ID	N015089-001I-MSD	SampType:	MSD	TestCode:	365.3_W_T	Units:	mg/L	Prep Date:	3/30/2015	RunNo:	99714
Client ID:	ZZZZZZ	Batch ID:	50065	TestNo:	EPA 365.3			Analysis Date:	4/1/2015	SeqNo:	1968453

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.426	0.020	0.4000	0.04700	94.8	80	120	0.4330	1.63	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015_W_DM

Sample ID **LCS-50038**	SampType: **LCS**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/26/2015**	RunNo: **99651**
Client ID: **LCSW**	Batch ID: **50038**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/26/2015**	SeqNo: **1965832**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	1.005	0.20	1.000	0	101	41	105				
Surr: p-Terphenyl	0.087		0.08000		108	48	133				

Sample ID **LCSD-50038**	SampType: **LCSD**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/26/2015**	RunNo: **99651**
Client ID: **LCSS02**	Batch ID: **50038**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/26/2015**	SeqNo: **1965833**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	1.002	0.20	1.000	0	100	41	105	1.005	0.369	20	
Surr: p-Terphenyl	0.085		0.08000		106	48	133		0		

Sample ID **MB-50038**	SampType: **MBLK**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/26/2015**	RunNo: **99651**
Client ID: **PBW**	Batch ID: **50038**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/26/2015**	SeqNo: **1965834**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	ND	0.20									
ORO	ND	0.20									
Surr: p-Terphenyl	0.076		0.08000		95.6	48	133				

Qualifiers:

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- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015GAS_WP

Sample ID **E150330LCS**	SampType: **LCS**	TestCode: **8015GAS_W**	Units: **mg/L**	Prep Date:	RunNo: **99683**
Client ID: **LCSW**	Batch ID: **E15VW021**	TestNo: **EPA 8015B**		Analysis Date: **3/30/2015**	SeqNo: **1966918**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	0.904	0.050	1.000	0	90.4	75	127				
Surr: Chlorobenzene - d5	47.081		50.00		94.2	73	132				

Sample ID **E150330MB1**	SampType: **MBLK**	TestCode: **8015GAS_W**	Units: **mg/L**	Prep Date:	RunNo: **99683**
Client ID: **PBW**	Batch ID: **E15VW021**	TestNo: **EPA 8015B**		Analysis Date: **3/30/2015**	SeqNo: **1966919**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	ND	0.050									
Surr: Chlorobenzene - d5	56.332		50.00		113	73	132				

Sample ID **N015089-001FMS**	SampType: **MS**	TestCode: **8015GAS_W**	Units: **mg/L**	Prep Date:	RunNo: **99683**
Client ID: **ZZZZZZ**	Batch ID: **E15VW021**	TestNo: **EPA 8015B**		Analysis Date: **3/30/2015**	SeqNo: **1966929**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	0.988	0.050	1.000	0	98.8	74	130				
Surr: Chlorobenzene - d5	54.623		50.00		109	73	132				

Sample ID **N015089-001FMSD**	SampType: **MSD**	TestCode: **8015GAS_W**	Units: **mg/L**	Prep Date:	RunNo: **99683**
Client ID: **ZZZZZZ**	Batch ID: **E15VW021**	TestNo: **EPA 8015B**		Analysis Date: **3/30/2015**	SeqNo: **1966930**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	0.978	0.050	1.000	0	97.8	74	130	0.9880	1.02	30	
Surr: Chlorobenzene - d5	52.293		50.00		105	73	132		0		

Qualifiers:

- B Analyte detected in the associated Method Blank
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- H Holding times for preparation or analysis exceeded
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CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID **P150329LCS**	SampType: **LCS**	TestCode: **8260WATER**	Units: **µg/L**	Prep Date:	RunNo: **99677**
Client ID: **LCSW**	Batch ID: **P15VW055**	TestNo: **EPA 8260B**		Analysis Date: **3/29/2015**	SeqNo: **1966735**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.830	0.50	20.00	0	99.2	80	120				
Ethylbenzene	19.430	0.50	20.00	0	97.2	80	120				
m,p-Xylene	38.950	1.0	40.00	0	97.4	80	120				
MTBE	19.240	0.50	20.00	0	96.2	77	120				
o-Xylene	19.340	0.50	20.00	0	96.7	80	120				
Tetrachloroethene	19.280	0.50	20.00	0	96.4	80	120				
Toluene	19.490	0.50	20.00	0	97.5	80	120				
Trichloroethene	20.600	0.50	20.00	0	103	80	120				
Xylenes, Total	58.290	1.5	60.00	0	97.2	70	130				
Surr: 1,2-Dichloroethane-d4	25.930		25.00		104	78	125				
Surr: 4-Bromofluorobenzene	25.630		25.00		103	80	120				
Surr: Dibromofluoromethane	24.650		25.00		98.6	80	122				
Surr: Toluene-d8	25.210		25.00		101	80	120				

Sample ID **N015066-003AMS**	SampType: **MS**	TestCode: **8260WATER**	Units: **µg/L**	Prep Date:	RunNo: **99677**
Client ID: **ZZZZZZ**	Batch ID: **P15VW055**	TestNo: **EPA 8260B**		Analysis Date: **3/29/2015**	SeqNo: **1966736**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.870	0.50	20.00	0	99.4	80	120				
Ethylbenzene	19.970	0.50	20.00	0	99.8	79	120				
m,p-Xylene	40.150	1.0	40.00	0	100	80	120				
MTBE	19.490	0.50	20.00	0	97.5	71	125				
o-Xylene	20.040	0.50	20.00	0	100	80	120				
Tetrachloroethene	20.500	0.50	20.00	0	103	71	123				
Toluene	19.880	0.50	20.00	0	99.4	80	120				
Trichloroethene	20.900	0.50	20.00	0	104	79	121				
Xylenes, Total	60.190	1.5	60.00	0	100	70	130				
Surr: 1,2-Dichloroethane-d4	25.910		25.00		104	78	125				
Surr: 4-Bromofluorobenzene	25.830		25.00		103	80	120				
Surr: Dibromofluoromethane	25.860		25.00		103	80	122				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID **N015066-003AMS**	SampType: **MS**	TestCode: **8260WATER**	Units: **µg/L**	Prep Date:	RunNo: **99677**
Client ID: **ZZZZZZ**	Batch ID: **P15VW055**	TestNo: **EPA 8260B**		Analysis Date: **3/29/2015**	SeqNo: **1966736**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: Toluene-d8	25.350		25.00		101	80	120				

Sample ID **N015066-003AMSD**	SampType: **MSD**	TestCode: **8260WATER**	Units: **µg/L**	Prep Date:	RunNo: **99677**
Client ID: **ZZZZZZ**	Batch ID: **P15VW055**	TestNo: **EPA 8260B**		Analysis Date: **3/29/2015**	SeqNo: **1966737**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.350	0.50	20.00	0	96.8	80	120	19.87	2.65	20	
Ethylbenzene	19.690	0.50	20.00	0	98.4	79	120	19.97	1.41	20	
m,p-Xylene	39.440	1.0	40.00	0	98.6	80	120	40.15	1.78	20	
MTBE	19.770	0.50	20.00	0	98.8	71	125	19.49	1.43	20	
o-Xylene	19.710	0.50	20.00	0	98.6	80	120	20.04	1.66	20	
Tetrachloroethene	19.930	0.50	20.00	0	99.7	71	123	20.50	2.82	20	
Toluene	19.250	0.50	20.00	0	96.2	80	120	19.88	3.22	20	
Trichloroethene	20.560	0.50	20.00	0	103	79	121	20.90	1.64	20	
Xylenes, Total	59.150	1.5	60.00	0	98.6	70	130	60.19	1.74	20	
Surr: 1,2-Dichloroethane-d4	25.550		25.00		102	78	125		0		
Surr: 4-Bromofluorobenzene	25.660		25.00		103	80	120		0		
Surr: Dibromofluoromethane	25.460		25.00		102	80	122		0		
Surr: Toluene-d8	24.830		25.00		99.3	80	120		0		

Sample ID **P150329MB3**	SampType: **MBLK**	TestCode: **8260WATER**	Units: **µg/L**	Prep Date:	RunNo: **99677**
Client ID: **PBW**	Batch ID: **P15VW055**	TestNo: **EPA 8260B**		Analysis Date: **3/29/2015**	SeqNo: **1966740**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.50									
Ethylbenzene	ND	0.50									
m,p-Xylene	ND	1.0									
MTBE	ND	0.50									
o-Xylene	ND	0.50									
Tetrachloroethene	ND	0.50									

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID **P150329MB3**	SampType: **MBLK**	TestCode: **8260WATER**	Units: **µg/L**	Prep Date:	RunNo: **99677**
Client ID: **PBW**	Batch ID: **P15VW055**	TestNo: **EPA 8260B**		Analysis Date: **3/29/2015**	SeqNo: **1966740**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Toluene	ND	0.50									
Trichloroethene	ND	0.50									
Xylenes, Total	ND	1.5									
Surr: 1,2-Dichloroethane-d4	25.040		25.00		100	78	125				
Surr: 4-Bromofluorobenzene	25.000		25.00		100	80	120				
Surr: Dibromofluoromethane	24.930		25.00		99.7	80	122				
Surr: Toluene-d8	25.220		25.00		101	80	120				

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID **MB-50051** SampType: **MBLK** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/27/2015** RunNo: **99685**
Client ID: **PBW** Batch ID: **50051** TestNo: **EPA 200.8** Analysis Date: **3/27/2015** SeqNo: **1967275**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	ND	0.50									
Arsenic	ND	0.10									
Barium	ND	1.0									
Beryllium	ND	0.50									
Boron	23.337	50									
Cadmium	ND	0.50									
Chromium	ND	1.0									
Copper	ND	1.0									
Lead	ND	1.0									
Manganese	ND	0.50									
Molybdenum	ND	0.50									
Selenium	ND	0.50									
Silver	0.176	0.50									
Thallium	ND	0.50									
Zinc	ND	10									

Sample ID **LCS-50051** SampType: **LCS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/27/2015** RunNo: **99685**
Client ID: **LCSW** Batch ID: **50051** TestNo: **EPA 200.8** Analysis Date: **3/27/2015** SeqNo: **1967278**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	9.844	0.50	10.00	0	98.4	85	115				
Arsenic	8.964	0.10	10.00	0	89.6	85	115				
Barium	99.486	1.0	100.0	0	99.5	85	115				
Beryllium	9.517	0.50	10.00	0	95.2	85	115				
Boron	936.935	50	1000	0	93.7	85	115				
Cadmium	9.327	0.50	10.00	0	93.3	85	115				
Chromium	9.371	1.0	10.00	0	93.7	85	115				
Copper	9.496	1.0	10.00	0	95.0	85	115				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID	LCS-50051	SampType:	LCS	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99685
Client ID:	LCSW	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/27/2015	SeqNo:	1967278

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	10.171	1.0	10.00	0	102	85	115				
Manganese	89.428	0.50	100.0	0	89.4	85	115				
Molybdenum	8.559	0.50	10.00	0	85.6	85	115				
Selenium	9.681	0.50	10.00	0	96.8	85	115				
Silver	8.870	0.50	10.00	0	88.7	85	115				
Thallium	10.143	0.50	10.00	0	101	85	115				
Zinc	91.211	10	100.0	0	91.2	85	115				

Sample ID	N015092-001C-MS	SampType:	MS	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99685
Client ID:	ZZZZZZ	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/27/2015	SeqNo:	1967282

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	11.392	0.50	10.00	0	114	75	125				
Arsenic	11.220	0.10	10.00	0.06979	111	75	125				
Barium	133.230	1.0	100.0	12.19	121	75	125				
Beryllium	12.253	0.50	10.00	0	123	75	125				
Boron	2018.760	50	1000	909.5	111	75	125				
Cadmium	8.730	0.50	10.00	0	87.3	75	125				
Chromium	9.980	1.0	10.00	0	99.8	75	125				
Copper	4.684	1.0	10.00	0	46.8	75	125				S
Manganese	70.888	0.50	100.0	0	70.9	75	125				S
Molybdenum	32.054	0.50	10.00	20.64	114	75	125				
Selenium	13.318	0.50	10.00	3.328	99.9	75	125				
Silver	9.473	0.50	10.00	0	94.7	75	125				
Zinc	88.790	10	100.0	0	88.8	75	125				

Sample ID	N015092-001C-MSD	SampType:	MSD	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99685
Client ID:	ZZZZZZ	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/27/2015	SeqNo:	1967283

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID **N015092-001C-MSD** SampType: **MSD** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/27/2015** RunNo: **99685**
Client ID: **ZZZZZZ** Batch ID: **50051** TestNo: **EPA 200.8** Analysis Date: **3/27/2015** SeqNo: **1967283**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Antimony	11.390	0.50	10.00	0	114	75	125	11.39	0.0139	20	
Arsenic	11.350	0.10	10.00	0.06979	113	75	125	11.22	1.16	20	
Barium	133.532	1.0	100.0	12.19	121	75	125	133.2	0.226	20	
Beryllium	12.272	0.50	10.00	0	123	75	125	12.25	0.161	20	
Boron	2025.451	50	1000	909.5	112	75	125	2019	0.331	20	
Cadmium	8.645	0.50	10.00	0	86.5	75	125	8.730	0.982	20	
Chromium	9.964	1.0	10.00	0	99.6	75	125	9.980	0.160	20	
Copper	4.650	1.0	10.00	0	46.5	75	125	4.684	0.733	20	S
Manganese	71.096	0.50	100.0	0	71.1	75	125	70.89	0.292	20	S
Molybdenum	32.071	0.50	10.00	20.64	114	75	125	32.05	0.0513	20	
Selenium	12.836	0.50	10.00	3.328	95.1	75	125	13.32	3.68	20	
Silver	9.518	0.50	10.00	0	95.2	75	125	9.473	0.477	20	
Zinc	88.554	10	100.0	0	88.6	75	125	88.79	0.266	20	

Sample ID **N015092-001C-MS** SampType: **MS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/27/2015** RunNo: **99685**
Client ID: **ZZZZZZ** Batch ID: **50051** TestNo: **EPA 200.8** Analysis Date: **3/27/2015** SeqNo: **1967291**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	11.426	5.0	10.00	0	114	75	125				
Thallium	10.633	2.5	10.00	0	106	75	125				

Sample ID **N015092-001C-MSD** SampType: **MSD** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/27/2015** RunNo: **99685**
Client ID: **ZZZZZZ** Batch ID: **50051** TestNo: **EPA 200.8** Analysis Date: **3/27/2015** SeqNo: **1967292**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	11.406	5.0	10.00	0	114	75	125	11.43	0.179	20	
Thallium	10.666	2.5	10.00	0	107	75	125	10.63	0.311	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015089
Project: CEDAR WASH, 303710602

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID	MB-50051	SampType:	MBLK	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99703
Client ID:	PBW	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/30/2015	SeqNo:	1967886

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	50									
Nickel	0.130	1.0									

Sample ID	LCS-50051	SampType:	LCS	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99703
Client ID:	LCSW	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/30/2015	SeqNo:	1967887

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	98.351	50	100.0	0	98.4	85	115				
Nickel	9.266	1.0	10.00	0	92.7	85	115				

Sample ID	N015092-001C-MS	SampType:	MS	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99703
Client ID:	ZZZZZZ	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/30/2015	SeqNo:	1967894

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	130.526	50	100.0	0	131	75	125				S
Nickel	13.081	1.0	10.00	2.011	111	75	125				

Sample ID	N015092-001C-MSD	SampType:	MSD	TestCode:	200.8_WDISS	Units:	µg/L	Prep Date:	3/27/2015	RunNo:	99703
Client ID:	ZZZZZZ	Batch ID:	50051	TestNo:	EPA 200.8			Analysis Date:	3/30/2015	SeqNo:	1967895

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	117.488	50	100.0	0	117	75	125	130.5	10.5	20	
Nickel	13.115	1.0	10.00	2.011	111	75	125	13.08	0.255	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

ASSET LABORATORIES
ANALYTICAL SUPPORT SERVICES FOR ENVIRONMENTAL TECHNOLOGIES
3151 W. Post Road, Las Vegas, NV 89118 P: 702.307.2659 F: 702.307.2691
www.assetlaboratories.com

Chain of Custody

Page ____ of ____

Client: NINYO & MOORE
Address:
Phone: **Fax:**
Project Name: CEDAR WASH
Project Number: 307710 002 **PO #**
Submitted By: COURT BROOKS
Title:
Signature: GTB **Date:** 3/24/15
I hereby authorize ASSET Laboratories to perform the tests indicated below:

ASSET LABORATORIES
ANALYTICAL SUPPORT SERVICES FOR ENVIRONMENTAL PROFESSIONALS

Nevada: 3151 W. Post Rd., LasVegas, NV 89118
Phone: 702.307.2659 Fax: 702.307.2691

California: 11060 Artesia Blvd., Ste C, Cerritos, CA 90703
Phone: 562.219.7435 Fax: 562.219.7436

Sample Condition Upon Receipt
Temp 1.5°C IR# 2
Method of Cooling ICED
Headspace N/A
Intact YES
Seal NO
Comments

Work Order No.	Sample ID/Location	Date	Time	Matrix: Water	Liquid	Soil	Solid	Wastewater	Groundwater	Others	8260 (Volatiles)	8015M (GRO)	8015B (DRO/ORO)	CAM 17 6010/7470/7471	SVOCs by EPA 8270C	PROFILE	CATEGORY IV	PETROLEUM	Collected	Turn Around Time	No. of container	Container Type	PRESERVATION	QA/QC: RTNE / RWQCB / CT / LEVEL IV	Remarks
NO15089-1	B-1	3/24/15	1300						X							X	X	X	X						

Send report to:
Name CBROOKS@NINYOANDMOORE.COM
Address
Email

Bill to:
Name ROUTINE TROLS
Address
Email

Sampled by:
I attest to the validity and authenticity of this sample. I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action.
Name COURT BROOKS Signature GTB

Special Instruction/Comments:

Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time
GTB	3/24/15	1510	[signature]	3/24/15	1510
[signature]	3/24/15	1547	[signature]	3/24/15	1547

TAT Starts at 8 AM the following day if samples received after 3 pm.
A ☐ ≤ 24 Hours D ☐ = 3 Workdays
B ☐ = Next Workday E ☐ = Routine 5-7 Workdays
C ☐ = 2 Workdays

Preservatives: H=HCl N=HNO_3 S=H_2SO_4 C=4°C Z=$Zn(AC)_2$ O=NaOH T=$Na_2S_2O_3$

Carrier: Airbill/Tracking #:

Container Type: T = Tube V = VOA L = Liter P = Pint J = Jar B = Tedlar G = Glass M = Metal P = Plastic

EDD Requirement: Excel EDD ☐ Geotracker ☐ Global ID ____ LabSpec ☐

Sample/Records Storage
All samples will be disposed in 45 days upon receipt and records will be destroyed in 5 years upon submission of final report.
Fees will be applied for extended storage.

White = Laboratory Copy Yellow = Customer's Copy

ASSET Laboratories

Please review the checklist below. Any NO signifies non-compliance. Any non-compliance will be noted and must be understood as having an impact on the quality of the data. All tests will be performed as requested regardless of any compliance issues.

If you have any questions or further instruction, please contact our Project Coordinator at (702) 307-2659.

Cooler Received/Opened On:	3/24/2015	Workorder:	N015089
Rep sample Temp (Deg C):	1.5	IR Gun ID:	2
Temp Blank:	☑ Yes ☐ No		
Carrier name:	ATL		
Last 4 digits of Tracking No.:	NA	Packing Material Used:	None
Cooling process:	☑ Ice ☐ Ice Pack ☐ Dry Ice ☐ Other ☐ None		

Sample Receipt Checklist

1. Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
2. Custody seals intact, signed, dated on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
3. Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
4. Chain of custody present?	Yes ☑	No ☐	
5. Sampler's name present in COC?	Yes ☑	No ☐	
6. Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
7. Chain of custody agrees with sample labels?	Yes ☑	No ☐	
8. Samples in proper container/bottle?	Yes ☑	No ☐	
9. Sample containers intact?	Yes ☑	No ☐	
10. Sufficient sample volume for indicated test?	Yes ☑	No ☐	
11. All samples received within holding time?	Yes ☐	No ☑	
12. Temperature of rep sample or Temp Blank within acceptable limit?	Yes ☑	No ☐	NA ☐
13. Water - VOA vials have zero headspace?	Yes ☑	No ☐	NA ☐
14. Water - pH acceptable upon receipt? Example: pH > 12 for (CN,S); pH<2 for Metals	Yes ☑	No ☐	NA ☐
15. Did the bottle labels indicate correct preservatives used?	Yes ☑	No ☐	NA ☐
16. Were there Non-Conformance issues at login?	Yes ☑	No ☐	NA ☐
Was Client notified?	Yes ☐	No ☐	NA ☑

Comments: Sample for pH was past holding time upon receipt.

Checklist Completed By: HG 3/27/2015

Reviewed By: 4/3/15

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Eurofins Eaton Analytical
750 Royal Oaks Drive, Ste 100
Monrovia, CA 91016

TEL:
FAX:
Acct #:

Field Sampler: C. Brooks

24-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				EPA 331.0		
N015089-001L / B-1	Groundwater	3/24/2015 1:00:00 PM	4OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15089A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Perchlorate by 331.0. Sample was sterile filtered.

		Date/Time			Date/Time
Relinquished by:	fGhlivg	3/24/15 0430 PM	**Received by:**	GSO # 527349401	
Relinquished by:			**Received by:**		

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Silver State Analytical Laboratory
3638 E. Sunset Road, Suite 100
Las Vegas, NV 89120

TEL: (702) 873-4478
FAX: (702) 873-7967
Acct #:

Field Sampler: C. Brooks

Fecal Coliert 18 Ecoli

24-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests ~~SM 9221 C,E~~	~~SM 9221 D~~	SM4500-Cl B (Res Cl)
N015089-001A / B-1 1541-1A	Groundwater	3/24/2015 1:00:00 PM	4OZP	1		
N015089-001B / B-1 -2A	Groundwater	3/24/2015 1:00:00 PM	4OZP		1	
N015089-001C / B-1 -3A	Groundwater	3/24/2015 1:00:00 PM	8OZP			1

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO# ~~N15089A~~ For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT N15089B 4/1/2015

Please analyze for Fecal Coliform, E.Coli and Residual Chlorine.

		Date/Time			Date/Time
Relinquished by:	Anthony Hattori	3/24/15:1645	**Received by:**	R. Bolshazy	3/24/15 1645
Relinquished by:			**Received by:**		

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:

Western Environmental Testing Laboratory
3230 Polaris Ave. #4
Las Vegas, NV 89102

TEL: (702) 475-8899
FAX:
Acct #:

Field Sampler:

25-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				~~D-4294~~ 200.7	SM4500-NH3C	
N015089-001H / B-1	Groundwater	3/24/2015 1:00:00 PM	8OZP		1	
N015089-001K / B-1	Groundwater	3/24/2015 1:00:00 PM	8OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15089C For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for TKN and Sulfur.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/25/15 1208	**Received by:**	[signature]	3/25/15 @ 1208
Relinquished by:			**Received by:**		

April 07, 2015

Courtney Brooks
Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

TEL: (702) 433-0330
FAX: (702) 227-2051

CA-ELAP No.: 2676
NV Cert. No.: NV-00922

Workorder No.: N015089

RE: CEDAR WASH, 303710602

Attention: Courtney Brooks

Enclosed are the results for sample(s) received on March 24, 2015 by ASSET Laboratories . The sample(s) are tested for the parameters as indicated in the enclosed chain of custody in accordance with the applicable laboratory certifications.

This is an addendum report. Please incorporate with documentation previously submitted.

Thank you for the opportunity to service the needs of your company.

Please feel free to call me at (702) 307-2659 if I can be of further assistance to your company.

Sincerely,

Glen Gesmundo
QA Manager

The cover letter is an integral part of this analytical report. This Laboratory Report cannot be reproduced in part or in its entirety without written permission from the client and Advanced Technology Laboratories - Las Vegas.

ASSET Laboratories

ANALYTICAL RESULTS

Print Date: *07-Apr-15*

CLIENT:	Ninyo & Moore	**Client Sample ID:**	B-1
Lab Order:	N015089	**Collection Date:**	3/24/2015 1:00:00 PM
Project:	CEDAR WASH, 303710602	**Matrix:**	GROUNDWATER
Lab ID:	N015089-001E		

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
TOTAL NITROGEN BY CALCULATION						
		CALCULATION				
RunID: WETCHEM_150407A	QC Batch: R99795			PrepDate:		Analyst: **GG**
Total Nitrogen	5.06	0.100		mg/L	1	4/7/2015

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	ND	Not Detected at the Reporting Limit
S	Spike/Surrogate outside of limits due to matrix interference		Results are wet unless otherwise specified
DO	Surrogate Diluted Out		

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: March 26, 2015

LABORATORY NO: 15-1541

CLIENT: ASSET Laboratories
3151-3153 W. Post Rd.
Las Vegas, NV 89118

PAGE: 1 of 1

CLIENT PROJECT:

CLIENT PO #:

Sampled By: C. Brooks
Date Sampled: 03/24/15
Time Sampled: 1300

Submitted by: A. Hattori
Date Received: 03/24/15
Time Received: 1645

Report Attention:

Location	Parameter	Result	Unit	Reporting Limit	Method	Date Analyzed	Analyst
N015089-001A/ B-1	Fecal Coliform	ND	CFU/100 mL	1.0	Colilert-18	03/24/15	CR
N015089-001B/ B-1	Coliforms, *E. coli*	ND	CFU/100 mL	1.0	Colilert-18	03/24/15	CR
N015089-001C/ B-1	Residual Chlorine [(1)]	ND	mg/L	0.50	SM4500Cl G	03/24/15	CL

ND: non-detect
EPA Flags: [(1)] Sample analyzed outside of method specified hold time requirement

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 • Las Vegas, NV 89120 • Tel: 702-873-4478 Fax: 702-873-7967
4587 Longley Lane, No. 2 • Reno, NV 89502 • Tel: 775-825-1127 Fax: 775-825-1167
www.ssalabs.com • www.envirotechonline.com

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Silver State Analytical Laboratory
3638 E. Sunset Road, Suite 100
Las Vegas, NV 89120

TEL: (702) 873-4478
FAX: (702) 873-7967
Acct #:

Field Sampler: C. Brooks

Fecal Coliert 18 Ecoli

24-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests ~~SM 9221 C,E~~	~~SM 9221 D~~	Res Cl SM4500-Cl B
N015089-001A / B-1 1541-1A	Groundwater	3/24/2015 1:00:00 PM	4OZP	1		
N015089-001B / B-1 -2A	Groundwater	3/24/2015 1:00:00 PM	4OZP		1	
N015089-001C / B-1 -3A	Groundwater	3/24/2015 1:00:00 PM	8OZP			1

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15089A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Fecal Coliform, E.Coli and Residual Chlorine.

		Date/Time			Date/Time
Relinquished by:	Anthony Hattori	3/24/15:1645	**Received by:**	R. Bolshazy	3/24/15 1645
Relinquished by:			**Received by:**		

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

NELAP ACCREDITED TNI LABORATORY ORELAP 4034

ilac-MRA

ACLASS ACCREDITED TESTING AT-1807

Laboratory Report

for

Advanced Technology Laboratories, Inc.
3151 W. Post Road
Las Vegas, NV 89118
Attention: Marlon Cartin
Fax: 702-307-2691

Date of Issue
03/27/2015

EUROFINS EATON ANALYTICAL

DST: David S Tripp

Project Manager

Report: 526684
Project: SUBCONTRACT
Group: DRINKING WATER

* Accredited in accordance with TNI 2009 and ISO/IEC 17025:2005.
* Laboratory certifies that the test results meet all **TNI 2009 and ISO/IEC 17025:2005** requirements unless noted under the individual analysis.
* Following the cover page are State Certification List, ISO 17025 Accredited Method List, Acknowledgement of Samples Received, Comments, Hits Report, Data Report, QC Summary, QC Report and Regulatory Forms, as applicable.
* Test results relate only to the sample(s) tested.

STATE CERTIFICATION LIST

State	Certification Number	State	Certification Number
Alabama	41060	**Mississippi**	Certified
Alaska	CA00006	**Montana**	Cert 0035
Arizona	AZ0778	**Nebraska**	Certified
Arkansas	Certified	**Nevada**	CA00006-2014-1
California-Monrovia-ELAP	2813	**New Hampshire ***	2959
California-Colton- ELAP	2812	**New Jersey ***	CA 008
California-Folsom- ELAP	2820	**New Mexico**	Certified
Colorado	Certified	**New York ***	11320
Connecticut	PH-0107	**North Carolina**	06701
Delaware	CA 006	**North Dakota**	R-009
Florida *	E871024	**Oregon (Primary AB) ***	**ORELAP 4034**
Georgia	947	**Pennsylvania ***	68-565
Guam	14-003r	**Rhode Island**	LAO00326
Hawaii	Certified	**South Carolina**	87016
Idaho	Certified	**South Dakota**	Certified
Illinois *	200033	**Tennessee**	TN02839
Indiana	C-CA-01	**Texas ***	T104704230-14-7
Kansas *	E-10268	**Utah ***	CA000062014-7
Kentucky	90107	**Vermont**	VT0114
Louisiana *	LA140009	**Virginia ***	460260
Maine	CA0006	**Washington**	C838
Maryland	224	**West Virginia**	9943 C
Commonwealth of Northern Marianas Is.	MP0004	**Wisconsin**	998316660
Massachusetts	M-CA006	**Wyoming**	8TMS-L
Michigan	9906	**EPA Region 5**	Certified
Los Angeles County Sanitation Districts	10264		

* NELAP/TNI Recognized Accreditation Bodies

The tests listed below are accredited and meet the requirements of ISO 17025 as verified by the ANSI-ASQ National Accreditation Board/ACLASS.
Refer to Certificate and scope of accreditation (AT 1807) found at: http://www.eatonanalytical.com

SPECIFIC TESTS	METHOD OR TECHNIQUE USED	Drinking Water	Food & Beverage	Waste Water
1,4-Dioxane	EPA 522	x	x	
2,3,7,8-TCDD	Modified EPA 1613B	x	x	
Acrylamide	In House Method	x	x	
Alkalinity	SM 2320B	x	x	x
Ammonia	EPA 350.1		x	x
Ammonia	SM 4500-NH3 H (18th)		x	x
Anions and DBPs by IC	EPA 300.0	x	x	x
Anions and DBPs by IC	EPA 300.1	x	x	
Asbestos	EPA 100.2	x		
Bicarbonate Alkalinity as HCO3	SM 2330B	x	x	x
BOD / CBOD	SM 5210B		x	x
Bromate	In House Method	x	x	
Carbamates	EPA 531.2	x	x	
Carbonate as CO3	SM 2330B	x	x	x
Carbonyls	EPA 556	x	x	
COD	EPA 410.4 / SM 5220D			x
Chloramines	SM 4500-CL G	x	x	x
Chlorinated Acids	EPA 515.4	x	x	
Chlorinated Acids	EPA 555	x	x	
Chlorine Dioxide	SM 4500-CLO2 D	x	x	
Chlorine -Total/Free/ Combined Residual	SM 4500-Cl G	x	x	x
Conductivity	EPA 120.1			x
Conductivity	SM 2510B	x	x	x
Corrosivity (Langelier Index)	SM 2330B	x	x	
Cyanide, Amenable	SM 4500-CN G	x		x
Cyanide, Free	SM 4500CN F	x	x	x
Cyanide, Total	EPA 335.4	x	x	x
Cyanogen Chloride (screen)	In House Method	x	x	
Diquat and Paraquat	EPA 549.2	x	x	
DBP/HAA	SM 6251B	x	x	
Dissolved Oxygen	SM 4500-O G		x	x
E. Coli	(MTF/EC+MUG)	x		
E. Coli	CFR 141.21(f)(6)(i)		x	x
E. Coli	SM 9223			x
E. Coli (Enumeration)	SM 9221B.1/ SM 9221F	x	x	
E. Coli (Enumeration)	SM 9223B	x	x	
EDB/DCBP	EPA 504.1	x		
EDB/DBCP and DBP	EPA 551.1	x	x	
EDTA and NTA	In House Method	x	x	
Endothall	EPA 548.1	x	x	
Enterococci	SM 9230B	x		x
Fecal Coliform	SM 9221 E (MTF/EC)	x		
Fecal Coliform	SM 9221C, E (MTF/EC)			x
Fecal Coliform (Enumeration)	SM 9221E (MTF/EC)	x	x	
Fecal Coliform with Chlorine Present	SM 9221E			x
Fecal Streptococci	SM 9230B	x		x
Fluoride	SM 4500-F C	x	x	x
Glyphosate	EPA 547	x	x	
Gross Alpha/Beta	EPA 900.0	x	x	x
HAAs/ Dalapon	EPA 552.3	x	x	
Hardness	SM 2340B	x	x	x
Heterotrophic Bacteria	In House Method	x	x	
Heterotrophic Bacteria	SM 9215 B	x	x	
Hexavalent Chromium	EPA 218.6	x	x	x
Hexavalent Chromium	EPA 218.7	x	x	
Hexavalent Chromium	SM 3500-Cr B or C (20th)			x

SPECIFIC TESTS	METHOD OR TECHNIQUE USED	Drinking Water	Food & Beverage	Waste Water
Hormones	EPA 539	x	x	
Hydroxide as OH Calc.	SM 2330B	x	x	
Kjeldahl Nitrogen	EPA 351.2			x
Mercury	EPA 245.1	x	x	x
Metals	EPA 200.7 / 200.8	x	x	x
Microcystin LR	ELISA	x	x	
NDMA	EPA 521	x	x	
Nitrate/Nitrite Nitrogen	EPA 353.2	x	x	x
OCL, Pesticides/PCB	EPA 505	x	x	
Ortho Phosphate	EPA 365.1	x	x	
Ortho Phosphate and Total Phosphorous	EPA 365.1/SM 4500-P E			x
Ortho Phosphorous	SM 4500P E	x	x	
Oxyhalides Disinfection Byproducts	EPA 317.0	x	x	
Perchlorate	EPA 331.0	x	x	
Perchlorate	EPA 314.0	x	x	
Perfluorinated Alkyl Acids	EPA 537	x	x	
pH	EPA 150.1	x		
pH	SM 4500-H+B	x	x	x
Phenylurea Pesticides/ Herbicides	In House Method	x	x	
Pseudomonas	IDEXX Pseudalert	x	x	
Radium-226	RA-226 GA	x	x	
Radium-228	RA-228 GA	x	x	
Radon-222	SM 7500RN	x	x	
Residue, Filterable	SM 2540C	x	x	x
Residue, Non-filterable	SM 2540D			x
Residue, Total	SM 2540B		x	x
Residue, Volatile	EPA 160.4			x
Semi-VOC	EPA 525.2	x	x	
Semi-VOC	EPA 625	x	x	x
Silica	SM 4500-Si D	x	x	x
Silica	SM 4500-SiO2 C	x		x
Sulfide	SM 4500-$S^{=}$ D			x
Sulfite	SM 4500-SO^3B	x	x	x
Surfactants	SM 5540C	x	x	x
Taste and Odor Analytes	SM 6040E	x	x	
Total Coliform	SM 9221 A, B	x	x	
Total Coliform (Enumeration)	SM 9221 A, B, C	x	x	
Total Coliform / E. coli	Colisure	x	x	
Total Coliform	SM 9221B			x
Total Coliform with Chlorine Present	SM 9221B			x
Total Coliform / E.coli	SM 9223	x	x	
TOC	SM 5310C		x	x
TOC/DOC	SM 5310C	x	x	
TOX	SM 5320B			x
Total Phenols	EPA 420.1			x
Total Phenols	EPA 420.4	x	x	x
Total Phosphorous	SM 4500 P F			x
Turbidity	EPA 180.1	x	x	x
Turbidity	SM 2130B	x		x
Uranium by ICP/MS	EPA 200.8	x	x	
UV 254	SM 5910B	x		
VOC	EPA 524.2/EPA 524.3	x	x	
VOC	EPA 624	x	x	x
VOC	EPA SW 846 8260	x	x	
VOC	In House Method	x	x	
Yeast and Mold	SM 9610	x	x	

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Acknowledgement of Samples Received

Addr: **Advanced Technology Laboratories, Inc.**
3151 W. Post Road
Las Vegas, NV 89118

Attn: Marlon Cartin
Phone: 702-307-2659

Client ID: ATL-NV
Folder #: 526684
Project: SUBCONTRACT
Sample Group: DRINKING WATER

Project Manager: David S Tripp
Phone: (626) 386-1158
PO #: N15089A

The following samples were received from you on **March 25, 2015** at **0905**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using Eurofins Eaton Analytical.

Sample #	Sample ID	Sample Date
201503250140	N015089-001L/B1	03/24/2015 1300
	@331-PHG-Sterile-Filtered	

Test Description

@331-PHG-Sterile-Filtered -- Perchlorate by EPA 331.0

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:

Eurofins Eaton Analytical
750 Royal Oaks Drive, Ste 100
Monrovia, CA 91016

TEL:
FAX:
Acct #:

Field Sampler: C. Brooks

24-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				EPA 331.0		
N015089-001L / B-1	Groundwater	3/24/2015 1:00:00 PM	4OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15089A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Perchlorate by 331.0. Sample was sterile filtered.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/24/15 0430 PM	**Received by:**	GSO # 527349401	
Relinquished by:			**Received by:**	[signature] EEA M. Escalante	3/25/15 0905

4.5-0.3 = 4.2°C on ice

GSO
GOLDEN STATE OVERNIGHT

800-322-5555 www.gso.com

Ship From
ADVANCED TECHNOLOGY LABORATORIES, INC.
MARLON CARTIN
3151 W. POST RD.
LAS VEGAS, NV 89118

Ship To
EUROFINS
DAVID TRIPP
750 ROYAL OAKS DR
STE 100
MONROVIA, CA 91016

COD: $0.00
Weight: 0 lb(s)
Reference:

Delivery Instructions:

Signature Type: REQUIRED

Tracking #: 527349401 **CPS**

NWK **E**
MONROVIA

D91006B

35662829

Print Date: 3/24/2015 4:14 PM

LABEL INSTRUCTIONS:

Do not copy or reprint this label for additional shipments - each package must have a unique barcode.

Use the "Print Label" button on this page to print the shipping label on a laser or inkjet printer. Securely attach this label to your package, do not cover the barcode.

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Comments
Report: 526684

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

The Comments Report may be blank if there are no comments for this report.

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Hits
Report: 526684

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

Samples Received on:
03/25/2015 0905

Analyzed	Analyte	Sample ID	Result	Federal MCL	Units	MRL
	201503250140	**N015089-001L/B1**				
03/26/2015 20:29	Perchlorate		6.7	6	ug/L	5

SUMMARY OF POSITIVE DATA ONLY

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 526684

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

Samples Received on:
03/25/2015 0905

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
N015089-001L/B1 (201503250140)						**Sampled on 03/24/2015 1300**		
			EPA 331.0 - Perchlorate by EPA 331.0					
	03/26/2015 20:29	828820	(EPA 331.0)	Perchlorate	6.7	ug/L	5	10

Rounding on totals after summation.
(c) - indicates calculated results

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Advanced Technology Laboratories, Inc.

QC Ref # 828820 - Perchlorate by EPA 331.0 **Analysis Date: 03/26/2015**

201503250140 N015089-001L/B1 Analyzed by: PHK

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory QC
Report: 526684

Advanced Technology Laboratories, Inc.

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 828820 - Perchlorate by EPA 331.0 by EPA 331.0						**Analysis Date: 03/26/2015**			
LCS1	Perchlorate		10	10.1	ug/L	101	(80-120)		
LCS2	Perchlorate		10	10.4	ug/L	104	(80-120)	20	2.9
MBLK	Perchlorate			<0.167	ug/L				
MRL_CHK	Perchlorate		0.5	0.516	ug/L	103	(50-150)		
MS_201502260256	Perchlorate	ND	0.5	0.560	ug/L	112	(50-150)		
MSD_201502260256	Perchlorate	ND	0.5	0.473	ug/L	95	(50-150)	50	17

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
(I) - Indicates internal standard compound.

4/6/2015

Advanced Technology Laboratories
3151 W Post Road
Las Vegas, NV 89118
Attn: Marlon Cartin

OrderID: *1503729*

Dear: Marlon Cartin

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, online edition, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 3/25/2015. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Andy Smith
QA Manager

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Report Comments

Advanced Technology Laboratories - 1503729

General Comments

None

Specific Comments

None

Per method recommendation (section 4.4), Samples analyzed by methods EPA 300.0 and EPA 300.1 have been filtered prior to analysis.

Report Legend

B	--	Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	--	Sample analyzed beyond the accepted holding time
J	--	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	--	Reported value is estimated; The sample matrix interfered with the analysis
N	--	There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	--	Not calculated due to matrix interference
Q	--	Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	--	Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC	--	Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered
U	--	The analyte was analyzed for, but was not detected above the level of the reported sample reporting/quantitation limit

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Western Environmental Testing Laboratory
Analytical Report

Advanced Technology Laboratories
3151 W Post Road
Las Vegas, NV 89118
Attn: Marlon Cartin
Phone: (702) 307-2659 **Fax:** (702) 307-2691

Date Printed: 4/6/2015
OrderID: *1503729*
PO\Project: *31503133/N15089C*

Customer Sample ID: N015089-001H **Collect Date/Time:** 3/24/2015 13:00
WETLAB Sample ID: 1503729-001 **Receive Date:** 3/25/2015 12:08

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Flow Injection Analyses							
Total Kjeldahl Nitrogen	EPA 351.2	0.56	mg/L	1	0.20	3/30/2015	NV00925

Customer Sample ID: N015089-001K **Collect Date/Time:** 3/24/2015 13:00
WETLAB Sample ID: 1503729-002 **Receive Date:** 3/25/2015 12:08

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Trace Metals by ICP-OES							
Sulfur	EPA 200.7	820 SC	mg/L	1	1.0	4/2/2015	NV00925
Sample Preparation							
Trace Metals Digestion	EPA 200.2	Complete		1		4/1/2015	NV00925

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

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Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
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Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC15031523	Blank 1	Total Kjeldahl Nitrogen	EPA 351.2	ND	mg/L
QC15040137	Blank 1	Sulfur	EPA 200.7	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC15031523	LCS 1	Total Kjeldahl Nitrogen	EPA 351.2	1.04	1.00	104	mg/L
QC15040137	LCS 1	Sulfur	EPA 200.7	9.83	10.0	98	mg/L

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC15031523	MS 1	Total Kjeldahl Nitrogen	EPA 351.2	1503725-001	ND	M	1.34	1.22	1.00	mg/L	NC	NC	NC
QC15031523	MS 2	Total Kjeldahl Nitrogen	EPA 351.2	1503725-003	ND	M	1.26	1.11	1.00	mg/L	NC	NC	NC
QC15040137	MS 1	Sulfur	EPA 200.7	1503729-002	815	SC	912	921	10.0	mg/L	NC	NC	NC

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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LAS VEGAS
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Las Vegas, Nevada 89102
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fax (702) 622-2868
EPA LAB ID: NV00932

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:

Western Environmental Testing Laboratory
3230 Polaris Ave. #4
Las Vegas, NV 89102

TEL: (702) 475-8899
FAX:
Acct #:

Field Sampler:

25-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests D-4294 200.7	Requested Tests SM4500-NH3C
N015089-001H / B-1	Groundwater	3/24/2015 1:00:00 PM	8OZP		1
N015089-001K / B-1	Groundwater	3/24/2015 1:00:00 PM	8OZP	1	

10 1°@ 1354 1240 MA 3 25 15

WETLAB Order ID: 1503729
Sparks Control #: _____
Elko Control #: _____
LV Control #: 3/503133

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15089C For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for TKN and Sulfur.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/25/15 1208	**Received by:**	[signature]	3/25/15 1208
Relinquished by:	[signature]	3-25-15 1530	**Received by:**	ONTRAC	3-25-15 1530

ON TRAC

Vanessa A Leyva 3/26/15 1345

March 24, 2015

Robert Troisi
Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

TEL: (702) 433-0330
FAX: (702) 227-2051

CA-ELAP No.: 2676
NV Cert. No.: NV-00922

Workorder No.: N014918

RE: Atkins / Cedar Ave, 303710002

Attention: Robert Troisi

Enclosed are the results for sample(s) received on March 09, 2015 by ASSET Laboratories . The sample(s) are tested for the parameters as indicated in the enclosed chain of custody in accordance with the applicable laboratory certifications.

Thank you for the opportunity to service the needs of your company.

Please feel free to call me at (702) 307-2659 if I can be of further assistance to your company.

Sincerely,

Glen Gesmundo
QA Manager

The cover letter is an integral part of this analytical report. This Laboratory Report cannot be reproduced in part or in its entirety without written permission from the client and Advanced Technology Laboratories - Las Vegas.

CLIENT: Ninyo & Moore
Project: Atkins / Cedar Ave, 303710002
Lab Order: N014918

CASE NARRATIVE

SAMPLE RECEIVING/GENERAL COMMENTS:

Sample was received intact with proper chain of custody documentation.

Cooler temperature and sample preservation were verified upon receipt of samples if applicable.

Information on sample receipt conditions including discrepancies can be found in attached Sample Receipt Checklist Form.

Samples were analyzed within method holding time except for pH. pH testing is specified to be performed in the field within 15 minutes of sampling;sample was received and analyzed past the regulatory holding time.

Subcontracted Analysis:

Perchlorate (EPA 331.0) was subcontracted to Eurofins Eaton Analytical - Monrovia, CA.

Residual Chlorine, Fecal Coliform and E.Coli were subcontracted to Silver State Analytical Laboratories- Las Vegas,NV.

TKN and Sulfur were subcontracted to Western Environmental Labs- Las Vegas,NV.

Analytical Comments for EPA 200.7:

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) are outside recovery criteria for Calcium and Magnesium since the analyte concentration in the sample is disproportionate to the spike level. The associated Laboratory Control Sample (LCS) recovery was acceptable.

Analytical Comments for EPA 245.1:

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) are outside recovery for QC samples N014918-001J-MS and N014918-001J-MSD criteria possibly due to matrix interference. The associated Laboratory Control Sample (LCS) recovery was acceptable.

Analytical Comments for EPA 8015B DRO/ORO:

RPD for Laboratory Control Sample (LCS) /Laboratory Control Sample Duplicate (LCSD) is outside criteria. All recoveries were wihin limit.

ASSET LABORATORIES
ANALYTICAL SUPPORT SERVICES FOR ENVIRONMENTAL TECHNOLOGIES
CALIFORNIA
11060 Artesia Blvd., Ste C, Cerritos, CA 90703
P: 562.219.7435 F: 562.219.7436
NEVADA
3151 W. Post Rd., Las Vegas, NV 89118
P: 702.307.2659 F: 702.307.2691

"Serving Clients with Passion and Professionalism"

ASSET Laboratories

Date: *24-Mar-15*

CLIENT: Ninyo & Moore
Project: Atkins / Cedar Ave, 303710002
Lab Order: N014918
Contract No:

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Matrix	Collection Date	Date Received	Date Reported
N014918-001A	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001B	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001C	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001D	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001E	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001F	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001G	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001H	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001I	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001J	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001K	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-001L	B-2	Groundwater	3/9/2015 11:25:00 AM	3/9/2015	3/24/2015
N014918-002A	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002B	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002C	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002D	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002E	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002F	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002G	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002H	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002I	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002J	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002K	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015
N014918-002L	B-6	Groundwater	3/9/2015 12:48:00 PM	3/9/2015	3/24/2015

ASSET Laboratories

ANALYTICAL RESULTS

Print Date: *24-Mar-15*

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-001

Client Sample ID: B-2
Collection Date: 3/9/2015 11:25:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PH						
		SM4500-H+B				
RunID: WETCHEM_150309D	QC Batch: R99354			PrepDate:		Analyst: **LR**
pH	7.6	0.10	H	pH Units	1	3/9/2015 06:30 PM
Temp. at time of pH Analysis	24	0.10	H	°C	1	3/9/2015 06:30 PM
TOTAL FILTERABLE RESIDUE						
		SM2540C				
RunID: WETCHEM_150310D	QC Batch: 49877			PrepDate:	3/10/2015	Analyst: **LR**
Total Dissolved Solids (Residue, Filterable)	1700	17		mg/L	1	3/10/2015 02:30 PM
TOTAL NON-FILTERABLE RESIDUE						
		SM2540D				
RunID: WETCHEM_150310B	QC Batch: 49878			PrepDate:	3/10/2015	Analyst: **LR**
Suspended Solids (Residue, Non-Filterable)	21	10		mg/L	1	3/10/2015 10:00 AM
TURBIDITY						
		EPA 180.1				
RunID: WETCHEM_150310A	QC Batch: R99357			PrepDate:		Analyst: **LR**
Turbidity	23	0.10		NTU	1	3/10/2015 09:45 AM
ALKALINITY, SPECIATED						
		SM 2320 B				
RunID: WETCHEM_150314B	QC Batch: R99517			PrepDate:		Analyst: **QBM**
Alkalinity, Bicarbonate (As CaCO3)	230	5.0		mg/L	1	3/14/2015
Alkalinity, Carbonate (As CaCO3)	ND	5.0		mg/L	1	3/14/2015
Alkalinity, Hydroxide (As CaCO3)	ND	5.0		mg/L	1	3/14/2015
Alkalinity, Total (As CaCO3)	230	5.0		mg/L	1	3/14/2015
TOTAL PHOSPHORUS						
		EPA 365.3				
RunID: WETCHEM_150314A	QC Batch: 49914			PrepDate:	3/13/2015	Analyst: **QBM**
Phosphorus, Total (As P)	ND	0.020		mg/L	1	3/14/2015
TOTAL NITROGEN BY CALCULATION						
		CALCULATION				
RunID: WETCHEM_150324A	QC Batch: R99596			PrepDate:		Analyst: **GG**
Total Nitrogen	1.0	0.10		mg/L	1	3/24/2015

Qualifiers:

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- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-001

Client Sample ID: B-2
Collection Date: 3/9/2015 11:25:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS BY GC/MS						
		EPA 8260B				
RunID: MS5_150313A	QC Batch: P15VW042			PrepDate:		Analyst: **QBM**
Benzene	ND	0.50		µg/L	1	3/13/2015 01:26 PM
Ethylbenzene	ND	0.50		µg/L	1	3/13/2015 01:26 PM
m,p-Xylene	ND	1.0		µg/L	1	3/13/2015 01:26 PM
MTBE	ND	0.50		µg/L	1	3/13/2015 01:26 PM
o-Xylene	ND	0.50		µg/L	1	3/13/2015 01:26 PM
Tetrachloroethene	ND	0.50		µg/L	1	3/13/2015 01:26 PM
Toluene	ND	0.50		µg/L	1	3/13/2015 01:26 PM
Trichloroethene	ND	0.50		µg/L	1	3/13/2015 01:26 PM
Xylenes, Total	ND	1.5		µg/L	1	3/13/2015 01:26 PM
Surr: 1,2-Dichloroethane-d4	95.6	78-125		%REC	1	3/13/2015 01:26 PM
Surr: 4-Bromofluorobenzene	99.9	80-120		%REC	1	3/13/2015 01:26 PM
Surr: Dibromofluoromethane	100	80-122		%REC	1	3/13/2015 01:26 PM
Surr: Toluene-d8	99.3	80-120		%REC	1	3/13/2015 01:26 PM
DIESEL & MOTOR OIL RANGE ORGANICS BY GC/FID						
	EPA 3510C			**EPA 8015B**		
RunID: GC3_150312A	QC Batch: 49883			PrepDate:	3/11/2015	Analyst: **MDM**
DRO	ND	0.21		mg/L	1	3/12/2015 08:14 PM
ORO	ND	0.21		mg/L	1	3/12/2015 08:14 PM
Surr: p-Terphenyl	99.1	48-133		%REC	1	3/12/2015 08:14 PM
ORGANOCHLORINE PESTICIDES BY GC/ECD						
	EPA 3510C			**EPA 8081A**		
RunID: GC8_150314A	QC Batch: 49908			PrepDate:	3/13/2015	Analyst: **MDM**
4,4´-DDD	ND	0.052		µg/L	1	3/14/2015 11:11 PM
4,4´-DDE	ND	0.052		µg/L	1	3/14/2015 11:11 PM
4,4´-DDT	ND	0.052		µg/L	1	3/14/2015 11:11 PM
Aldrin	ND	0.026		µg/L	1	3/14/2015 11:11 PM
alpha-BHC	ND	0.026		µg/L	1	3/14/2015 11:11 PM
alpha-Chlordane	ND	0.026		µg/L	1	3/14/2015 11:11 PM
beta-BHC	ND	0.026		µg/L	1	3/14/2015 11:11 PM
Chlordane	ND	0.26		µg/L	1	3/14/2015 11:11 PM
delta-BHC	ND	0.026		µg/L	1	3/14/2015 11:11 PM
Dieldrin	ND	0.052		µg/L	1	3/14/2015 11:11 PM
Endosulfan I	ND	0.026		µg/L	1	3/14/2015 11:11 PM
Endosulfan II	ND	0.052		µg/L	1	3/14/2015 11:11 PM
Endosulfan sulfate	ND	0.052		µg/L	1	3/14/2015 11:11 PM

Qualifiers:

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- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-001

Client Sample ID: B-2
Collection Date: 3/9/2015 11:25:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ORGANOCHLORINE PESTICIDES BY GC/ECD						
EPA 3510C				**EPA 8081A**		
RunID: GC8_150314A	QC Batch: 49908			PrepDate:	3/13/2015	Analyst: **MDM**
Endrin	ND	0.052		µg/L	1	3/14/2015 11:11 PM
Endrin aldehyde	ND	0.052		µg/L	1	3/14/2015 11:11 PM
Endrin ketone	ND	0.052		µg/L	1	3/14/2015 11:11 PM
gamma-BHC	ND	0.026		µg/L	1	3/14/2015 11:11 PM
gamma-Chlordane	ND	0.026		µg/L	1	3/14/2015 11:11 PM
Heptachlor	ND	0.026		µg/L	1	3/14/2015 11:11 PM
Heptachlor epoxide	ND	0.026		µg/L	1	3/14/2015 11:11 PM
Methoxychlor	ND	0.26		µg/L	1	3/14/2015 11:11 PM
Toxaphene	ND	2.6		µg/L	1	3/14/2015 11:11 PM
Surr: Tetrachloro-m-xylene	22.7	12-120		%REC	1	3/14/2015 11:11 PM
Surr: Decachlorobiphenyl	50.7	36-120		%REC	1	3/14/2015 11:11 PM
GASOLINE RANGE ORGANICS BY GC/FID						
				EPA 8015B		
RunID: GC4_150310A	QC Batch: E15VW016			PrepDate:		Analyst: **QBM**
GRO	ND	0.050		mg/L	1	3/10/2015 03:46 PM
Surr: Chlorobenzene - d5	120	73-132		%REC	1	3/10/2015 03:46 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Chloride	94	10		mg/L	20	3/10/2015 12:37 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Fluoride	0.96	0.10		mg/L	1	3/10/2015 11:22 AM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrite	ND	0.10		mg/L	1	3/10/2015 11:22 AM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrate (As N)	1.0	0.10		mg/L	1	3/10/2015 11:22 AM

Qualifiers:

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- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-001

Client Sample ID: B-2
Collection Date: 3/9/2015 11:25:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ANIONS BY ION CHROMATOGRAPHY				**EPA 300.0**		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Sulfate	880	100		mg/L	100	3/10/2015 01:49 PM
DISSOLVED MERCURY BY COLD VAPOR TECHNIQUE				**EPA 245.1**		
RunID: AA1_150318B	QC Batch: 49946			PrepDate:	3/17/2015	Analyst: **CEI**
Mercury	ND	0.20		µg/L	1	3/18/2015 11:38 AM
DISSOLVED METALS BY ICP				**EPA 200.7**		
RunID: ICP2_150311C	QC Batch: 49885			PrepDate:	3/11/2015	Analyst: **JAA**
Calcium	140	0.50		mg/L	1	3/11/2015 09:38 PM
Iron	ND	0.50		mg/L	1	3/11/2015 09:38 PM
Magnesium	200	0.10		mg/L	1	3/11/2015 09:38 PM
DISSOLVED METALS BY ICP				**EPA 200.7**		
RunID: ICP2_150312B	QC Batch: 49885			PrepDate:	3/11/2015	Analyst: **CEI**
Potassium	19	2.5		mg/L	5	3/12/2015 11:20 AM
Sodium	110	2.5		mg/L	5	3/12/2015 11:20 AM
HARDNESS BY CALCULATION				**SM 2340 B**		
RunID: ICP2_150311C	QC Batch: R99391			PrepDate:		Analyst: **JAA**
Hardness, Calcium (As CaCO3)	340	0.50		mg/L	1	3/11/2015 09:38 PM
Total Hardness (As CaCO3)	1200	1.0		mg/L	1	3/11/2015 09:38 PM
DISSOLVED METALS BY ICPMS				**EPA 200.8**		
RunID: ICP7_150321A	QC Batch: 49989			PrepDate:	3/20/2015	Analyst: **CEI**
Aluminum	120	50		µg/L	1	3/21/2015 01:35 PM
Antimony	ND	0.50		µg/L	1	3/21/2015 01:35 PM
Arsenic	4.7	0.10		µg/L	1	3/21/2015 01:35 PM
Barium	12	1.0		µg/L	1	3/21/2015 01:35 PM
Beryllium	ND	0.50		µg/L	1	3/21/2015 01:35 PM
Boron	400	50		µg/L	1	3/21/2015 01:35 PM
Cadmium	ND	0.50		µg/L	1	3/21/2015 01:35 PM
Chromium	1.1	1.0		µg/L	1	3/21/2015 01:35 PM
Copper	ND	1.0		µg/L	1	3/21/2015 01:35 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

ASSET Laboratories

ANALYTICAL RESULTS

Print Date: *24-Mar-15*

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-001

Client Sample ID: B-2
Collection Date: 3/9/2015 11:25:00 AM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
DISSOLVED METALS BY ICPMS						
		EPA 200.8				
RunID: ICP7_150321A	QC Batch: 49989				PrepDate: 3/20/2015	Analyst: **CEI**
Lead	ND	1.0		µg/L	1	3/21/2015 01:35 PM
Manganese	ND	0.50		µg/L	1	3/21/2015 01:35 PM
Molybdenum	12	0.50		µg/L	1	3/22/2015 11:23 PM
Nickel	ND	1.0		µg/L	1	3/21/2015 01:35 PM
Selenium	2.1	0.50		µg/L	1	3/21/2015 01:35 PM
Silver	ND	0.50		µg/L	1	3/21/2015 01:35 PM
Thallium	ND	0.50		µg/L	1	3/21/2015 01:35 PM
Zinc	ND	10		µg/L	1	3/21/2015 01:35 PM

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-002

Client Sample ID: B-6
Collection Date: 3/9/2015 12:48:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PH						
		SM4500-H+B				
RunID: WETCHEM_150309D	QC Batch: R99354			PrepDate:		Analyst: **LR**
pH	7.6	0.10		pH Units	1	3/9/2015 06:30 PM
Temp. at time of pH Analysis	24	0.10		pH Units°C	1	3/9/2015 06:30 PM
TOTAL FILTERABLE RESIDUE						
		SM2540C				
RunID: WETCHEM_150310D	QC Batch: 49877			PrepDate:	3/10/2015	Analyst: **LR**
Total Dissolved Solids (Residue, Filterable)	2700	25		mg/L	1	3/10/2015 02:30 PM
TOTAL NON-FILTERABLE RESIDUE						
		SM2540D				
RunID: WETCHEM_150310B	QC Batch: 49878			PrepDate:	3/10/2015	Analyst: **LR**
Suspended Solids (Residue, Non-Filterable)	15	10		mg/L	1	3/10/2015 10:00 AM
TURBIDITY						
		EPA 180.1				
RunID: WETCHEM_150310A	QC Batch: R99357			PrepDate:		Analyst: **LR**
Turbidity	16	0.10		NTU	1	3/10/2015 09:45 AM
ALKALINITY, SPECIATED						
		SM 2320 B				
RunID: WETCHEM_150314B	QC Batch: R99517			PrepDate:		Analyst: **QBM**
Alkalinity, Bicarbonate (As CaCO3)	240	5.0		mg/L	1	3/14/2015
Alkalinity, Carbonate (As CaCO3)	ND	5.0		mg/L	1	3/14/2015
Alkalinity, Hydroxide (As CaCO3)	ND	5.0		mg/L	1	3/14/2015
Alkalinity, Total (As CaCO3)	240	5.0		mg/L	1	3/14/2015
TOTAL PHOSPHORUS						
		EPA 365.3				
RunID: WETCHEM_150314A	QC Batch: 49914			PrepDate:	3/13/2015	Analyst: **QBM**
Phosphorus, Total (As P)	ND	0.020		mg/L	1	3/14/2015
TOTAL NITROGEN BY CALCULATION						
		CALCULATION				
RunID: WETCHEM_150324A	QC Batch: R99596			PrepDate:		Analyst: **GG**
Total Nitrogen	4.4	0.10		mg/L	1	3/24/2015

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-002

Client Sample ID: B-6
Collection Date: 3/9/2015 12:48:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS BY GC/MS						
			EPA 8260B			
RunID: MS5_150313A	QC Batch: P15VW042			PrepDate:		Analyst: **QBM**
Benzene	ND	0.50		µg/L	1	3/13/2015 01:51 PM
Ethylbenzene	ND	0.50		µg/L	1	3/13/2015 01:51 PM
m,p-Xylene	ND	1.0		µg/L	1	3/13/2015 01:51 PM
MTBE	ND	0.50		µg/L	1	3/13/2015 01:51 PM
o-Xylene	ND	0.50		µg/L	1	3/13/2015 01:51 PM
Tetrachloroethene	ND	0.50		µg/L	1	3/13/2015 01:51 PM
Toluene	ND	0.50		µg/L	1	3/13/2015 01:51 PM
Trichloroethene	ND	0.50		µg/L	1	3/13/2015 01:51 PM
Xylenes, Total	ND	1.5		µg/L	1	3/13/2015 01:51 PM
Surr: 1,2-Dichloroethane-d4	99.9	78-125		%REC	1	3/13/2015 01:51 PM
Surr: 4-Bromofluorobenzene	98.6	80-120		%REC	1	3/13/2015 01:51 PM
Surr: Dibromofluoromethane	102	80-122		%REC	1	3/13/2015 01:51 PM
Surr: Toluene-d8	102	80-120		%REC	1	3/13/2015 01:51 PM
DIESEL & MOTOR OIL RANGE ORGANICS BY GC/FID						
EPA 3510C			**EPA 8015B**			
RunID: GC3_150312A	QC Batch: 49883			PrepDate:	3/11/2015	Analyst: **MDM**
DRO	ND	0.21		mg/L	1	3/12/2015 08:40 PM
ORO	ND	0.21		mg/L	1	3/12/2015 08:40 PM
Surr: p-Terphenyl	115	48-133		%REC	1	3/12/2015 08:40 PM
ORGANOCHLORINE PESTICIDES BY GC/ECD						
EPA 3510C			**EPA 8081A**			
RunID: GC8_150314A	QC Batch: 49908			PrepDate:	3/13/2015	Analyst: **MDM**
4,4´-DDD	ND	0.051		µg/L	1	3/14/2015 11:38 PM
4,4´-DDE	ND	0.051		µg/L	1	3/14/2015 11:38 PM
4,4´-DDT	ND	0.051		µg/L	1	3/14/2015 11:38 PM
Aldrin	ND	0.026		µg/L	1	3/14/2015 11:38 PM
alpha-BHC	ND	0.026		µg/L	1	3/14/2015 11:38 PM
alpha-Chlordane	ND	0.026		µg/L	1	3/14/2015 11:38 PM
beta-BHC	ND	0.026		µg/L	1	3/14/2015 11:38 PM
Chlordane	ND	0.26		µg/L	1	3/14/2015 11:38 PM
delta-BHC	ND	0.026		µg/L	1	3/14/2015 11:38 PM
Dieldrin	ND	0.051		µg/L	1	3/14/2015 11:38 PM
Endosulfan I	ND	0.026		µg/L	1	3/14/2015 11:38 PM
Endosulfan II	ND	0.051		µg/L	1	3/14/2015 11:38 PM
Endosulfan sulfate	ND	0.051		µg/L	1	3/14/2015 11:38 PM

Qualifiers:

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S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-002

Client Sample ID: B-6
Collection Date: 3/9/2015 12:48:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ORGANOCHLORINE PESTICIDES BY GC/ECD						
EPA 3510C				**EPA 8081A**		
RunID: GC8_150314A	QC Batch: 49908			PrepDate:	3/13/2015	Analyst: **MDM**
Endrin	ND	0.051		µg/L	1	3/14/2015 11:38 PM
Endrin aldehyde	ND	0.051		µg/L	1	3/14/2015 11:38 PM
Endrin ketone	ND	0.051		µg/L	1	3/14/2015 11:38 PM
gamma-BHC	ND	0.026		µg/L	1	3/14/2015 11:38 PM
gamma-Chlordane	ND	0.026		µg/L	1	3/14/2015 11:38 PM
Heptachlor	ND	0.026		µg/L	1	3/14/2015 11:38 PM
Heptachlor epoxide	ND	0.026		µg/L	1	3/14/2015 11:38 PM
Methoxychlor	ND	0.26		µg/L	1	3/14/2015 11:38 PM
Toxaphene	ND	2.6		µg/L	1	3/14/2015 11:38 PM
Surr: Tetrachloro-m-xylene	62.4	12-120		%REC	1	3/14/2015 11:38 PM
Surr: Decachlorobiphenyl	66.3	36-120		%REC	1	3/14/2015 11:38 PM
GASOLINE RANGE ORGANICS BY GC/FID						
				EPA 8015B		
RunID: GC4_150310A	QC Batch: E15VW016			PrepDate:		Analyst: **QBM**
GRO	ND	0.050		mg/L	1	3/10/2015 04:18 PM
Surr: Chlorobenzene - d5	119	73-132		%REC	1	3/10/2015 04:18 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Chloride	240	25		mg/L	50	3/10/2015 12:50 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Fluoride	1.4	0.50		mg/L	5	3/10/2015 11:34 AM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrite	ND	0.50		mg/L	5	3/10/2015 11:34 AM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrate (As N)	4.4	0.50		mg/L	5	3/10/2015 11:34 AM

Qualifiers:

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- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-002

Client Sample ID: B-6
Collection Date: 3/9/2015 12:48:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ANIONS BY ION CHROMATOGRAPHY				**EPA 300.0**		
RunID: IC2_150310A	QC Batch: R99362			PrepDate:		Analyst: **QBM**
Sulfate	1400	200		mg/L	200	3/10/2015 02:14 PM
DISSOLVED MERCURY BY COLD VAPOR TECHNIQUE				**EPA 245.1**		
RunID: AA1_150318B	QC Batch: 49946			PrepDate:	3/17/2015	Analyst: **CEI**
Mercury	ND	0.20		µg/L	1	3/18/2015 11:41 AM
DISSOLVED METALS BY ICP				**EPA 200.7**		
RunID: ICP2_150311C	QC Batch: 49885			PrepDate:	3/11/2015	Analyst: **JAA**
Calcium	230	0.50		mg/L	1	3/11/2015 09:44 PM
Iron	ND	0.50		mg/L	1	3/11/2015 09:44 PM
Magnesium	290	0.10		mg/L	1	3/11/2015 09:44 PM
DISSOLVED METALS BY ICP				**EPA 200.7**		
RunID: ICP2_150312B	QC Batch: 49885			PrepDate:	3/11/2015	Analyst: **CEI**
Potassium	39	5.0		mg/L	10	3/12/2015 12:58 PM
Sodium	220	5.0		mg/L	10	3/12/2015 12:58 PM
HARDNESS BY CALCULATION				**SM 2340 B**		
RunID: ICP2_150311C	QC Batch: R99391			PrepDate:		Analyst: **JAA**
Hardness, Calcium (As CaCO3)	580	0.50		mg/L	1	3/11/2015 09:44 PM
Total Hardness (As CaCO3)	1800	1.0		mg/L	1	3/11/2015 09:44 PM
DISSOLVED METALS BY ICPMS				**EPA 200.8**		
RunID: ICP7_150321A	QC Batch: 49989			PrepDate:	3/20/2015	Analyst: **CEI**
Aluminum	ND	250		µg/L	5	3/21/2015 03:33 PM
Antimony	ND	0.50		µg/L	1	3/21/2015 01:41 PM
Arsenic	5.8	0.10		µg/L	1	3/21/2015 01:41 PM
Barium	5.7	1.0		µg/L	1	3/21/2015 01:41 PM
Beryllium	ND	0.50		µg/L	1	3/21/2015 01:41 PM
Boron	780	50		µg/L	1	3/21/2015 01:41 PM
Cadmium	ND	0.50		µg/L	1	3/21/2015 01:41 PM
Chromium	1.2	1.0		µg/L	1	3/21/2015 01:41 PM
Copper	ND	1.0		µg/L	1	3/21/2015 01:41 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

CLIENT: Ninyo & Moore
Lab Order: N014918
Project: Atkins / Cedar Ave, 303710002
Lab ID: N014918-002

Client Sample ID: B-6
Collection Date: 3/9/2015 12:48:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
DISSOLVED METALS BY ICPMS						
		EPA 200.8				
RunID: ICP7_150321A	QC Batch: 49989				PrepDate: 3/20/2015	Analyst: **CEI**
Lead	ND	1.0		µg/L	1	3/21/2015 01:41 PM
Manganese	ND	0.50		µg/L	1	3/21/2015 01:41 PM
Molybdenum	22	0.50		µg/L	1	3/22/2015 11:29 PM
Nickel	ND	1.0		µg/L	1	3/21/2015 01:41 PM
Selenium	7.5	0.50		µg/L	1	3/21/2015 01:41 PM
Silver	ND	0.50		µg/L	1	3/21/2015 01:41 PM
Thallium	ND	0.50		µg/L	1	3/21/2015 01:41 PM
Zinc	ND	10		µg/L	1	3/21/2015 01:41 PM

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 150.1_4500H+B_W

Sample ID: **N014918-001E DUP** SampType: **DUP** TestCode: **150.1_4500H** Units: **pH Units** Prep Date: RunNo: **99354**
Client ID: **ZZZZZZ** Batch ID: **R99354** TestNo: **SM4500-H+B** Analysis Date: **3/9/2015** SeqNo: **1948463**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
pH	7.590	0.10						7.570	0.264	10	H
Temp. at time of pH Analysis	24.300	0.10						24.40	0.411	10	H

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 160.1_2540C_W

Sample ID: **MB-49877**	SampType: **MBLK**	TestCode: **160.1_2540C**	Units: **mg/L**	Prep Date: **3/10/2015**	RunNo: **99377**
Client ID: **PBW**	Batch ID: **49877**	TestNo: **SM2540C**		Analysis Date: **3/10/2015**	SeqNo: **1949913**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	ND	10									

Sample ID: **LCS-49877**	SampType: **LCS**	TestCode: **160.1_2540C**	Units: **mg/L**	Prep Date: **3/10/2015**	RunNo: **99377**
Client ID: **LCSW**	Batch ID: **49877**	TestNo: **SM2540C**		Analysis Date: **3/10/2015**	SeqNo: **1949914**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	959.000	10	1000	0	95.9	80	120				

Sample ID: **N014918-002E DUP**	SampType: **DUP**	TestCode: **160.1_2540C**	Units: **mg/L**	Prep Date: **3/10/2015**	RunNo: **99377**
Client ID: **ZZZZZZ**	Batch ID: **49877**	TestNo: **SM2540C**		Analysis Date: **3/10/2015**	SeqNo: **1949917**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	2605.000	25						2708	3.86	5	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 160.2_2540D_W

Sample ID: **MB-49878**	SampType: **MBLK**	TestCode: **160.2_2540D**	Units: **mg/L**	Prep Date: **3/10/2015**	RunNo: **99359**
Client ID: **PBW**	Batch ID: **49878**	TestNo: **SM2540D**		Analysis Date: **3/10/2015**	SeqNo: **1948535**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	ND	10									

Sample ID: **LCS-49878**	SampType: **LCS**	TestCode: **160.2_2540D**	Units: **mg/L**	Prep Date: **3/10/2015**	RunNo: **99359**
Client ID: **LCSW**	Batch ID: **49878**	TestNo: **SM2540D**		Analysis Date: **3/10/2015**	SeqNo: **1948536**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	982.000	10	1000	0	98.2	80	120				

Sample ID: **N014918-001E DUP**	SampType: **DUP**	TestCode: **160.2_2540D**	Units: **mg/L**	Prep Date: **3/10/2015**	RunNo: **99359**
Client ID: **ZZZZZZ**	Batch ID: **49878**	TestNo: **SM2540D**		Analysis Date: **3/10/2015**	SeqNo: **1948538**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	20.000	10						21.00	4.88	5	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 180.1_W

Sample ID: **N014918-002E DUP**	SampType: **DUP**	TestCode: **180.1_W**	Units: **NTU**	Prep Date:					RunNo: **99357**		
Client ID: **ZZZZZZ**	Batch ID: **R99357**	TestNo: **EPA 180.1**		Analysis Date: **3/10/2015**					SeqNo: **1948534**		
Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	15.600	0.10						15.70	0.639	30	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD

Sample ID: **MB-49885**	SampType: **MBLK**	TestCode: **200.7_WD**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99391**
Client ID: **PBW**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/11/2015**	SeqNo: **1950521**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	ND	0.50									
Iron	ND	0.50									
Magnesium	ND	0.10									

Sample ID: **LCS1-49885**	SampType: **LCS**	TestCode: **200.7_WD**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99391**
Client ID: **LCSW**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/11/2015**	SeqNo: **1950522**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	11.084	0.50	10.00	0	111	85	115				
Iron	10.991	0.50	10.00	0	110	85	115				
Magnesium	11.446	0.10	10.00	0	114	85	115				

Sample ID: **N014870-001J-MS1**	SampType: **MS**	TestCode: **200.7_WD**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99391**
Client ID: **ZZZZZZ**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/11/2015**	SeqNo: **1950526**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	334.019	0.50	10.00	331.7	22.8	75	125				S
Iron	11.123	0.50	10.00	0.09494	110	75	125				
Magnesium	393.971	0.10	10.00	387.6	63.5	75	125				S

Sample ID: **N014870-001J-MSD1**	SampType: **MSD**	TestCode: **200.7_WD**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99391**
Client ID: **ZZZZZZ**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/11/2015**	SeqNo: **1950527**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	344.930	0.50	10.00	331.7	132	75	125	334.0	3.21	20	S
Iron	11.225	0.50	10.00	0.09494	111	75	125	11.12	0.919	20	
Magnesium	405.738	0.10	10.00	387.6	181	75	125	394.0	2.94	20	S

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD1

Sample ID: **MB-49885**	SampType: **MBLK**	TestCode: **200.7_WD1**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99408**
Client ID: **PBW**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/12/2015**	SeqNo: **1950950**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	ND	0.50									
Sodium	ND	0.50									

Sample ID: **LCS2-49885**	SampType: **LCS**	TestCode: **200.7_WD1**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99408**
Client ID: **LCSW**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/12/2015**	SeqNo: **1950951**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	18.406	0.50	20.00	0	92.0	85	115				
Sodium	18.185	0.50	20.00	0	90.9	85	115				

Sample ID: **N014918-001J-MS2**	SampType: **MS**	TestCode: **200.7_WD1**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99408**
Client ID: **ZZZZZZ**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/12/2015**	SeqNo: **1950974**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	38.019	2.5	20.00	19.30	93.6	75	125				
Sodium	128.667	2.5	20.00	111.9	83.6	75	125				

Sample ID: **N014918-001J-MSD2**	SampType: **MSD**	TestCode: **200.7_WD1**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99408**
Client ID: **ZZZZZZ**	Batch ID: **49885**	TestNo: **EPA 200.7**		Analysis Date: **3/12/2015**	SeqNo: **1950975**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	38.525	2.5	20.00	19.30	96.1	75	125	38.02	1.32	20	
Sodium	130.584	2.5	20.00	111.9	93.2	75	125	128.7	1.48	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **MB-49989** SampType: **MBLK** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **PBW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960016**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	50									
Antimony	ND	0.50									
Arsenic	ND	0.10									
Barium	ND	1.0									
Beryllium	ND	0.50									
Boron	ND	50									
Cadmium	ND	0.50									
Chromium	ND	1.0									
Copper	0.202	1.0									
Lead	ND	1.0									
Manganese	ND	0.50									
Nickel	0.080	1.0									
Selenium	ND	0.50									
Silver	ND	0.50									
Thallium	ND	0.50									
Zinc	ND	10									

Sample ID: **LCS-49989** SampType: **LCS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **LCSW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960017**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	99.177	50	100.0	0	99.2	85	115				
Antimony	10.425	0.50	10.00	0	104	85	115				
Arsenic	9.370	0.10	10.00	0	93.7	85	115				
Barium	99.776	1.0	100.0	0	99.8	85	115				
Beryllium	9.683	0.50	10.00	0	96.8	85	115				
Boron	929.400	50	1000	0	92.9	85	115				
Cadmium	9.634	0.50	10.00	0	96.3	85	115				
Chromium	9.419	1.0	10.00	0	94.2	85	115				
Copper	10.053	1.0	10.00	0	101	85	115				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **LCS-49989**	SampType: **LCS**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99565**
Client ID: **LCSW**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/21/2015**	SeqNo: **1960017**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	10.156	1.0	10.00	0	102	85	115				
Manganese	93.116	0.50	100.0	0	93.1	85	115				
Nickel	9.620	1.0	10.00	0	96.2	85	115				
Selenium	9.054	0.50	10.00	0	90.5	85	115				
Silver	10.496	0.50	10.00	0	105	85	115				
Thallium	9.785	0.50	10.00	0	97.8	85	115				
Zinc	91.961	10	100.0	0	92.0	85	115				

Sample ID: **N015012-001B-MS**	SampType: **MS**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99565**
Client ID: **ZZZZZZ**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/21/2015**	SeqNo: **1960021**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	107.112	50	100.0	2.188	105	75	125				
Antimony	12.105	0.50	10.00	0	121	75	125				
Arsenic	11.813	0.10	10.00	1.173	106	75	125				
Beryllium	11.580	0.50	10.00	0	116	75	125				
Boron	1148.603	50	1000	188.8	96.0	75	125				
Cadmium	9.971	0.50	10.00	0	99.7	75	125				
Chromium	18.508	1.0	10.00	9.089	94.2	75	125				
Copper	9.298	1.0	10.00	0	93.0	75	125				
Lead	11.716	1.0	10.00	0	117	75	125				
Manganese	96.140	0.50	100.0	0	96.1	75	125				
Nickel	9.815	1.0	10.00	0	98.2	75	125				
Selenium	11.416	0.50	10.00	1.245	102	75	125				
Silver	11.264	0.50	10.00	0	113	75	125				
Thallium	11.844	0.50	10.00	0	118	75	125				
Zinc	111.222	10	100.0	17.13	94.1	75	125				

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **N015012-001B-MSD** SampType: **MSD** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **ZZZZZZ** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960022**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	108.354	50	100.0	2.188	106	75	125	107.1	1.15	20	
Antimony	12.199	0.50	10.00	0	122	75	125	12.11	0.767	20	
Arsenic	11.745	0.10	10.00	1.173	106	75	125	11.81	0.581	20	
Beryllium	11.607	0.50	10.00	0	116	75	125	11.58	0.237	20	
Boron	1157.328	50	1000	188.8	96.8	75	125	1149	0.757	20	
Cadmium	10.105	0.50	10.00	0	101	75	125	9.971	1.33	20	
Chromium	18.678	1.0	10.00	9.089	95.9	75	125	18.51	0.910	20	
Copper	9.185	1.0	10.00	0	91.9	75	125	9.298	1.22	20	
Lead	11.657	1.0	10.00	0	117	75	125	11.72	0.504	20	
Manganese	96.400	0.50	100.0	0	96.4	75	125	96.14	0.270	20	
Nickel	9.876	1.0	10.00	0	98.8	75	125	9.815	0.622	20	
Selenium	10.877	0.50	10.00	1.245	96.3	75	125	11.42	4.83	20	
Silver	11.258	0.50	10.00	0	113	75	125	11.26	0.0480	20	
Thallium	11.833	0.50	10.00	0	118	75	125	11.84	0.0951	20	
Zinc	110.139	10	100.0	17.13	93.0	75	125	111.2	0.979	20	

Sample ID: **MB-49989** SampType: **MBLK** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99581**
Client ID: **PBW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/22/2015** SeqNo: **1961968**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	ND	0.50									

Sample ID: **LCS-49989** SampType: **LCS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99581**
Client ID: **LCSW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/22/2015** SeqNo: **1961969**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	9.932	0.50	10.00	0	99.3	85	115				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **N015012-001B-MS**	SampType: **MS**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99581**
Client ID: **ZZZZZZ**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/22/2015**	SeqNo: **1961973**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	16.671	0.50	10.00	5.313	114	75	125				

Sample ID: **N015012-001B-MSD**	SampType: **MSD**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99581**
Client ID: **ZZZZZZ**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/22/2015**	SeqNo: **1961974**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	16.800	0.50	10.00	5.313	115	75	125	16.67	0.772	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 2320_W_SP

Sample ID: **LCS-R99517** SampType: **LCS** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99517**
Client ID: **LCSW** Batch ID: **R99517** TestNo: **SM 2320 B** Analysis Date: **3/14/2015** SeqNo: **1957155**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	92.672	5.0	100.0	0	92.7	85	115				
Alkalinity, Total (As CaCO3)	99.138	5.0	100.0	0	99.1	85	115				

Sample ID: **MB-R99517** SampType: **MBLK** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99517**
Client ID: **PBW** Batch ID: **R99517** TestNo: **SM 2320 B** Analysis Date: **3/14/2015** SeqNo: **1957156**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	ND	5.0									
Alkalinity, Carbonate (As CaCO3)	ND	5.0									
Alkalinity, Hydroxide (As CaCO3)	ND	5.0									
Alkalinity, Total (As CaCO3)	ND	5.0									

Sample ID: **N014918-001EDUP** SampType: **DUP** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99517**
Client ID: **ZZZZZZ** Batch ID: **R99517** TestNo: **SM 2320 B** Analysis Date: **3/14/2015** SeqNo: **1957158**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	228.448	5.0						229.5	0.471	30	
Alkalinity, Carbonate (As CaCO3)	ND	5.0						0	0	30	
Alkalinity, Hydroxide (As CaCO3)	ND	5.0						0	0	30	
Alkalinity, Total (As CaCO3)	228.448	5.0						229.5	0.471	30	

Sample ID: **N014918-002EMS** SampType: **MS** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99517**
Client ID: **ZZZZZZ** Batch ID: **R99517** TestNo: **SM 2320 B** Analysis Date: **3/14/2015** SeqNo: **1957160**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	341.595	5.0	100.0	239.2	102	75	125				
Alkalinity, Total (As CaCO3)	341.595	5.0	100.0	239.2	102	75	125				

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 2320_W_SP

Sample ID: **N014918-002EMSD** SampType: **MSD** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99517**
Client ID: **ZZZZZZ** Batch ID: **R99517** TestNo: **SM 2320 B** Analysis Date: **3/14/2015** SeqNo: **1957161**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	337.284	5.0	100.0	239.2	98.1	75	125	341.6	1.27	20	
Alkalinity, Total (As CaCO3)	337.284	5.0	100.0	239.2	98.1	75	125	341.6	1.27	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 245.1_WD

Sample ID: **MB-49946**	SampType: **MBLK**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/17/2015**	RunNo: **99509**
Client ID: **PBW**	Batch ID: **49946**	TestNo: **EPA 245.1**		Analysis Date: **3/18/2015**	SeqNo: **1956429**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.20									

Sample ID: **LCS-49946**	SampType: **LCS**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/17/2015**	RunNo: **99509**
Client ID: **LCSW**	Batch ID: **49946**	TestNo: **EPA 245.1**		Analysis Date: **3/18/2015**	SeqNo: **1956430**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	5.028	0.20	5.000	0	101	85	115				

Sample ID: **N014918-001J-MS**	SampType: **MS**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/17/2015**	RunNo: **99509**
Client ID: **ZZZZZZ**	Batch ID: **49946**	TestNo: **EPA 245.1**		Analysis Date: **3/18/2015**	SeqNo: **1956431**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	3.585	0.20	5.000	0	71.7	75	125				S

Sample ID: **N014918-001J-MSD**	SampType: **MSD**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/17/2015**	RunNo: **99509**
Client ID: **ZZZZZZ**	Batch ID: **49946**	TestNo: **EPA 245.1**		Analysis Date: **3/18/2015**	SeqNo: **1956432**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	3.726	0.20	5.000	0	74.5	75	125	3.585	3.87	20	S

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_CL

Sample ID: MB-R99362_CL	SampType: MBLK	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: PBW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948607

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	ND	0.50									

Sample ID: LCS-R99362_CL	SampType: LCS	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: LCSW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948608

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	2.476	0.50	2.500	0	99.0	90	110				

Sample ID: N014918-001EDUP	SampType: DUP	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948611

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	95.560	10						94.04	1.60	20	

Sample ID: N014918-002EMS	SampType: MS	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948615

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	722.600	100	500.0	244.5	95.6	80	120				

Sample ID: N014918-002EMSD	SampType: MSD	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948616

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	728.000	100	500.0	244.5	96.7	80	120	722.6	0.745	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_F

Sample ID: MB-R99362_F	SampType: MBLK	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: PBW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948600

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	ND	0.10									

Sample ID: LCS-R99362_F	SampType: LCS	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: LCSW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948601

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	2.452	0.10	2.500	0	98.1	90	110				

Sample ID: N014918-001EDUP	SampType: DUP	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948604

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	0.951	0.10						0.9570	0.629	20	

Sample ID: N014918-002EMS	SampType: MS	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948605

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	13.200	0.50	12.50	1.435	94.1	80	120				

Sample ID: N014918-002EMSD	SampType: MSD	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948606

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	13.070	0.50	12.50	1.435	93.1	80	120	13.20	0.990	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_NO2

Sample ID: MB-R99362_NO2	SampType: MBLK	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: PBW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948617

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	ND	0.10									

Sample ID: LCS-R99362_NO2	SampType: LCS	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: LCSW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948618

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	0.999	0.10	1.000	0	99.9	90	110				

Sample ID: N014918-001EDUP	SampType: DUP	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948621

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	ND	0.10						0	0	20	

Sample ID: N014918-002EMS	SampType: MS	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948622

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	5.455	0.50	5.000	0	109	80	120				

Sample ID: N014918-002EMSD	SampType: MSD	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948623

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	5.500	0.50	5.000	0	110	80	120	5.455	0.822	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_NO3

Sample ID: MB-R99362_NO3	SampType: MBLK	TestCode: 300_W_NO3	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: PBW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948624

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	ND	0.10									

Sample ID: LCS-R99362_NO3	SampType: LCS	TestCode: 300_W_NO3	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: LCSW	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948625

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	0.980	0.10	1.000	0	98.0	90	110				

Sample ID: N014918-001EDUP	SampType: DUP	TestCode: 300_W_NO3	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948628

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	0.984	0.10						1.013	2.90	20	

Sample ID: N014918-002EMS	SampType: MS	TestCode: 300_W_NO3	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948629

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	9.440	0.50	5.000	4.350	102	80	120				

Sample ID: N014918-002EMSD	SampType: MSD	TestCode: 300_W_NO3	Units: mg/L	Prep Date:	RunNo: 99362
Client ID: ZZZZZZ	Batch ID: R99362	TestNo: EPA 300.0		Analysis Date: 3/10/2015	SeqNo: 1948630

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	9.450	0.50	5.000	4.350	102	80	120	9.440	0.106	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_SO4

Sample ID: **MB-R99362_SO4**	SampType: **MBLK**	TestCode: **300_W_SO4**	Units: **mg/L**	Prep Date:	RunNo: **99362**
Client ID: **PBW**	Batch ID: **R99362**	TestNo: **EPA 300.0**		Analysis Date: **3/10/2015**	SeqNo: **1948631**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	ND	1.0									

Sample ID: **LCS-R99362_SO4**	SampType: **LCS**	TestCode: **300_W_SO4**	Units: **mg/L**	Prep Date:	RunNo: **99362**
Client ID: **LCSW**	Batch ID: **R99362**	TestNo: **EPA 300.0**		Analysis Date: **3/10/2015**	SeqNo: **1948632**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	4.973	1.0	5.000	0	99.5	90	110				

Sample ID: **N014918-001EDUP**	SampType: **DUP**	TestCode: **300_W_SO4**	Units: **mg/L**	Prep Date:	RunNo: **99362**
Client ID: **ZZZZZZ**	Batch ID: **R99362**	TestNo: **EPA 300.0**		Analysis Date: **3/10/2015**	SeqNo: **1948635**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	889.800	100						877.8	1.36	20	

Sample ID: **N014918-002EMS**	SampType: **MS**	TestCode: **300_W_SO4**	Units: **mg/L**	Prep Date:	RunNo: **99362**
Client ID: **ZZZZZZ**	Batch ID: **R99362**	TestNo: **EPA 300.0**		Analysis Date: **3/10/2015**	SeqNo: **1948637**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	2454.600	200	1000	1403	105	80	120				

Sample ID: **N014918-002EMSD**	SampType: **MSD**	TestCode: **300_W_SO4**	Units: **mg/L**	Prep Date:	RunNo: **99362**
Client ID: **ZZZZZZ**	Batch ID: **R99362**	TestNo: **EPA 300.0**		Analysis Date: **3/10/2015**	SeqNo: **1948638**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	2423.400	200	1000	1403	102	80	120	2455	1.28	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 365.3_W_T

Sample ID: **LCS-49914**	SampType: **LCS**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/13/2015**	RunNo: **99427**
Client ID: **LCSW**	Batch ID: **49914**	TestNo: **EPA 365.3**		Analysis Date: **3/14/2015**	SeqNo: **1951962**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.386	0.020	0.4000	0	96.5	80	120				

Sample ID: **MB-49914**	SampType: **MBLK**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/13/2015**	RunNo: **99427**
Client ID: **PBW**	Batch ID: **49914**	TestNo: **EPA 365.3**		Analysis Date: **3/14/2015**	SeqNo: **1951963**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	ND	0.020									

Sample ID: **N014914-010A-MS**	SampType: **MS**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/13/2015**	RunNo: **99427**
Client ID: **ZZZZZZ**	Batch ID: **49914**	TestNo: **EPA 365.3**		Analysis Date: **3/14/2015**	SeqNo: **1951971**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.416	0.020	0.4000	0.06800	87.0	80	120				

Sample ID: **N014914-010A-MSD**	SampType: **MSD**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/13/2015**	RunNo: **99427**
Client ID: **ZZZZZZ**	Batch ID: **49914**	TestNo: **EPA 365.3**		Analysis Date: **3/14/2015**	SeqNo: **1951972**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.422	0.020	0.4000	0.06800	88.5	80	120	0.4160	1.43	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015_W_DM

Sample ID: **LCS-49883_DRO**	SampType: **LCS**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99412**
Client ID: **LCSW**	Batch ID: **49883**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/12/2015**	SeqNo: **1951250**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	0.680	0.20	1.000	0	68.0	41	105				
Surr: p-Terphenyl	0.093		0.08000		116	48	133				

Sample ID: **LCSD-49883_DRO**	SampType: **LCSD**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99412**
Client ID: **LCSS02**	Batch ID: **49883**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/12/2015**	SeqNo: **1951251**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	0.446	0.20	1.000	0	44.6	41	105	0.6805	41.7	20	R
Surr: p-Terphenyl	0.071		0.08000		88.8	48	133		0		

Sample ID: **LCS-49883_ORO**	SampType: **LCS**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99412**
Client ID: **LCSW**	Batch ID: **49883**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/12/2015**	SeqNo: **1951252**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ORO	0.900	0.20	1.000	0	90.0	70	130				
Surr: p-Terphenyl	0.083		0.08000		104	48	133				

Sample ID: **LCSD-49883_ORO**	SampType: **LCSD**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99412**
Client ID: **LCSS02**	Batch ID: **49883**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/12/2015**	SeqNo: **1951253**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ORO	0.914	0.20	1.000	0	91.4	70	130	0.8997	1.62	20	
Surr: p-Terphenyl	0.080		0.08000		100	48	133		0		

Sample ID: **MB-49883**	SampType: **MBLK**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/11/2015**	RunNo: **99412**
Client ID: **PBW**	Batch ID: **49883**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/12/2015**	SeqNo: **1951254**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	ND	0.20									

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015_W_DM

Sample ID: **MB-49883** SampType: **MBLK** TestCode: **8015_W_DM** Units: **mg/L** Prep Date: **3/11/2015** RunNo: **99412**
Client ID: **PBW** Batch ID: **49883** TestNo: **EPA 8015B** **EPA 3510C** Analysis Date: **3/12/2015** SeqNo: **1951254**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ORO	ND	0.20									
Surr: p-Terphenyl	0.089		0.08000		112	48	133				

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015GAS_WP

Sample ID: **E150310LCS** SampType: **LCS** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99368**
Client ID: **LCSW** Batch ID: **E15VW016** TestNo: **EPA 8015B** Analysis Date: **3/10/2015** SeqNo: **1948769**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	1.220	0.050	1.000	0	122	75	127				
Surr: Chlorobenzene - d5	49.190		50.00		98.4	73	132				

Sample ID: **E150310MB1** SampType: **MBLK** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99368**
Client ID: **PBW** Batch ID: **E15VW016** TestNo: **EPA 8015B** Analysis Date: **3/10/2015** SeqNo: **1948770**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	ND	0.050									
Surr: Chlorobenzene - d5	55.492		50.00		111	73	132				

Sample ID: **N014870-001FMS** SampType: **MS** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99368**
Client ID: **ZZZZZZ** Batch ID: **E15VW016** TestNo: **EPA 8015B** Analysis Date: **3/10/2015** SeqNo: **1948785**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	1.223	0.050	1.000	0	122	74	130				
Surr: Chlorobenzene - d5	51.253		50.00		103	73	132				

Sample ID: **N014870-001FMSD** SampType: **MSD** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99368**
Client ID: **ZZZZZZ** Batch ID: **E15VW016** TestNo: **EPA 8015B** Analysis Date: **3/10/2015** SeqNo: **1948786**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	1.242	0.050	1.000	0	124	74	130	1.223	1.54	30	
Surr: Chlorobenzene - d5	53.208		50.00		106	73	132		0		

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8081WATER

Sample ID: **LCS-49908_OCP** SampType: **LCS** TestCode: **8081WATER** Units: **µg/L** Prep Date: **3/13/2015** RunNo: **99449**
Client ID: **LCSW** Batch ID: **49908** TestNo: **EPA 8081A** **EPA 3510C** Analysis Date: **3/14/2015** SeqNo: **1953307**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
4,4´-DDD	0.427	0.050	0.5000	0	85.4	55	126				
4,4´-DDE	0.386	0.050	0.5000	0	77.3	52	125				
4,4´-DDT	0.491	0.050	0.5000	0	98.1	68	136				
Aldrin	0.299	0.025	0.5000	0	59.8	28	120				
alpha-BHC	0.333	0.025	0.5000	0	66.6	48	126				
alpha-Chlordane	0.359	0.025	0.5000	0	71.8	49	127				
beta-BHC	0.316	0.025	0.5000	0	63.1	56	106				
delta-BHC	0.287	0.025	0.5000	0	57.4	26	122				
Dieldrin	0.420	0.050	0.5000	0	83.9	50	132				
Endosulfan I	0.372	0.025	0.5000	0	74.3	50	124				
Endosulfan II	0.433	0.050	0.5000	0	86.6	52	134				
Endosulfan sulfate	0.380	0.050	0.5000	0	76.0	52	126				
Endrin	0.565	0.050	0.5000	0	113	34	183				
Endrin aldehyde	0.431	0.050	0.5000	0	86.3	49	120				
Endrin ketone	0.481	0.050	0.5000	0	96.3	40	148				
gamma-BHC	0.335	0.025	0.5000	0	66.9	51	122				
gamma-Chlordane	0.363	0.025	0.5000	0	72.6	52	124				
Heptachlor	0.321	0.025	0.5000	0	64.2	23	138				
Heptachlor epoxide	0.359	0.025	0.5000	0	71.9	52	123				
Methoxychlor	0.474	0.25	0.5000	0	94.8	49	147				
Surr: Tetrachloro-m-xylene	0.279		0.5000		55.7	12	120				
Surr: Decachlorobiphenyl	0.376		0.5000		75.2	36	120				

Sample ID: **LCSD-49908_OCP** SampType: **LCSD** TestCode: **8081WATER** Units: **µg/L** Prep Date: **3/13/2015** RunNo: **99449**
Client ID: **LCSS02** Batch ID: **49908** TestNo: **EPA 8081A** **EPA 3510C** Analysis Date: **3/14/2015** SeqNo: **1953308**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
4,4´-DDD	0.438	0.050	0.5000	0	87.6	55	126	0.4271	2.49	20	
4,4´-DDE	0.410	0.050	0.5000	0	82.0	52	125	0.3864	5.92	20	
4,4´-DDT	0.506	0.050	0.5000	0	101	68	136	0.4906	3.11	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8081WATER

Sample ID: **LCSD-49908_OCP**	SampType: **LCSD**	TestCode: **8081WATER**	Units: **µg/L**	Prep Date: **3/13/2015**	RunNo: **99449**
Client ID: **LCSS02**	Batch ID: **49908**	TestNo: **EPA 8081A**	**EPA 3510C**	Analysis Date: **3/14/2015**	SeqNo: **1953308**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aldrin	0.346	0.025	0.5000	0	69.2	28	120	0.2992	14.5	20	
alpha-BHC	0.370	0.025	0.5000	0	73.9	48	126	0.3329	10.5	20	
alpha-Chlordane	0.385	0.025	0.5000	0	77.1	49	127	0.3588	7.10	20	
beta-BHC	0.336	0.025	0.5000	0	67.3	56	106	0.3157	6.35	20	
delta-BHC	0.293	0.025	0.5000	0	58.6	26	122	0.2872	1.94	20	
Dieldrin	0.441	0.050	0.5000	0	88.2	50	132	0.4196	4.95	20	
Endosulfan I	0.390	0.025	0.5000	0	78.1	50	124	0.3717	4.92	20	
Endosulfan II	0.432	0.050	0.5000	0	86.4	52	134	0.4331	0.217	20	
Endosulfan sulfate	0.379	0.050	0.5000	0	75.9	52	126	0.3801	0.220	20	
Endrin	0.587	0.050	0.5000	0	117	34	183	0.5648	3.91	20	
Endrin aldehyde	0.436	0.050	0.5000	0	87.1	49	120	0.4313	1.01	20	
Endrin ketone	0.486	0.050	0.5000	0	97.1	40	148	0.4814	0.863	20	
gamma-BHC	0.371	0.025	0.5000	0	74.1	51	122	0.3346	10.2	20	
gamma-Chlordane	0.386	0.025	0.5000	0	77.2	52	124	0.3631	6.18	20	
Heptachlor	0.366	0.025	0.5000	0	73.1	23	138	0.3210	13.0	20	
Heptachlor epoxide	0.384	0.025	0.5000	0	76.7	52	123	0.3593	6.54	20	
Methoxychlor	0.484	0.25	0.5000	0	96.7	49	147	0.4739	2.03	20	
Surr: Tetrachloro-m-xylene	0.305		0.5000		61.0	12	120		0		
Surr: Decachlorobiphenyl	0.377		0.5000		75.4	36	120		0		

Sample ID: **MB-49908**	SampType: **MBLK**	TestCode: **8081WATER**	Units: **µg/L**	Prep Date: **3/13/2015**	RunNo: **99449**
Client ID: **PBW**	Batch ID: **49908**	TestNo: **EPA 8081A**	**EPA 3510C**	Analysis Date: **3/14/2015**	SeqNo: **1953309**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
4,4´-DDD	ND	0.050									
4,4´-DDE	ND	0.050									
4,4´-DDT	ND	0.050									
Aldrin	ND	0.025									
alpha-BHC	ND	0.025									
alpha-Chlordane	ND	0.025									

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8081WATER

Sample ID: **MB-49908** SampType: **MBLK** TestCode: **8081WATER** Units: **µg/L** Prep Date: **3/13/2015** RunNo: **99449**
Client ID: **PBW** Batch ID: **49908** TestNo: **EPA 8081A** **EPA 3510C** Analysis Date: **3/14/2015** SeqNo: **1953309**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
beta-BHC	ND	0.025									
Chlordane	ND	0.25									
delta-BHC	ND	0.025									
Dieldrin	ND	0.050									
Endosulfan I	ND	0.025									
Endosulfan II	ND	0.050									
Endosulfan sulfate	ND	0.050									
Endrin	ND	0.050									
Endrin aldehyde	ND	0.050									
Endrin ketone	ND	0.050									
gamma-BHC	ND	0.025									
gamma-Chlordane	ND	0.025									
Heptachlor	ND	0.025									
Heptachlor epoxide	ND	0.025									
Methoxychlor	ND	0.25									
Toxaphene	ND	2.5									
Surr: Tetrachloro-m-xylene	0.290		0.5000		57.9	12	120				
Surr: Decachlorobiphenyl	0.390		0.5000		78.1	36	120				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID: **P150313LCS2** SampType: **LCS** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99437**
Client ID: **LCSW** Batch ID: **P15VW042** TestNo: **EPA 8260B** Analysis Date: **3/13/2015** SeqNo: **1952740**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.850	0.50	20.00	0	99.2	80	120				
Ethylbenzene	19.180	0.50	20.00	0	95.9	80	120				
m,p-Xylene	40.080	1.0	40.00	0	100	80	120				
MTBE	17.470	0.50	20.00	0	87.4	77	120				
o-Xylene	20.420	0.50	20.00	0	102	80	120				
Tetrachloroethene	21.480	0.50	20.00	0	107	80	120				
Toluene	20.370	0.50	20.00	0	102	80	120				
Trichloroethene	22.010	0.50	20.00	0	110	80	120				
Xylenes, Total	60.500	1.5	60.00	0	101	70	130				
Surr: 1,2-Dichloroethane-d4	23.120		25.00		92.5	78	125				
Surr: 4-Bromofluorobenzene	25.540		25.00		102	80	120				
Surr: Dibromofluoromethane	24.090		25.00		96.4	80	122				
Surr: Toluene-d8	25.770		25.00		103	80	120				

Sample ID: **N014918-001FMS** SampType: **MS** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99437**
Client ID: **ZZZZZZ** Batch ID: **P15VW042** TestNo: **EPA 8260B** Analysis Date: **3/13/2015** SeqNo: **1952741**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.010	0.50	20.00	0	95.1	80	120				
Ethylbenzene	18.620	0.50	20.00	0	93.1	79	120				
m,p-Xylene	39.170	1.0	40.00	0	97.9	80	120				
MTBE	17.360	0.50	20.00	0	86.8	71	125				
o-Xylene	20.090	0.50	20.00	0	100	80	120				
Tetrachloroethene	20.890	0.50	20.00	0	104	71	123				
Toluene	19.850	0.50	20.00	0	99.2	80	120				
Trichloroethene	21.410	0.50	20.00	0	107	79	121				
Xylenes, Total	59.260	1.5	60.00	0	98.8	70	130				
Surr: 1,2-Dichloroethane-d4	23.710		25.00		94.8	78	125				
Surr: 4-Bromofluorobenzene	26.020		25.00		104	80	120				
Surr: Dibromofluoromethane	24.070		25.00		96.3	80	122				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID: **N014918-001FMS** SampType: **MS** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99437**
Client ID: **ZZZZZZ** Batch ID: **P15VW042** TestNo: **EPA 8260B** Analysis Date: **3/13/2015** SeqNo: **1952741**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: Toluene-d8	25.660		25.00		103	80	120				

Sample ID: **N014918-001FMSD** SampType: **MSD** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99437**
Client ID: **ZZZZZZ** Batch ID: **P15VW042** TestNo: **EPA 8260B** Analysis Date: **3/13/2015** SeqNo: **1952742**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.280	0.50	20.00	0	96.4	80	120	19.01	1.41	20	
Ethylbenzene	19.010	0.50	20.00	0	95.1	79	120	18.62	2.07	20	
m,p-Xylene	39.750	1.0	40.00	0	99.4	80	120	39.17	1.47	20	
MTBE	17.540	0.50	20.00	0	87.7	71	125	17.36	1.03	20	
o-Xylene	20.070	0.50	20.00	0	100	80	120	20.09	0.0996	20	
Tetrachloroethene	21.480	0.50	20.00	0	107	71	123	20.89	2.78	20	
Toluene	19.840	0.50	20.00	0	99.2	80	120	19.85	0.0504	20	
Trichloroethene	21.580	0.50	20.00	0	108	79	121	21.41	0.791	20	
Xylenes, Total	59.820	1.5	60.00	0	99.7	70	130	59.26	0.941	20	
Surr: 1,2-Dichloroethane-d4	22.810		25.00		91.2	78	125		0		
Surr: 4-Bromofluorobenzene	25.520		25.00		102	80	120		0		
Surr: Dibromofluoromethane	23.830		25.00		95.3	80	122		0		
Surr: Toluene-d8	25.240		25.00		101	80	120		0		

Sample ID: **P150313MB3** SampType: **MBLK** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99437**
Client ID: **PBW** Batch ID: **P15VW042** TestNo: **EPA 8260B** Analysis Date: **3/13/2015** SeqNo: **1952745**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.50									
Ethylbenzene	ND	0.50									
m,p-Xylene	ND	1.0									
MTBE	ND	0.50									
o-Xylene	ND	0.50									
Tetrachloroethene	ND	0.50									

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N014918
Project: Atkins / Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID: **P150313MB3** SampType: **MBLK** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99437**
Client ID: **PBW** Batch ID: **P15VW042** TestNo: **EPA 8260B** Analysis Date: **3/13/2015** SeqNo: **1952745**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Toluene	ND	0.50									
Trichloroethene	ND	0.50									
Xylenes, Total	ND	1.5									
Surr: 1,2-Dichloroethane-d4	23.900		25.00		95.6	78	125				
Surr: 4-Bromofluorobenzene	25.040		25.00		100	80	120				
Surr: Dibromofluoromethane	25.060		25.00		100	80	122				
Surr: Toluene-d8	24.670		25.00		98.7	80	120				

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

Chain of Custody

Page 1 of 1

Client: Ninyo + Moore
Address: 6700 Paradise Road, Suite E
Las Vegas Nevada 89119
Phone: 702-433-0330 Fax: 702-433-0707
Project Name: Atkins / Cedar Ave
Project Number: 303710002 PO #
Submitted By: CJE
Title: Technician
Signature: [signature] Date: 3-9-15
I hereby authorize ASSET Laboratories to perform the tests indicated below:

ASSET LABORATORIES
ANALYTICAL LABORATORY SERVICES FOR ENVIRONMENTAL TECHNOLOGIES

Nevada: 3151 W. Post Rd., LasVegas, NV 89118
Phone: 702.307.2659 Fax: 702.307.2691

California: 11060 Artesia Blvd., Ste C, Cerritos, CA 90703
Phone: 562.219.7435 Fax: 562.219.7436

Sample Condition Upon Receipt
Temp 2.1 IR# 1
Method of Cooling ICE
Headspace
Intact
Seal
Comments

Work Order No.	Sample ID/Location	Date	Time	Matrix: Water	Liquid	Soil	Solid	Wastewater	Groundwater	Others	8260 (Volatiles)	8015M (GRO)	8015B (DRO/ORO)	CAM 17 6010/7470/7471	SVOCs by EPA 8270C	Cat 4	Perchlorate 331.0	Turn Around Time	No. of container	Container Type	PRESERVATION	QA/QC: RTNE / RWQCB / CT / LEVEL IV	Remarks
N0149161	B-2	3/9/15	11:25						X							X	X	X	E				
-2	B-6	↓	12:48						↓							X	X	X	↓				

Send report to:
Name Robert Trpisi
Address 6700 Paradise Rd Suite E
Las Vegas, NV 89119
Email rtrpisi@ninyoandmoore.com

Bill to:
Name Same
Address
Email

Sampled by:
I attest to the validity and authenticity of this sample. I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action.
Name Corey Ensenbarger Signature [signature]

Special Instruction/Comments:

Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time
[signature]	3-9-15	15:15	[signature]	3/9/15	1575

TAT Starts at 8 AM the following day if samples received after 3 pm.
A ☐ ≤ 24 Hours D ☐ = 3 Workdays
B ☐ = Next Workday E ☐ = Routine 5-7 Workdays
C ☐ = 2 Workdays

Preservatives: H=HCl N=HNO_3 S=H_2SO_4 C=4°C Z=$Zn(AC)_2$ O=NaOH T=$Na_2S_2O_3$

Carrier: Airbill/Tracking #:

Container Type: T = Tube V = VOA L = Liter P = Pint J = Jar B = Tedlar G = Glass M = Metal P = Plastic

EDD Requirement: Excel EDD ☐ Geotracker ☐ Global ID ____ LabSpec ☐

Sample/Records Storage
All samples will be disposed in 45 days upon receipt and records will be destroyed in 5 years upon submission of final report.
Fees will be applied for extended storage.

White = Laboratory Copy Yellow = Customer's Copy

ASSET Laboratories

Please review the checklist below. Any NO signifies non-compliance. Any non-compliance will be noted and must be understood as having an impact on the quality of the data. All tests will be performed as requested regardless of any compliance issues.

If you have any questions or further instruction, please contact our Project Coordinator at (702) 307-2659.

Cooler Received/Opened On:	3/9/2015	Workorder:	N014918
Rep sample Temp (Deg C):	2.1	IR Gun ID:	1

Temp Blank: ☐ Yes ☑ No

Carrier name: Client

Last 4 digits of Tracking No.: NA Packing Material Used: None

Cooling process: ☑ Ice ☐ Ice Pack ☐ Dry Ice ☐ Other ☐ None

Sample Receipt Checklist

1. Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
2. Custody seals intact, signed, dated on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
3. Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
4. Chain of custody present?	Yes ☑	No ☐	
5. Sampler's name present in COC?	Yes ☑	No ☐	
6. Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
7. Chain of custody agrees with sample labels?	Yes ☑	No ☐	
8. Samples in proper container/bottle?	Yes ☑	No ☐	
9. Sample containers intact?	Yes ☑	No ☐	
10. Sufficient sample volume for indicated test?	Yes ☑	No ☐	
11. All samples received within holding time?	Yes ☐	No ☑	
12. Temperature of rep sample or Temp Blank within acceptable limit?	Yes ☑	No ☐	NA ☐
13. Water - VOA vials have zero headspace?	Yes ☑	No ☐	NA ☐
14. Water - pH acceptable upon receipt? Example: pH > 12 for (CN,S); pH<2 for Metals	Yes ☑	No ☐	NA ☐
15. Did the bottle labels indicate correct preservatives used?	Yes ☑	No ☐	NA ☐
16. Were there Non-Conformance issues at login?	Yes ☑	No ☐	NA ☐
Was Client notified?	Yes ☐	No ☐	NA ☑

Comments: Sample for pH was past holding time upon receipt.

Checklist Completed By: HG 3/13/2015

Reviewed By: 03/16/15

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Western Environmental Testing Laboratory
3230 Polaris Ave. #4
Las Vegas, NV 89102

TEL: (702) 475-8899
FAX:
Acct #:

Field Sampler: Corey Erchanbrack

09-Mar-15

	Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests: ~~D-4294~~ 200.7	Requested Tests: SM4500-NH3C	
①	N014918-001H / B-2	Groundwater	3/9/2015 11:25:00 AM	8OZP		1	
	N014918-001K / B-2	Groundwater	3/9/2015 11:25:00 AM	8OZP	1		
①	N014918-002H / B-6	Groundwater	3/9/2015 12:48:00 PM	8OZP		1	
	N014918-002K / B-6	Groundwater	3/9/2015 12:48:00 PM	8OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.
Please use PO#:N14918B For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT .
Please analyze for TKN and Sulfur.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/10/15 @ 925	Received by:	[signature]	3/10/15 @ 1925
Relinquished by:			Received by:		

① Confirmed with Hannah @ Asset that samples are preserved with H_2SO_4

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Silver State Analytical Laboratory
3638 E. Sunset Road, Suite 100
Las Vegas, NV 89120

TEL: (702) 873-4478
FAX: (702) 873-7967
Acct #:

Field Sampler: Corey Erchanbrack

09-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				~~SM 9221 C,E~~ FECAL COLIFORM	~~SM 9221 D~~ E. COLI	SM4500-Cl B
N014918-001A / B-2	Groundwater	3/9/2015 11:25:00 AM	4OZP	1		
N014918-001B / B-2	Groundwater	3/9/2015 11:25:00 AM	4OZP		1	
N014918-001C / B-2	Groundwater	3/9/2015 11:25:00 AM	8OZP			1
N014918-002A / B-6	Groundwater	3/9/2015 12:48:00 PM	4OZP	1		
N014918-002B / B-6	Groundwater	3/9/2015 12:48:00 PM	4OZP		1	
N014918-002C / B-6	Groundwater	3/9/2015 12:48:00 PM	8OZP			1

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N14918A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Fecal Coliform, E.Coli and Total Residual Chlorine.

		Date/Time			Date/Time
Relinquished by:	Phrlander Galang	3/9/15 / 1635	**Received by:**	R. Bolshaw	3/9/15 1635
Relinquished by:			**Received by:**		

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Eurofins Eaton Analytical
750 Royal Oaks Drive, Ste 100
Monrovia, CA 91016

TEL:
FAX:
Acct #:

Field Sampler: Corey Erchanbrack

09-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				EPA 331.0		
N014918-001L / B-2	Groundwater	3/9/2015 11:25:00 AM	4OZP	1		
N014918-002L / B-6	Groundwater	3/9/2015 12:48:00 PM	4OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N014918C For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Perchlorate by 331.0. Sample wass sterile filtered.

		Date/Time			Date/Time
Relinquished by:	Hoborg	3/9/15@1700	**Received by:**	GSO # 527183299	
Relinquished by:			**Received by:**		

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

NELAP ACCREDITED TNI LABORATORY ORELAP 4034

ilac-MRA

ACLASS ACCREDITED TESTING AT-1807

Laboratory Report

for

Advanced Technology Laboratories, Inc.
3151 W. Post Road
Las Vegas, NV 89118
Attention: Marlon Cartin
Fax: 702-307-2691

Date of Issue
03/13/2015

EUROFINS EATON ANALYTICAL

DST: David S Tripp

Project Manager

Report: 524095
Project: SUBCONTRACT
Group: DRINKING WATER

* Accredited in accordance with TNI 2009 and ISO/IEC 17025:2005.
* Laboratory certifies that the test results meet all **TNI 2009 and ISO/IEC 17025:2005** requirements unless noted under the individual analysis.
* Following the cover page are State Certification List, ISO 17025 Accredited Method List, Acknowledgement of Samples Received, Comments, Hits Report, Data Report, QC Summary, QC Report and Regulatory Forms, as applicable.
* Test results relate only to the sample(s) tested.

STATE CERTIFICATION LIST

State	Certification Number	State	Certification Number
Alabama	41060	**Mississippi**	Certified
Alaska	CA00006	**Montana**	Cert 0035
Arizona	AZ0778	**Nebraska**	Certified
Arkansas	Certified	**Nevada**	CA00006-2014-1
California-Monrovia-ELAP	2813	**New Hampshire ***	2959
California-Colton- ELAP	2812	**New Jersey ***	CA 008
California-Folsom- ELAP	2820	**New Mexico**	Certified
Colorado	Certified	**New York ***	11320
Connecticut	PH-0107	**North Carolina**	06701
Delaware	CA 006	**North Dakota**	R-009
Florida *	E871024	**Oregon (Primary AB) ***	**ORELAP 4034**
Georgia	947	**Pennsylvania ***	68-565
Guam	14-003r	**Rhode Island**	LAO00326
Hawaii	Certified	**South Carolina**	87016
Idaho	Certified	**South Dakota**	Certified
Illinois *	200033	**Tennessee**	TN02839
Indiana	C-CA-01	**Texas ***	T104704230-14-7
Kansas *	E-10268	**Utah ***	CA000062014-7
Kentucky	90107	**Vermont**	VT0114
Louisiana *	LA140009	**Virginia ***	460260
Maine	CA0006	**Washington**	C838
Maryland	224	**West Virginia**	9943 C
Commonwealth of Northern Marianas Is.	MP0004	**Wisconsin**	998316660
Massachusetts	M-CA006	**Wyoming**	8TMS-L
Michigan	9906	**EPA Region 5**	Certified
Los Angeles County Sanitation Districts	10264		

* NELAP/TNI Recognized Accreditation Bodies

The tests listed below are accredited and meet the requirements of ISO 17025 as verified by the ANSI-ASQ National Accreditation Board/ACLASS.
Refer to Certificate and scope of accreditation (AT 1807) found at: http://www.eatonanalytical.com

SPECIFIC TESTS	METHOD OR TECHNIQUE USED	Drinking Water	Food & Beverage	Waste Water
1,4-Dioxane	EPA 522	x	x	
2,3,7,8-TCDD	Modified EPA 1613B	x	x	
Acrylamide	In House Method	x	x	
Alkalinity	SM 2320B	x	x	x
Ammonia	EPA 350.1		x	x
Ammonia	SM 4500-NH3 H (18th)		x	x
Anions and DBPs by IC	EPA 300.0	x	x	x
Anions and DBPs by IC	EPA 300.1	x	x	
Asbestos	EPA 100.2	x		
Bicarbonate Alkalinity as HCO3	SM 2330B	x	x	x
BOD / CBOD	SM 5210B		x	x
Bromate	In House Method	x	x	
Carbamates	EPA 531.2	x	x	
Carbonate as CO3	SM 2330B	x	x	x
Carbonyls	EPA 556	x	x	
COD	EPA 410.4 / SM 5220D			x
Chloramines	SM 4500-CL G	x	x	x
Chlorinated Acids	EPA 515.4	x	x	
Chlorinated Acids	EPA 555	x	x	
Chlorine Dioxide	SM 4500-CLO2 D	x	x	
Chlorine -Total/Free/ Combined Residual	SM 4500-Cl G	x	x	x
Conductivity	EPA 120.1			x
Conductivity	SM 2510B	x	x	x
Corrosivity (Langelier Index)	SM 2330B	x	x	
Cyanide, Amenable	SM 4500-CN G	x		x
Cyanide, Free	SM 4500CN F	x	x	x
Cyanide, Total	EPA 335.4	x	x	x
Cyanogen Chloride (screen)	In House Method	x	x	
Diquat and Paraquat	EPA 549.2	x	x	
DBP/HAA	SM 6251B	x	x	
Dissolved Oxygen	SM 4500-O G		x	x
E. Coli	(MTF/EC+MUG)	x		
E. Coli	CFR 141.21(f)(6)(i)		x	x
E. Coli	SM 9223			x
E. Coli (Enumeration)	SM 9221B.1/ SM 9221F	x	x	
E. Coli (Enumeration)	SM 9223B	x	x	
EDB/DCBP	EPA 504.1	x		
EDB/DBCP and DBP	EPA 551.1	x	x	
EDTA and NTA	In House Method	x	x	
Endothall	EPA 548.1	x	x	
Enterococci	SM 9230B	x		x
Fecal Coliform	SM 9221 E (MTF/EC)	x		
Fecal Coliform	SM 9221C, E (MTF/EC)			x
Fecal Coliform (Enumeration)	SM 9221E (MTF/EC)	x	x	
Fecal Coliform with Chlorine Present	SM 9221E			x
Fecal Streptococci	SM 9230B	x		x
Fluoride	SM 4500-F C	x	x	x
Glyphosate	EPA 547	x	x	
Gross Alpha/Beta	EPA 900.0	x	x	x
HAAs/ Dalapon	EPA 552.3	x	x	
Hardness	SM 2340B	x	x	x
Heterotrophic Bacteria	In House Method	x	x	
Heterotrophic Bacteria	SM 9215 B	x	x	
Hexavalent Chromium	EPA 218.6	x	x	x
Hexavalent Chromium	EPA 218.7	x	x	
Hexavalent Chromium	SM 3500-Cr B or C (20th)			x

SPECIFIC TESTS	METHOD OR TECHNIQUE USED	Drinking Water	Food & Beverage	Waste Water
Hormones	EPA 539	x	x	
Hydroxide as OH Calc.	SM 2330B	x	x	
Kjeldahl Nitrogen	EPA 351.2			x
Mercury	EPA 245.1	x	x	x
Metals	EPA 200.7 / 200.8	x	x	x
Microcystin LR	ELISA	x	x	
NDMA	EPA 521	x	x	
Nitrate/Nitrite Nitrogen	EPA 353.2	x	x	x
OCL, Pesticides/PCB	EPA 505	x	x	
Ortho Phosphate	EPA 365.1	x	x	
Ortho Phosphate and Total Phosphorous	EPA 365.1/SM 4500-P E			x
Ortho Phosphorous	SM 4500P E	x	x	
Oxyhalides Disinfection Byproducts	EPA 317.0	x	x	
Perchlorate	EPA 331.0	x	x	
Perchlorate	EPA 314.0	x	x	
Perfluorinated Alkyl Acids	EPA 537	x	x	
pH	EPA 150.1	x		
pH	SM 4500-H+B	x	x	x
Phenylurea Pesticides/ Herbicides	In House Method	x	x	
Pseudomonas	IDEXX Pseudalert	x	x	
Radium-226	RA-226 GA	x	x	
Radium-228	RA-228 GA	x	x	
Radon-222	SM 7500RN	x	x	
Residue, Filterable	SM 2540C	x	x	x
Residue, Non-filterable	SM 2540D			x
Residue, Total	SM 2540B		x	x
Residue, Volatile	EPA 160.4			x
Semi-VOC	EPA 525.2	x	x	
Semi-VOC	EPA 625	x	x	x
Silica	SM 4500-Si D	x	x	x
Silica	SM 4500-SiO2 C	x		x
Sulfide	SM 4500-$S^{=}$ D			x
Sulfite	SM 4500-SO^3B	x	x	x
Surfactants	SM 5540C	x	x	x
Taste and Odor Analytes	SM 6040E	x	x	
Total Coliform	SM 9221 A, B	x	x	
Total Coliform (Enumeration)	SM 9221 A, B, C	x	x	
Total Coliform / E. coli	Colisure	x	x	
Total Coliform	SM 9221B			x
Total Coliform with Chlorine Present	SM 9221B			x
Total Coliform / E.coli	SM 9223	x	x	
TOC	SM 5310C		x	x
TOC/DOC	SM 5310C	x	x	
TOX	SM 5320B			x
Total Phenols	EPA 420.1			x
Total Phenols	EPA 420.4	x	x	x
Total Phosphorous	SM 4500 P F			x
Turbidity	EPA 180.1	x	x	x
Turbidity	SM 2130B	x		x
Uranium by ICP/MS	EPA 200.8	x	x	
UV 254	SM 5910B	x		
VOC	EPA 524.2/EPA 524.3	x	x	
VOC	EPA 624	x	x	x
VOC	EPA SW 846 8260	x	x	
VOC	In House Method	x	x	
Yeast and Mold	SM 9610	x	x	

eurofins | Eaton Analytical

Acknowledgement of Samples Received

Addr: **Advanced Technology Laboratories, Inc.**
3151 W. Post Road
Las Vegas, NV 89118

Attn: Marlon Cartin
Phone: 702-307-2659

Client ID: ATL-NV
Folder #: 524095
Project: SUBCONTRACT
Sample Group: DRINKING WATER

Project Manager: David S Tripp
Phone: (626) 386-1158
PO #: N014918C

The following samples were received from you on **March 10, 2015** at **1410**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using Eurofins Eaton Analytical.

Sample #	Sample ID	Sample Date
201503100725	NO14918-001L/ B-2	03/09/2015 1125
	@331-PHG-Sterile-Filtered	
201503100726	NO14918-002L/ B-6	03/09/2015 1248
	@331-PHG-Sterile-Filtered	

Test Description

@331-PHG-Sterile-Filtered -- Perchlorate by EPA 331.0

524095

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:

Eurofins Eaton Analytical
750 Royal Oaks Drive, Ste 100
Monrovia, CA 91016

TEL:
FAX:
Acct #:

Field Sampler: Corey Erchanbrack

09-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests: EPA 331.0		
N014918-001L / B-2	Groundwater	3/9/2015 11:25:00 AM	4OZP	1		
N014918-002L / B-6	Groundwater	3/9/2015 12:48:00 PM	4OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N014918C For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Perchlorate by 331.0. Sample wass sterile filtered.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/9/15@1700	**Received by:**	GSO # 527183299	
Relinquished by:			**Received by:**	EEA	3/10/15 1410

4.8-0.3 = 4.5°C on ice
474A

GSO
GOLDEN STATE OVERNIGHT

800-322-5555 www.gso.com

Ship From
ADVANCED TECHNOLOGY LABORATORIES, INC.
MARLON CARTIN
3151 W. POST RD.
LAS VEGAS, NV 89118

Ship To
EUROFINS
DAVID TRIPP
750 ROYAL OAKS DR
STE 100
MONROVIA, CA 91016

COD: $0.00
Weight: 0 lb(s)
Reference:

Delivery Instructions:

Signature Type: REQUIRED

Tracking #: 527183299 **CPS**

NWK **E**
MONROVIA

D91006B

35039063

Print Date: 3/9/2015 3:53 PM

LABEL INSTRUCTIONS:

Do not copy or reprint this label for additional shipments - each package must have a unique barcode.

Use the "Print Label" button on this page to print the shipping label on a laser or inkjet printer. Securely attach this label to your package, do not cover the barcode.

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Comments
Report: 524095

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

The Comments Report may be blank if there are no comments for this report.

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Hits
Report: 524095

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

Samples Received on:
03/10/2015 1410

Analyzed	Analyte	Sample ID	Result	Federal MCL	Units	MRL
	201503100725	**NO14918-001L/ B-2**				
03/12/2015 09:53	Perchlorate		2.6	6	ug/L	0.5
	201503100726	**NO14918-002L/ B-6**				
03/12/2015 10:26	Perchlorate		7.4	6	ug/L	0.5

SUMMARY OF POSITIVE DATA ONLY

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 524095

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

Samples Received on:
03/10/2015 1410

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
NO14918-001L/ B-2 (201503100725)						**Sampled on 03/09/2015 1125**		
			EPA 331.0 - Perchlorate by EPA 331.0					
	03/12/2015 09:53	825191	(EPA 331.0)	Perchlorate	2.6	ug/L	0.5	1
NO14918-002L/ B-6 (201503100726)						**Sampled on 03/09/2015 1248**		
			EPA 331.0 - Perchlorate by EPA 331.0					
	03/12/2015 10:26	825191	(EPA 331.0)	Perchlorate	7.4	ug/L	0.5	1

Rounding on totals after summation.
(c) - indicates calculated results

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Advanced Technology Laboratories, Inc.

QC Ref # 825191 - Perchlorate by EPA 331.0 **Analysis Date: 03/12/2015**

201503100725	NO14918-001L/ B-2	Analyzed by: LHZ
201503100726	NO14918-002L/ B-6	Analyzed by: LHZ

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory QC
Report: 524095

Advanced Technology Laboratories, Inc.

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 825191 - Perchlorate by EPA 331.0 by EPA 331.0						**Analysis Date: 03/12/2015**			
LCS1	Perchlorate		10	10.2	ug/L	102	(80-120)		
LCS2	Perchlorate		10	10.4	ug/L	104	(80-120)	20	1.9
MBLK	Perchlorate			<0.167	ug/L				
MRL_CHK	Perchlorate		0.5	0.653	ug/L	131	(50-150)		
MS2_201503100725	Perchlorate	2.6	10	13.1	ug/L	105	(80-120)		
MSD2_201503100725	Perchlorate	2.6	10	12.6	ug/L	100	(80-120)	20	3.9

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
(I) - Indicates internal standard compound.

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: March 10, 2015

LABORATORY NO: 15-1206

CLIENT: ASSET Laboratories
3151-3153 W. Post Rd.
Las Vegas, NV 89118

PAGE: 1 of 1

CLIENT PROJECT:

CLIENT PO #:

Sampled By: C. Erchanbrack
Date Sampled: 03/09/15
Time Sampled: Refer to COC

Submitted by: P. Galang
Date Received: 03/09/15
Time Received: 1635

Report Attention:

Location	Parameter	Result	Unit	Reporting Limit	Method	Date Analyzed	Analyst
N014918-001A/ B-2	Fecal Coliform	ND	CFU/100 mL	1.0	Colilert-18	03/09/15	CR
N014918-001B/ B-2	Coliforms, *E. coli*	1.0	CFU/100 mL	1.0	Colilert-18	03/09/15	CR
N014918-001C/ B-2	Residual Chlorine [(1)]	ND	mg/L	0.50	SM4500Cl G	03/09/15	CL
N014918-002A/ B-6	Fecal Coliform	ND	CFU/100 mL	1.0	Colilert-18	03/09/15	CR
N014918-002B/ B-6	Coliforms, *E. coli*	8.6	CFU/100 mL	1.0	Colilert-18	03/09/15	CR
N014918-002C/ B-6	Residual Chlorine [(1)]	ND	mg/L	0.50	SM4500Cl G	03/09/15	CL

ND: non-detect
EPA Flags: [(1)] Sample analyzed outside of method specified hold time requirement

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 • Las Vegas, NV 89120 • Tel: 702-873-4478 Fax: 702-873-7967
4587 Longley Lane, No. 2 • Reno, NV 89502 • Tel: 775-825-1127 Fax: 775-825-1167
www.ssalabs.com • www.envirotechonline.com

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Silver State Analytical Laboratory
3638 E. Sunset Road, Suite 100
Las Vegas, NV 89120

TEL: (702) 873-4478
FAX: (702) 873-7967
Acct #:

Field Sampler: Corey Erchanbrack

09-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests: ~~SM 9221 C,E~~ FECAL COLIFORM	Requested Tests: ~~SM 9221 D~~ E. COLI	Requested Tests: SM4500-Cl B
N014918-001A / B-2 1206-1A	Groundwater	3/9/2015 11:25:00 AM	4OZP	1		
N014918-001B / B-2 -2A	Groundwater	3/9/2015 11:25:00 AM	4OZP		1	
N014918-001C / B-2 -3A	Groundwater	3/9/2015 11:25:00 AM	8OZP			1
N014918-002A / B-6 -4A	Groundwater	3/9/2015 12:48:00 PM	4OZP	1		
N014918-002B / B-6 -5A	Groundwater	3/9/2015 12:48:00 PM	4OZP		1	
N014918-002C / B-6 -6A	Groundwater	3/9/2015 12:48:00 PM	8OZP			1

General Comments: Please email sample receipt acknowledgement to the PM.
Please use PO#:N14918A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT
Please analyze for Fecal Coliform, E.Coli and Total Residual Chlorine.

		Date/Time			Date/Time
Relinquished by:	Phrlander Galang	3/9/15 / 1635	Received by:	R. Bolshaw	3/9/15 1635
Relinquished by:			Received by:		

3/20/2015

Advanced Technology Laboratories
3151 W Post Road
Las Vegas, NV 89118
Attn: Marlon Cartin

OrderID: *1503297*

Dear: Marlon Cartin

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, online edition, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 3/10/2015. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Report Comments

Advanced Technology Laboratories - 1503297

General Comments

None

Specific Comments

None

Per method recommendation (section 4.4), Samples analyzed by methods EPA 300.0 and EPA 300.1 have been filtered prior to analysis.

Report Legend

B	--	Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	--	Sample analyzed beyond the accepted holding time
J	--	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	--	Reported value is estimated; The sample matrix interfered with the analysis
N	--	There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	--	Not calculated due to matrix interference
Q	--	Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	--	Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC	--	Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered
U	--	The analyte was analyzed for, but was not detected above the level of the reported sample reporting/quantitation limit

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Analytical Report

Advanced Technology Laboratories
3151 W Post Road
Las Vegas, NV 89118
Attn: Marlon Cartin
Phone: (702) 307-2659 **Fax:** (702) 307-2691

Date Printed: 3/20/2015
OrderID: *1503297*
PO\Project: *31503062/N14918B*

Customer Sample ID: N014918-001H **Collect Date/Time:** 3/9/2015 11:25
WETLAB Sample ID: 1503297-001 **Receive Date:** 3/10/2015 09:28

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Flow Injection Analyses							
Total Kjeldahl Nitrogen	EPA 351.2	ND	mg/L	1	0.20	3/13/2015	NV00925

Customer Sample ID: N014918-001K **Collect Date/Time:** 3/9/2015 11:25
WETLAB Sample ID: 1503297-002 **Receive Date:** 3/10/2015 09:28

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Trace Metals by ICP-OES							
Sulfur	EPA 200.7	370 SC	mg/L	100	100	3/20/2015	NV00925
Sample Preparation							
Trace Metals Digestion	EPA 200.2	Complete		1		3/18/2015	NV00925

Customer Sample ID: N014918-002H **Collect Date/Time:** 3/9/2015 12:48
WETLAB Sample ID: 1503297-003 **Receive Date:** 3/10/2015 09:28

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Flow Injection Analyses							
Total Kjeldahl Nitrogen	EPA 351.2	ND	mg/L	1	0.20	3/13/2015	NV00925

Customer Sample ID: N014918-002K **Collect Date/Time:** 3/9/2015 12:48
WETLAB Sample ID: 1503297-004 **Receive Date:** 3/10/2015 09:28

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Trace Metals by ICP-OES							
Sulfur	EPA 200.7	630	mg/L	100	100	3/20/2015	NV00925
Sample Preparation							
Trace Metals Digestion	EPA 200.2	Complete		1		3/18/2015	NV00925

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC15030703	Blank 1	Total Kjeldahl Nitrogen	EPA 351.2	ND	mg/L
QC15030952	Blank 1	Sulfur	EPA 200.7	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC15030703	LCS 1	Total Kjeldahl Nitrogen	EPA 351.2	0.984	1.00	98	mg/L
QC15030952	LCS 1	Sulfur	EPA 200.7	1.04	1.00	104	mg/L

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC15030703	MS 1	Total Kjeldahl Nitrogen	EPA 351.2	1503244-003	ND		1.13	1.06	1.00	mg/L	102	95	6%
QC15030703	MS 2	Total Kjeldahl Nitrogen	EPA 351.2	1503262-001	1.20		2.27	2.01	1.00	mg/L	107	81	12%
QC15030952	MS 1	Sulfur	EPA 200.7	1503297-002	372	SC	408	375	1.00	mg/L	NC	NC	NC

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Western Environmental Testing Laboratory
3230 Polaris Ave. #4
Las Vegas, NV 89102

TEL: (702) 475-8899
FAX:
Acct #:

Field Sampler: Corey Erchanbrack

09-Mar-15

	Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests: ~~D-4294~~ 200.7	Requested Tests: SM4500-NH3C	
②	N014918-001H / B-2	Groundwater	3/9/2015 11:25:00 AM	8OZP		1	
	N014918-001K / B-2	Groundwater	3/9/2015 11:25:00 AM	8OZP	1		
②	N014918-002H / B-6	Groundwater	3/9/2015 12:48:00 PM	8OZP		1	
	N014918-002K / B-6	Groundwater	3/9/2015 12:48:00 PM	8OZP	1		

6.9°C @ 0945 3/10/15 MA

WETLAB Order ID: 1503297
Sparks Control #: _____
Elko Control #: _____
LV Control #: 31503062

3 1
4

General Comments: Please email sample receipt acknowledgement to the PM.
Please use PO#:N14918B For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT
Please analyze for TKN and Sulfur.

		Date/Time			Date/Time
Relinquished by:		3/10/15 @ 925	**Received by:**		3/10/15 @ 1928
Relinquished by:		3/10/15 1530	**Received by:**		3/10/15 1530

② Confirmed with Hannah @ Asset that samples are preserved with H_2SO_4

ON TRAC

Vanessa Geyer 3/11/15 1530

March 30, 2015

Robert Troisi
Ninyo & Moore
6700 Paradise Road, Suite E
Las Vegas, NV 89119

TEL: (702) 433-0330
FAX: (702) 227-2051

CA-ELAP No.: 2676
NV Cert. No.: NV-00922

Workorder No.: N015000

RE: 303710002 Atkins/Cedar Ave, 303710002

Attention: Robert Troisi

Enclosed are the results for sample(s) received on March 17, 2015 by ASSET Laboratories . The sample(s) are tested for the parameters as indicated in the enclosed chain of custody in accordance with the applicable laboratory certifications.

Thank you for the opportunity to service the needs of your company.

Please feel free to call me at (702) 307-2659 if I can be of further assistance to your company.

Sincerely,

Glen Gesmundo
QA Manager

The cover letter is an integral part of this analytical report. This Laboratory Report cannot be reproduced in part or in its entirety without written permission from the client and Advanced Technology Laboratories - Las Vegas.

CLIENT: Ninyo & Moore
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab Order: N015000

CASE NARRATIVE

SAMPLE RECEIVING/GENERAL COMMENTS:

Sample was received intact with proper chain of custody documentation.

Cooler temperature and sample preservation were verified upon receipt of samples if applicable.

Information on sample receipt conditions including discrepancies can be found in attached Sample Receipt Checklist Form.

Samples were analyzed within method holding time except for pH. pH testing is specified to be performed in the field within 15 minutes of sampling;sample was received and analyzed past the regulatory holding time.

Subcontracted Analysis:

Perchlorate (EPA 331.0) was subcontracted to Eurofins Eaton Analytical - Monrovia, CA.

Residual Chlorine, Fecal Coliform and E.Coli were subcontracted to Silver State Analytical Laboratories- Las Vegas,NV.

TKN and Sulfur were subcontracted to Western Environmental Labs- Las Vegas,NV.

Analytical Comments for EPA 200.7:

Matrix Spike (MS) and /or Matrix Spike Duplicate (MSD) are outside recovery criteria or Calcium and Magnesium on QC samples N015000-001J-MS and N015000-001J-MSD since the analyte concentration in the sample is disproportionate to the spike level. The associated Laboratory Control Sample (LCS) recovery was acceptable.

ASSET Laboratories

Date: *30-Mar-15*

CLIENT: Ninyo & Moore
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab Order: N015000
Contract No:

Work Order Sample Summary

Lab Sample ID	Client Sample ID	Matrix	Collection Date	Date Received	Date Reported
N015000-001A	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001B	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001C	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001D	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001E	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001F	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001G	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001H	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001I	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001J	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001K	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015
N015000-001L	B-20	Groundwater	3/17/2015 1:05:00 PM	3/17/2015	3/30/2015

CLIENT: Ninyo & Moore
Lab Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab ID: N015000-001

Client Sample ID: B-20
Collection Date: 3/17/2015 1:05:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
PH						
		SM4500-H+B				
RunID: WETCHEM_150317C	QC Batch: R99480			PrepDate:		Analyst: **LR**
pH	7.4	0.10	H	pH Units	1	3/17/2015 02:30 PM
Temp. at time of pH Analysis	25	0.10	H	°C	1	3/17/2015 02:30 PM
TOTAL FILTERABLE RESIDUE						
		SM2540C				
RunID: WETCHEM_150318H	QC Batch: 49962			PrepDate:	3/18/2015	Analyst: **LR**
Total Dissolved Solids (Residue, Filterable)	4200	33		mg/L	1	3/18/2015 02:30 PM
TOTAL NON-FILTERABLE RESIDUE						
		SM2540D				
RunID: WETCHEM_150318D	QC Batch: 49961			PrepDate:	3/18/2015	Analyst: **LR**
Suspended Solids (Residue, Non-Filterable)	19	10		mg/L	1	3/18/2015 10:00 AM
TURBIDITY						
		EPA 180.1				
RunID: WETCHEM_150317B	QC Batch: R99479			PrepDate:		Analyst: **LR**
Turbidity	14	0.10		NTU	1	3/17/2015 03:00 PM
ALKALINITY, SPECIATED						
		SM 2320 B				
RunID: WETCHEM_150320D	QC Batch: R99541			PrepDate:		Analyst: **QBM**
Alkalinity, Bicarbonate (As CaCO3)	290	5.0		mg/L	1	3/20/2015
Alkalinity, Carbonate (As CaCO3)	ND	5.0		mg/L	1	3/20/2015
Alkalinity, Hydroxide (As CaCO3)	ND	5.0		mg/L	1	3/20/2015
Alkalinity, Total (As CaCO3)	290	5.0		mg/L	1	3/20/2015
TOTAL PHOSPHORUS						
		EPA 365.3				
RunID: WETCHEM_150325C	QC Batch: 49971			PrepDate:	3/23/2015	Analyst: **CEI**
Phosphorus, Total (As P)	0.048	0.020		mg/L	1	3/25/2015
TOTAL NITROGEN BY CALCULATION						
		CALCULATION				
RunID: WETCHEM_150330A	QC Batch: R99678			PrepDate:		Analyst: **GG**
Total Nitrogen	6.56	0.100		mg/L	1	3/30/2015

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Lab Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab ID: N015000-001

Client Sample ID: B-20
Collection Date: 3/17/2015 1:05:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
VOLATILE ORGANIC COMPOUNDS BY GC/MS				**EPA 8260B**		
RunID: MS5_150321A	QC Batch: P15VW048			PrepDate:		Analyst: **QBM**
Benzene	ND	0.50		µg/L	1	3/21/2015 12:43 PM
Ethylbenzene	ND	0.50		µg/L	1	3/21/2015 12:43 PM
m,p-Xylene	ND	1.0		µg/L	1	3/21/2015 12:43 PM
MTBE	ND	0.50		µg/L	1	3/21/2015 12:43 PM
o-Xylene	ND	0.50		µg/L	1	3/21/2015 12:43 PM
Tetrachloroethene	ND	0.50		µg/L	1	3/21/2015 12:43 PM
Toluene	ND	0.50		µg/L	1	3/21/2015 12:43 PM
Trichloroethene	ND	0.50		µg/L	1	3/21/2015 12:43 PM
Xylenes, Total	ND	1.5		µg/L	1	3/21/2015 12:43 PM
Surr: 1,2-Dichloroethane-d4	95.3	78-125		%REC	1	3/21/2015 12:43 PM
Surr: 4-Bromofluorobenzene	99.1	80-120		%REC	1	3/21/2015 12:43 PM
Surr: Dibromofluoromethane	100	80-122		%REC	1	3/21/2015 12:43 PM
Surr: Toluene-d8	101	80-120		%REC	1	3/21/2015 12:43 PM
DIESEL & MOTOR OIL RANGE ORGANICS BY GC/FID						
EPA 3510C				**EPA 8015B**		
RunID: GC1_150319A	QC Batch: 49968			PrepDate:	3/19/2015	Analyst: **MDM**
DRO	ND	0.20		mg/L	1	3/19/2015 10:06 PM
ORO	ND	0.20		mg/L	1	3/19/2015 10:06 PM
Surr: p-Terphenyl	91.3	48-133		%REC	1	3/19/2015 10:06 PM
ORGANOCHLORINE PESTICIDES BY GC/ECD						
EPA 3510C				**EPA 8081A**		
RunID: GC8_150323B	QC Batch: 50006			PrepDate:	3/23/2015	Analyst: **MDM**
4,4´-DDD	ND	0.053		µg/L	1	3/23/2015 08:21 PM
4,4´-DDE	ND	0.053		µg/L	1	3/23/2015 08:21 PM
4,4´-DDT	ND	0.053		µg/L	1	3/23/2015 08:21 PM
Aldrin	ND	0.027		µg/L	1	3/23/2015 08:21 PM
alpha-BHC	ND	0.027		µg/L	1	3/23/2015 08:21 PM
alpha-Chlordane	ND	0.027		µg/L	1	3/23/2015 08:21 PM
beta-BHC	ND	0.027		µg/L	1	3/23/2015 08:21 PM
Chlordane	ND	0.27		µg/L	1	3/23/2015 08:21 PM
delta-BHC	ND	0.027		µg/L	1	3/23/2015 08:21 PM
Dieldrin	ND	0.053		µg/L	1	3/23/2015 08:21 PM
Endosulfan I	ND	0.027		µg/L	1	3/23/2015 08:21 PM
Endosulfan II	ND	0.053		µg/L	1	3/23/2015 08:21 PM
Endosulfan sulfate	ND	0.053		µg/L	1	3/23/2015 08:21 PM

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Lab Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab ID: N015000-001

Client Sample ID: B-20
Collection Date: 3/17/2015 1:05:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ORGANOCHLORINE PESTICIDES BY GC/ECD						
EPA 3510C				**EPA 8081A**		
RunID: GC8_150323B	QC Batch: 50006			PrepDate: 3/23/2015		Analyst: **MDM**
Endrin	ND	0.053		µg/L	1	3/23/2015 08:21 PM
Endrin aldehyde	ND	0.053		µg/L	1	3/23/2015 08:21 PM
Endrin ketone	ND	0.053		µg/L	1	3/23/2015 08:21 PM
gamma-BHC	ND	0.027		µg/L	1	3/23/2015 08:21 PM
gamma-Chlordane	ND	0.027		µg/L	1	3/23/2015 08:21 PM
Heptachlor	ND	0.027		µg/L	1	3/23/2015 08:21 PM
Heptachlor epoxide	ND	0.027		µg/L	1	3/23/2015 08:21 PM
Methoxychlor	ND	0.27		µg/L	1	3/23/2015 08:21 PM
Toxaphene	ND	2.7		µg/L	1	3/23/2015 08:21 PM
Surr: Tetrachloro-m-xylene	69.4	12-120		%REC	1	3/23/2015 08:21 PM
Surr: Decachlorobiphenyl	76.1	36-120		%REC	1	3/23/2015 08:21 PM
GASOLINE RANGE ORGANICS BY GC/FID						
				EPA 8015B		
RunID: GC4_150319A	QC Batch: E15VW019			PrepDate:		Analyst: **QBM**
GRO	ND	0.050		mg/L	1	3/19/2015 12:34 PM
Surr: Chlorobenzene - d5	125	73-132		%REC	1	3/19/2015 12:34 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150317A	QC Batch: R99490			PrepDate:		Analyst: **QBM**
Chloride	390	50		mg/L	100	3/17/2015 05:48 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150317A	QC Batch: R99490			PrepDate:		Analyst: **QBM**
Fluoride	2.4	0.50		mg/L	5	3/17/2015 04:17 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150317A	QC Batch: R99490			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrite	ND	0.50		mg/L	5	3/17/2015 04:17 PM
ANIONS BY ION CHROMATOGRAPHY						
				EPA 300.0		
RunID: IC2_150317A	QC Batch: R99490			PrepDate:		Analyst: **QBM**
Nitrogen, Nitrate (As N)	6.3	0.50		mg/L	5	3/17/2015 04:17 PM

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

ASSET Laboratories

ANALYTICAL RESULTS

Print Date: *30-Mar-15*

CLIENT: Ninyo & Moore
Lab Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab ID: N015000-001

Client Sample ID: B-20
Collection Date: 3/17/2015 1:05:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
ANIONS BY ION CHROMATOGRAPHY				**EPA 300.0**		
RunID: IC2_150317A	QC Batch: R99490			PrepDate:		Analyst: **QBM**
Sulfate	2200	200		mg/L	200	3/17/2015 07:04 PM
DISSOLVED MERCURY BY COLD VAPOR TECHNIQUE				**EPA 245.1**		
RunID: AA1_150326A	QC Batch: 50036			PrepDate:	3/26/2015	Analyst: **CEI**
Mercury	ND	0.20		µg/L	1	3/26/2015 10:05 AM
DISSOLVED METALS BY ICP				**EPA 200.7**		
RunID: ICP2_150321A	QC Batch: 49981			PrepDate:	3/20/2015	Analyst: **CEI**
Calcium	260	0.50		mg/L	1	3/21/2015 11:37 AM
Iron	ND	0.50		mg/L	1	3/21/2015 11:37 AM
Magnesium	410	0.10		mg/L	1	3/21/2015 11:37 AM
DISSOLVED METALS BY ICP				**EPA 200.7**		
RunID: ICP2_150324A	QC Batch: 49981			PrepDate:	3/20/2015	Analyst: **CEI**
Potassium	50	5.0		mg/L	10	3/24/2015 10:50 AM
Sodium	390	25		mg/L	50	3/24/2015 11:34 AM
HARDNESS BY CALCULATION				**SM 2340 B**		
RunID: ICP2_150321A	QC Batch: R99554			PrepDate:		Analyst: **CEI**
Hardness, Calcium (As CaCO3)	650	0.50		mg/L	1	3/21/2015 11:37 AM
Total Hardness (As CaCO3)	2300	1.0		mg/L	1	3/21/2015 11:37 AM
DISSOLVED METALS BY ICPMS				**EPA 200.8**		
RunID: ICP7_150321A	QC Batch: 49989			PrepDate:	3/20/2015	Analyst: **CEI**
Aluminum	ND	250		µg/L	5	3/21/2015 04:12 PM
Antimony	ND	0.50		µg/L	1	3/21/2015 01:46 PM
Arsenic	19	0.10		µg/L	1	3/21/2015 01:46 PM
Barium	ND	1.0		µg/L	1	3/21/2015 01:46 PM
Beryllium	ND	0.50		µg/L	1	3/21/2015 01:46 PM
Boron	1700	50		µg/L	1	3/21/2015 01:46 PM
Cadmium	ND	0.50		µg/L	1	3/21/2015 01:46 PM
Chromium	ND	1.0		µg/L	1	3/21/2015 01:46 PM
Copper	ND	1.0		µg/L	1	3/21/2015 01:46 PM

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- S Spike/Surrogate outside of limits due to matrix interference
- Results are wet unless otherwise specified
- DO Surrogate Diluted Out

ASSET Laboratories

ANALYTICAL RESULTS

Print Date: *30-Mar-15*

CLIENT: Ninyo & Moore
Lab Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002
Lab ID: N015000-001

Client Sample ID: B-20
Collection Date: 3/17/2015 1:05:00 PM
Matrix: GROUNDWATER

Analyses	Result	PQL	Qual	Units	DF	Date Analyzed
DISSOLVED METALS BY ICPMS						
		EPA 200.8				
RunID: ICP7_150321A	QC Batch: 49989				PrepDate: 3/20/2015	Analyst: **CEI**
Lead	ND	1.0		µg/L	1	3/21/2015 01:46 PM
Manganese	6.8	0.50		µg/L	1	3/21/2015 01:46 PM
Molybdenum	94	0.50		µg/L	1	3/22/2015 11:34 PM
Nickel	ND	1.0		µg/L	1	3/21/2015 01:46 PM
Selenium	24	0.50		µg/L	1	3/21/2015 01:46 PM
Silver	ND	0.50		µg/L	1	3/21/2015 01:46 PM
Thallium	ND	0.50		µg/L	1	3/21/2015 01:46 PM
Zinc	ND	10		µg/L	1	3/21/2015 01:46 PM

Qualifiers:

B	Analyte detected in the associated Method Blank
H	Holding times for preparation or analysis exceeded
S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out
E	Value above quantitation range
ND	Not Detected at the Reporting Limit
	Results are wet unless otherwise specified

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 150.1_4500H+B_W

Sample ID: **N015000-001E DUP** SampType: **DUP** TestCode: **150.1_4500H+** Units: **pH Units** Prep Date: RunNo: **99480**
Client ID: **ZZZZZZ** Batch ID: **R99480** TestNo: **SM4500-H+B** Analysis Date: **3/17/2015** SeqNo: **1954797**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
pH	7.430	0.10						7.360	0.947	10	H
Temp. at time of pH Analysis	24.900	0.10						24.80	0.402	10	H

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 160.1_2540C_W

Sample ID: **MB-49962**	SampType: **MBLK**	TestCode: **160.1_2540C_**	Units: **mg/L**	Prep Date: **3/18/2015**	RunNo: **99519**
Client ID: **PBW**	Batch ID: **49962**	TestNo: **SM2540C**		Analysis Date: **3/18/2015**	SeqNo: **1957165**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	ND	10									

Sample ID: **LCS-49962**	SampType: **LCS**	TestCode: **160.1_2540C_**	Units: **mg/L**	Prep Date: **3/18/2015**	RunNo: **99519**
Client ID: **LCSW**	Batch ID: **49962**	TestNo: **SM2540C**		Analysis Date: **3/18/2015**	SeqNo: **1957166**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	983.000	10	1000	0	98.3	80	120				

Sample ID: **N015014-002A-DUP**	SampType: **DUP**	TestCode: **160.1_2540C_**	Units: **mg/L**	Prep Date: **3/18/2015**	RunNo: **99519**
Client ID: **ZZZZZZ**	Batch ID: **49962**	TestNo: **SM2540C**		Analysis Date: **3/18/2015**	SeqNo: **1957171**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Total Dissolved Solids (Residue, Filtera	4660.000	50						4890	4.82	5	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 160.2_2540D_W

Sample ID: **MB-49961**	SampType: **MBLK**	TestCode: **160.2_2540D_**	Units: **mg/L**	Prep Date: **3/18/2015**	RunNo: **99500**
Client ID: **PBW**	Batch ID: **49961**	TestNo: **SM2540D**		Analysis Date: **3/18/2015**	SeqNo: **1955877**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	ND	10									

Sample ID: **LCS-49961**	SampType: **LCS**	TestCode: **160.2_2540D_**	Units: **mg/L**	Prep Date: **3/18/2015**	RunNo: **99500**
Client ID: **LCSW**	Batch ID: **49961**	TestNo: **SM2540D**		Analysis Date: **3/18/2015**	SeqNo: **1955878**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	950.000	10	1000	0	95.0	80	120				

Sample ID: **N015000-001EDUP**	SampType: **DUP**	TestCode: **160.2_2540D_**	Units: **mg/L**	Prep Date: **3/18/2015**	RunNo: **99500**
Client ID: **ZZZZZZ**	Batch ID: **49961**	TestNo: **SM2540D**		Analysis Date: **3/18/2015**	SeqNo: **1955880**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Suspended Solids (Residue, Non-Filter	20.000	10						19.00	5.13	5	R

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 180.1_W

Sample ID: **N015000-001E** SampType: **DUP** TestCode: **180.1_W** Units: **NTU** Prep Date: RunNo: **99479**
Client ID: **ZZZZZZ** Batch ID: **R99479** TestNo: **EPA 180.1** Analysis Date: **3/17/2015** SeqNo: **1954795**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Turbidity	14.360	0.10						14.08	1.97	30	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD

Sample ID: MB-49981	SampType: MBLK	TestCode: 200.7_WD	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99554
Client ID: PBW	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/21/2015	SeqNo: 1958766

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	0.113	0.50									
Iron	0.012	0.50									
Magnesium	0.013	0.10									

Sample ID: LCS-49981	SampType: LCS	TestCode: 200.7_WD	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99554
Client ID: LCSW	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/21/2015	SeqNo: 1958767

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	9.539	0.50	10.00	0	95.4	85	115				
Iron	0.106	0.50	0.1000	0	106	85	115				
Magnesium	9.945	0.10	10.00	0	99.5	85	115				

Sample ID: N015000-001J-MS	SampType: MS	TestCode: 200.7_WD	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99554
Client ID: ZZZZZZ	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/21/2015	SeqNo: 1958771

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	270.420	0.50	10.00	259.4	110	75	125				
Iron	0.294	0.50	0.1000	0.2001	93.9	75	125				
Magnesium	425.079	0.10	10.00	410.4	147	75	125				S

Sample ID: N015000-001J-MSD	SampType: MSD	TestCode: 200.7_WD	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99554
Client ID: ZZZZZZ	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/21/2015	SeqNo: 1958772

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Calcium	261.735	0.50	10.00	259.4	23.6	75	125	270.4	3.26	20	S
Iron	0.303	0.50	0.1000	0.2001	103	75	125	0.2939	0	20	
Magnesium	410.737	0.10	10.00	410.4	3.51	75	125	425.1	3.43	20	S

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD1

Sample ID: MB-49981	SampType: MBLK	TestCode: 200.7_WD1	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99592
Client ID: PBW	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/24/2015	SeqNo: 1962485

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	ND	0.50									
Sodium	ND	0.50									

Sample ID: LCS-49981	SampType: LCS	TestCode: 200.7_WD1	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99592
Client ID: LCSW	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/24/2015	SeqNo: 1962486

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	20.050	0.50	20.00	0	100	85	115				
Sodium	19.451	0.50	20.00	0	97.3	85	115				

Sample ID: N015017-001A-MS2	SampType: MS	TestCode: 200.7_WD1	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99592
Client ID: ZZZZZZ	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/24/2015	SeqNo: 1962499

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	32.298	0.50	20.00	11.54	104	75	125				

Sample ID: N015017-001A-MSD	SampType: MSD	TestCode: 200.7_WD1	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99592
Client ID: ZZZZZZ	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/24/2015	SeqNo: 1962500

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Potassium	31.846	0.50	20.00	11.54	102	75	125	32.30	1.41	20	

Sample ID: N015017-001A-MS2	SampType: MS	TestCode: 200.7_WD1	Units: mg/L	Prep Date: 3/20/2015	RunNo: 99592
Client ID: ZZZZZZ	Batch ID: 49981	TestNo: EPA 200.7		Analysis Date: 3/24/2015	SeqNo: 1962511

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sodium	73.727	2.5	20.00	53.84	99.4	75	125				

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.7_WD1

Sample ID: **N015017-001A-MSD** SampType: **MSD** TestCode: **200.7_WD1** Units: **mg/L** Prep Date: **3/20/2015** RunNo: **99592**
Client ID: **ZZZZZZ** Batch ID: **49981** TestNo: **EPA 200.7** Analysis Date: **3/24/2015** SeqNo: **1962512**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sodium	76.811	2.5	20.00	53.84	115	75	125	73.73	4.10	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **MB-49989** SampType: **MBLK** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **PBW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960016**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	ND	50									
Antimony	ND	0.50									
Arsenic	ND	0.10									
Barium	ND	1.0									
Beryllium	ND	0.50									
Boron	ND	50									
Cadmium	ND	0.50									
Chromium	ND	1.0									
Copper	0.202	1.0									
Lead	ND	1.0									
Manganese	ND	0.50									
Nickel	0.080	1.0									
Selenium	ND	0.50									
Silver	ND	0.50									
Thallium	ND	0.50									
Zinc	ND	10									

Sample ID: **LCS-49989** SampType: **LCS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **LCSW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960017**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	99.177	50	100.0	0	99.2	85	115				
Antimony	10.425	0.50	10.00	0	104	85	115				
Arsenic	9.370	0.10	10.00	0	93.7	85	115				
Barium	99.776	1.0	100.0	0	99.8	85	115				
Beryllium	9.683	0.50	10.00	0	96.8	85	115				
Boron	929.400	50	1000	0	92.9	85	115				
Cadmium	9.634	0.50	10.00	0	96.3	85	115				
Chromium	9.419	1.0	10.00	0	94.2	85	115				
Copper	10.053	1.0	10.00	0	101	85	115				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **LCS-49989** SampType: **LCS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **LCSW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960017**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Lead	10.156	1.0	10.00	0	102	85	115				
Manganese	93.116	0.50	100.0	0	93.1	85	115				
Nickel	9.620	1.0	10.00	0	96.2	85	115				
Selenium	9.054	0.50	10.00	0	90.5	85	115				
Silver	10.496	0.50	10.00	0	105	85	115				
Thallium	9.785	0.50	10.00	0	97.8	85	115				
Zinc	91.961	10	100.0	0	92.0	85	115				

Sample ID: **N015012-001B-MS** SampType: **MS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **ZZZZZZ** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960021**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	107.112	50	100.0	2.188	105	75	125				
Antimony	12.105	0.50	10.00	0	121	75	125				
Arsenic	11.813	0.10	10.00	1.173	106	75	125				
Beryllium	11.580	0.50	10.00	0	116	75	125				
Boron	1148.603	50	1000	188.8	96.0	75	125				
Cadmium	9.971	0.50	10.00	0	99.7	75	125				
Chromium	18.508	1.0	10.00	9.089	94.2	75	125				
Copper	9.298	1.0	10.00	0	93.0	75	125				
Lead	11.716	1.0	10.00	0	117	75	125				
Manganese	96.140	0.50	100.0	0	96.1	75	125				
Nickel	9.815	1.0	10.00	0	98.2	75	125				
Selenium	11.416	0.50	10.00	1.245	102	75	125				
Silver	11.264	0.50	10.00	0	113	75	125				
Thallium	11.844	0.50	10.00	0	118	75	125				
Zinc	111.222	10	100.0	17.13	94.1	75	125				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **N015012-001B-MSD** SampType: **MSD** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99565**
Client ID: **ZZZZZZ** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960022**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aluminum	108.354	50	100.0	2.188	106	75	125	107.1	1.15	20	
Antimony	12.199	0.50	10.00	0	122	75	125	12.11	0.767	20	
Arsenic	11.745	0.10	10.00	1.173	106	75	125	11.81	0.581	20	
Beryllium	11.607	0.50	10.00	0	116	75	125	11.58	0.237	20	
Boron	1157.328	50	1000	188.8	96.8	75	125	1149	0.757	20	
Cadmium	10.105	0.50	10.00	0	101	75	125	9.971	1.33	20	
Chromium	18.678	1.0	10.00	9.089	95.9	75	125	18.51	0.910	20	
Copper	9.185	1.0	10.00	0	91.9	75	125	9.298	1.22	20	
Lead	11.657	1.0	10.00	0	117	75	125	11.72	0.504	20	
Manganese	96.400	0.50	100.0	0	96.4	75	125	96.14	0.270	20	
Nickel	9.876	1.0	10.00	0	98.8	75	125	9.815	0.622	20	
Selenium	10.877	0.50	10.00	1.245	96.3	75	125	11.42	4.83	20	
Silver	11.258	0.50	10.00	0	113	75	125	11.26	0.0480	20	
Thallium	11.833	0.50	10.00	0	118	75	125	11.84	0.0951	20	
Zinc	110.139	10	100.0	17.13	93.0	75	125	111.2	0.979	20	

Sample ID: **MB-49989** SampType: **MBLK** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99567**
Client ID: **PBW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960792**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	ND	0.50									

Sample ID: **LCS-49989** SampType: **LCS** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99567**
Client ID: **LCSW** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/21/2015** SeqNo: **1960793**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	93.116	0.50	100.0	0	93.1	85	115				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **N015012-001B-MS**	SampType: **MS**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99567**
Client ID: **ZZZZZZ**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/21/2015**	SeqNo: **1960797**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	96.140	0.50	100.0	0	96.1	75	125				

Sample ID: **N015012-001B-MSD**	SampType: **MSD**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99567**
Client ID: **ZZZZZZ**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/21/2015**	SeqNo: **1960798**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Manganese	96.400	0.50	100.0	0	96.4	75	125	96.14	0.270	20	

Sample ID: **MB-49989**	SampType: **MBLK**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99581**
Client ID: **PBW**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/22/2015**	SeqNo: **1961968**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	ND	0.50									

Sample ID: **LCS-49989**	SampType: **LCS**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99581**
Client ID: **LCSW**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/22/2015**	SeqNo: **1961969**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	9.932	0.50	10.00	0	99.3	85	115				

Sample ID: **N015012-001B-MS**	SampType: **MS**	TestCode: **200.8_WDISS**	Units: **µg/L**	Prep Date: **3/20/2015**	RunNo: **99581**
Client ID: **ZZZZZZ**	Batch ID: **49989**	TestNo: **EPA 200.8**		Analysis Date: **3/22/2015**	SeqNo: **1961973**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	16.671	0.50	10.00	5.313	114	75	125				

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 200.8_WDISS

Sample ID: **N015012-001B-MSD** SampType: **MSD** TestCode: **200.8_WDISS** Units: **µg/L** Prep Date: **3/20/2015** RunNo: **99581**
Client ID: **ZZZZZZ** Batch ID: **49989** TestNo: **EPA 200.8** Analysis Date: **3/22/2015** SeqNo: **1961974**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Molybdenum	16.800	0.50	10.00	5.313	115	75	125	16.67	0.772	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 2320_W_SP

Sample ID: **LCS-R99541** SampType: **LCS** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99541**
Client ID: **LCSW** Batch ID: **R99541** TestNo: **SM 2320 B** Analysis Date: **3/20/2015** SeqNo: **1957939**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	98.101	5.0	100.0	0	98.1	85	115				
Alkalinity, Total (As CaCO3)	100.211	5.0	100.0	0	100	85	115				

Sample ID: **MB-R99541** SampType: **MBLK** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99541**
Client ID: **PBW** Batch ID: **R99541** TestNo: **SM 2320 B** Analysis Date: **3/20/2015** SeqNo: **1957940**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	ND	5.0									
Alkalinity, Carbonate (As CaCO3)	ND	5.0									
Alkalinity, Hydroxide (As CaCO3)	ND	5.0									
Alkalinity, Total (As CaCO3)	ND	5.0									

Sample ID: **N015012-001DDUP** SampType: **DUP** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99541**
Client ID: **ZZZZZZ** Batch ID: **R99541** TestNo: **SM 2320 B** Analysis Date: **3/20/2015** SeqNo: **1957943**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	84.388	5.0						85.44	1.24	30	
Alkalinity, Carbonate (As CaCO3)	ND	5.0						0	0	30	
Alkalinity, Hydroxide (As CaCO3)	ND	5.0						0	0	30	
Alkalinity, Total (As CaCO3)	84.388	5.0						85.44	1.24	30	

Sample ID: **N015014-002AMS** SampType: **MS** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99541**
Client ID: **ZZZZZZ** Batch ID: **R99541** TestNo: **SM 2320 B** Analysis Date: **3/20/2015** SeqNo: **1957947**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	239.451	5.0	100.0	141.4	98.1	75	125				
Alkalinity, Total (As CaCO3)	239.451	5.0	100.0	141.4	98.1	75	125				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 2320_W_SP

Sample ID: **N015014-002AMSD** SampType: **MSD** TestCode: **2320_W_SP** Units: **mg/L** Prep Date: RunNo: **99541**
Client ID: **ZZZZZZ** Batch ID: **R99541** TestNo: **SM 2320 B** Analysis Date: **3/20/2015** SeqNo: **1957948**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Alkalinity, Bicarbonate (As CaCO3)	238.397	5.0	100.0	141.4	97.0	75	125	239.5	0.442	20	
Alkalinity, Total (As CaCO3)	238.397	5.0	100.0	141.4	97.0	75	125	239.5	0.442	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 245.1_WD

Sample ID: **MB-50036**	SampType: **MBLK**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/26/2015**	RunNo: **99638**
Client ID: **PBW**	Batch ID: **50036**	TestNo: **EPA 245.1**		Analysis Date: **3/26/2015**	SeqNo: **1965174**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	ND	0.20									

Sample ID: **LCS-50036**	SampType: **LCS**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/26/2015**	RunNo: **99638**
Client ID: **LCSW**	Batch ID: **50036**	TestNo: **EPA 245.1**		Analysis Date: **3/26/2015**	SeqNo: **1965175**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	4.276	0.20	5.000	0	85.5	85	115				

Sample ID: **N015000-001J-MS**	SampType: **MS**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/26/2015**	RunNo: **99638**
Client ID: **ZZZZZZ**	Batch ID: **50036**	TestNo: **EPA 245.1**		Analysis Date: **3/26/2015**	SeqNo: **1965176**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	3.836	0.20	5.000	0	76.7	75	125				

Sample ID: **N015000-001J-MSD**	SampType: **MSD**	TestCode: **245.1_WD**	Units: **µg/L**	Prep Date: **3/26/2015**	RunNo: **99638**
Client ID: **ZZZZZZ**	Batch ID: **50036**	TestNo: **EPA 245.1**		Analysis Date: **3/26/2015**	SeqNo: **1965177**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Mercury	4.491	0.20	5.000	0	89.8	75	125	3.836	15.7	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_CL

Sample ID: MB-R99490_CL	SampType: MBLK	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: PBW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955228

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	ND	0.50									

Sample ID: LCS-R99490_CL	SampType: LCS	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: LCSW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955229

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	2.448	0.50	2.500	0	97.9	90	110				

Sample ID: N015000-001EDUP	SampType: DUP	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955231

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	389.000	50						390.6	0.410	20	

Sample ID: N015000-001EMS	SampType: MS	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955232

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	649.300	50	250.0	390.6	103	80	120				

Sample ID: N015000-001EMSD	SampType: MSD	TestCode: 300_W_CL	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955233

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Chloride	652.200	50	250.0	390.6	105	80	120	649.3	0.446	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_F

Sample ID: MB-R99490_F	SampType: MBLK	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: PBW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955222

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	ND	0.10									

Sample ID: LCS-R99490_F	SampType: LCS	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: LCSW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955223

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	2.371	0.10	2.500	0	94.8	90	110				

Sample ID: N015000-001EDUP	SampType: DUP	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955225

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	2.470	0.50						2.395	3.08	20	

Sample ID: N015000-001EMS	SampType: MS	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955226

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	25.840	1.0	25.00	2.395	93.8	80	120				

Sample ID: N015000-001EMSD	SampType: MSD	TestCode: 300_W_F	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955227

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Fluoride	25.980	1.0	25.00	2.395	94.3	80	120	25.84	0.540	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_NO2

Sample ID: MB-R99490_NO2	SampType: MBLK	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: PBW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955234

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	ND	0.10									

Sample ID: LCS-R99490_NO2	SampType: LCS	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: LCSW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955235

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	0.939	0.10	1.000	0	93.9	90	110				

Sample ID: N015000-001EDUP	SampType: DUP	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955237

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	ND	0.50						0	0	20	

Sample ID: N015000-001EMS	SampType: MS	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955238

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	11.550	1.0	10.00	0	116	80	120				

Sample ID: N015000-001EMSD	SampType: MSD	TestCode: 300_W_NO2	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955239

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrite	11.300	1.0	10.00	0	113	80	120	11.55	2.19	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_NO3

Sample ID: **MB-R99490_NO3**	SampType: **MBLK**	TestCode: **300_W_NO3**	Units: **mg/L**	Prep Date:	RunNo: **99490**
Client ID: **PBW**	Batch ID: **R99490**	TestNo: **EPA 300.0**		Analysis Date: **3/17/2015**	SeqNo: **1955240**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	ND	0.10									

Sample ID: **LCS-R99490_NO3**	SampType: **LCS**	TestCode: **300_W_NO3**	Units: **mg/L**	Prep Date:	RunNo: **99490**
Client ID: **LCSW**	Batch ID: **R99490**	TestNo: **EPA 300.0**		Analysis Date: **3/17/2015**	SeqNo: **1955241**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	0.969	0.10	1.000	0	96.9	90	110				

Sample ID: **N015000-001EDUP**	SampType: **DUP**	TestCode: **300_W_NO3**	Units: **mg/L**	Prep Date:	RunNo: **99490**
Client ID: **ZZZZZZ**	Batch ID: **R99490**	TestNo: **EPA 300.0**		Analysis Date: **3/17/2015**	SeqNo: **1955243**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	6.390	0.50						6.265	1.98	20	

Sample ID: **N015000-001EMS**	SampType: **MS**	TestCode: **300_W_NO3**	Units: **mg/L**	Prep Date:	RunNo: **99490**
Client ID: **ZZZZZZ**	Batch ID: **R99490**	TestNo: **EPA 300.0**		Analysis Date: **3/17/2015**	SeqNo: **1955244**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	16.270	1.0	10.00	6.265	100	80	120				

Sample ID: **N015000-001EMSD**	SampType: **MSD**	TestCode: **300_W_NO3**	Units: **mg/L**	Prep Date:	RunNo: **99490**
Client ID: **ZZZZZZ**	Batch ID: **R99490**	TestNo: **EPA 300.0**		Analysis Date: **3/17/2015**	SeqNo: **1955245**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Nitrogen, Nitrate (As N)	16.080	1.0	10.00	6.265	98.2	80	120	16.27	1.17	20	

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits

Calculations are based on raw values

- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 300_W_SO4

Sample ID: MB-R99490_SO4	SampType: MBLK	TestCode: 300_W_SO4	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: PBW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955246

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	ND	1.0									

Sample ID: LCS-R99490_SO4	SampType: LCS	TestCode: 300_W_SO4	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: LCSW	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955247

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	5.032	1.0	5.000	0	101	90	110				

Sample ID: N015000-001EDUP	SampType: DUP	TestCode: 300_W_SO4	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955249

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	2206.000	200						2215	0.389	20	

Sample ID: N015000-001EMS	SampType: MS	TestCode: 300_W_SO4	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955250

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	3185.800	200	1000	2215	97.1	80	120				

Sample ID: N015000-001EMSD	SampType: MSD	TestCode: 300_W_SO4	Units: mg/L	Prep Date:	RunNo: 99490
Client ID: ZZZZZZ	Batch ID: R99490	TestNo: EPA 300.0		Analysis Date: 3/17/2015	SeqNo: 1955251

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Sulfate	3209.400	200	1000	2215	99.5	80	120	3186	0.738	20	

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 365.3_W_T

Sample ID: **LCS-49971**	SampType: **LCS**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/23/2015**	RunNo: **99618**
Client ID: **LCSW**	Batch ID: **49971**	TestNo: **EPA 365.3**		Analysis Date: **3/25/2015**	SeqNo: **1964074**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.419	0.020	0.4000	0	105	80	120				

Sample ID: **MB-49971**	SampType: **MBLK**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/23/2015**	RunNo: **99618**
Client ID: **PBW**	Batch ID: **49971**	TestNo: **EPA 365.3**		Analysis Date: **3/25/2015**	SeqNo: **1964075**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	ND	0.020									

Sample ID: **N014990-001A-MS**	SampType: **MS**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/23/2015**	RunNo: **99618**
Client ID: **ZZZZZZ**	Batch ID: **49971**	TestNo: **EPA 365.3**		Analysis Date: **3/25/2015**	SeqNo: **1964077**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.477	0.020	0.4000	0.1050	93.0	80	120				

Sample ID: **N014990-001A-MSD**	SampType: **MSD**	TestCode: **365.3_W_T**	Units: **mg/L**	Prep Date: **3/23/2015**	RunNo: **99618**
Client ID: **ZZZZZZ**	Batch ID: **49971**	TestNo: **EPA 365.3**		Analysis Date: **3/25/2015**	SeqNo: **1964078**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Phosphorus, Total (As P)	0.487	0.020	0.4000	0.1050	95.5	80	120	0.4770	2.07	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015_W_DM

Sample ID: **LCS-49968_DRO**	SampType: **LCS**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/19/2015**	RunNo: **99531**
Client ID: **LCSW**	Batch ID: **49968**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/19/2015**	SeqNo: **1957443**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	0.917	0.20	1.000	0	91.7	41	105				
Surr: p-Terphenyl	0.085		0.08000		107	48	133				

Sample ID: **LCSD-49968_DRO**	SampType: **LCSD**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/19/2015**	RunNo: **99531**
Client ID: **LCSS02**	Batch ID: **49968**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/19/2015**	SeqNo: **1957444**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	0.904	0.20	1.000	0	90.4	41	105	0.9166	1.43	20	
Surr: p-Terphenyl	0.084		0.08000		105	48	133		0		

Sample ID: **LCS-49968_ORO**	SampType: **LCS**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/19/2015**	RunNo: **99531**
Client ID: **LCSW**	Batch ID: **49968**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/19/2015**	SeqNo: **1957445**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ORO	1.013	0.20	1.000	0	101	70	130				
Surr: p-Terphenyl	0.072		0.08000		90.0	48	133				

Sample ID: **LCSD-49968_ORO**	SampType: **LCSD**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/19/2015**	RunNo: **99531**
Client ID: **LCSS02**	Batch ID: **49968**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/19/2015**	SeqNo: **1957446**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ORO	1.009	0.20	1.000	0	101	70	130	1.013	0.461	20	
Surr: p-Terphenyl	0.065		0.08000		81.6	48	133		0		

Sample ID: **MB-49968**	SampType: **MBLK**	TestCode: **8015_W_DM**	Units: **mg/L**	Prep Date: **3/19/2015**	RunNo: **99531**
Client ID: **PBW**	Batch ID: **49968**	TestNo: **EPA 8015B**	**EPA 3510C**	Analysis Date: **3/19/2015**	SeqNo: **1957447**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
DRO	ND	0.20									

Qualifiers:

- B Analyte detected in the associated Method Blank
- ND Not Detected at the Reporting Limit
- DO Surrogate Diluted Out
- E Value above quantitation range
- R RPD outside accepted recovery limits
- Calculations are based on raw values
- H Holding times for preparation or analysis exceeded
- S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015_W_DM

Sample ID: **MB-49968** SampType: **MBLK** TestCode: **8015_W_DM** Units: **mg/L** Prep Date: **3/19/2015** RunNo: **99531**
Client ID: **PBW** Batch ID: **49968** TestNo: **EPA 8015B** **EPA 3510C** Analysis Date: **3/19/2015** SeqNo: **1957447**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
ORO	ND	0.20									
Surr: p-Terphenyl	0.075		0.08000		93.8	48	133				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8015GAS_WP

Sample ID: **E150319LCS** SampType: **LCS** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99526**
Client ID: **LCSW** Batch ID: **E15VW019** TestNo: **EPA 8015B** Analysis Date: **3/19/2015** SeqNo: **1957858**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	1.006	0.050	1.000	0	101	75	127				
Surr: Chlorobenzene - d5	48.690		50.00		97.4	73	132				

Sample ID: **E150319MB1** SampType: **MBLK** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99526**
Client ID: **PBW** Batch ID: **E15VW019** TestNo: **EPA 8015B** Analysis Date: **3/19/2015** SeqNo: **1957859**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	ND	0.050									
Surr: Chlorobenzene - d5	60.309		50.00		121	73	132				

Sample ID: **N015021-001DMS** SampType: **MS** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99526**
Client ID: **ZZZZZZ** Batch ID: **E15VW019** TestNo: **EPA 8015B** Analysis Date: **3/19/2015** SeqNo: **1957866**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	1.105	0.050	1.000	0	110	74	130				
Surr: Chlorobenzene - d5	58.520		50.00		117	73	132				

Sample ID: **N015021-001DMSD** SampType: **MSD** TestCode: **8015GAS_WP** Units: **mg/L** Prep Date: RunNo: **99526**
Client ID: **ZZZZZZ** Batch ID: **E15VW019** TestNo: **EPA 8015B** Analysis Date: **3/19/2015** SeqNo: **1957867**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
GRO	1.146	0.050	1.000	0	115	74	130	1.105	3.64	30	
Surr: Chlorobenzene - d5	58.895		50.00		118	73	132		0		

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8081WATER

Sample ID: **LCS-50006** SampType: **LCS** TestCode: **8081WATER** Units: **µg/L** Prep Date: **3/23/2015** RunNo: **99584**
Client ID: **LCSW** Batch ID: **50006** TestNo: **EPA 8081A** **EPA 3510C** Analysis Date: **3/23/2015** SeqNo: **1962131**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
4,4´-DDD	0.430	0.050	0.5000	0	86.1	55	126				
4,4´-DDE	0.382	0.050	0.5000	0	76.4	52	125				
4,4´-DDT	0.424	0.050	0.5000	0	84.8	68	136				
Aldrin	0.200	0.025	0.5000	0	40.0	28	120				
alpha-BHC	0.359	0.025	0.5000	0	71.9	48	126				
alpha-Chlordane	0.362	0.025	0.5000	0	72.3	49	127				
beta-BHC	0.365	0.025	0.5000	0	72.9	56	106				
delta-BHC	0.299	0.025	0.5000	0	59.9	26	122				
Dieldrin	0.437	0.050	0.5000	0	87.4	50	132				
Endosulfan I	0.401	0.025	0.5000	0	80.2	50	124				
Endosulfan II	0.411	0.050	0.5000	0	82.3	52	134				
Endosulfan sulfate	0.420	0.050	0.5000	0	84.1	52	126				
Endrin	0.470	0.050	0.5000	0	94.0	34	183				
Endrin aldehyde	0.418	0.050	0.5000	0	83.7	49	120				
Endrin ketone	0.406	0.050	0.5000	0	81.3	40	148				
gamma-BHC	0.368	0.025	0.5000	0	73.6	51	122				
gamma-Chlordane	0.340	0.025	0.5000	0	68.0	52	124				
Heptachlor	0.250	0.025	0.5000	0	49.9	23	138				
Heptachlor epoxide	0.382	0.025	0.5000	0	76.4	52	123				
Methoxychlor	0.480	0.25	0.5000	0	95.9	49	147				
Surr: Tetrachloro-m-xylene	0.172		0.5000		34.5	12	120				
Surr: Decachlorobiphenyl	0.360		0.5000		72.1	36	120				

Sample ID: **LCSD-50006** SampType: **LCSD** TestCode: **8081WATER** Units: **µg/L** Prep Date: **3/23/2015** RunNo: **99584**
Client ID: **LCSS02** Batch ID: **50006** TestNo: **EPA 8081A** **EPA 3510C** Analysis Date: **3/23/2015** SeqNo: **1962132**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
4,4´-DDD	0.453	0.050	0.5000	0	90.5	55	126	0.4305	5.04	20	
4,4´-DDE	0.404	0.050	0.5000	0	80.7	52	125	0.3819	5.55	20	
4,4´-DDT	0.443	0.050	0.5000	0	88.6	68	136	0.4240	4.42	20	

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8081WATER

Sample ID: **LCSD-50006**	SampType: **LCSD**	TestCode: **8081WATER**	Units: **µg/L**	Prep Date: **3/23/2015**	RunNo: **99584**
Client ID: **LCSS02**	Batch ID: **50006**	TestNo: **EPA 8081A**	**EPA 3510C**	Analysis Date: **3/23/2015**	SeqNo: **1962132**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Aldrin	0.231	0.025	0.5000	0	46.2	28	120	0.2000	14.4	20	
alpha-BHC	0.407	0.025	0.5000	0	81.4	48	126	0.3595	12.4	20	
alpha-Chlordane	0.387	0.025	0.5000	0	77.4	49	127	0.3617	6.73	20	
beta-BHC	0.390	0.025	0.5000	0	78.1	56	106	0.3645	6.87	20	
delta-BHC	0.322	0.025	0.5000	0	64.4	26	122	0.2994	7.27	20	
Dieldrin	0.466	0.050	0.5000	0	93.3	50	132	0.4370	6.51	20	
Endosulfan I	0.427	0.025	0.5000	0	85.4	50	124	0.4008	6.38	20	
Endosulfan II	0.433	0.050	0.5000	0	86.6	52	134	0.4114	5.14	20	
Endosulfan sulfate	0.444	0.050	0.5000	0	88.8	52	126	0.4203	5.43	20	
Endrin	0.499	0.050	0.5000	0	99.8	34	183	0.4700	5.97	20	
Endrin aldehyde	0.446	0.050	0.5000	0	89.2	49	120	0.4184	6.40	20	
Endrin ketone	0.427	0.050	0.5000	0	85.3	40	148	0.4064	4.87	20	
gamma-BHC	0.410	0.025	0.5000	0	82.0	51	122	0.3682	10.8	20	
gamma-Chlordane	0.367	0.025	0.5000	0	73.4	52	124	0.3399	7.68	20	
Heptachlor	0.290	0.025	0.5000	0	57.9	23	138	0.2496	14.9	20	
Heptachlor epoxide	0.409	0.025	0.5000	0	81.8	52	123	0.3821	6.86	20	
Methoxychlor	0.501	0.25	0.5000	0	100	49	147	0.4795	4.32	20	
Surr: Tetrachloro-m-xylene	0.203		0.5000		40.7	12	120		0		
Surr: Decachlorobiphenyl	0.374		0.5000		74.8	36	120		0		

Sample ID: **MB-50006**	SampType: **MBLK**	TestCode: **8081WATER**	Units: **µg/L**	Prep Date: **3/23/2015**	RunNo: **99584**
Client ID: **PBW**	Batch ID: **50006**	TestNo: **EPA 8081A**	**EPA 3510C**	Analysis Date: **3/23/2015**	SeqNo: **1962133**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
4,4´-DDD	ND	0.050									
4,4´-DDE	ND	0.050									
4,4´-DDT	ND	0.050									
Aldrin	ND	0.025									
alpha-BHC	ND	0.025									
alpha-Chlordane	ND	0.025									

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8081WATER

Sample ID: **MB-50006** SampType: **MBLK** TestCode: **8081WATER** Units: **µg/L** Prep Date: **3/23/2015** RunNo: **99584**
Client ID: **PBW** Batch ID: **50006** TestNo: **EPA 8081A** **EPA 3510C** Analysis Date: **3/23/2015** SeqNo: **1962133**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
beta-BHC	ND	0.025									
Chlordane	ND	0.25									
delta-BHC	ND	0.025									
Dieldrin	ND	0.050									
Endosulfan I	ND	0.025									
Endosulfan II	ND	0.050									
Endosulfan sulfate	ND	0.050									
Endrin	ND	0.050									
Endrin aldehyde	ND	0.050									
Endrin ketone	ND	0.050									
gamma-BHC	ND	0.025									
gamma-Chlordane	ND	0.025									
Heptachlor	ND	0.025									
Heptachlor epoxide	ND	0.025									
Methoxychlor	ND	0.25									
Toxaphene	ND	2.5									
Surr: Tetrachloro-m-xylene	0.194		0.5000		38.7	12	120				
Surr: Decachlorobiphenyl	0.373		0.5000		74.6	36	120				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID: **P150321LCS** SampType: **LCS** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99551**
Client ID: **LCSW** Batch ID: **P15VW048** TestNo: **EPA 8260B** Analysis Date: **3/21/2015** SeqNo: **1958721**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.800	0.50	20.00	0	99.0	80	120				
Ethylbenzene	18.680	0.50	20.00	0	93.4	80	120				
m,p-Xylene	39.450	1.0	40.00	0	98.6	80	120				
MTBE	19.530	0.50	20.00	0	97.6	77	120				
o-Xylene	20.110	0.50	20.00	0	101	80	120				
Tetrachloroethene	20.930	0.50	20.00	0	105	80	120				
Toluene	20.700	0.50	20.00	0	104	80	120				
Trichloroethene	22.360	0.50	20.00	0	112	80	120				
Xylenes, Total	59.560	1.5	60.00	0	99.3	70	130				
Surr: 1,2-Dichloroethane-d4	22.940		25.00		91.8	78	125				
Surr: 4-Bromofluorobenzene	25.670		25.00		103	80	120				
Surr: Dibromofluoromethane	23.940		25.00		95.8	80	122				
Surr: Toluene-d8	25.170		25.00		101	80	120				

Sample ID: **N015000-001FMS** SampType: **MS** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99551**
Client ID: **ZZZZZZ** Batch ID: **P15VW048** TestNo: **EPA 8260B** Analysis Date: **3/21/2015** SeqNo: **1958722**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	19.220	0.50	20.00	0	96.1	80	120				
Ethylbenzene	18.440	0.50	20.00	0	92.2	79	120				
m,p-Xylene	39.260	1.0	40.00	0	98.2	80	120				
MTBE	18.290	0.50	20.00	0	91.4	71	125				
o-Xylene	19.840	0.50	20.00	0	99.2	80	120				
Tetrachloroethene	20.690	0.50	20.00	0	103	71	123				
Toluene	20.110	0.50	20.00	0	101	80	120				
Trichloroethene	21.830	0.50	20.00	0	109	79	121				
Xylenes, Total	59.100	1.5	60.00	0	98.5	70	130				
Surr: 1,2-Dichloroethane-d4	22.080		25.00		88.3	78	125				
Surr: 4-Bromofluorobenzene	26.000		25.00		104	80	120				
Surr: Dibromofluoromethane	23.400		25.00		93.6	80	122				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID: **N015000-001FMS**	SampType: **MS**	TestCode: **8260WATERP**	Units: **µg/L**	Prep Date:	RunNo: **99551**
Client ID: **ZZZZZZ**	Batch ID: **P15VW048**	TestNo: **EPA 8260B**		Analysis Date: **3/21/2015**	SeqNo: **1958722**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Surr: Toluene-d8	25.280		25.00		101	80	120				

Sample ID: **N015000-001FMSD**	SampType: **MSD**	TestCode: **8260WATERP**	Units: **µg/L**	Prep Date:	RunNo: **99551**
Client ID: **ZZZZZZ**	Batch ID: **P15VW048**	TestNo: **EPA 8260B**		Analysis Date: **3/21/2015**	SeqNo: **1958723**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	20.010	0.50	20.00	0	100	80	120	19.22	4.03	20	
Ethylbenzene	19.120	0.50	20.00	0	95.6	79	120	18.44	3.62	20	
m,p-Xylene	39.930	1.0	40.00	0	99.8	80	120	39.26	1.69	20	
MTBE	18.910	0.50	20.00	0	94.6	71	125	18.29	3.33	20	
o-Xylene	20.320	0.50	20.00	0	102	80	120	19.84	2.39	20	
Tetrachloroethene	21.710	0.50	20.00	0	109	71	123	20.69	4.81	20	
Toluene	20.830	0.50	20.00	0	104	80	120	20.11	3.52	20	
Trichloroethene	23.130	0.50	20.00	0	116	79	121	21.83	5.78	20	
Xylenes, Total	60.250	1.5	60.00	0	100	70	130	59.10	1.93	20	
Surr: 1,2-Dichloroethane-d4	22.480		25.00		89.9	78	125		0		
Surr: 4-Bromofluorobenzene	25.610		25.00		102	80	120		0		
Surr: Dibromofluoromethane	23.710		25.00		94.8	80	122		0		
Surr: Toluene-d8	25.810		25.00		103	80	120		0		

Sample ID: **P150321MB3**	SampType: **MBLK**	TestCode: **8260WATERP**	Units: **µg/L**	Prep Date:	RunNo: **99551**
Client ID: **PBW**	Batch ID: **P15VW048**	TestNo: **EPA 8260B**		Analysis Date: **3/21/2015**	SeqNo: **1958724**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Benzene	ND	0.50									
Ethylbenzene	ND	0.50									
m,p-Xylene	ND	1.0									
MTBE	ND	0.50									
o-Xylene	ND	0.50									
Tetrachloroethene	ND	0.50									

Qualifiers:

B	Analyte detected in the associated Method Blank	E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
ND	Not Detected at the Reporting Limit	R	RPD outside accepted recovery limits	S	Spike/Surrogate outside of limits due to matrix interference
DO	Surrogate Diluted Out		Calculations are based on raw values		

CLIENT: Ninyo & Moore
Work Order: N015000
Project: 303710002 Atkins/Cedar Ave, 303710002

ANALYTICAL QC SUMMARY REPORT

TestCode: 8260WATERP

Sample ID: **P150321MB3** SampType: **MBLK** TestCode: **8260WATERP** Units: **µg/L** Prep Date: RunNo: **99551**
Client ID: **PBW** Batch ID: **P15VW048** TestNo: **EPA 8260B** Analysis Date: **3/21/2015** SeqNo: **1958724**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Toluene	ND	0.50									
Trichloroethene	ND	0.50									
Xylenes, Total	ND	1.5									
Surr: 1,2-Dichloroethane-d4	22.890		25.00		91.6	78	125				
Surr: 4-Bromofluorobenzene	24.790		25.00		99.2	80	120				
Surr: Dibromofluoromethane	23.960		25.00		95.8	80	122				
Surr: Toluene-d8	24.590		25.00		98.4	80	120				

Qualifiers:

B Analyte detected in the associated Method Blank
ND Not Detected at the Reporting Limit
DO Surrogate Diluted Out
E Value above quantitation range
R RPD outside accepted recovery limits
Calculations are based on raw values
H Holding times for preparation or analysis exceeded
S Spike/Surrogate outside of limits due to matrix interference

Chain of Custody

Page 1 of 1

Client: Ninyo + Moore
Address: 6700 Paradise Road, Suite E
Las Vegas, NV 89119
Phone: 702 433-0330 Fax: 702 433-0707
Project Name: 303710002 Atkins/Cedar Ave
Project Number: 303710002 PO #
Submitted By: CJG
Title: Technician
Signature: [signature] Date: 3-17-15
I hereby authorize ASSET Laboratories to perform the tests indicated below:

ASSET LABORATORIES
Nevada: 3151 W. Post Rd., LasVegas, NV 89118
Phone: 702.307.2659 Fax: 702.307.2691
California: 11060 Artesia Blvd., Ste C, Cerritos, CA 90703
Phone: 562.219.7435 Fax: 562.219.7436

Sample Condition Upon Receipt
Temp 3.2°C IR# 1
Method of Cooling ICE
Headspace
Intact YES
Seal NO
Comments

Work Order No.	Sample ID/Location	Date	Time	Matrix: Water	Liquid	Soil	Solid	Wastewater	Groundwater	Others	8260 (Volatiles)	8015M (GRO)	8015B (DRO/ORO)	CAM 17 6010/7470/7471)	SVOCs by EPA 8270C	Profile	Cat 4	331.0 perchlorate	Turn Around Time	No. of container	Container Type	PRESERVATION	QA/QC: RTNE / RWQCB / CT / LEVEL IV	Remarks
N015000-1	B-20	3/17/15	1:05						X							X	X	X	E					

Send report to:
Name Robert Troisi
Address 6700 Paradise Rd. Suite E
Las Vegas, NV 89119
Email rtroisi@ninyoandmoore.com

Bill to:
Name Same
Address
Email

Sampled by:
I attest to the validity and authenticity of this sample. I am aware that tampering with or intentionally mislabeling the sample location, date or time of collection is considered fraud and may be grounds for legal action.
Name Corey Engenbrech Signature [signature]

Special Instruction/Comments:
see list for this project.

Relinquished by (Signature)	Date	Time	Received by (Signature)	Date	Time
[signature]	3/17/15	1:05	[signature]	3/17/15	1308

TAT Starts at 8 AM the following day if samples received after 3 pm.
A ☐ ≤ 24 Hours D ☐ = 3 Workdays
B ☐ = Next Workday E ☐ = Routine 5-7 Workdays
C ☐ = 2 Workdays

Preservatives: H=HCl N=HNO_3 S=H_2SO_4 C=4°C Z=$Zn(AC)_2$ O=NaOH T=$Na_2S_2O_3$

Carrier: CLIENT
Airbill/Tracking #:

Container Type: T = Tube V = VOA L = Liter P = Pint J = Jar B = Tedlar G = Glass M = Metal P = Plastic

EDD Requirement Excel EDD ☐ Geotracker ☐ LabSpec ☐ Global ID

Sample/Records Storage
All samples will be disposed in 45 days upon receipt and records will be destroyed in 5 years upon submission of final report.
Fees will be applied for extended storage.

White = Laboratory Copy Yellow = Customer's Copy

ASSET Laboratories

Please review the checklist below. Any NO signifies non-compliance. Any non-compliance will be noted and must be understood as having an impact on the quality of the data. All tests will be performed as requested regardless of any compliance issues.

If you have any questions or further instruction, please contact our Project Coordinator at (702) 307-2659.

Cooler Received/Opened On:	3/17/2015	Workorder:	N015000
Rep sample Temp (Deg C):	3.2	IR Gun ID:	1
Temp Blank:	☐ Yes ☑ No		
Carrier name:	Client		
Last 4 digits of Tracking No.:	NA	Packing Material Used:	None
Cooling process:	☑ Ice ☐ Ice Pack ☐ Dry Ice ☐ Other ☐ None		

Sample Receipt Checklist

1. Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
2. Custody seals intact, signed, dated on shippping container/cooler?	Yes ☐	No ☐	Not Present ☑
3. Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
4. Chain of custody present?	Yes ☑	No ☐	
5. Sampler's name present in COC?	Yes ☑	No ☐	
6. Chain of custody signed when relinquished and received?	Yes ☑	No ☐	
7. Chain of custody agrees with sample labels?	Yes ☑	No ☐	
8. Samples in proper container/bottle?	Yes ☑	No ☐	
9. Sample containers intact?	Yes ☑	No ☐	
10. Sufficient sample volume for indicated test?	Yes ☑	No ☐	
11. All samples received within holding time?	Yes ☐	No ☑	
12. Temperature of rep sample or Temp Blank within acceptable limit?	Yes ☑	No ☐	NA ☐
13. Water - VOA vials have zero headspace?	Yes ☑	No ☐	NA ☐
14. Water - pH acceptable upon receipt? Example: pH > 12 for (CN,S); pH<2 for Metals	Yes ☑	No ☐	NA ☐
15. Did the bottle labels indicate correct preservatives used?	Yes ☑	No ☐	NA ☐
16. Were there Non-Conformance issues at login?	Yes ☑	No ☐	NA ☐
Was Client notified?	Yes ☐	No ☐	NA ☑

Comments: Sample for pH is past holding time upon receipt.

Checklist Completed By: MBC For: 3/17/2015

Reviewed By: 03/18/15

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.etl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Silver State Analytical Laboratory
3638 E. Sunset Road, Suite 100
Las Vegas, NV 89120

TEL: (702) 873-4478
FAX: (702) 873-7967
Acct #:

Field Sampler: Corey Ercanbrack

17-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				SM 9221 C,E	SM 9221 D	SM4500-Cl B
N015000-001A / B-20	Groundwater	3/17/2015 1:05:00 PM	4OZP	1		
N015000-001B / B-20	Groundwater	3/17/2015 1:05:00 PM	4OZP		1	
N015000-001C / B-20	Groundwater	3/17/2015 1:05:00 PM	8OZP			1

General Comments: Please email sample receipt acknowledgement to the PM.
Please use PO#:N15000A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT
Please analyze Fecal Coliform, E.Coli and Total Residual Chlorine.

		Date/Time			Date/Time
Relinquished by:	Anthony Hatbri	3/17/15 1409	**Received by:**	R Balsharay	3/17/15 1409
Relinquished by:			**Received by:**		

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Western Environmental Testing Laboratory
3230 Polaris Ave. #4
Las Vegas, NV 89102

TEL: (702) 475-8899
FAX:
Acct #:

Field Sampler: Corey Ercanbrack

17-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests: ~~D-4294~~ 200.7	Requested Tests: SM4500-NH3C	
N015000-001H / B-20	Groundwater	3/17/2015 1:05:00 PM	8OZP		1	
N015000-001K / B-20	Groundwater	3/17/2015 1:05:00 PM	8OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.
Please use PO#:N15000B For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT
Please analyze for TKN and Sulfur.

		Date/Time			Date/Time
Relinquished by:		3/17/15 1418	**Received by:**		3/17/15 1418
Relinquished by:			**Received by:**		

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:

Eurofins Eaton Analytical
750 Royal Oaks Drive, Ste 100
Monrovia, CA 91016

TEL:
FAX:
Acct #:

Field Sampler:

17-Mar-15

				Requested Tests		
Sample ID	**Matrix**	**Date Collected**	**Bottle Type**	**EPA 331.0**		
N015000-001L / B-20	Groundwater	3/17/2015 1:05:00 PM	4OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15000C For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Perchlorate by 331.0. Sample was sterile filtered.

		Date/Time			**Date/Time**
Relinquished by:		3/17/2015 17:00	**Received by:**	GSO #: 527268900	
Relinquished by:			**Received by:**		

SilverState
Analytical Laboratories

LABORATORY REPORT

DATE: March 19, 2015

LABORATORY NO: 15-1385

CLIENT: ASSET Laboratories
3151-3153 W. Post Rd.
Las Vegas, NV 89118

PAGE: 1 of 1

CLIENT PROJECT:

CLIENT PO #:

Sampled By: C. Ercanbrack
Date Sampled: 03/17/15
Time Sampled: 1305

Submitted by: A. Hattori
Date Received: 03/17/15
Time Received: 1409

Report Attention:

Location	Parameter	Result	Unit	Reporting Limit	Method	Date Analyzed	Analyst
N015000-001A/ B-20	Fecal Coliform	ND	CFU/100 mL	1.0	Colilert-18	03/17/15	CR
N015000-001B/ B-20	Coliforms, *E. coli*	ND	CFU/100 mL	1.0	Colilert-18	03/17/15	CR/CL
N015000-001C/ B-20	Residual Chlorine [(1)]	ND	mg/L	0.50	SM4500Cl G	03/17/15	CL

ND: non-detect
EPA Flags: [(1)] Sample analyzed outside of method specified hold time requirement

REVIEWED BY:

John Sloan
Laboratory Director
EPA: NV00930

3638 East Sunset Road, Suite 100 • Las Vegas, NV 89120 • Tel: 702-873-4478 Fax: 702-873-7967
4587 Longley Lane, No. 2 • Reno, NV 89502 • Tel: 775-825-1127 Fax: 775-825-1167
www.ssalabs.com • www.envirotechonline.com

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Silver State Analytical Laboratory
3638 E. Sunset Road, Suite 100
Las Vegas, NV 89120

TEL: (702) 873-4478
FAX: (702) 873-7967
Acct #:

Field Sampler: Corey Ercanbrack

17-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				SM 9221 C,E	SM 9221 D	SM4500-Cl B
N015000-001A / B-20 1385-1A	Groundwater	3/17/2015 1:05:00 PM	4OZP	1		
N015000-001B / B-20 -2A	Groundwater	3/17/2015 1:05:00 PM	4OZP		1	
N015000-001C / B-20 -3A	Groundwater	3/17/2015 1:05:00 PM	8OZP			1

General Comments: Please email sample receipt acknowledgement to the PM.
Please use PO#:N15000A For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT
Please analyze Fecal Coliform, E.Coli and Total Residual Chlorine.

		Date/Time			Date/Time
Relinquished by:	Anthony Hattori	3/17/15 1409	**Received by:**	R Bolshazy	3/17/15 1409
Relinquished by:			**Received by:**		

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750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

NELAP ACCREDITED TNI LABORATORY ORELAP 4034

ilac-MRA

ACLASS ACCREDITED TESTING AT-1807

Laboratory Report

for

Advanced Technology Laboratories, Inc.
3151 W. Post Road
Las Vegas, NV 89118
Attention: Marlon Cartin
Fax: 702-307-2691

Date of Issue
03/20/2015

EUROFINS EATON ANALYTICAL

DST: David S Tripp

Project Manager

Report: 525618
Project: SUBCONTRACT
Group: DRINKING WATER

* Accredited in accordance with TNI 2009 and ISO/IEC 17025:2005.
* Laboratory certifies that the test results meet all **TNI 2009 and ISO/IEC 17025:2005** requirements unless noted under the individual analysis.
* Following the cover page are State Certification List, ISO 17025 Accredited Method List, Acknowledgement of Samples Received, Comments, Hits Report, Data Report, QC Summary, QC Report and Regulatory Forms, as applicable.
* Test results relate only to the sample(s) tested.

STATE CERTIFICATION LIST

State	Certification Number	State	Certification Number
Alabama	41060	**Mississippi**	Certified
Alaska	CA00006	**Montana**	Cert 0035
Arizona	AZ0778	**Nebraska**	Certified
Arkansas	Certified	**Nevada**	CA00006-2014-1
California-Monrovia-ELAP	2813	**New Hampshire ***	2959
California-Colton- ELAP	2812	**New Jersey ***	CA 008
California-Folsom- ELAP	2820	**New Mexico**	Certified
Colorado	Certified	**New York ***	11320
Connecticut	PH-0107	**North Carolina**	06701
Delaware	CA 006	**North Dakota**	R-009
Florida *	E871024	**Oregon (Primary AB) ***	**ORELAP 4034**
Georgia	947	**Pennsylvania ***	68-565
Guam	14-003r	**Rhode Island**	LAO00326
Hawaii	Certified	**South Carolina**	87016
Idaho	Certified	**South Dakota**	Certified
Illinois *	200033	**Tennessee**	TN02839
Indiana	C-CA-01	**Texas ***	T104704230-14-7
Kansas *	E-10268	**Utah ***	CA000062014-7
Kentucky	90107	**Vermont**	VT0114
Louisiana *	LA140009	**Virginia ***	460260
Maine	CA0006	**Washington**	C838
Maryland	224	**West Virginia**	9943 C
Commonwealth of Northern Marianas Is.	MP0004	**Wisconsin**	998316660
Massachusetts	M-CA006	**Wyoming**	8TMS-L
Michigan	9906	**EPA Region 5**	Certified
Los Angeles County Sanitation Districts	10264		

* NELAP/TNI Recognized Accreditation Bodies

The tests listed below are accredited and meet the requirements of ISO 17025 as verified by the ANSI-ASQ National Accreditation Board/ACLASS.
Refer to Certificate and scope of accreditation (AT 1807) found at: http://www.eatonanalytical.com

SPECIFIC TESTS	METHOD OR TECHNIQUE USED	Drinking Water	Food & Beverage	Waste Water
1,4-Dioxane	EPA 522	x	x	
2,3,7,8-TCDD	Modified EPA 1613B	x	x	
Acrylamide	In House Method	x	x	
Alkalinity	SM 2320B	x	x	x
Ammonia	EPA 350.1		x	x
Ammonia	SM 4500-NH3 H (18th)		x	x
Anions and DBPs by IC	EPA 300.0	x	x	x
Anions and DBPs by IC	EPA 300.1	x	x	
Asbestos	EPA 100.2	x		
Bicarbonate Alkalinity as HCO3	SM 2330B	x	x	x
BOD / CBOD	SM 5210B		x	x
Bromate	In House Method	x	x	
Carbamates	EPA 531.2	x	x	
Carbonate as CO3	SM 2330B	x	x	x
Carbonyls	EPA 556	x	x	
COD	EPA 410.4 / SM 5220D			x
Chloramines	SM 4500-CL G	x	x	x
Chlorinated Acids	EPA 515.4	x	x	
Chlorinated Acids	EPA 555	x	x	
Chlorine Dioxide	SM 4500-CLO2 D	x	x	
Chlorine -Total/Free/ Combined Residual	SM 4500-Cl G	x	x	x
Conductivity	EPA 120.1			x
Conductivity	SM 2510B	x	x	x
Corrosivity (Langelier Index)	SM 2330B	x	x	
Cyanide, Amenable	SM 4500-CN G	x		x
Cyanide, Free	SM 4500CN F	x	x	x
Cyanide, Total	EPA 335.4	x	x	x
Cyanogen Chloride (screen)	In House Method	x	x	
Diquat and Paraquat	EPA 549.2	x	x	
DBP/HAA	SM 6251B	x	x	
Dissolved Oxygen	SM 4500-O G		x	x
E. Coli	(MTF/EC+MUG)	x		
E. Coli	CFR 141.21(f)(6)(i)		x	x
E. Coli	SM 9223			x
E. Coli (Enumeration)	SM 9221B.1/ SM 9221F	x	x	
E. Coli (Enumeration)	SM 9223B	x	x	
EDB/DCBP	EPA 504.1	x		
EDB/DBCP and DBP	EPA 551.1	x	x	
EDTA and NTA	In House Method	x	x	
Endothall	EPA 548.1	x	x	
Enterococci	SM 9230B	x		x
Fecal Coliform	SM 9221 E (MTF/EC)	x		
Fecal Coliform	SM 9221C, E (MTF/EC)			x
Fecal Coliform (Enumeration)	SM 9221E (MTF/EC)	x	x	
Fecal Coliform with Chlorine Present	SM 9221E			x
Fecal Streptococci	SM 9230B	x		x
Fluoride	SM 4500-F C	x	x	x
Glyphosate	EPA 547	x	x	
Gross Alpha/Beta	EPA 900.0	x	x	x
HAAs/ Dalapon	EPA 552.3	x	x	
Hardness	SM 2340B	x	x	x
Heterotrophic Bacteria	In House Method	x	x	
Heterotrophic Bacteria	SM 9215 B	x	x	
Hexavalent Chromium	EPA 218.6	x	x	x
Hexavalent Chromium	EPA 218.7	x	x	
Hexavalent Chromium	SM 3500-Cr B or C (20th)			x

SPECIFIC TESTS	METHOD OR TECHNIQUE USED	Drinking Water	Food & Beverage	Waste Water
Hormones	EPA 539	x	x	
Hydroxide as OH Calc.	SM 2330B	x	x	
Kjeldahl Nitrogen	EPA 351.2			x
Mercury	EPA 245.1	x	x	x
Metals	EPA 200.7 / 200.8	x	x	x
Microcystin LR	ELISA	x	x	
NDMA	EPA 521	x	x	
Nitrate/Nitrite Nitrogen	EPA 353.2	x	x	x
OCL, Pesticides/PCB	EPA 505	x	x	
Ortho Phosphate	EPA 365.1	x	x	
Ortho Phosphate and Total Phosphorous	EPA 365.1/SM 4500-P E			x
Ortho Phosphorous	SM 4500P E	x	x	
Oxyhalides Disinfection Byproducts	EPA 317.0	x	x	
Perchlorate	EPA 331.0	x	x	
Perchlorate	EPA 314.0	x	x	
Perfluorinated Alkyl Acids	EPA 537	x	x	
pH	EPA 150.1	x		
pH	SM 4500-H+B	x	x	x
Phenylurea Pesticides/ Herbicides	In House Method	x	x	
Pseudomonas	IDEXX Pseudalert	x	x	
Radium-226	RA-226 GA	x	x	
Radium-228	RA-228 GA	x	x	
Radon-222	SM 7500RN	x	x	
Residue, Filterable	SM 2540C	x	x	x
Residue, Non-filterable	SM 2540D			x
Residue, Total	SM 2540B		x	x
Residue, Volatile	EPA 160.4			x
Semi-VOC	EPA 525.2	x	x	
Semi-VOC	EPA 625	x	x	x
Silica	SM 4500-Si D	x	x	x
Silica	SM 4500-SiO2 C	x		x
Sulfide	SM 4500-$S^{=}$ D			x
Sulfite	SM 4500-SO^3B	x	x	x
Surfactants	SM 5540C	x	x	x
Taste and Odor Analytes	SM 6040E	x	x	
Total Coliform	SM 9221 A, B	x	x	
Total Coliform (Enumeration)	SM 9221 A, B, C	x	x	
Total Coliform / E. coli	Colisure	x	x	
Total Coliform	SM 9221B			x
Total Coliform with Chlorine Present	SM 9221B			x
Total Coliform / E.coli	SM 9223	x	x	
TOC	SM 5310C		x	x
TOC/DOC	SM 5310C	x	x	
TOX	SM 5320B			x
Total Phenols	EPA 420.1			x
Total Phenols	EPA 420.4	x	x	x
Total Phosphorous	SM 4500 P F			x
Turbidity	EPA 180.1	x	x	x
Turbidity	SM 2130B	x		x
Uranium by ICP/MS	EPA 200.8	x	x	
UV 254	SM 5910B	x		
VOC	EPA 524.2/EPA 524.3	x	x	
VOC	EPA 624	x	x	x
VOC	EPA SW 846 8260	x	x	
VOC	In House Method	x	x	
Yeast and Mold	SM 9610	x	x	

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Acknowledgement of Samples Received

Addr: **Advanced Technology Laboratories, Inc.**
3151 W. Post Road
Las Vegas, NV 89118

Attn: Marlon Cartin
Phone: 702-307-2659

Client ID: ATL-NV
Folder #: 525618
Project: SUBCONTRACT
Sample Group: DRINKING WATER

Project Manager: David S Tripp
Phone: (626) 386-1158
PO #: N15000C

The following samples were received from you on **March 18, 2015** at **0954**. They have been scheduled for the tests listed below each sample. If this information is incorrect, please contact your service representative. Thank you for using Eurofins Eaton Analytical.

Sample #	Sample ID	Sample Date
201503180340	N015000-001L/B-20	03/17/2015 1305
	@331-PHG-Sterile-Filtered	

Test Description

@331-PHG-Sterile-Filtered -- Perchlorate by EPA 331.0

525618

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 *FAX: 7023072691*

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Eurofins Eaton Analytical
750 Royal Oaks Drive, Ste 100
Monrovia, CA 91016

TEL:
FAX:
Acct #:

Field Sampler:

17-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests		
				EPA 331.0		
N015000-001L / B-20	Groundwater	3/17/2015 1:05:00 PM	4OZP	1		

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15000C For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for Perchlorate by 331.0. Sample was sterile filtered.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/17/2015 17:00	**Received by:**	GSO #: 527268900	
Relinquished by:			**Received by:**	[signature] EEA M. Escalante	3/18/15 0954

5.0-0.3 = 4.7°C On ice

GSO
GOLDEN STATE OVERNIGHT

800-322-5555 www.gso.com

Ship From
ADVANCED TECHNOLOGY LABORATORIES, INC.
MARLON CARTIN
3151 W. POST RD.
LAS VEGAS, NV 89118

Ship To
EUROFINS
DAVID TRIPP
750 ROYAL OAKS DR
STE 100
MONROVIA, CA 91016

COD: $0.00
Weight: 0 lb(s)
Reference:

Delivery Instructions:

Signature Type: REQUIRED

Tracking #: 527268900 **CPS**

NWK **E**
MONROVIA

D91006B

35372532

Print Date: 3/17/2015 1:35 PM

LABEL INSTRUCTIONS:

Do not copy or reprint this label for additional shipments - each package must have a unique barcode.

Use the "Print Label" button on this page to print the shipping label on a laser or inkjet printer. Securely attach this label to your package, do not cover the barcode.

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Comments
Report: 525618

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

The Comments Report may be blank if there are no comments for this report.

eurofins | Eaton Analytical

750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory Hits
Report: 525618

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

Samples Received on:
03/18/2015 0954

Analyzed	Analyte	Sample ID	Result	Federal MCL	Units	MRL
	201503180340	**N015000-001L/B-20**				
03/20/2015 9:30	Perchlorate		7.6	6	ug/L	0.5

SUMMARY OF POSITIVE DATA ONLY

eurofins | Eaton Analytical

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1 800 566 LABS (1 800 566 5227)

Laboratory Data
Report: 525618

Advanced Technology Laboratories, Inc.
Marlon Cartin
3151 W. Post Road
Las Vegas, NV 89118

Samples Received on:
03/18/2015 0954

Prepared	Analyzed	QC Ref #	Method	Analyte	Result	Units	MRL	Dilution
N015000-001L/B-20 (201503180340)						**Sampled on 03/17/2015 1305**		
			EPA 331.0 - Perchlorate by EPA 331.0					
	03/20/2015 9:30	827386	(EPA 331.0)	Perchlorate	7.6	ug/L	0.5	1

Rounding on totals after summation.
(c) - indicates calculated results

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750 Royal Oaks Drive, Suite 100
Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Advanced Technology Laboratories, Inc.

QC Ref # 827386 - Perchlorate by EPA 331.0 **Analysis Date: 03/20/2015**

201503180340 N015000-001L/B-20 Analyzed by: PHK

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Monrovia, California 91016-3629
Tel: (626) 386-1100
Fax: (626) 386-1101
1 800 566 LABS (1 800 566 5227)

Laboratory QC
Report: 525618

Advanced Technology Laboratories, Inc.

QC Type	Analyte	Native	Spiked	Recovered	Units	Yield (%)	Limits (%)	RPDLimit (%)	RPD%
QC Ref# 827386 - Perchlorate by EPA 331.0 by EPA 331.0						**Analysis Date: 03/20/2015**			
LCS1	Perchlorate		10	10.2	ug/L	102	(80-120)		
LCS2	Perchlorate		10	10.2	ug/L	102	(80-120)	20	0.0
MBLK	Perchlorate			<0.167	ug/L				
MRL_CHK	Perchlorate		0.5	0.602	ug/L	120	(50-150)		
MS_201501240428	Perchlorate	ND	0.5	0.906	ug/L	111	(50-150)		
MSD_201501240428	Perchlorate	ND	0.5	0.770	ug/L	84	(50-150)	50	16

Spike recovery is already corrected for native results.
Spikes which exceed Limits and Method Blanks with positive results are highlighted by Underlining.
Criteria for MS and Dup are advisory only, batch control is based on LCS. Criteria for duplicates are advisory only, unless otherwise specified in the method.
RPD not calculated for LCS2 when different a concentration than LCS1 is used.
RPD not calculated for Duplicates when the result is not five times the MRL (Minimum Reporting Level).
(S) - Indicates surrogate compound.
(I) - Indicates internal standard compound.

3/27/2015

Advanced Technology Laboratories
3151 W Post Road
Las Vegas, NV 89118
Attn: Marlon Cartin

OrderID: *1503488*

Dear: Marlon Cartin

This is to transmit the attached analytical report. The analytical data and information contained therein was generated using specified or selected methods contained in references, such as Standard Methods for the Examination of Water and Wastewater, online edition, Methods for Determination of Organic Compounds in Drinking Water, EPA-600/4-79-020, and Test Methods for Evaluation of Solid Waste, Physical/Chemical Methods (SW846) Third Edition.

The samples were received by WETLAB-Western Environmental Testing Laboratory in good condition on 3/17/2015. Additional comments are located on page 2 of this report.

If you should have any questions or comments regarding this report, please do not hesitate to call.

Sincerely,

Jennifer Delaney
QA Specialist

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Report Comments

Advanced Technology Laboratories - 1503488

General Comments

None

Specific Comments

None

Per method recommendation (section 4.4), Samples analyzed by methods EPA 300.0 and EPA 300.1 have been filtered prior to analysis.

Report Legend

B	--	Blank contamination; Analyte detected above the method reporting limit in an associated blank
HT	--	Sample analyzed beyond the accepted holding time
J	--	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit
M	--	Reported value is estimated; The sample matrix interfered with the analysis
N	--	There was insufficient sample available to perform a spike and/or duplicate on this analytical batch.
NC	--	Not calculated due to matrix interference
Q	--	Reported value is estimated; The value failed to meet QC criteria for either precision or accuracy
S	--	Surrogate recovery was outside of laboratory acceptance limits due to matrix interference. The associated blank and LCS surrogate recovery was within acceptance limits
SC	--	Spike recovery not calculated. Sample concentration >4X the spike amount; therefore, the spike could not be adequately recovered
U	--	The analyte was analyzed for, but was not detected above the level of the reported sample reporting/quantitation limit

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LAS VEGAS
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Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
Analytical Report

Advanced Technology Laboratories
3151 W Post Road
Las Vegas, NV 89118
Attn: Marlon Cartin
Phone: (702) 307-2659 **Fax:** (702) 307-2691

Date Printed: 3/27/2015
OrderID: *1503488*
PO\Project: *31503101/N15000B*

Customer Sample ID: N015000-001H
WETLAB Sample ID: 1503488-001
Collect Date/Time: 3/17/2015 13:05
Receive Date: 3/17/2015 14:18

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Flow Injection Analyses							
Total Kjeldahl Nitrogen	EPA 351.2	0.26	mg/L	1	0.20	3/24/2015	NV00925

Customer Sample ID: N015000-001K
WETLAB Sample ID: 1503488-002
Collect Date/Time: 3/17/2015 13:05
Receive Date: 3/17/2015 14:18

Analyte	Method	Results	Units	DF	RL	Analyzed	LabID
Trace Metals by ICP-OES							
Sulfur	EPA 200.7	920	mg/L	50	50	3/25/2015	NV00925
Sample Preparation							
Trace Metals Digestion	EPA 200.2	Complete		1		3/24/2015	NV00925

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

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475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

Western Environmental Testing Laboratory
QC Report

QCBatchID	QCType	Parameter	Method	Result	Units
QC15031162	Blank 1	Total Kjeldahl Nitrogen	EPA 351.2	ND	mg/L
QC15031275	Blank 1	Sulfur	EPA 200.7	ND	mg/L

QCBatchID	QCType	Parameter	Method	Result	Actual	% Recovery	Units
QC15031162	LCS 1	Total Kjeldahl Nitrogen	EPA 351.2	1.01	1.00	101	mg/L
QC15031275	LCS 1	Sulfur	EPA 200.7	9.52	10.0	95	mg/L

QCBatchID	QCType	Parameter	Method	Spike Sample	Sample Result		MS Result	MSD Result	Spike Value	Units	MS % Rec.	MSD % Rec.	RPD
QC15031162	MS 1	Total Kjeldahl Nitrogen	EPA 351.2	1503472-001	0.612	M	1.93	1.74	1.00	mg/L	NC	NC	NC
QC15031162	MS 2	Total Kjeldahl Nitrogen	EPA 351.2	1503472-002	0.398	M	1.58	1.37	1.00	mg/L	NC	NC	NC
QC15031275	MS 1	Sulfur	EPA 200.7	1503488-002	915		925	910	10.0	mg/L	100	0	2%

DF=Dilution Factor, RL=Reporting Limit, ND=Not Detected or <RL

SPARKS
475 E. Greg Street, Suite 119
Sparks, Nevada 89431
tel (775) 355-0202
fax (775) 355-0817
EPA LAB ID: NV00925 - ELAP No: 2523

ELKO
1084 Lamoille Hwy
Elko, Nevada 89801
tel (775) 777-9933
fax (775) 777-9933
EPA LAB ID: NV00926

LAS VEGAS
3230 Polaris Ave. Suite 4
Las Vegas, Nevada 89102
tel (702) 475-8899
fax (702) 622-2868
EPA LAB ID: NV00932

ASSET Laboratories
3151-3153 W Post Rd., Las Vegas, NV 89118
www.atl-labs.com
TEL: 7023072659 FAX: 7023072691

CHAIN-OF-CUSTODY RECORD

QC Level: RTNE

Subcontractor:
Western Environmental Testing Laboratory
3230 Polaris Ave. #4
Las Vegas, NV 89102

TEL: (702) 475-8899
FAX:
Acct #:

Field Sampler: Corey Ercanbrack

17-Mar-15

Sample ID	Matrix	Date Collected	Bottle Type	Requested Tests: ~~D-4294~~ 200.7	Requested Tests: SM4500-NH3C	
N015000-001H / B-20	Groundwater	3/17/2015 1:05:00 PM	8OZP		1	
N015000-001K / B-20	Groundwater	3/17/2015 1:05:00 PM	8OZP	1		

14.3°C @ 1437 3/17/15 NA

WETLAB Order ID: 1503488
Sparks Control #:
Elko Control #:
LV Control #: 31503101

General Comments: Please email sample receipt acknowledgement to the PM.

Please use PO#:N15000B For questions, call Marlon at (702)-307-2659. Please e-mail results to reports.lv@assetlaboratories.com by:Normal TAT

Please analyze for TKN and Sulfur.

		Date/Time			Date/Time
Relinquished by:	[signature]	3/17/15 1418	**Received by:**	[signature]	3/17/15 1418
Relinquished by:	[signature]	3/17/15 @ 1530	**Received by:**	on TNC	3/17/15 @ 1530
ON TNC			Vanessa Meyer		3/18/15 1045 2.4°C

APPENDIX C

HYDROGEOLOGIC AQUIFER TEST ANALYSES AND MODELING

Hydrogeologic Data Sheet - Construction Dewatering Estimates

Tests	B-1		B-2		B-6		B-20	
	Conductivity (ft/d)		Conductivity (ft/d)		Conductivity (ft/d)		Conductivity (ft/d)	
	Bouwer & Rice Method	Hvorslev Method	Bouwer & Rice Method	Hvorslev Method	Bouwer & Rice Method	Hvorslev Method	Bouwer & Rice Method	Hvorslev Method
Test 1	0.77	**0.84**	1.02	1.11	4.82	**5.53**	23.03	29.22
Test 2	0.63	0.76	1.03	1.19	4.82	5.41	26.03	33.18
Test 3	0.30	0.34	1.53	1.53			5.32	6.05

Model Estimated Pumping Data - West End Hydraulic Conductivity = 6 wells at K = 1.0 ft/day

Static Water Elev (ft-amsl)	Target Pumping Elev (ft-amsl)	Pumping Rate per Well (gpm)	Pumping Rate per Well (ft^3/d)	6 Well Pumping Rate (gpm)	Model Pumping Drawdown (ft)	Model Pumping Elevation (ft-amsl)
1770	1764	1	193	6	5	1765
		2	385	12	6	1764
		3	578	18	7	1763

Model Estimated Pumping Data - East End Hydraulic Conductivity = 6 wells at K = 5.5 ft/day

Static Water Elev (ft-amsl)	Target Pumping Elev (ft-amsl)	Pumping Rate per Well (gpm)	Pumping Rate per Well (ft^3/d)	6 Well Pumping Rate (gpm)	Model Pumping Drawdown (ft)	Model Pumping Elevation (ft-amsl)
1770	1767	1	193	6	2	1768
		2	385	12	4	1766
		3	578	18	6	1764

Model Estimated Pumping Data - East End Hydraulic Conductivity = 6 wells at K = 33 ft/day

Static Water Elev (ft-amsl)	Target Pumping Elev (ft-amsl)	Pumping Rate per Well (gpm)	Pumping Rate per Well (ft^3/d)	6 Well Pumping Rate (gpm)	Model Pumping Drawdown (ft)	Model Pumping Elevation (ft-amsl)
1770	1767	10	2888	60	1	1769
		20	3850	120	3	1767
		30	5780	180	5	1765

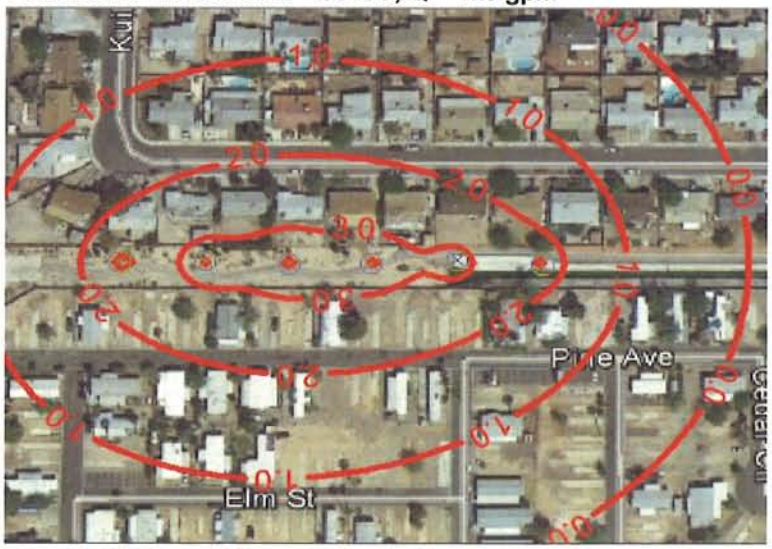
Drawdown Contours: K = 1.0 ft/d, Q = 6 gpm



Drawdown Contours: K = 5.5 ft/d, Q = 18 gpm



Drawdown Contours: K = 33 ft/d, Q = 120 gpm

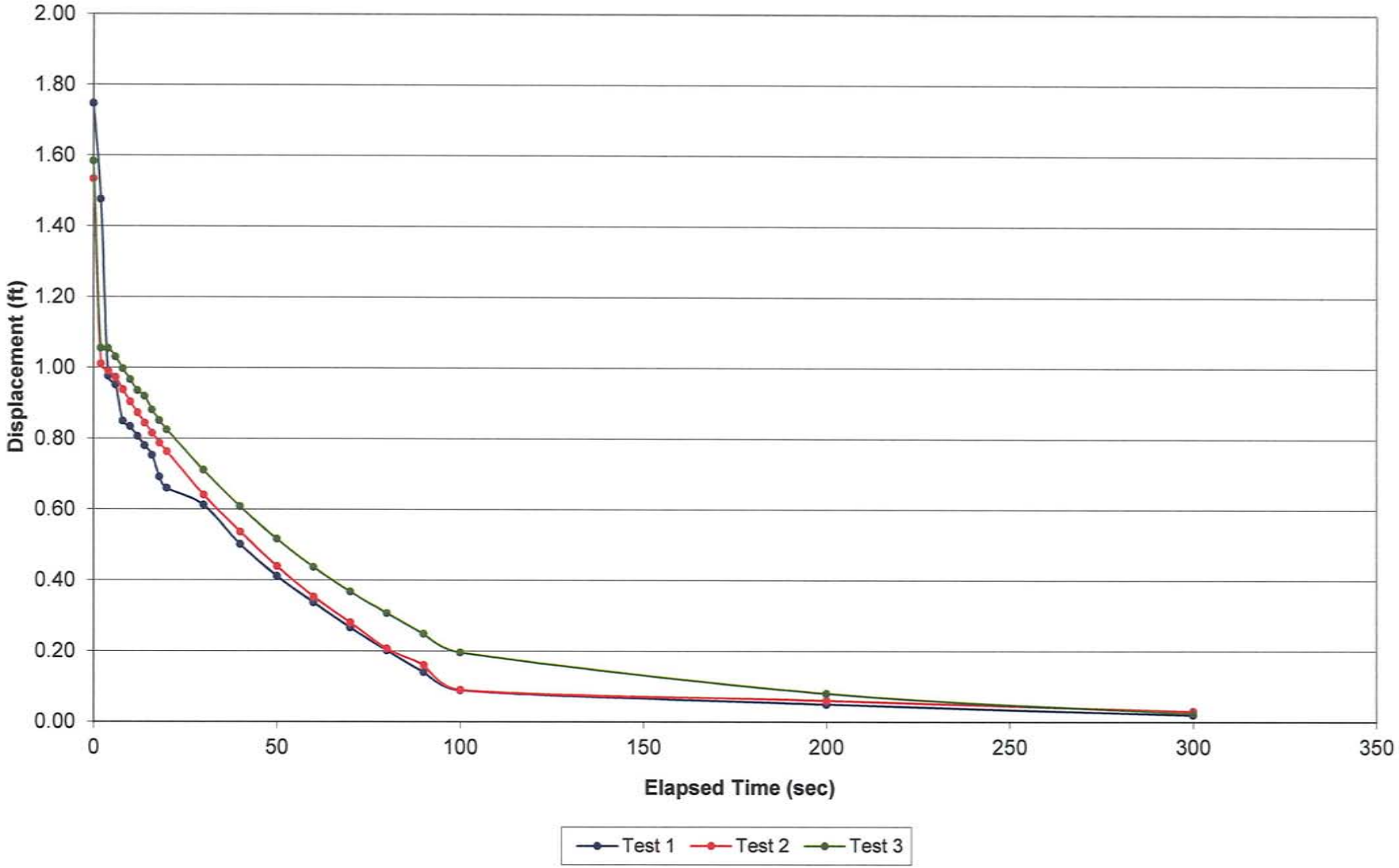


B-1

Static DTW 10.65
Static Reading 12.57

Elapsed Time (sec)	Test 1		Test 2		Test 3	
	Reading (ft)	Displacement (ft)	Reading (ft)	Displacement (ft)	Reading (ft)	Displacement (ft)
0	14.32	1.75	14.10	1.53	14.15	1.58
2	14.05	1.48	13.58	1.01	13.62	1.05
4	13.55	0.98	13.56	0.99	13.62	1.05
6	13.52	0.95	13.54	0.97	13.60	1.03
8	13.42	0.85	13.51	0.94	13.57	1.00
10	13.40	0.83	13.47	0.90	13.54	0.97
12	13.38	0.81	13.44	0.87	13.51	0.94
14	13.35	0.78	13.41	0.84	13.49	0.92
16	13.32	0.75	13.39	0.82	13.45	0.88
18	13.26	0.69	13.36	0.79	13.42	0.85
20	13.23	0.66	13.33	0.76	13.40	0.83
30	13.18	0.61	13.21	0.64	13.28	0.71
40	13.07	0.50	13.11	0.54	13.18	0.61
50	12.98	0.41	13.01	0.44	13.09	0.52
60	12.91	0.34	12.92	0.35	13.01	0.44
70	12.84	0.27	12.85	0.28	12.94	0.37
80	12.77	0.20	12.78	0.21	12.88	0.31
90	12.71	0.14	12.73	0.16	12.82	0.25
100	12.66	0.09	12.66	0.09	12.77	0.20
200	12.62	0.05	12.63	0.06	12.65	0.08
300	12.59	0.02	12.60	0.03	12.59	0.02

B-1 Slug Test Data

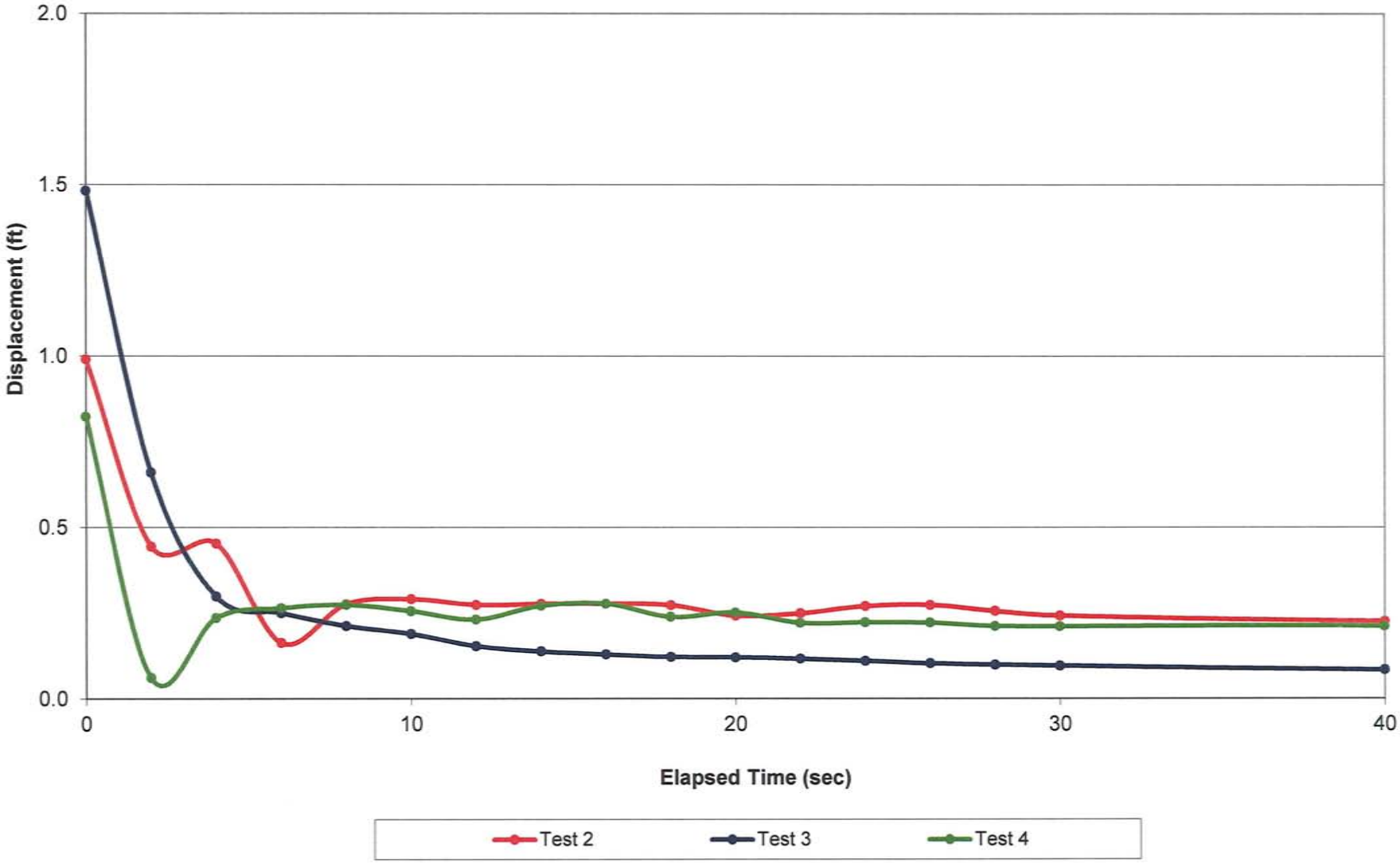


B-2 Slugs

Static DTW	12.78
Static Reading	8.78

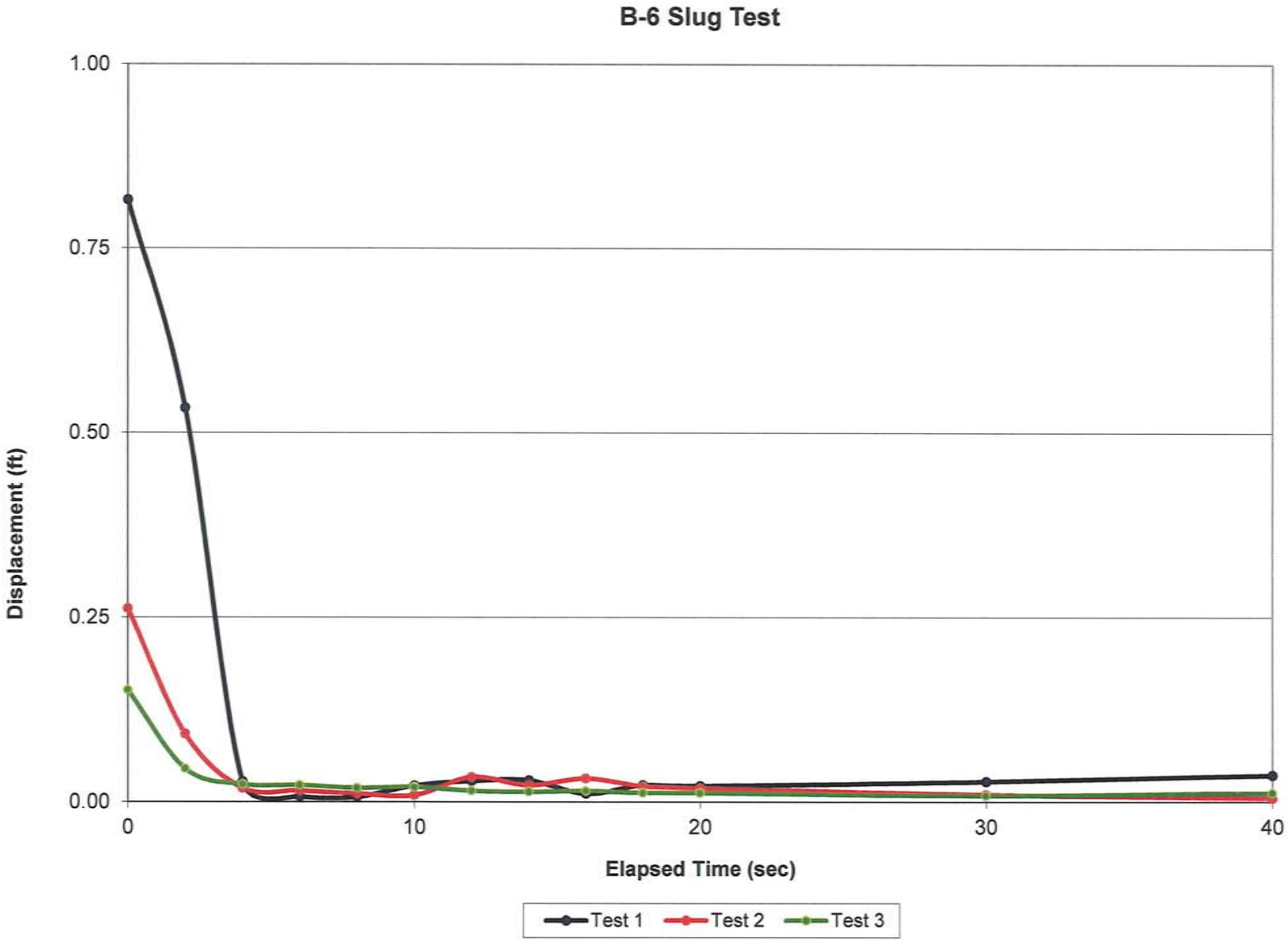
Elapsed Time (sec)	Test 1		Test 2		Test 3		Test 4		Test 5	
	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)
0	9.48	0.70	9.77	0.99	7.30	1.48	9.60	0.82	7.19	1.59
2	9.01	0.23	9.23	0.45	8.12	0.66	8.84	0.06	8.37	0.41
4	9.07	0.29	9.23	0.45	8.48	0.30	9.02	0.24	8.45	0.33
6	9.08	0.30	8.94	0.16	8.53	0.25	9.04	0.26	8.11	0.67
8	9.10	0.32	9.06	0.28	8.57	0.21	9.05	0.27	6.80	1.98
10	9.10	0.32	9.07	0.29	8.59	0.19	9.04	0.26	6.93	1.85
12	9.08	0.30	9.05	0.27	8.63	0.15	9.01	0.23	6.37	2.41
14	9.08	0.30	9.06	0.28	8.64	0.14	9.05	0.27	8.59	0.19
16	9.07	0.29	9.06	0.28	8.65	0.13	9.06	0.28	8.60	0.18
18	9.07	0.29	9.05	0.27	8.66	0.12	9.02	0.24	8.60	0.18
20	8.96	0.18	9.02	0.24	8.66	0.12	9.03	0.25	8.61	0.17
22	9.07	0.29	9.03	0.25	8.66	0.12	9.00	0.22	8.61	0.17
24	9.09	0.31	9.05	0.27	8.67	0.11	9.00	0.22	8.61	0.17
26	9.06	0.28	9.05	0.27	8.68	0.10	9.00	0.22	8.62	0.16
28	9.05	0.27	9.04	0.26	8.68	0.10	8.99	0.21	8.62	0.16
30	9.05	0.27	9.02	0.24	8.68	0.10	8.99	0.21	8.62	0.16
40	9.05	0.27	9.01	0.23	8.70	0.08	8.99	0.21	8.64	0.14
50	9.03	0.25	9.00	0.22	8.70	0.08	8.97	0.19	8.65	0.13
60	9.05	0.27	9.01	0.23	8.70	0.08	8.98	0.20	8.66	0.12
70	9.02	0.24	9.00	0.22	8.71	0.07	8.96	0.18	8.67	0.11
80	9.11	0.33	8.98	0.20	8.72	0.06	8.95	0.17	8.67	0.11
90	8.62	0.16	8.99	0.21	8.72	0.06	8.97	0.19	8.68	0.10
100	8.66	0.12	8.98	0.20	8.73	0.05	8.94	0.16	8.68	0.10
110	8.68	0.10	8.97	0.19	8.73	0.05	8.92	0.14	8.68	0.10
120	8.68	0.10	8.96	0.18	8.73	0.05	8.92	0.14	8.69	0.09
130	8.69	0.09	8.95	0.17			8.93	0.15	8.69	0.09
140	8.70	0.08					8.91	0.13	8.69	0.09
150	8.70	0.08					8.91	0.13	8.70	0.08

B-2 Slug Tests



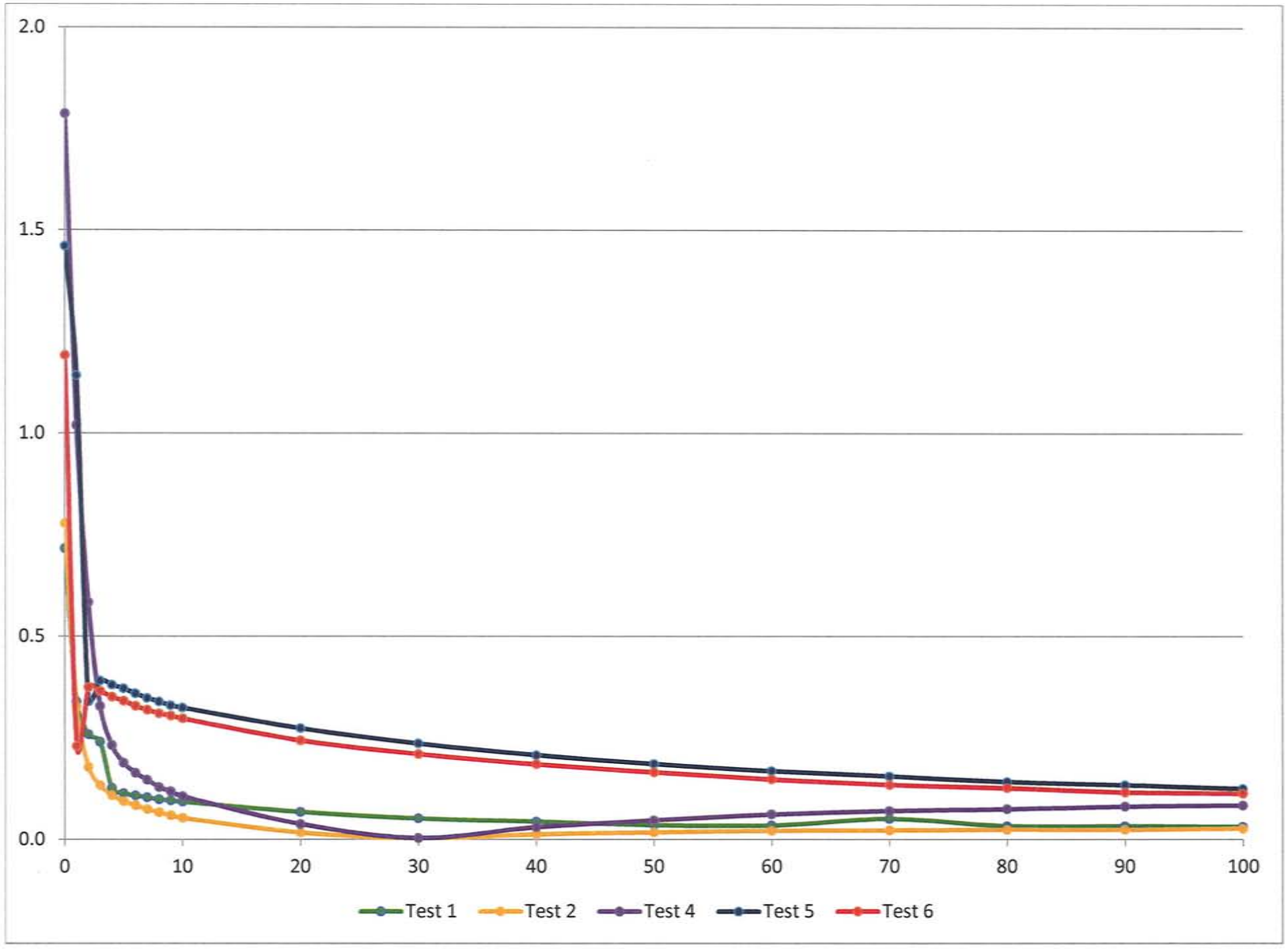
B-6
Static Reading 9.18

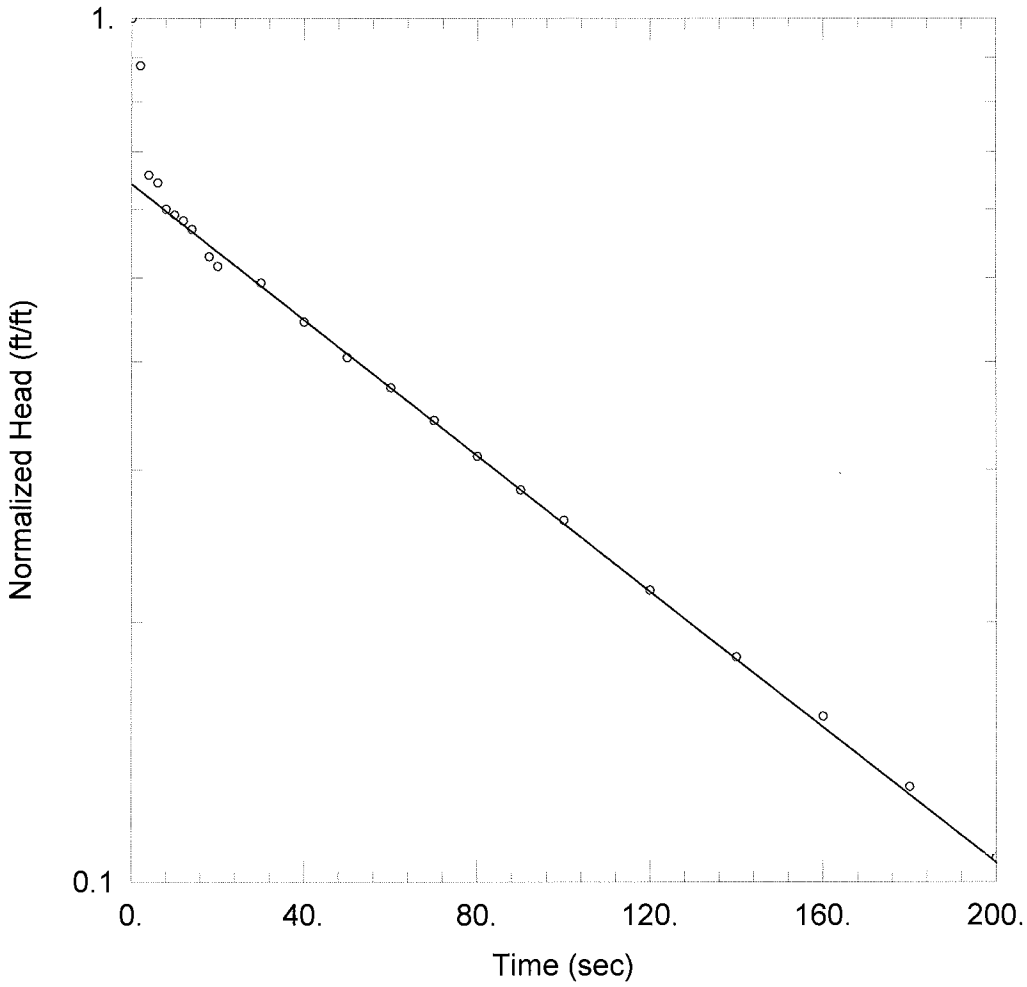
Elapsed Time (sec)	Test 1		Test 2		Test 3	
	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)
0	10.00	0.82	8.92	0.26	9.03	0.15
2	9.71	0.53	9.09	0.09	9.13	0.05
4	9.21	0.03	9.16	0.02	9.16	0.02
6	9.19	0.01	9.16	0.02	9.16	0.02
8	9.19	0.01	9.17	0.01	9.16	0.02
10	9.20	0.02	9.17	0.01	9.16	0.02
12	9.15	0.03	9.21	0.03	9.16	0.02
14	9.15	0.03	9.20	0.02	9.17	0.01
16	9.17	0.01	9.21	0.03	9.17	0.02
18	9.16	0.02	9.20	0.02	9.17	0.01
20	9.16	0.02	9.20	0.02	9.17	0.01
30	9.15	0.03	9.19	0.01	9.17	0.01
40	9.14	0.04	9.18	0.00	9.17	0.01
50	9.14	0.04	9.18	0.00	9.17	0.01
60	9.16	0.02	9.18	0.00	9.17	0.01
70	9.10	0.08	9.18	0.00	9.17	0.01
78	9.09	0.09	9.18	0.00	9.17	0.01


B-6 Slug Test
1.00
0.75
0.50
0.25
0.00
Displacement (ft)
0
10
20
30
40
Elapsed Time (sec)
Test 1
Test 2
Test 3

B-20
Static Reading 7.42

Elapsed Time (sec)	Test 1		Test 2		Test 3		Test 4		Test 5		Test 6	
	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)	Reading	Displacement (ft)
0	8.14	0.72	6.64	0.78	9.17	1.75	5.63	1.79	8.88	1.46	8.61	1.19
1	7.76	0.34	7.09	0.33	8.35	0.93	6.40	1.02	8.56	1.14	7.65	0.23
2	7.68	0.26	7.24	0.18	7.95	0.53	6.84	0.58	7.76	0.34	7.79	0.37
3	7.66	0.24	7.29	0.13	7.72	0.30	7.09	0.33	7.81	0.39	7.79	0.37
4	7.55	0.13	7.31	0.11	7.93	0.51	7.19	0.23	7.80	0.38	7.77	0.35
5	7.53	0.11	7.33	0.09	7.88	0.46	7.23	0.19	7.79	0.37	7.76	0.34
6	7.53	0.11	7.34	0.08	7.76	0.34	7.26	0.16	7.78	0.36	7.75	0.33
7	7.52	0.10	7.35	0.07	7.81	0.39	7.27	0.15	7.77	0.35	7.74	0.32
8	7.52	0.10	7.35	0.07	7.77	0.35	7.29	0.13	7.76	0.34	7.73	0.31
9	7.52	0.10	7.36	0.06	7.90	0.48	7.30	0.12	7.75	0.33	7.72	0.30
10	7.51	0.09	7.37	0.05	7.70	0.28	7.31	0.11	7.74	0.32	7.72	0.30
20	7.49	0.07	7.40	0.02	7.69	0.27	7.38	0.04	7.69	0.27	7.66	0.24
30	7.47	0.05	7.42	0.00	7.68	0.26	7.42	0.00	7.66	0.24	7.63	0.21
40	7.46	0.04	7.43	0.01	7.64	0.22	7.45	0.03	7.63	0.21	7.60	0.18
50	7.46	0.04	7.44	0.02	7.61	0.19	7.47	0.05	7.61	0.19	7.59	0.17
60	7.45	0.03	7.44	0.02	7.59	0.17	7.48	0.06	7.59	0.17	7.57	0.15
70	7.47	0.05	7.44	0.02	7.58	0.16	7.49	0.07	7.58	0.16	7.55	0.13
80	7.45	0.03	7.44	0.02	7.57	0.15	7.49	0.07	7.56	0.14	7.55	0.13
90	7.45	0.03	7.44	0.02	7.56	0.14	7.50	0.08	7.55	0.13	7.54	0.12
100	7.45	0.03	7.45	0.03	7.55	0.13	7.50	0.08	7.55	0.13	7.53	0.11
120	7.45	0.03	7.45	0.03	7.54	0.12	7.51	0.09	7.54	0.12	7.52	0.10
140	7.45	0.03	7.45	0.03	7.53	0.11	7.51	0.09	7.53	0.11	7.52	0.10
160	7.45	0.03	7.45	0.03	7.53	0.11	7.51	0.09	7.53	0.11	7.52	0.10


2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
80
90
100
Test 1
Test 2
Test 4
Test 5
Test 6



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-1 T1 BR.aqt
Date: 04/16/15 Time: 09:29:17

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-1

AQUIFER DATA

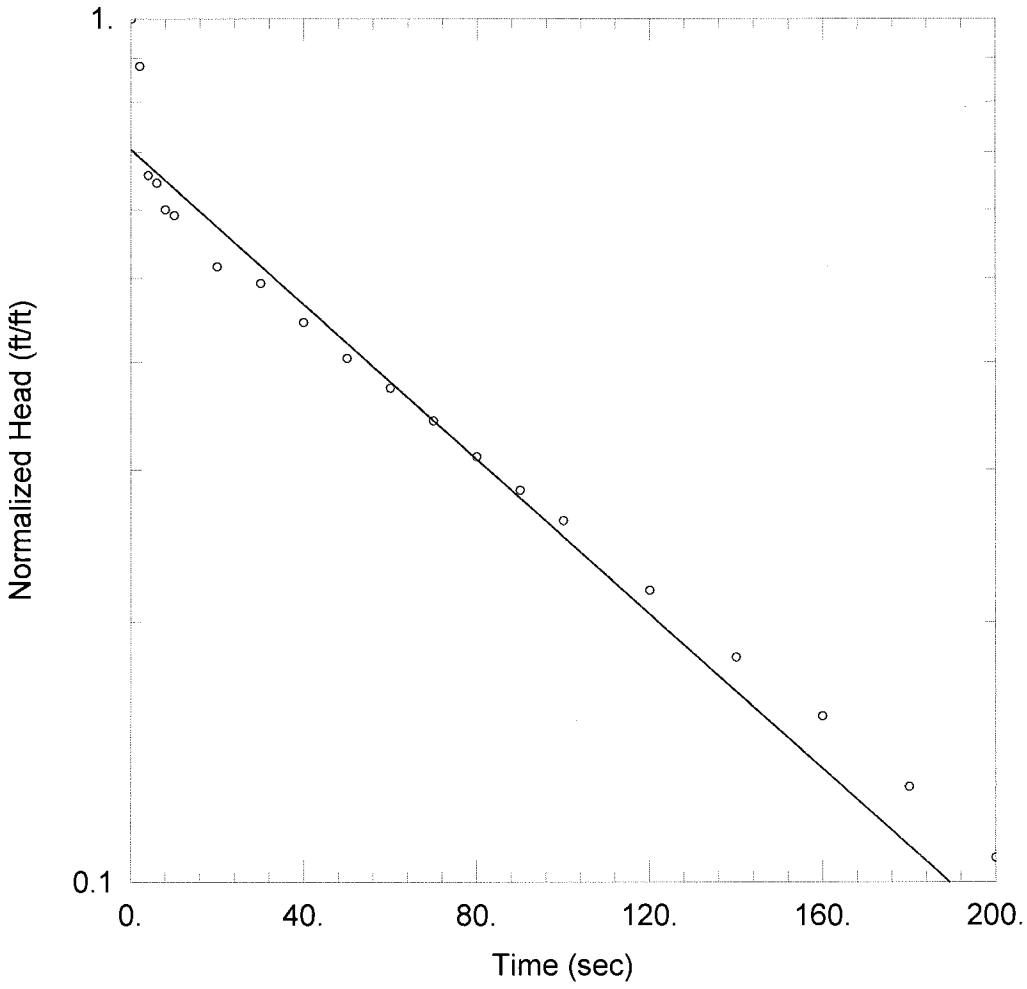
Saturated Thickness: 14.5 ft
Anisotropy Ratio (Kz/Kr): 0.1

WELL DATA (B-1)

Initial Displacement: 2.25 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.5 ft
Screen Length: 15. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.7681 ft/day
y0 = 1.444 ft



WELL TEST ANALYSIS

Data Set: G:\...\B-1 T1 HV.aqt
Date: 04/16/15 Time: 08:52:56

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-1

AQUIFER DATA

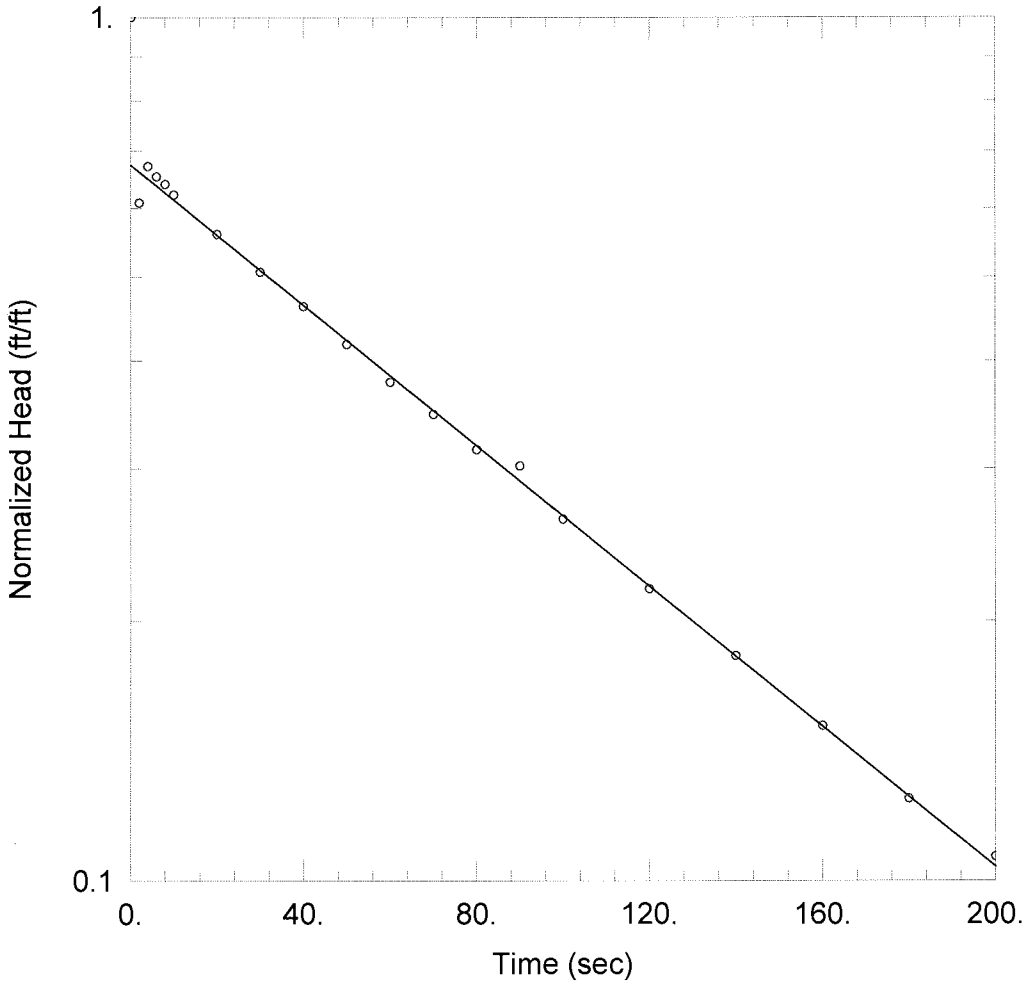
Saturated Thickness: 14.5 ft Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-1)

Initial Displacement: 2.25 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.5 ft
Screen Length: 15. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.8423 ft/day
y0 = 1.585 ft



WELL TEST ANALYSIS

Data Set: G:\...\B-1 T2 BR.aqt
Date: 04/16/15 Time: 08:53:04

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-1

AQUIFER DATA

Saturated Thickness: 14.5 ft Anisotropy Ratio (Kz/Kr): 0.01

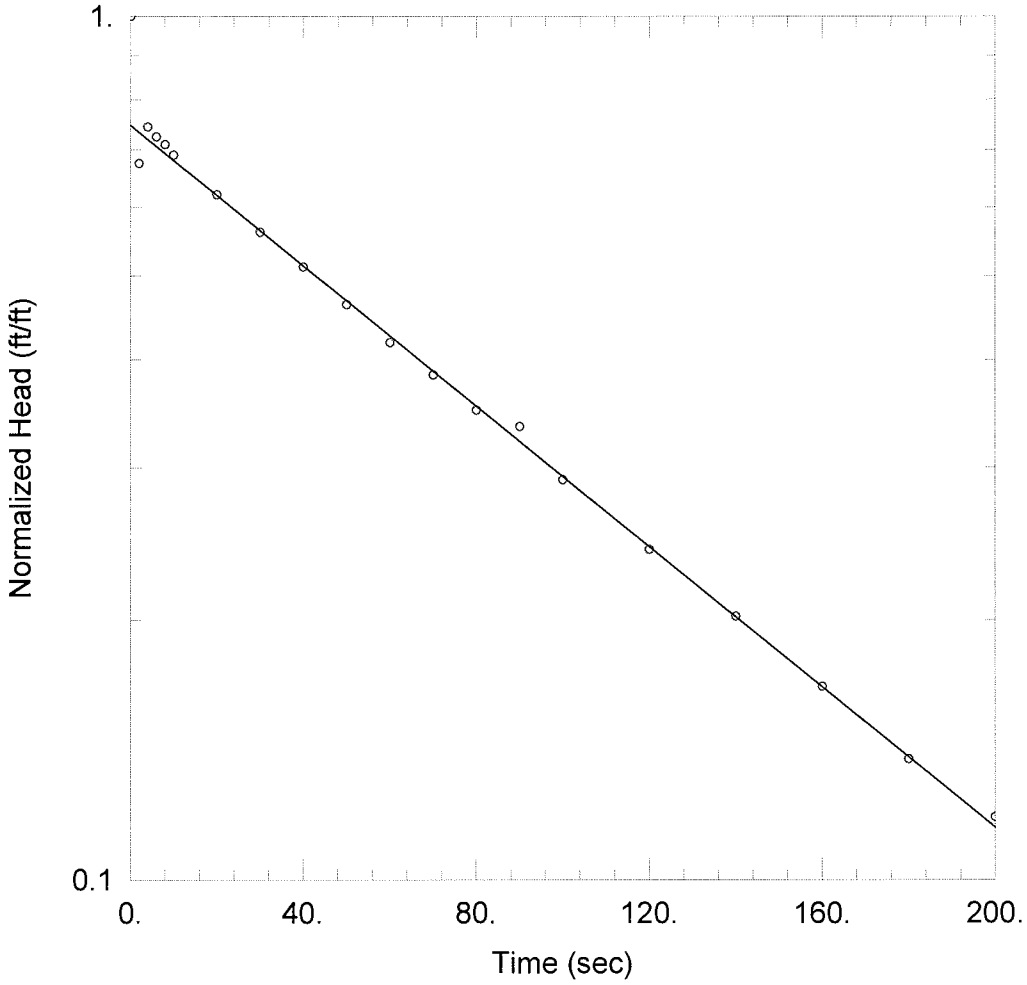
WELL DATA (B-1)

Initial Displacement: 2.25 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.5 ft
Screen Length: 15. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 0.6291 ft/day y0 = 1.516 ft



WELL TEST ANALYSIS

Data Set: G:\...\B-1 T2 HV.aqt
Date: 04/16/15 Time: 08:53:09

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-1

AQUIFER DATA

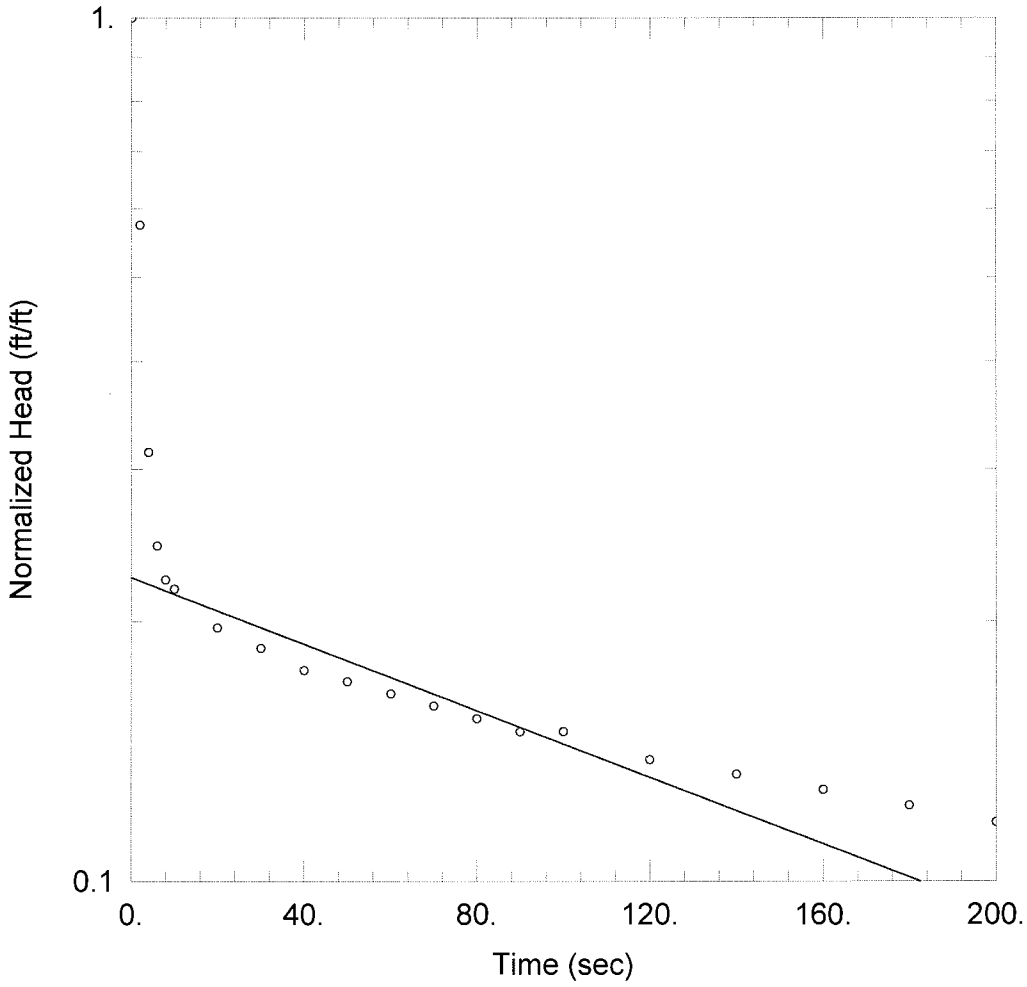
Saturated Thickness: 14.5 ft Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-1)

Initial Displacement: 2.03 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.5 ft
Screen Length: 15. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.7641 ft/day
y0 = 1.516 ft



WELL TEST ANALYSIS

Data Set: G:\...\B-1 T3 BR.aqt
Date: 04/16/15 Time: 08:53:14

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-1

AQUIFER DATA

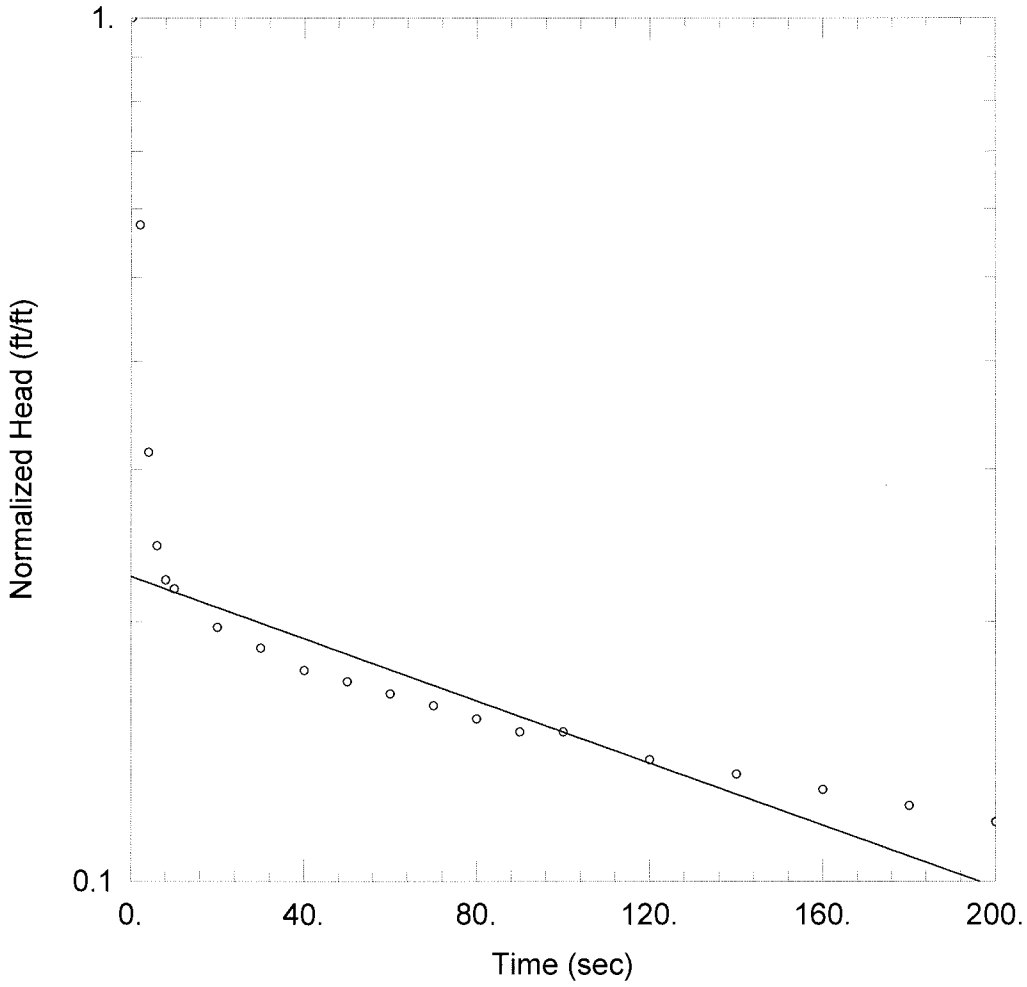
Saturated Thickness: 14.5 ft Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-1)

Initial Displacement: 1.88 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.5 ft
Screen Length: 15. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.2987 ft/day
y0 = 0.4228 ft



WELL TEST ANALYSIS

Data Set: G:\...\B-1 T3 HV.aqt
Date: 04/16/15 Time: 08:53:22

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-1

AQUIFER DATA

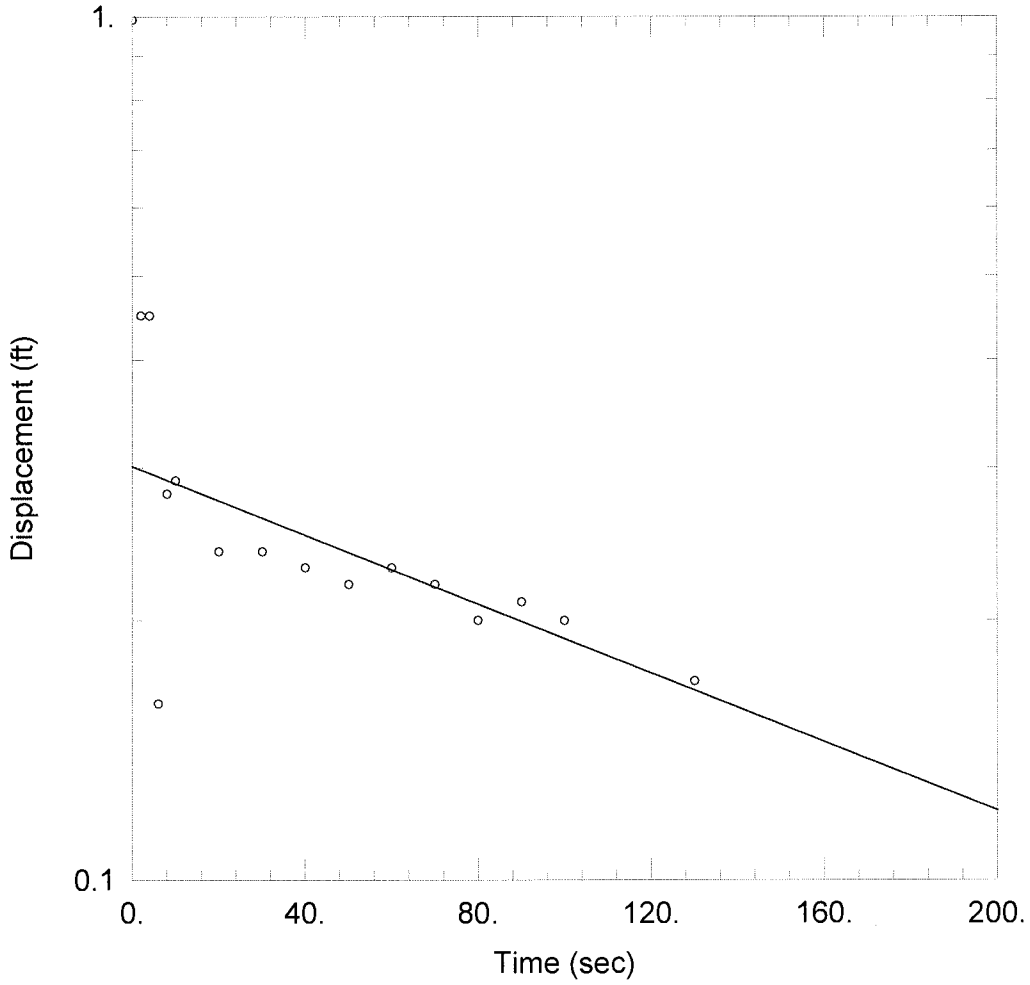
Saturated Thickness: 14.5 ft Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-1)

Initial Displacement: 1.88 ft
Total Well Penetration Depth: 25. ft
Casing Radius: 0.0833 ft
Static Water Column Height: 14.5 ft
Screen Length: 15. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 0.3386 ft/day
y0 = 0.4239 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-2 1 BR.aqt
Date: 04/16/15 Time: 09:02:24

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-2

AQUIFER DATA

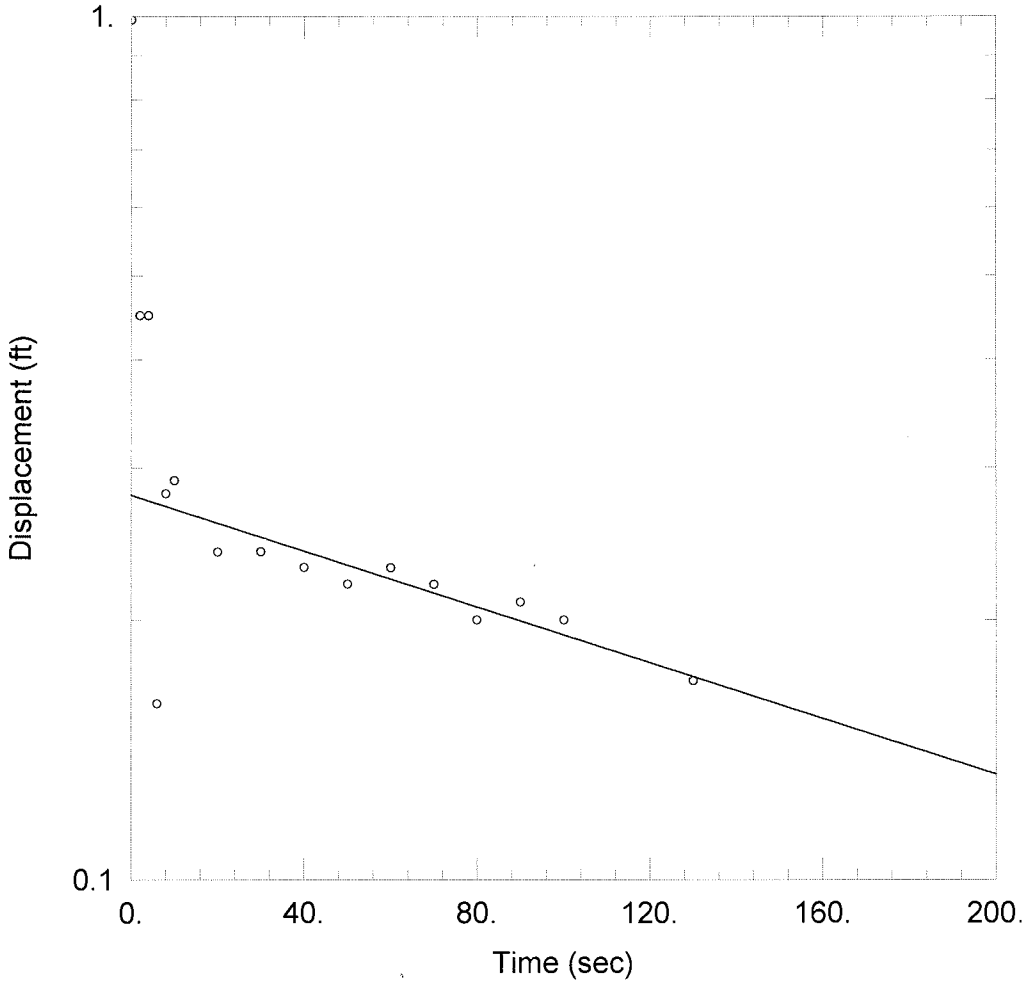
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-2)

Initial Displacement: 0.99 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.27 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.022 ft/day
y0 = 0.3014 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-2 1 HV.aqt
Date: 04/16/15 Time: 09:02:20

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-2

AQUIFER DATA

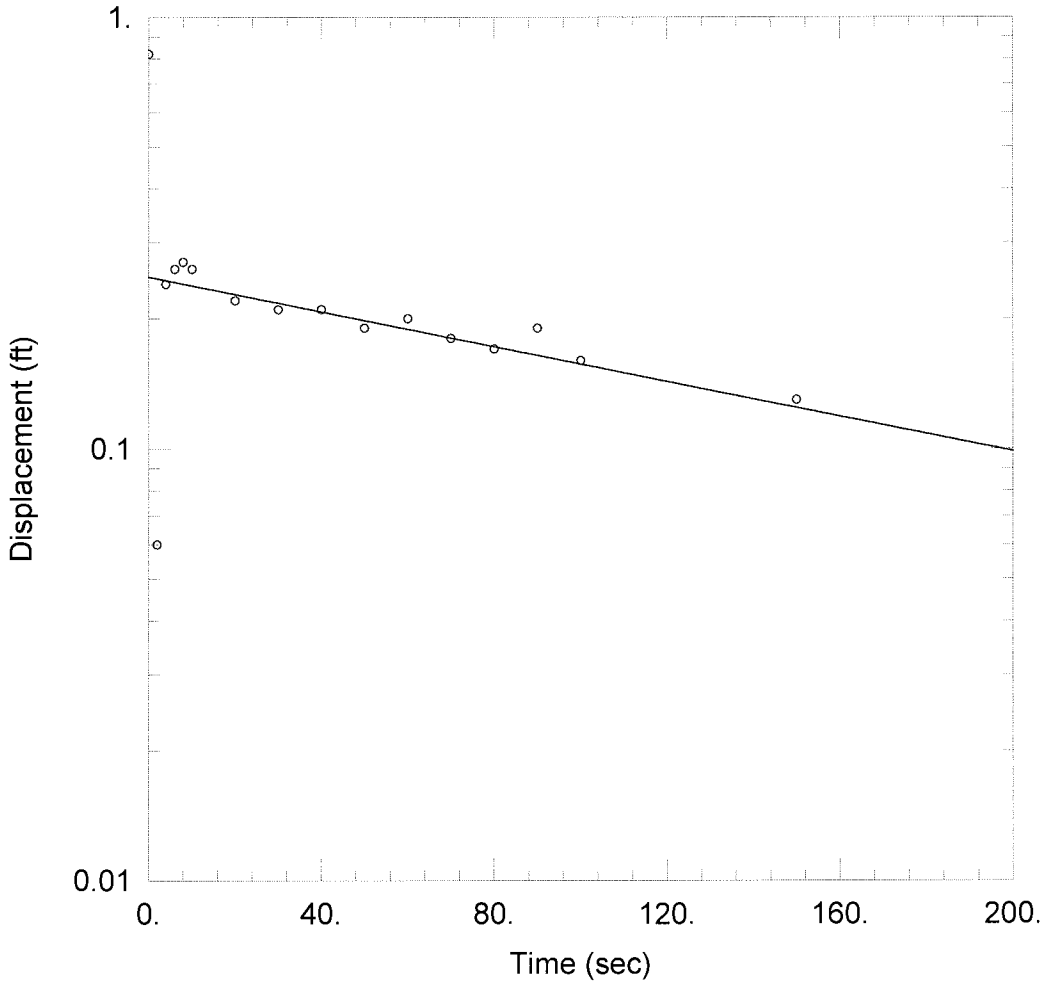
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-2)

Initial Displacement: 0.99 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.27 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
K = 1.114 ft/day
Solution Method: Hvorslev
y0 = 0.279 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-2 2 BR.aqt
Date: 04/16/15 Time: 09:02:15

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Location: Cedar Wash Trail
Test Well: B-2

AQUIFER DATA

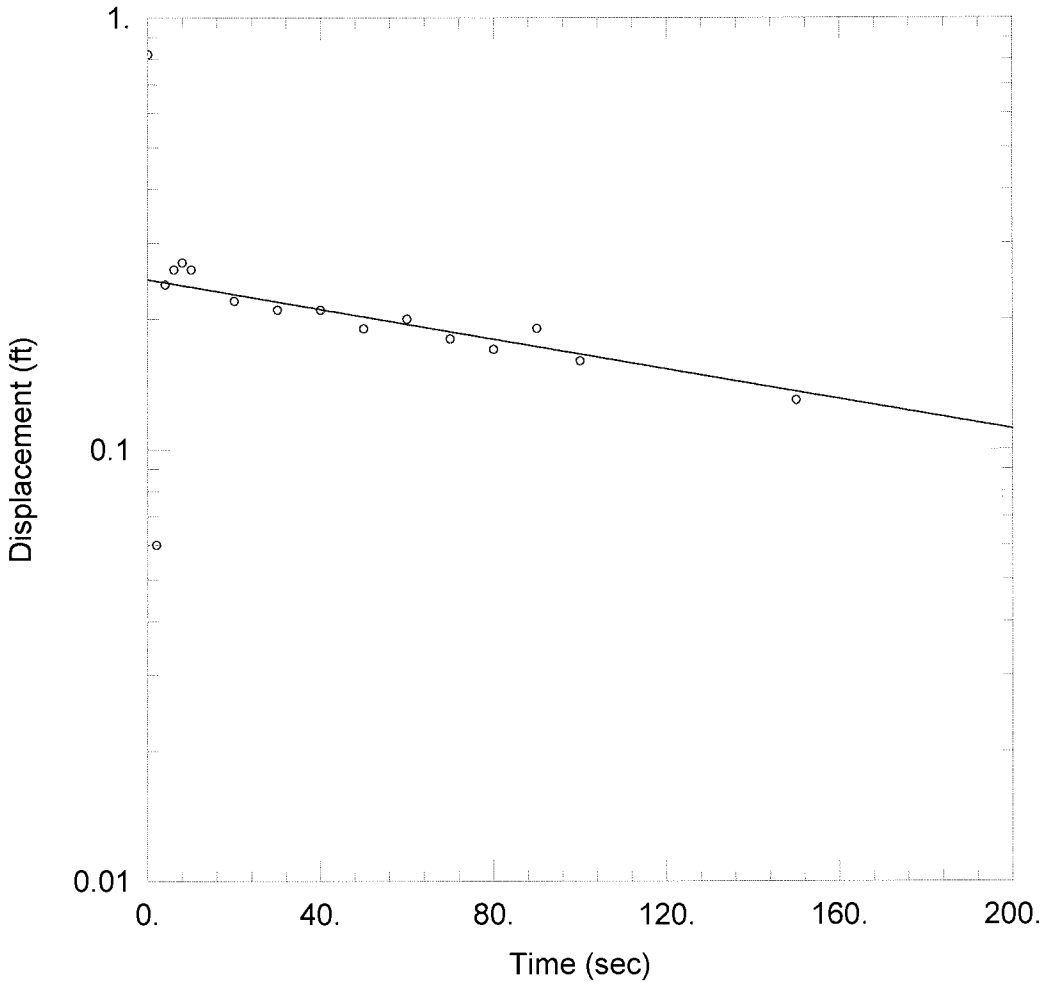
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 0.82 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.27 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.032 ft/day
y0 = 0.2497 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-2 2 HV.aqt
Date: 04/16/15 Time: 09:02:11

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Location: Cedar Wash Trail
Test Well: B-2

AQUIFER DATA

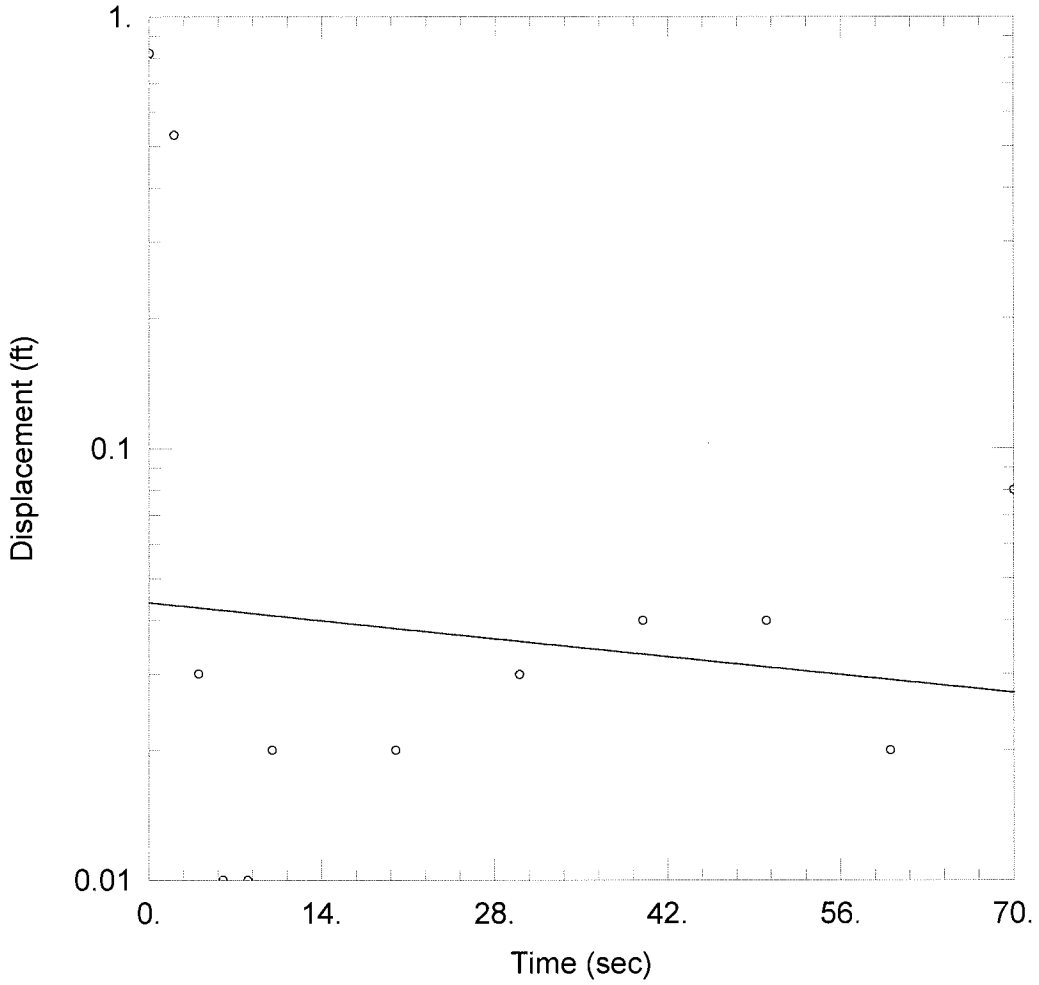
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 0.82 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.27 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.188 ft/day
y0 = 0.2471 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-2 3 BR.aqt
Date: 04/16/15 Time: 09:02:06

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-2

AQUIFER DATA

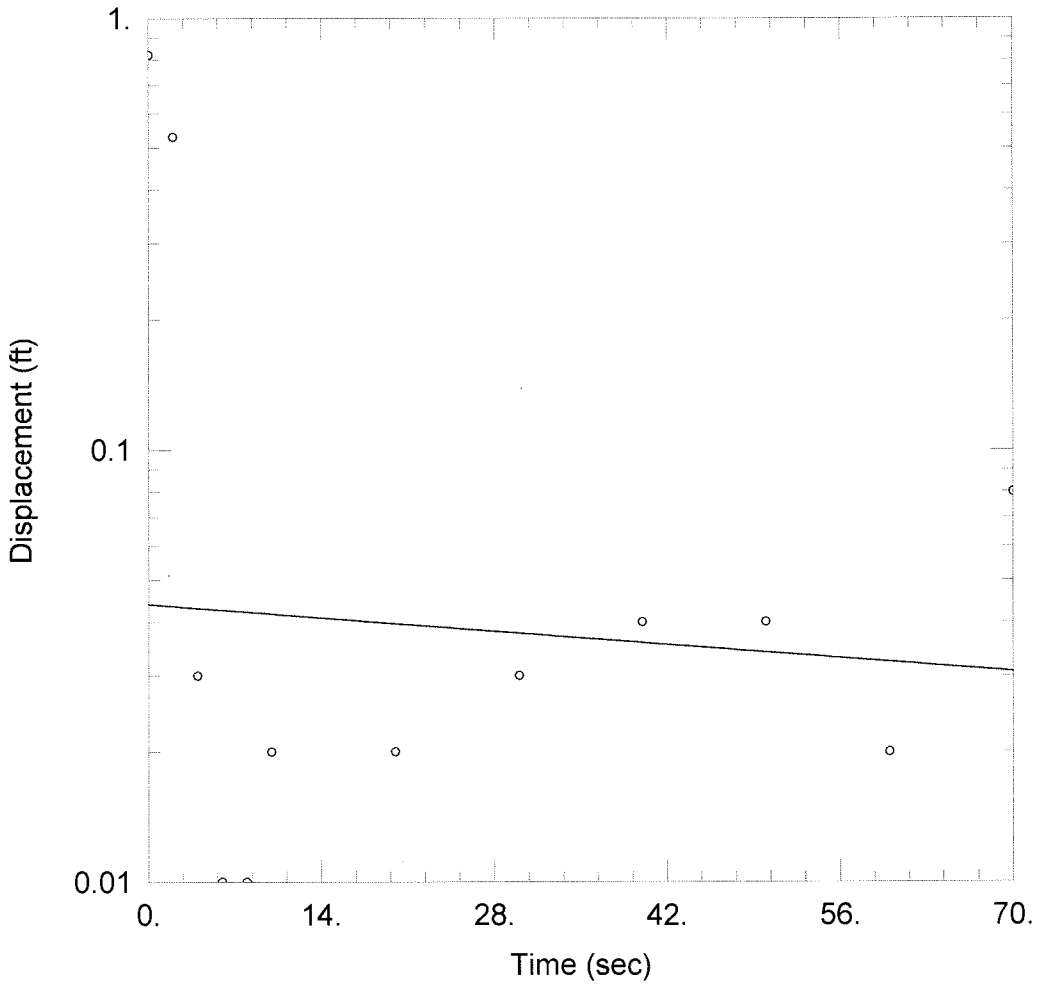
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-2)

Initial Displacement: 0.82 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.66 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.526 ft/day
y0 = 0.04397 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-2 3 HV.aqt
Date: 04/16/15 Time: 09:02:02

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 30371002
Test Well: B-2

AQUIFER DATA

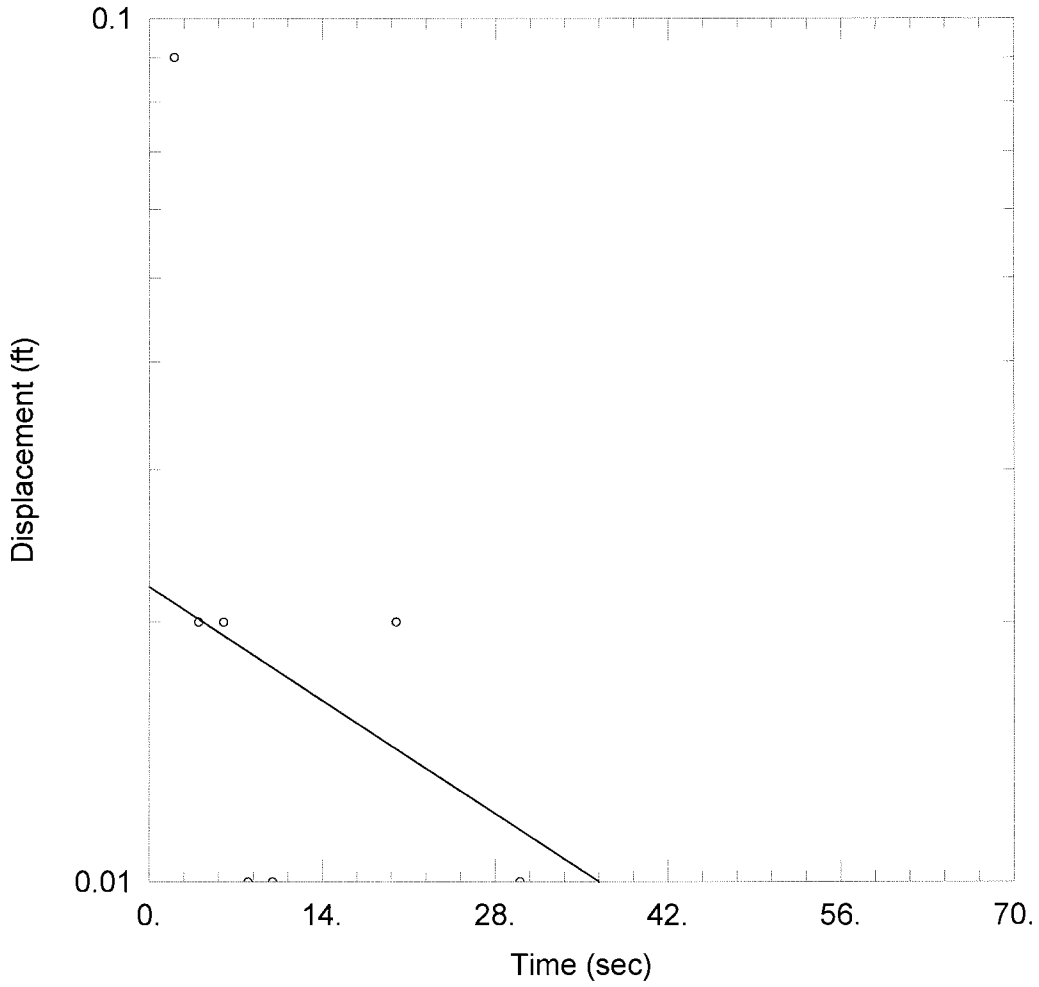
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 0.82 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.66 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
K = 1.526 ft/day
Solution Method: Hvorslev
y0 = 0.04397 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-6 1 BR.aqt
Date: 04/16/15 Time: 09:15:58

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-6

AQUIFER DATA

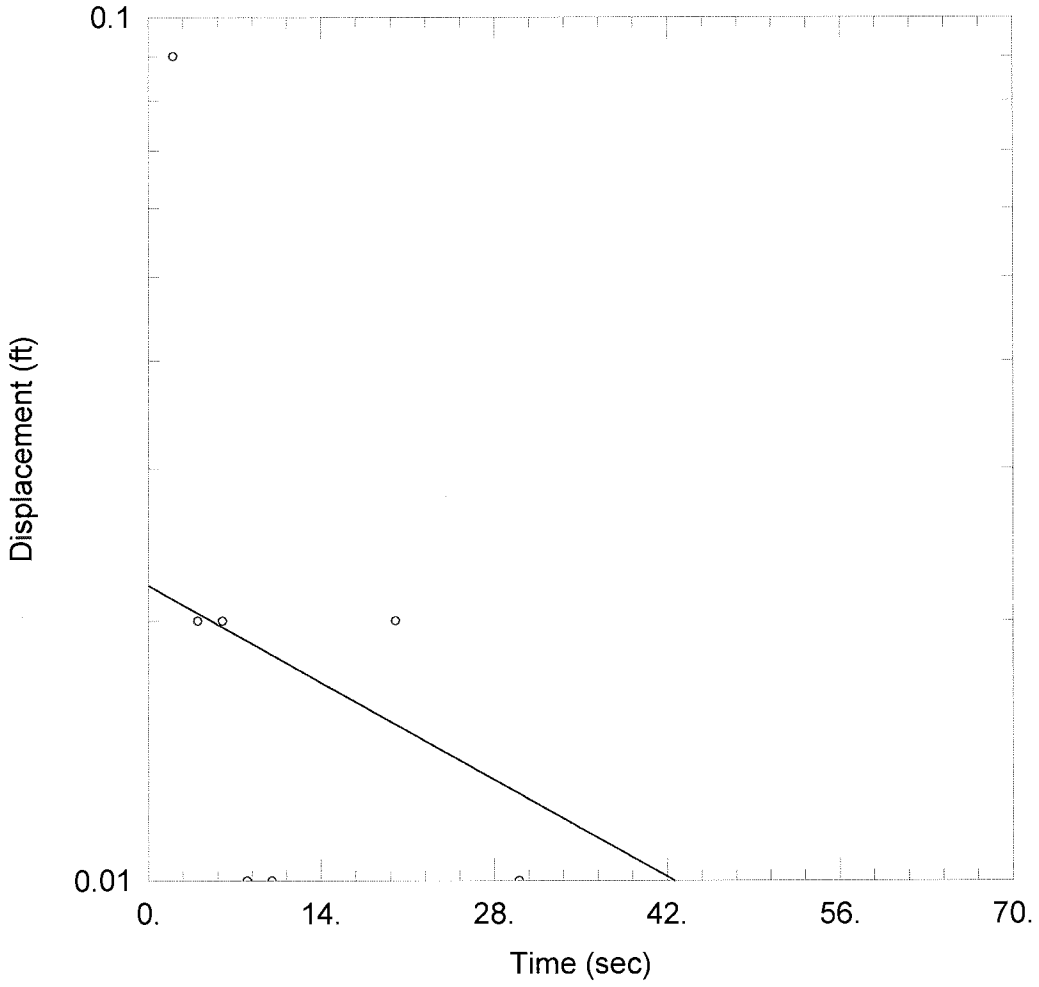
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-6)

Initial Displacement: 0.26 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.66 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.816 ft/day
y0 = 0.02197 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-6 1 HV.aqt
Date: 04/16/15 Time: 09:15:53

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303739004
Test Well: B-6

AQUIFER DATA

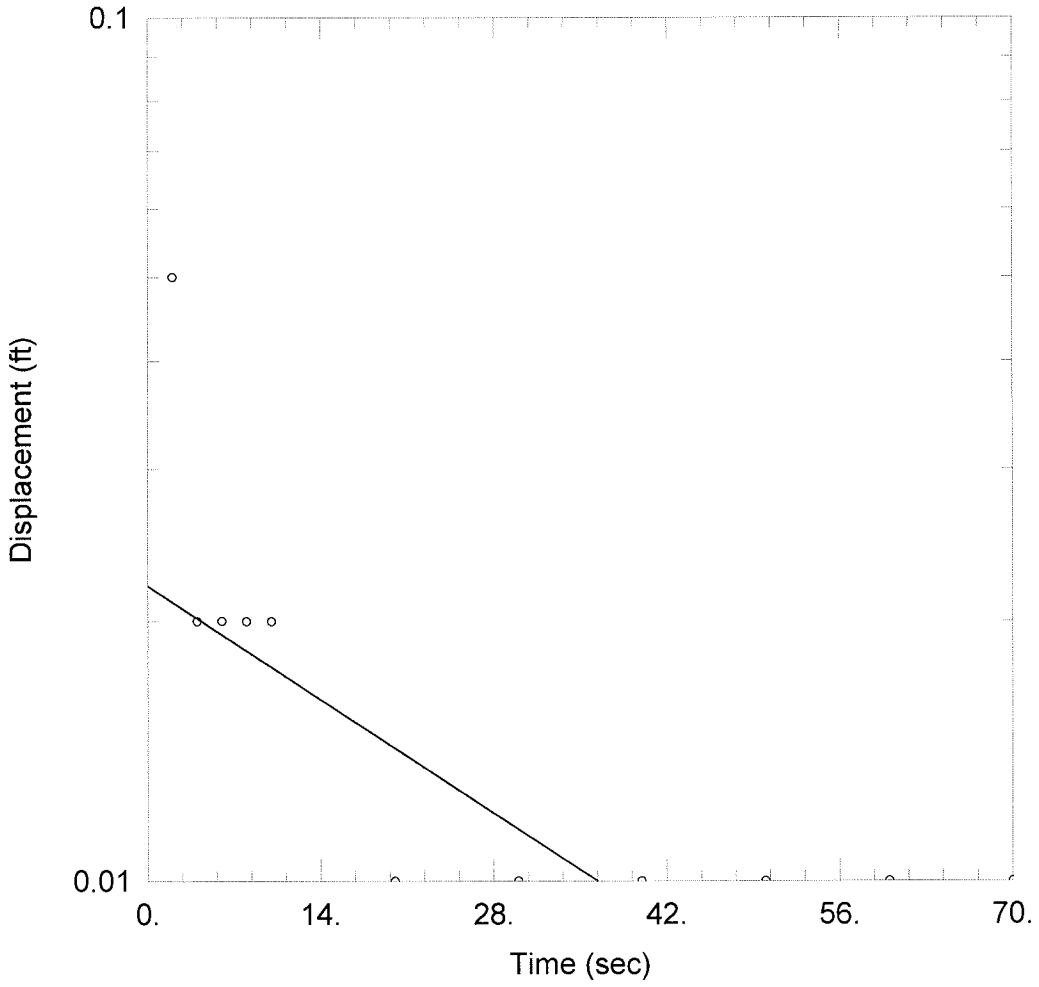
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-6)

Initial Displacement: 0.26 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.66 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.528 ft/day
y0 = 0.02196 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-6 2 BR.aqt
Date: 04/16/15 Time: 09:15:43

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-6

AQUIFER DATA

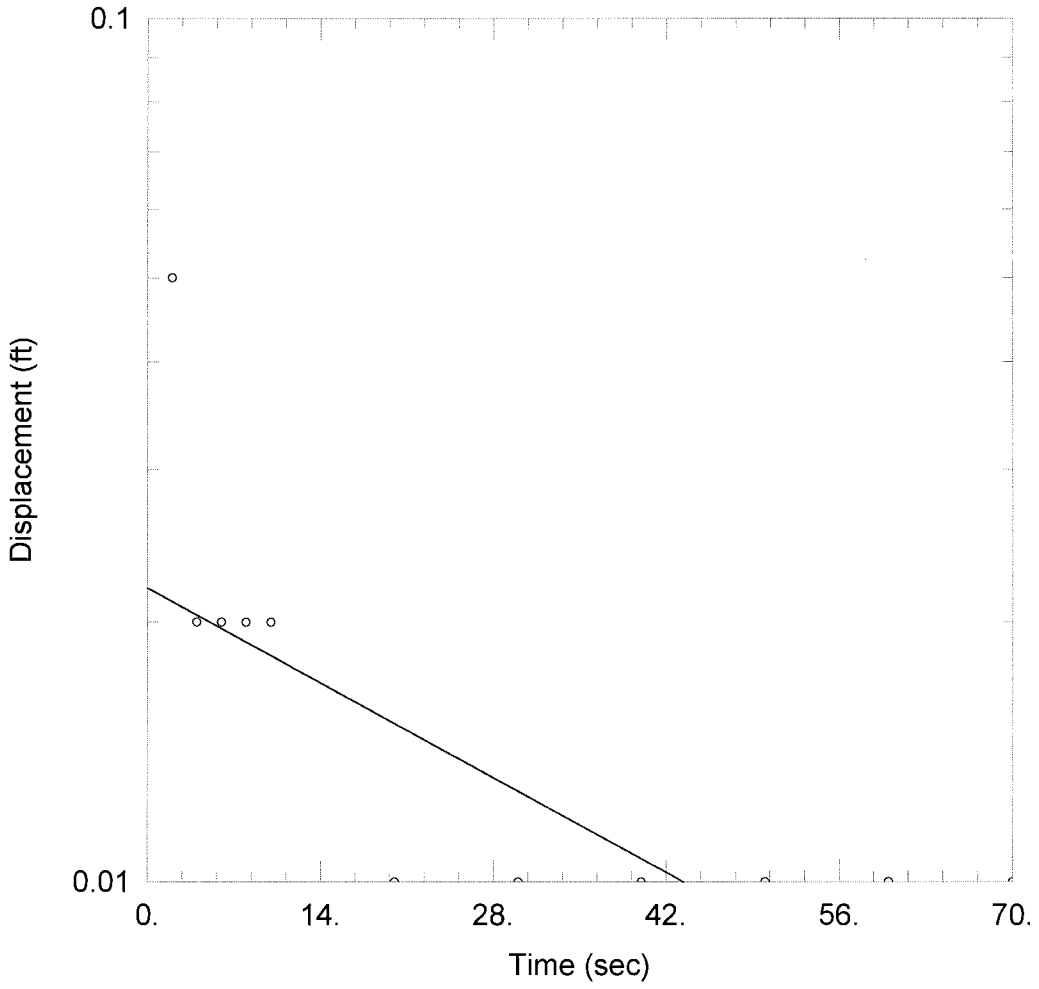
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 0.15 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.66 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.816 ft/day
y0 = 0.02197 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-6 2 HV.aqt
Date: 04/16/15 Time: 09:15:49

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-2

AQUIFER DATA

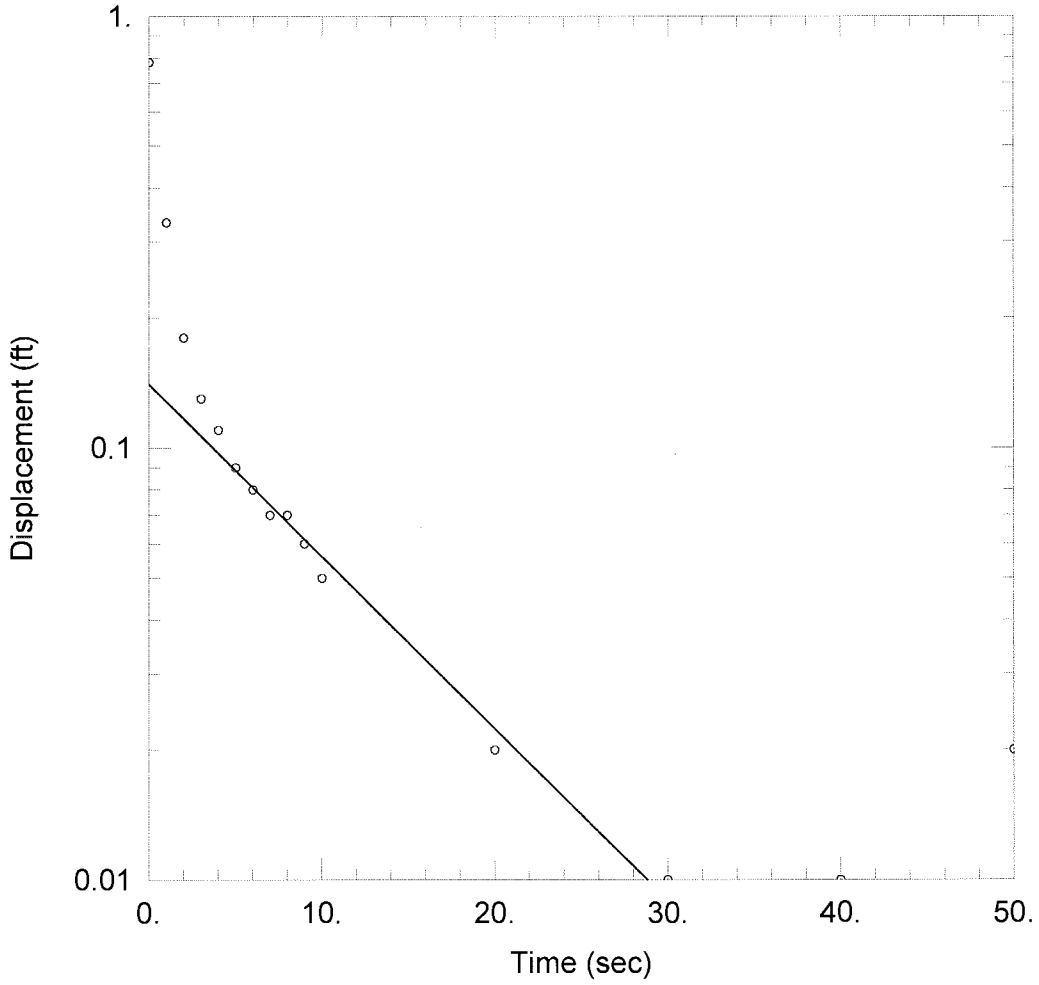
Saturated Thickness: 5.27 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 0.15 ft
Total Well Penetration Depth: 18. ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.66 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.405 ft/day
y0 = 0.02189 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-20 1 BR.aqt
Date: 04/16/15 Time: 09:21:36

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-20

AQUIFER DATA

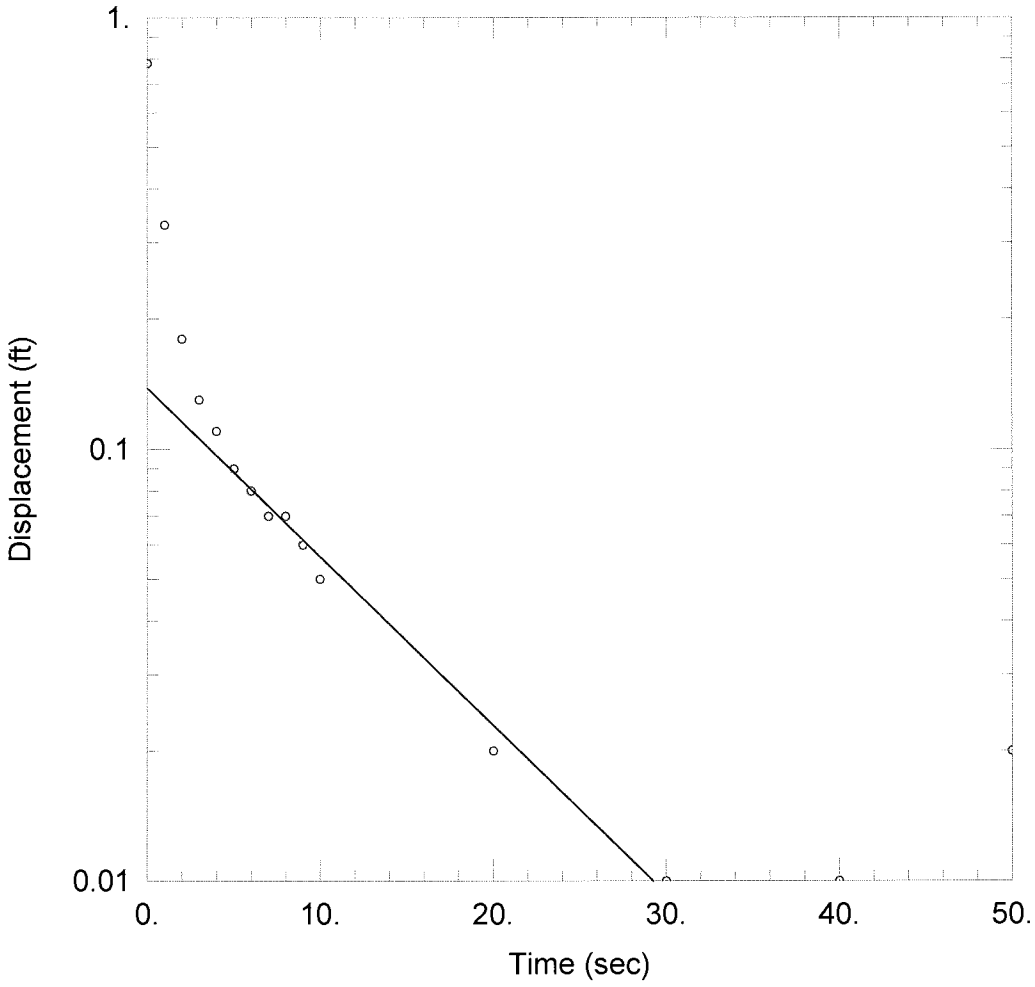
Saturated Thickness: 4.85 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-20)

Initial Displacement: 0.78 ft
Total Well Penetration Depth: 24. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.85 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
K = 23.03 ft/day
Solution Method: Bouwer-Rice
y0 = 0.1403 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-20 1 HV.aqt
Date: 04/16/15 Time: 09:21:32

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-20

AQUIFER DATA

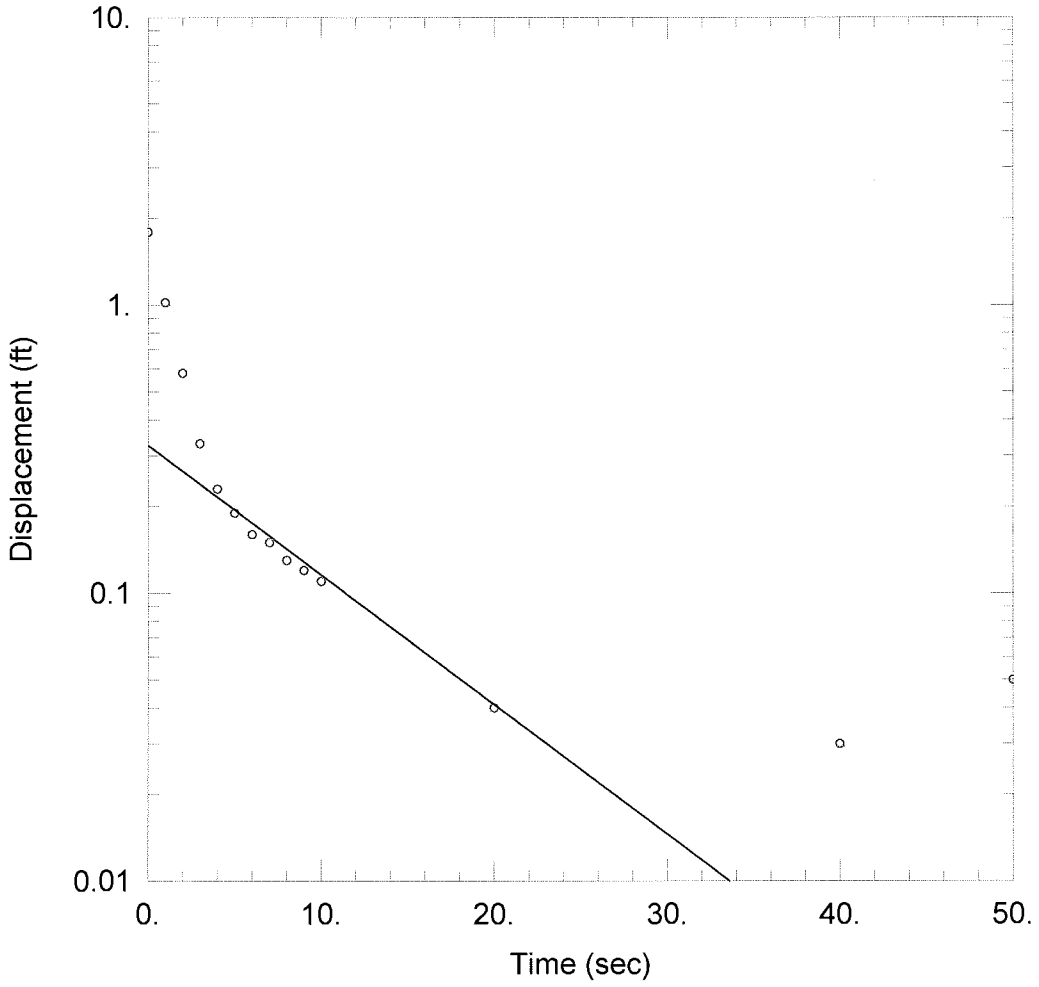
Saturated Thickness: 4.85 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (B-20)

Initial Displacement: 0.78 ft
Total Well Penetration Depth: 24. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.85 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 29.22 ft/day
y0 = 0.1384 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-20 2 BR.aqt
Date: 04/16/15 Time: 09:21:27

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-20

AQUIFER DATA

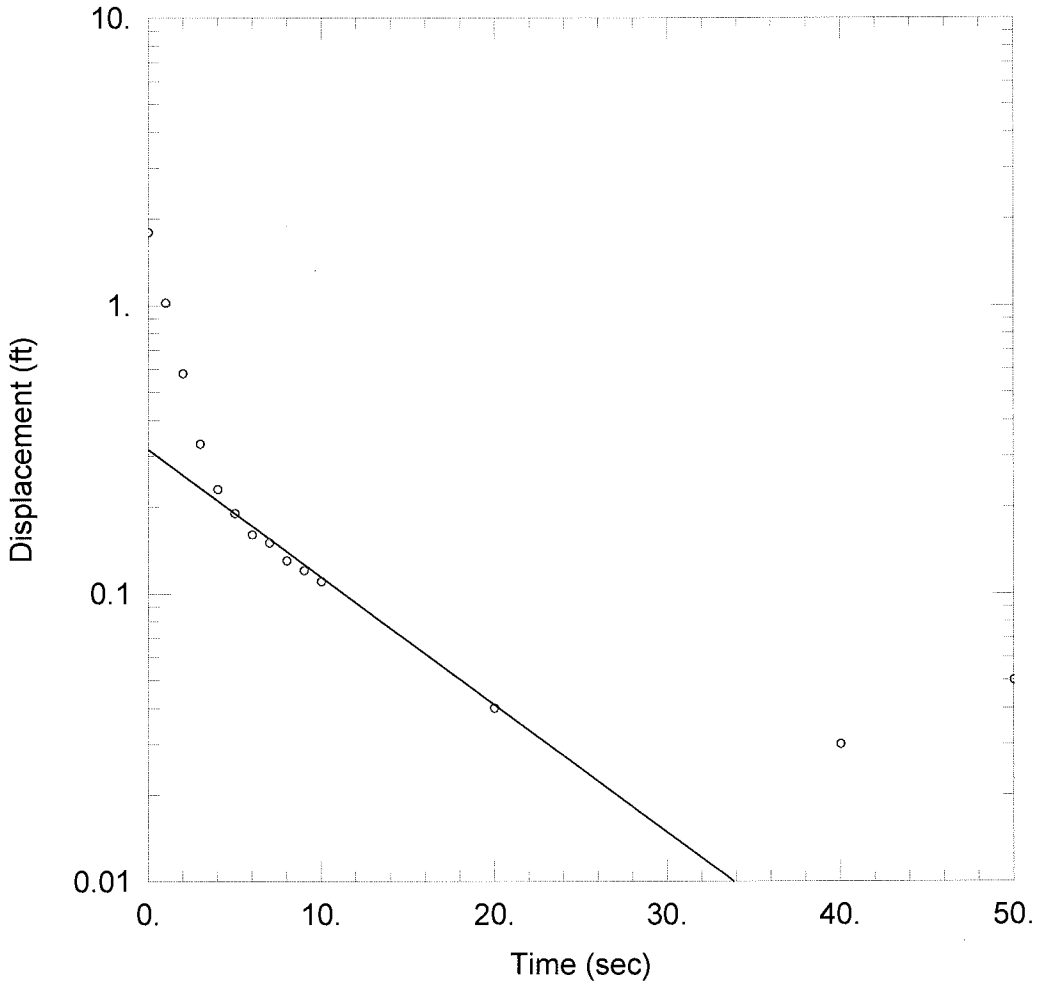
Saturated Thickness: 4.85 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 1.79 ft
Total Well Penetration Depth: 24. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.85 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 26.03 ft/day
y0 = 0.3259 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-20 2 HV.aqt
Date: 04/16/15 Time: 09:21:23

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-20

AQUIFER DATA

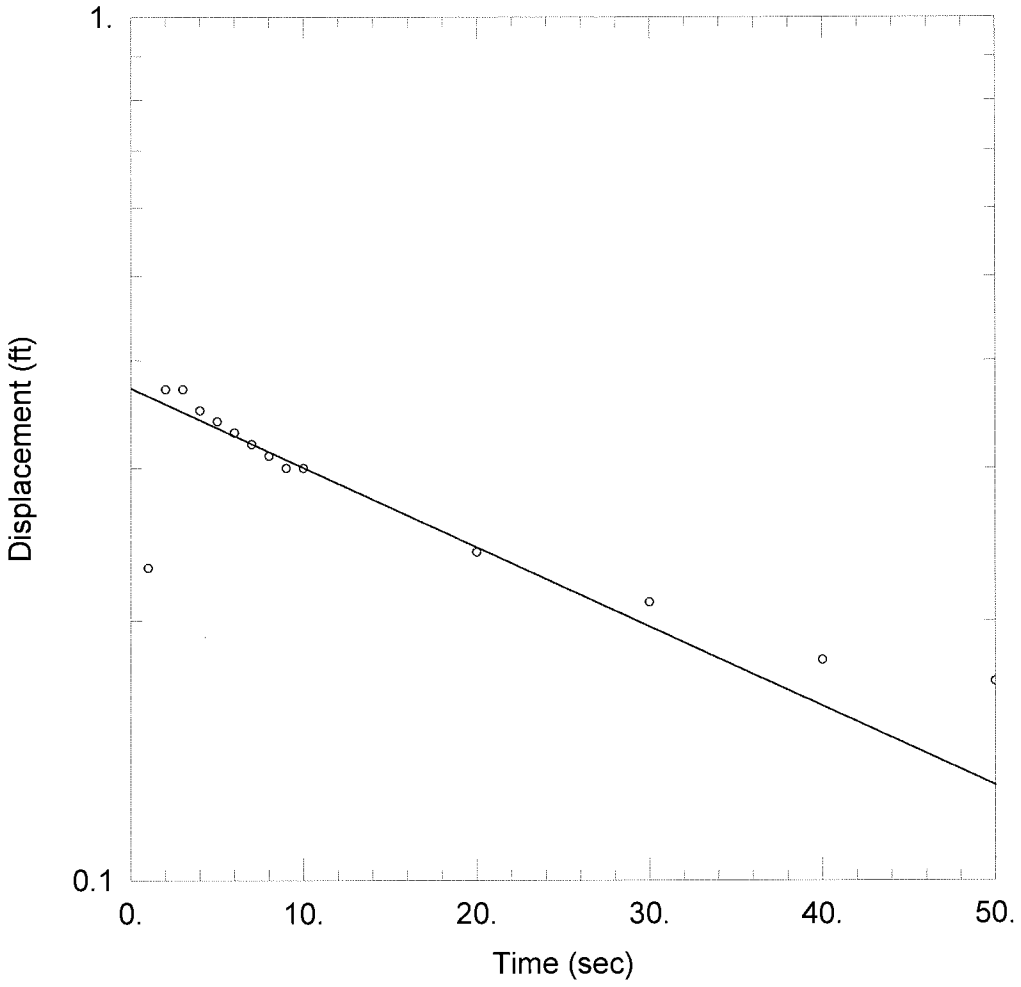
Saturated Thickness: 4.85 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 1.79 ft
Total Well Penetration Depth: 24. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.85 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 33.18 ft/day
y0 = 0.3157 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-20 3 BR.aqt
Date: 04/16/15 Time: 09:21:19

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-20

AQUIFER DATA

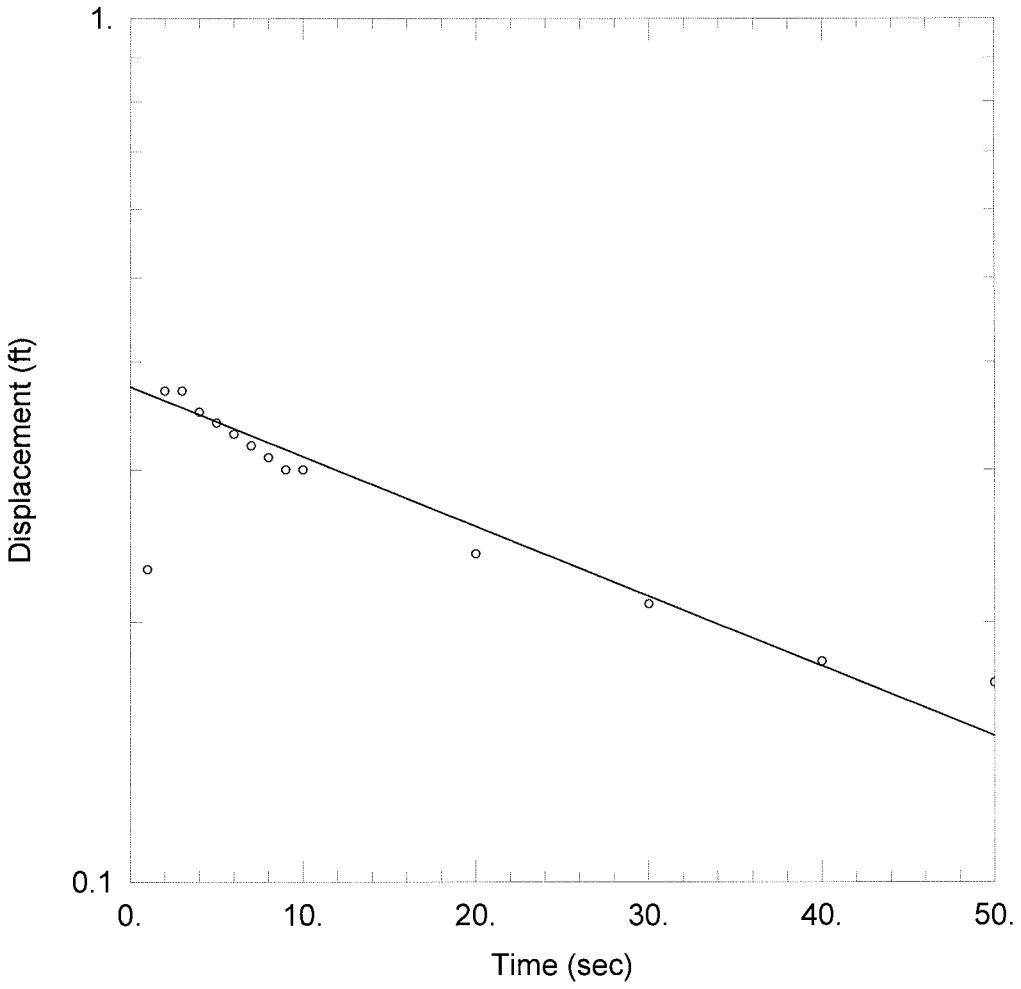
Saturated Thickness: 4.85 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 1.19 ft
Total Well Penetration Depth: 24. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.85 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
K = 5.315 ft/day
Solution Method: Bouwer-Rice
y0 = 0.3713 ft



WELL TEST ANALYSIS

Data Set: G:\File Share\CJB.temp\303710002 Cedar Trail DW\303739002 Cedar Trail\B-20 3 HV.aqt
Date: 04/16/15 Time: 09:21:14

PROJECT INFORMATION

Company: Ninyo & Moore
Project: 303710002
Test Well: B-20

AQUIFER DATA

Saturated Thickness: 4.85 ft
Anisotropy Ratio (Kz/Kr): 0.01

WELL DATA (New Well)

Initial Displacement: 1.19 ft
Total Well Penetration Depth: 24. ft
Casing Radius: 0.083 ft
Static Water Column Height: 4.85 ft
Screen Length: 10. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
K = 6.048 ft/day
Solution Method: Hvorslev
y0 = 0.3745 ft

ATKINS

Las Vegas Wash Central, Cedar Avenue Channel

Preliminary Design Report

June 22, 2015

Prepared for City of Las Vegas, Nevada

Prepared by ATKINS North America, Inc.
2270 Corporate Circle, Suite 200
Henderson NV 89074-7755
702.263.7275



ATKINS

June 22, 2015

Rosa Cortez, P.E.
Engineering Project Manager
City of Las Vegas.
Department of Public Works
333 Rancho Drive
Las Vegas, Nevada 89107

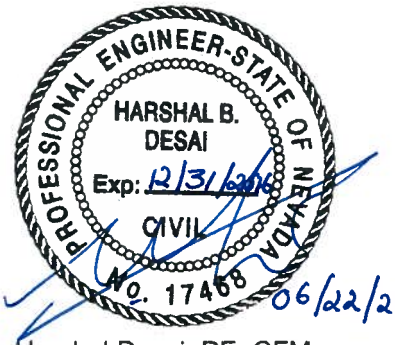
RE: Preliminary Design Report for Las Vegas Wash Central, Cedar Avenue Channel

Dear Ms. Cortez,

Transmitted herewith are the Preliminary Design Report and the 30% Design Plan Submittal for the Las Vegas Wash Central, Cedar Avenue Channel Project (Cedar Avenue Channel).

Please feel free to contact me if you have any questions.

Sincerely,



Harshal Desai, PE, CFM
Project Manager

Atkins • 2270 Corporate Circle, Suite 200, Henderson, NV 89074 • Tel. 702.263.7275 • Fax. 702.263.7200 • www.atkinsglobal.com

Executive Summary

This Preliminary Design Report (PDR) has been prepared to describe the 30% design and analysis of the Las Vegas Wash Central, Cedar Avenue Channel project (hereafter referred to as the CAC). The project improvements extend from the Las Vegas Wash at the downstream end to the intersection of Pecos Road and Stewart Avenue at the upstream end. The regional facilities encompassed in this project are described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers CACH 0000 through 0148 and CACN 0001.

The project involves expanding the existing Cedar Avenue Channel from a trapezoidal channel to a rectangular channel ranging from 25 to 36 feet wide and from 6 to 17 feet deep. The project also involves installing approximately 2,000 feet of RCB storm drain upstream of the channel that varies in size from a 12' x 6' RCB to an 18' x 4' RCB. The proposed storm drain facilities will extend from the upstream end of the Cedar Avenue Channel to the intersection of Pecos Road and Stewart Avenue. The project entails the construction of these facilities and associated collection system including, but not limited to: laterals, drop inlets, manholes, and all necessary appurtenances to complete the Cedar Avenue Channel improvements.

It should be noted that the original Scope of Services previously provided for this project assumed that the storm drain improvements would extend west in Stewart Avenue from Pecos Road to Mojave Road and in Pecos Road south of Stewart Avenue to Sunrise Avenue. However, due to preliminary hydrologic/hydraulic analysis and coordination with the City, the project extents were shifted downstream in order to design channel improvements that will increase the limited capacity of the existing Cedar Avenue Channel.

Hydrologic analysis has been performed using the HEC-1 computer program to develop 100-year design flows for the CAC. These design flows were subsequently used in the hydraulic analysis to size the conveyance facilities accordingly. Hydraulic calculations for the storm drain were based on normal depth calculations and WSPG modeling, while the open channel portion of the project was analyzed using HEC-RAS.

The 30% Design Plans are provided with this PDR submittal. Other important aspects of the 30% design effort are presented in this PDR, including geotechnical investigations, survey summary, required permits, right-of-way information, and utility conflicts.

The overall, estimated construction cost of the project is **$16,652,193**, which includes a 15-percent contingency to offset the level of detail provided at this submittal phase.

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Appendix C Geotechnical Investigations

- Appendix C-1: Draft Geotechnical Data Report
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- Appendix C-3: Draft Hydrogeologic Aquifer Testing Report

Appendix D Record of Survey

Appendix E Utility Conflict Schedule

Appendix F Cost Estimate

Electronic Data CD

- Preliminary Drainage Memorandum
- Cedar Avenue Channel Capacity Analysis
- Hydrologic/Hydraulic Models
- Geotechnical Reports
- PDF version of the Preliminary Design Report
- PDF version of the 30% Design Plans

1. Introduction

1.1. Purpose

The purpose of this Preliminary Design Report (PDR) is to describe the criteria, parameters, considerations, assumptions, and methodology used in the preliminary design and analysis of the Las Vegas Wash Central, Cedar Avenue Channel (hereafter referred to as CAC). This PDR includes pertinent aspects of the project explored to date and facilitates review of the design by the City of Las Vegas (the City), the Clark County Regional Flood Control District (CCRFCD), and other stakeholders.

It is important to note that the proposed drainage system and the associated analysis presented in this PDR is still a work in progress and represents the latest information corresponding to the 30% milestone submittal. Thus, the analysis, design, and information presented herein are subject to amendments, additions, and revisions in the future as comments are received and more analyses are completed throughout the detailed design phase. The content presented herein will later be updated as necessary and incorporated into the Draft Final Design Report at the 70% milestone.

1.2. Project Description and Location

The scope of services to be provided under the terms of the project contract includes the design and preparation of contract drawings, special provisions, cost estimates, and reports for the CAC. The project improvements extend from the Las Vegas Wash at the downstream end to the intersection of Pecos Road and Stewart Avenue at the upstream end. The regional facilities encompassed in this project are described in the 2013 Las Vegas Valley Flood Control Master Plan Update (MPU) as facility numbers CACH 0000 through 0148 and CACN 0001.

The project involves expanding the existing Cedar Avenue Channel from a trapezoidal channel to a rectangular channel ranging from 25 to 36 feet wide and from 6 to 17 feet deep. At this phase of the design the intent is to preserve all of the existing bridge crossings along the channel and make improvements to the channel section only. The project also involves installing approximately 2,000 feet of RCB storm drain upstream of the channel that varies in size from a 12’ x 6’ RCB to an 18’ x 4’ RCB. The proposed storm drain facilities will extend from the upstream end of the Cedar Avenue Channel to the intersection of Pecos Road and Stewart Avenue. The project entails the construction of these facilities and associated collection system including, but not limited to: laterals, drop inlets, manholes, and all necessary appurtenances to complete this project.

There will also be drop inlet facilities and lateral storm drains required on the north and south of Stewart Avenue, just west of Pecos Road, to collect runoff from the street and convey it to the main storm drain facility. Detailed sizes, location, and alignments of the proposed storm drain facilities are shown on the 30% Design Plans that accompany this report and will be described later in this PDR.

The project site is located in the area referred to as the “Central Watershed” in the 2013 MPU, within Sections 31 and 32 of Township 20S, Range 62E and Section 36 of Township 20S, Range 61E. The general project location is shown on a vicinity map in **Figure 1**. **Figure 2** is a reproduction of Figure F-26 and Table F-26 from the 2008 MPU that show the original alignment and geometry of the proposed system. **Figure 3** shows the general location (alignment) of the CAC.

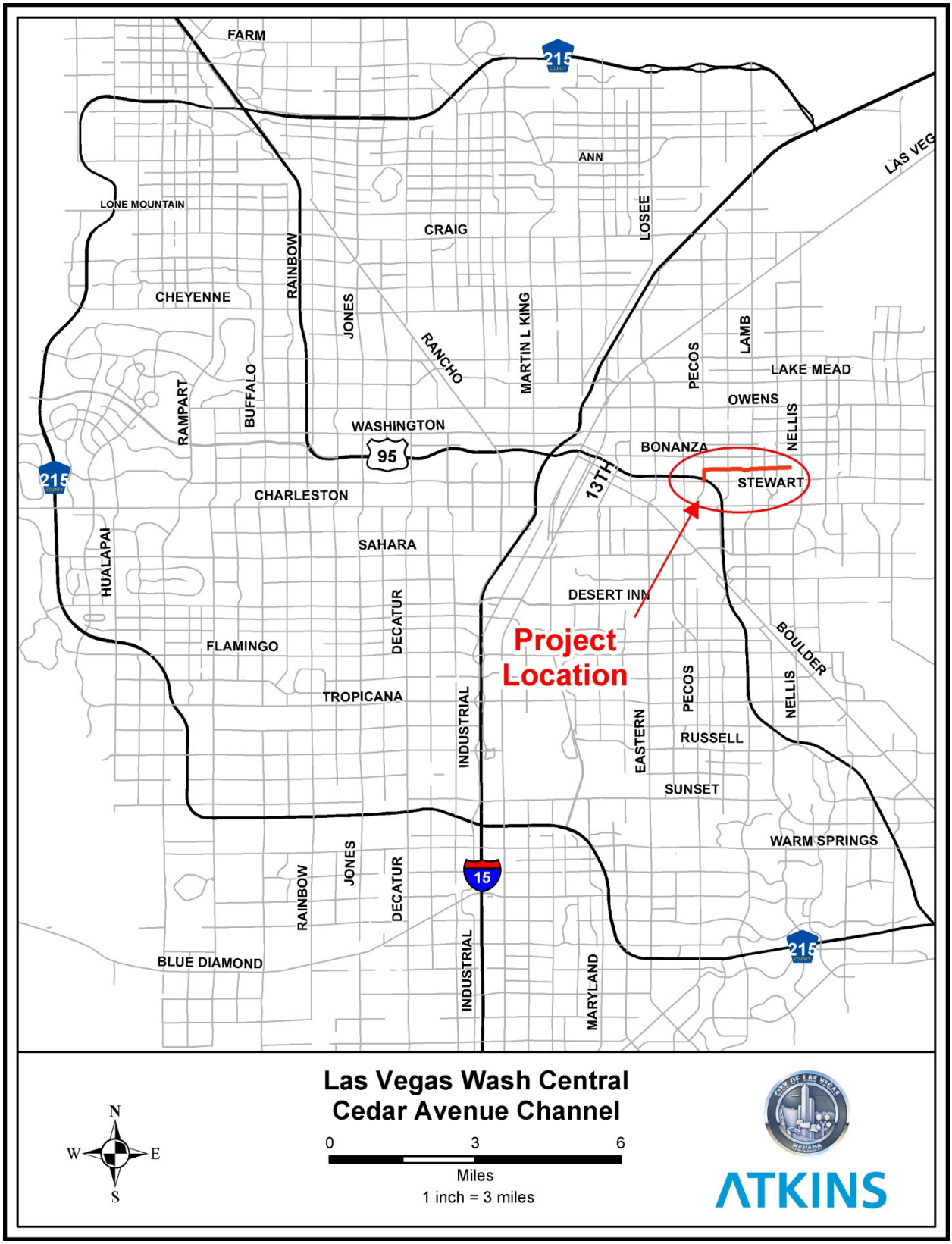


Figure 1. Cedar Avenue Channel Project Vicinity Map

REGIONAL FLOOD CONTROL DISTRICT

2013
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FIGURE F- 32
FLOOD CONTROL FACILITIES

LEGEND

- Ultimate Development Boundary
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Local Existing Facilities
- Local Proposed Facilities
- Detention Basin
- Stormdrain
- Lined Channel
- Unlined Channel
- Levee/Dike
- Natural Wash/Floodway
- ID-Mile Separator

Remove & Replace/Parallel Facilities

Category A	Category B
Channel	Channel
Stormdrain	Stormdrain

Project Location

N

0 500 1,000 2,000 3,000
Feet

Scale: 1 inch = 2,000 feet

Refer to Figure G-2 for Aerial Source(s)

US95 I-15 I-215

		1	2	3				A1	A2			
		4	5	6				A3	A4			
			7	8	9	10	A5	A6				
	11	12	13	14	15	16	17					
		18	19	20	21	22	23					
		24	25	26	27	28						
		29	30	31	32	33	34					
		35	36	37	38	39	40					
		41	42	43	44	45	46					
		47	48	49	50	51	52					
		53	54	55	56							
		57	58	59								

Figure 2 - 2013 MPU Flood Control Facility Map

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BHSA		**BOULDER HIGHWAY SAHARA AVENUE**						
0000	P2	14' X 10' RCB	1350	3837	CSA13*	SW3	7.93	0.50
0026	P1	14' X 11' RCB	4000	3837	CSA13*	SW3	7.93	1.30
0075	P1	12' X 11' RCB	5280	3837	CSA13*	SW3	7.93	2.11
0175	P1	14' X 14' RCB	6000	3837	CSA13	SW3	7.93	0.67
CABZ		**CEDAR AVENUE - BONANZA**						
0000	E	72" RCP	525					0.30
0010	E	66" RCP	1450					0.30
CACH		**CEDAR AVENUE CHANNEL**						
0000	E	Conc Chnl 10'W 8'D 1.5:1 SS	1681	1544	CCA10-C	SW3	1.81	0.20
0027	E	2: 15'X5' RCBC @ Marion	82	1544	CCA10-C	SW3	1.81	0.35
0029	E	Conc Chnl 10'W 8'D 1.5:1 SS	1284	1544	CCA10-C	SW3	1.81	0.37
0051	E	2: 15'X5' RCBC @ Page	64	1544	CCA10-C	SW3	1.81	0.38
0053	E	Conc Chnl 10'W 6'D 1.5:1 SS	1275	1544	CCA10-C	SW3	1.81	0.38
0079	E	2: 12' X 6' RCBC @ Lamb	100	1387	CCA08-C	SW3	1.61	0.38
0081	E	Conc Chnl 12'W 6'D 1.5:1 SS	2562	1387	CCA08-C	SW3	1.61	0.20
0127	E	3: 12'X4' RCBC @ Sandhill	80	1387	CCA08-C	SW3	1.61	0.20
0129	E	Conc Chnl 10'W 8'D 1.5:1 SS	971	1387	CCA08-C	SW3	1.61	0.26
0146	E	2: 12' X 5.5' RCBC @ Honolulu	62	1387	CCA08-C	SW3	1.61	0.53
0148	E	Conc Chnl 10'W 8'D 1.5:1 SS	959	1387	CCA08-C	SW3	1.61	0.53
CACN		**CEDAR AVENUE - CHARLESTON**						
0000	E	72" RCP (Replace w/ CACN0001)	1867	933	CCA05	SW3	0.96	0.41
0001	P1	10 'X 9' RCB (Replaces CACN0000)	1867	933	CCA05	SW3	0.96	0.41
0034	E	2: 48" RCP (Replace w/ CACN0035)	685	254	CA05	SW3	0.24	0.30
0035	P0	6' X 6' RCB (Replaces CACN0034)	685	254	CA05	SW3	0.24	0.30
0049	E	66" RCP (Replace w/ CACN0050)	2146	254	CA05	SW3	0.24	0.60
0050	P0	6' X 5' RCB (Replaces CACN0049)	2146	254	CA05	SW3	0.24	0.60
CNST		**CEDAR AVENUE CHANNEL - STEWART**						
0000	P1	8' X 7' RCB	2120	690	CCA04	SW3	0.72	0.90
COLM		**COLORADO / LAMB**						
0000	E	72" RCP	1500	470	CCH94	SW3	0.63	0.87
FLAG		**FLAMINGO WASH - ALGONQUIN**						
0000	E	72" RCP	1080	513	FW21	FLAM3A	0.47	0.50
0020	E	66" RCP	460	513	FW21	FLAM3A	0.47	1.00
FLBN		**FLAMINGO - BOULDER HIGHWAY NORTH**						
0001	E	5: 10' X 6' RCB	350	4784	CCFR03	BOULDER4	11.13	0.58
0008	E	3: 14' X 12' RCB	1055	4784	CCFR03	BOULDER4	11.13	0.20
0028	E	3: 14' X 12' RCB	275	4784	CCFR03	BOULDER4	11.13	0.20
0033	E	3: 14' X 12' RCB	500	4784	CCFR03	BOULDER4	11.13	0.20
0038	P1	15' X 10' RCB	6600	2448	CFR03	SW3	3.46	0.59
0167	P1	2: 10' X 6' RCB	700	2046	CCH68-C	SW3	2.86	1.14
0180	P1	2: 10' X 6' RCB	1300	1799	CCCH67-C	SW3	2.55	1.31
0205	P1	10' X 6' RCB	4000	1461	CCH63-C	SW3	1.88	2.30
0281	P1	10' X 7' RCB	3100	1259	CCH56	SW3	1.64	1.33
0312	P1	7' X 4' RCB	1800	555	CCH52	SW3	0.55	4.20
0342	P1	7' X 4'' RCB	2500	555	CCH52	SW3	0.55	4.20
FLBS		**FLAMINGO - BOULDER HIGHWAY SOUTH**						
0000	E	Unlined Median Chnl 0'W 6.5'D 4.5:1 SS	4060	945	CB4	FLAM3A	1.38	1.30
0167	E	Unlined Median Chnl 0'W 3.5'D 9:1 SS	8850	452	CB4N	FLAM3A	0.63	0.90
FLDN		**DESERT INN DRAIN EAST**						
0000	E	60" RCP (Replace w/ FLDN0001)	6160	1267	CFW30AW	FLAM3A	2.12	1.22
0001	P0	12' X 6' RCB (Replaces FLDN0000)	6160	1267	CFW30AW	FLAM3A	2.12	1.22
0116	E	54" RCP (Replace w/ FLDN0117)	2330	1178	CFW29	FLAM3A	1.82	1.77
0117	P0	10' X 6' RCB (Replaces FLDN0116)	2330	1178	CFW29	FLAM3A	1.82	1.77
0160	E	48" RCP (Replace w/ FLDN0160)	2950	906	CFW28	FLAM3A	1.51	1.28
0161	P0	10' X 6' RCB (Replaces FLDN0161)	2950	906	CFW28	FLAM3A	1.51	1.28

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
FLMP		**FLAMINGO WASH-MARYLAND PARKWAY SYSTEM**						
0000	P1	8' X 6' RCB	3800	492	CCH60A-C	SW3	0.75	0.49
FLSP		**FLAMINGO WASH - SPENCER**						
0000	E	48" RCP	420	513	FW21	FLAM3A	0.47	1.10
FLWA		**FLAMINGO WASH**						
0000	E	Grass Chnl 107'W 5'D 2:1 SS (Replace w/ FLWA0001)	4570	10952	CFW36*	FLAM5B	36.14	0.40
0001	P1	Conc Chnl 100'W 7.5'D 1:1 SS (Replaces FLWA0000)	4570	10952	CFW36*	FLAM5B	36.14	0.40
0078	E	3 Span Bridge 108.25'W 5.5'D @ Nellis	120	10952	CFW36	FLAM5B	36.14	0.70
0080	E	Conc Chnl 50'W 8.5'D 1:1 SS	5080	10952	CFW36	FLAM5B	36.14	1.20
0174	E	9: 10' X 6' RCBC @ Lamb	110	10822	CFW34	FLAM5B	35.66	1.40
0176	E	Conc Chnl 60'W 9'D 1:1 SS	1180	10822	CFW34	FLAM5B	35.66	0.70
0200	E	Conc Chnl 70'W 8'D to 12'D w/ Pier 0:1 SS	1245	10822	CFW34	FLAM5B	35.66	0.50
0226	E	Free Span Bridge 100'W 10'D @ I-515	170	10822	CFW34	FLAM5B	35.66	0.80
0228	E	Conc Chnl 70'W 8'D to 12'D 0:1 SS	1500	10788	CFW33	FLAM5B	35.36	0.80
0255	E	2 Span Bridge 150'W 9'D @ Boulder Hwy	65	10788	CFW33	FLAM5B	35.36	1.00
0256	E	Conc Chnl 60'W 7.5'D 0:1 SS	40	8146	CFW33W	FLAM5B	24.23	1.00
0257	E	2 Span Bridge 150'W 9'D @ Boulder Hwy	60	8146	CFW33W	FLAM5B	24.23	1.00
0258	E	Conc Chnl 60'W 7.5'D 0:1 SS	750	8146	CFW33W	FLAM5B	24.23	0.44
0273	E	Free Span Bridge 60'W 9'D @ MMMHP	20	8146	CFW33W	FLAM5B	24.23	0.40
0274	E	Conc Chnl 60'W 8.1'D 0:1 SS	1370	8146	CFW33W	FLAM5B	24.23	1.00
0295	E	Conc Chnl 60'W 8.1'D 0:1 SS	430	7669	CFW31	FLAM5B	22.62	0.80
0307	E	Conc Chnl 60'W 8.1'D 2:1 SS	410	7669	CFW31	FLAM5B	22.62	0.70
0314	E	Conc Chnl 60'W 8.1'D 2:1 SS	1500	7195	CFW30B	FLAM5B	21.25	0.90
0347	E	5: 10' X 8' RCBC @ Mojave	80	7195	CFW30B	FLAM5B	21.25	0.94
0348	E	Conc Chnl 30'W 12'D 1:1 SS	1150	7195	CFW30B	FLAM5B	21.25	0.70
0375	E	5: 10' X 8' RCBC @ Desert Inn	140	7102	CFW30A	FLAM5B	20.96	2.70
0377	E	Conc Chnl 50'W 9.5'D 0:1 SS	1372	6964	CFW23	FLAM5B	19.36	1.04
0399	E	Free Span Bridge 60'W 16'D @ McLeod	120	6964	CFW23	FLAM5B	19.36	0.50
0401	E	Conc Chnl 50'W 11.5'D 0:1 SS	123	6964	CFW23	FLAM5B	19.36	0.50
0406	E	Conc Chnl 33'W 11.5'D 0:1 SS	690	6964	CFW23	FLAM5B	19.36	1.01
0419	E	Conc Chnl 33'-50'W 9.8'D 0:1 SS	200	6964	CFW23	FLAM5B	19.36	2.00
0423	E	Conc Chnl 50'W 9.8'D 0:1 SS	1686	6964	CFW23	FLAM5B	19.36	0.76
0455	E	Conc Chnl 50'-75'W 9.8'D 0:1 SS	169	6964	CFW23	FLAM5B	19.36	1.83
0458	E	Conc Chnl 75'-80'W 9.8'D 0:1 SS	347	6964	CFW23	FLAM5B	19.36	1.50
0471	E	5: 10' X 8' RCBC @ Eastern	110	5781	CFW22W	FLAM5B	14.95	1.30
0472	P1	Add 1: 22' X 8' RCBC @ Eastern	110	5781	CFW22W	FLAM5B	14.95	0.50
0473	E	Grass Chnl 60'W 15'D 2:1 SS	100	5781	CFW22W	FLAM5B	14.95	0.47
0477	E	3 Span Bridge 47'W 15'D	10	5781	CFW22W	FLAM5B	14.95	0.80
0478	E	Grass Chnl 60'W 15'D 2:1 SS	520	5781	CFW22W	FLAM5B	14.95	0.47
0481	E	3: 90" CMAP @ Tioga (Replace w/ FLWA0482)	60	5781	CFW22W	FLAM5B	14.95	0.87
0482	P1	4: 20' X 8' RCBC @ Tioga (Replaces FLWA0481)	60	5781	CFW22W	FLAM5B	14.95	0.87
0483	E	Grass Chnl 60'W 15'D 2:1 SS	300	5781	CFW22W	FLAM5B	14.95	0.63
0492	E	3 Span Bridge 47'W 15'D	10	5781	CFW22W	FLAM5B	14.95	0.50
0493	E	Grass Chnl 60'W 15'D 2:1 SS	1520	5781	CFW22W	FLAM5B	14.95	0.46
0555	E	3 Span Bridge 47'W 15'D	10	5701	CFW21	FLAM5B	14.55	0.50
0556	E	Earth Chnl 60'W 15'D 2:1 SS (Replace w/ FLWA0557)	520	5701	CFW21	FLAM5B	14.55	0.54
0557	P1	Gabion Chnl 30'W 10.5'D 2:1 SS (Replaces FLWA0556)	520	5701	CFW21	FLAM5B	14.55	0.54
LVBZ		**LAS VEGAS WASH - BONANZA**						
0000	P1	2: 12' X 7' RCB	3400	1636	CBN15-C	SW3	2.40	0.40
0064	P1	2: 12' X 6' RCB	2630	1449	CBN12-C	SW3	2.12	0.40
0114	P1	2: 12' X 6' RCB	2740	1256	CBN10-C	SW3	1.79	0.40
0166	E	54" RCP (Replace w/ LVBZ0167)	1095	1051	CBN09	SW3	1.54	0.45
0167	P0	10' X 9' RCB (Replaces LVBZ0166)	1095	1051	CBN09	SW3	1.54	0.45
0187	E	48" RCP (Replace w/ LVBZ0188)	1235	1051	CBN09	SW3	1.54	0.71
0188	P0	9' X 9' RCB (Replaces LVBZ0187)	1235	1051	CBN09	SW3	1.54	0.71
0210	E	42" RCP (Replace w/ LVBZ0211)	704	911	CBN08	SW3	1.30	1.37
0211	P0	8' X 7' RCB (Replaces LVBZ0210)	704	911	CBN08	SW3	1.30	1.37
0223	E	36" RCP (Replace w/ LVBZ0224)	2275	722	CBN03	SW3	1.09	0.72
0224	P0	8' X 7' RCB (Replaces LVBZ0223)	2275	722	CBN03	SW3	1.09	0.72

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
LVCA		**LAS VEGAS WASH - CHARLESTON**						
0000	P1	12' X 9' RCB	4600	1104	CCH77-C	SW3	1.34	0.30
LVCO		**COLORADO AVENUE SYSTEM**						
0000	E	18' X 8' RCB	610	1015	CNEL06	SW3	1.30	0.24
0012	E	14' X 8' RCB	2560	1015	CNEL06	SW3	1.30	0.24
0064	E	10' X 8' RCB	2165	827	CCCH94	SW3	0.98	0.24
0106	E	10' X 8' RCB	590	394	CCH92-C	SW3	0.35	0.24
0109	E	10' X 5' RCB	2350	394	CCH92-C	SW3	0.35	0.67
LVMD		**LAS VEGAS WASH - MIDDLE**						
1032	E	Earth Chnl 75'W 10'-12'D 1:1 SS (Replace w/ LVMD1033)	715	15156	CNLWY	CLVWASH5	118.28	0.30
1033	P1	Conc Chnl 75'W 11'D 1:1 SS (Replaces LVMD1032)	739	15156	CNLWY	CLVWASH5	118.28	0.30
1045	E	5 Span Bridge 75'W 10'D 1:1 SS (Replace w/ LVMD1046)	120	15156	CNLWY	CLVWASH5	118.28	0.52
1046	P1	Bridge 75'W 9.5'D 1:1 SS @ Nellis (Replaces LVMD1045)	120	15156	CNLWY	CLVWASH5	118.28	0.52
1047	E	Earth Chnl 80'W 8'D 2:1 SS (Replace w/ LVMD1048)	340	15083	CCNEL06	CLVWASH5	117.81	0.50
1048	P1	Conc Chnl 120'W 8'D 0:1 SS (Replaces LVMD1047)	340	15083	CCNEL06	CLVWASH5	117.81	0.50
1053	E	Earth Chnl 80'W 8'D 2:1 SS (Replace w/ LVMD1054)	860	14811	CNEL04-2	CLVWASH5	116.51	0.50
1054	P1	Conc Chnl 120'W 8'D 0:1 SS (Replaces LVMD1053)	860	14811	CNEL04-2	CLVWASH5	116.51	0.50
1068	E	5 Span Bridge 90'W 6'D 2:1 SS (Replace w/ LVMD1069)	120	14438	CCST03-C	CLVWASH5	114.87	0.50
1069	P1	5 Span Bridge 110'W 8'D 2:1 SS (Replaces LVMD1068)	120	14438	CCST03-C	CLVWASH5	114.87	0.50
1070	E	Earth Chnl 90'W 10'-12'D 1.5:1 SS (Replace w/ LVMD1071)	2587	14438	CCST03-C	CLVWASH5	114.87	0.43
1071	P1	Conc Chnl 90'W 9'D 1.5:1 SS (Replaces LVMD1070)	2587	14438	CCST03-C	CLVWASH5	114.87	0.43
1119	E	5 Span Bridge 90'W 12'D 2:1 SS @ Stewart	120	14354	CCCA10-C	CLVWASH5	114.40	0.20
1120	E	Earth Chnl 90'W 12'D 1:1 SS (Replace w/ LVMD1121)	1400	14354	CCCA10-C	CLVWASH5	114.40	0.20
1121	P1	Conc Chnl 90'W 10.5'D 1:1 SS (Replaces LVMD1120)	1400	14354	CCCA10-C	CLVWASH5	114.40	0.20
1148	E	Earth Chnl 70'W 18'-20'D 1.5:1 SS (Replace w/ LVMD1149)	1675	13944	CCBN15-C	CLVWASH5	112.59	0.41
1149	P1	Conc Chnl 70'W 10'D 1.5:1 SS (Replaces LVMD1148)	1675	13944	CCBN15-C	CLVWASH5	112.59	0.41
1176	E	5 Span Bridge 110'W 20'D 2:1 SS @ Bonanza	120	12690	CLVW04-C	CLVWASH5	106.80	0.57
1178	E	Earth Chnl 30'W 18'-20'D 2:1 SS (Replace w/ LVMD1179)	1500	12690	CLVW04-C	CLVWASH5	106.80	0.57
1179	P1	Conc Chnl 60'W 9.5'D 2:1 SS (Replaces LVMD1178)	1500	12690	CLVW04-C	CLVWASH5	106.80	0.57
LVNE		**LAS VEGAS WASH - NELLIS**						
0000	P1	2: 13' X 10' RCB	4675	2303	CNEL02-C	WEST3	3.39	0.20
LVOE		**OWENS AVENUE - EAST**						
0345	P1	13' X 11' RCB	1685	2369	DLVOE	SW5	22.79	0.60
LVWH		**WASHINGTON AVENUE CHANNEL**						
0389	E	12' X 8' RCB	2110	1607	(1/2) CV1-C	SW5SC	15.16	0.90
0426	E	16' X 8' RCB	150	1607	(1/2) CV1-C	SW5SC	15.16	1.08
0429	E	Splitter Structure (2: 12' X 8' RCB)	190	2870	DCLC21	SW5	22.79	1.90
0431	E	3: 14.33' X 10' RCB	665	2870	DCLC21	SW5	22.79	0.15
0446	E	Junction Structure	69	2870	DCLC21	SW5	22.79	0.15
0447	E	3: 14.33' X 10' RCB	1955	4978	CCAL93	SW5	22.19	0.15
NLFL		**NELLIS FLAMINGO STORM DRAIN**						
0028	P0	Add 1: 7' X 6' RCB	1530	338^	CM3^	FLAM3A	1.27	0.39
0029	E	76" & 48" RCP	1530	391^	CM3^	FLAM3A	1.27	0.39
0059	E	60" RCP	1370	143^	CM3^	FLAM3A	1.27	0.30
0060	P0	Add 1: 12' X 6' RCB	1370	586^	CM3^	FLAM3A	1.27	0.34
0084	E	48" RCP	2490	79^	CM2^	FLAM3A	0.98	0.30
0085	P0	Add 1: 11' X 6' RCB	2490	505^	CM2^	FLAM3A	0.98	0.30
0131	E	42" RCP	650	350	M1	FLAM3A	0.51	0.23
0144	E	36" RCP	620	350	M1	FLAM3A	0.51	0.20
NLWY		**NELLIS - WYOMING CHANNEL**						
0000	E	Conc Chnl 8'W 4'D 1.3:1 SS	260	338	FW35	FLAM3A	0.47	1.71
0004	E	15' X 6' RCAC	80	338	FW35	FLAM3A	0.47	1.30
0006	E	Conc Chnl 8'W 4'D 1.3:1 SS	400	338	FW35	FLAM3A	0.47	0.38
0014	E	12' X 4' RCBC @ Winterwood	70	338	FW35	FLAM3A	0.47	0.40
0015	E	Conc Chnl 8'W 4'D 1.3:1 SS	720	338	FW35	FLAM3A	0.47	0.38
0028	E	12' X 4' RCBC @ Wyoming	90	338	FW35	FLAM3A	0.47	0.80
0030	E	Conc Chnl 8'W 4'D 1.3:1 SS	250	338	FW35	FLAM3A	0.47	0.38
SAEA		**SAHARA AVENUE - EASTERN LATERAL**						
0000	P1	10' X 8' RCB	1440	564	CFR02	SW3	0.66	0.20

ID / River Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
VAVD		**VEGAS VALLEY DRIVE**						
0000	P1	8' X 6' RCB	1300	606	CFW32WW	FLAM3A	0.84	2.10
0025	P1	84" RCP	5300	606	CFW32WW	FLAM3A	0.84	1.60
VBCH		**VAN BUSKIRK CHANNEL**						
0000	E	12' X 3' RCB	500	888	CVB16	FLAM3A	1.16	1.00
0008	E	8' X 5' RCB	5490	888	CVB16	FLAM3A	1.16	1.00
VBEA		**VAN BUSKIRK - EASTERN AVE**						
0000	P1	14' X 6' RCB	3020	1561	CVB11	FLAM3A	3.35	1.30
VBMC		**VAN BUSKIRK - McLEOD DRIVE**						
0000	E	2: 8' X 8' RCB	3850	997	CVB13	FLAM3A	3.43	0.50
VBTW		**VAN BUSKIRK - TWAIN**						
0000	E	18" RCP	6640	541	CB2	FLAM3A	0.74	0.70
WAGC		**WASHINGTON AVENUE CHANNEL - GRAND CENTRAL**						
0000	E	2: 12' X 4' RCB	700	557	LC21	SW3	0.60	0.20
0014	E	1: 12' X 4' RCB and 1: 11' X 4' RCB	2440	557	LC21	SW3	0.60	0.20
WAPR		**WASHINGTON AVENUE CHANNEL PARALLEL**						
0132	E	2: 9' X 8' RCB	387	1607	(1/2) CV1-C	SW5SC	15.16	1.67

** The HEC-1 node shown identifies the controlling concentration point for the associated facility and is located upstream of this facility due to decreasing peak flow with increasing tributary area caused by storm distribution transitions, depth area reduction factors, or attenuation of flow from routing.*

*** As-built or design slopes were used when available. All other slopes are based on existing topography. The user should verify the facility slope listed prior to performing any facility specific analysis.*

^ For parallel facilities, the existing facility flow equals its normal depth capacity, and the proposed parallel facility flow equals the remaining flow (i.e., HEC-1 Node flow = existing facility normal depth capacity + proposed parallel facility flow).

REGIONAL FLOOD CONTROL DISTRICT

2013 LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

FACILITY INVENTORY
FIGURE F - 32

LEGEND

ID (Facility Identifier) AABB
- Parent Stream Name
- Stream Name

River Mile 0000
- Distance Above Confluence with Parent Stream (Miles)
- Miles in Hundredths

Existing Facility.....E
Proposed or Modified Facility.....P
Contingency Level
- Category B.....P0
- Master Plan.....P1
- Preliminary Design.....P2
- Design.....P3

Bottom Width.....W
Depth.....D
Side Slope, H:V.....SS

Construction Features

Cast in Place Concrete Pipe	CIPCP	Reinforced Concrete Arch Culvert	RCAC
Corrugated Metal Arch Pipe Culvert	CMAP	Reinforced Concrete Box	RCB
Corrugated Metal Pipe Culvert	CMPC	Reinforced Concrete Box Culvert	RCBC
High Density Polyethylene	HDPE	Reinforced Concrete Pipe	RCP
Horizontal Elliptical Reinforced Concrete Pipe	HERCP	Reinforced Concrete Pipe Culvert	RCPC
Reinforced Concrete Arch Pipe	RCAP	Storm Sewer Pipe	SSP

Figure 2 (continued) - 2013 MPU Facility Inventory Table

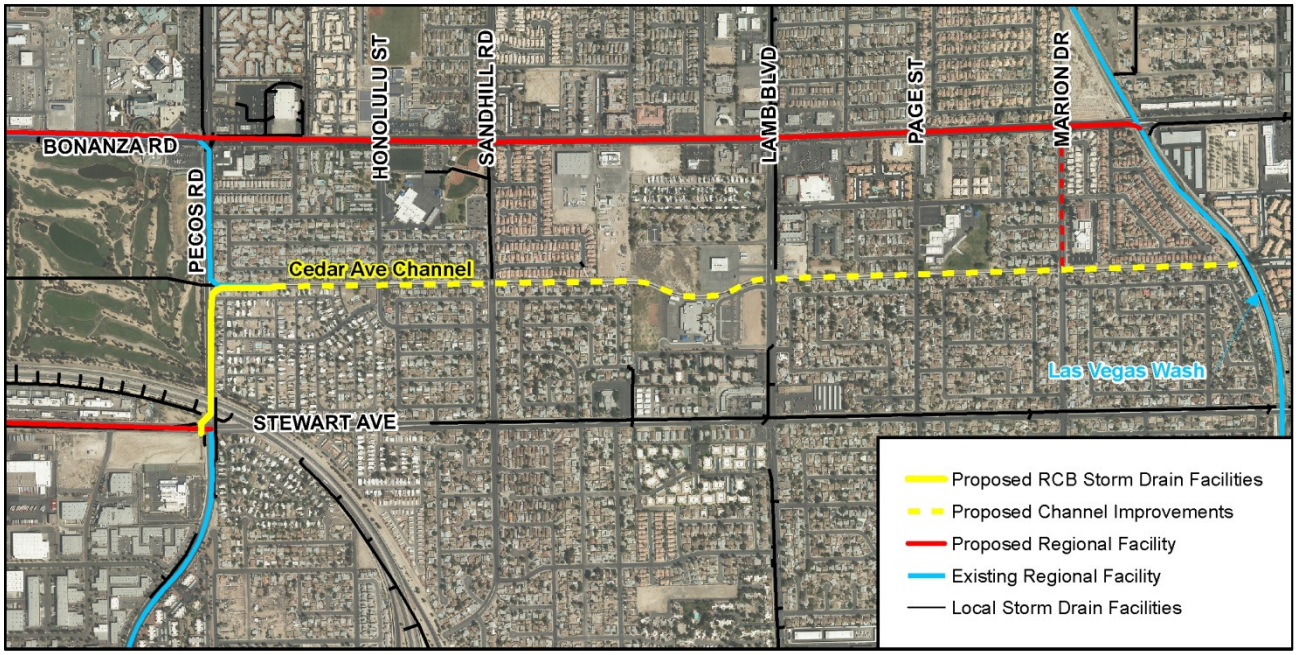


Figure 3. Cedar Avenue Channel Project Alignment

1.3. Inventory of the Existing Condition

The watershed area impacting the CAC encompasses approximately 3.5-square-miles of urbanized area in the central portion of the City. The watershed is generally bounded by Maryland Parkway on the west, Bonanza Road on the North, Charleston Boulevard on the south, and the Las Vegas Wash on the east.The overall drainage pattern in the study area is from west to east, with surface runoff being conveyed on surface streets and in local channels and minor storm drain facilities.

Panel 32003C2186F and 32003C2187F of Federal Emergency Management Agency's (FEMA's) Flood Insurance Rate Maps (FIRMs) shows the majority of the project area is not within a Special Flood Hazard Area. A small reach at the end of the proposed channel lies within a Zone AE flood zone. FIRMettes showing the flood zone boundaries in the study area in included in **Appendix A**.

During early phases of the project, field investigations were performed by Atkins in the study area to assess drainage patterns, confirm design data that was collected, and evaluate the current condition of the project site and tributary areas. Detailed topography, aerial photos, and previously completed drainage studies were also reviewed and relevant information extracted in order to inventory the existing condition and understand constraints and design considerations in the study area. In addition, photos were taken during field investigations and compiled in a photo library included in **Appendix A**.

A few observations regarding the existing condition are summarized in the following paragraphs.

The intersection of Stewart Avenue and Pecos Road is the main collection point for the proposed storm drain facilities. The flows impacting this intersection come primarily from the west on the surface of Stewart Avenue. There are existing drop inlets and lateral storm drains on the north and south side of Pecos Road that collect a small portion of the surface flow. There is also a drainage swale that runs from south to north along the west side of Pecos Road that connects to a headwall under Stewart Avenue. The flow collected at the headwall and in the drop inlets is conveyed through local storm drains to an existing 72" RCP in Pecos Road that drains north and eventually discharges to the Cedar Avenue Channel. These facilities are undersized and do not have adequate capacity to convey the 100-year flow impacting the intersection.

South of Stewart Avenue, Pecos Road has relatively minor surface flows on the street because the majority of the flow in the area is already conveyed in the existing 66" RCP (which transitions to dual 48" RCPs) in Pecos Road and in local, on-site storm drains that convey flow through parking lots and commercial areas immediately west of Pecos Rd. The drainage facilities in Pecos Road are adequately sized and will connect to proposed storm drain facilities constructed with this project. More detailed information regarding the drainage patterns and hydrology in this area is included in Section 2.

Any flow that is not collected by drop inlets on Stewart Avenue will bypass the intersection and continue east on Stewart Avenue. There is an existing low point further downstream on Stewart Avenue, west of Marion Drive, where flow will pond up during storm events. This project will help alleviate or reduce some of the flooding problems occurring downstream on Stewart Avenue.

The Cedar Avenue Channel collects flow from the 72" RCP in Pecos Road, as well as another 72" RCP that brings flow into the channel from the Desert Pines Golf Course area and Bonanza Road. The channel conveys this flow eastward under 5 bridge structures at Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive until eventually discharging to the Las Vegas Wash at the downstream end. Additional flow comes into the channel via drop inlets at each of the bridge structures. During an early progress meeting on the project, the City stated that the Cedar Avenue Channel was limited in capacity and has experienced overtopping at Lamb Boulevard in the past. Atkins performed normal depth and HEC-RAS analysis and confirmed that the channel had limited capacity to convey the project design flows in the existing condition.

The overall intent of the project is to collect as much of the 100-year flow as possible at Stewart Avenue and Pecos Road and to increase the conveyance capacity of the Cedar Avenue Channel, thereby improving flood protection in this area.

1.4. Existing Facilities and Adjacent Completed Projects Summary

There are completed and ongoing projects and storm drain facilities in the study area that are related to this project and may impact the storm drain design considerations/constraints. The major projects and facilities are described below.

1.4.1. Pecos Road Storm Drain

There is a 66" RCP storm drain in Pecos Road that conveys flow north from Charleston Boulevard. The pipe transitions to dual 48" RCPs north of Sunrise Avenue in order to cross over a 36"sewer line. After crossing the sewer and Stewart Avenue, the dual 48" RCP transitions to a large 72" RCP that continues north and then east until discharging to the Cedar Avenue Channel. The 72" RCP will be replaced and upsized with this

project, while the dual 48" RCP and 66" RCP will remain in place and connect with proposed storm drain facilities constructed with this project.

1.4.2. Stewart Avenue Storm Drain

There is a 24" RCP storm drain in Stewart Avenue that extends from just west of Mojave Road to Pecos Road. This storm drain collects flow from existing drop inlets on Stewart Avenue and eventually connects to the 72" RCP in Pecos Road. The 24" RCP facility will connect with proposed storm drain facilities constructed with this project.

1.4.3. Desert Pines Golf Course Storm Drain

The Desert Pines Golf Course, located east of Pecos Road and north of US 95, has a 60" RCP storm drain running from west to east through the middle of the golf course. This facility collects flow from Cedar Avenue and the golf course and conveys it to Pecos Road. At Pecos Road, it combines with another 60" RCP that comes from the north (from Bonanza Road), and then continues as a 72" storm drain that eventually discharges to the upstream end of the Cedar Avenue Channel.

1.4.4. BOMO Force Main – Phase 2

This ongoing sewer project has a proposed alignment in Pecos Road and Stewart Avenue in the immediate vicinity of the proposed storm drain improvements. Coordination with this project is ongoing. Atkins reviewed the preliminary layout of the BOMO system at the 70% design level to resolve potential conflicts. Coordination with this project should continue through final design.

1.4.5. Multi-Family Residential Development (APN 140-31-501-021)

There is an ongoing land development project for a multi-family residential site that is located just north of the Cedar Avenue Channel and west of Lamb Boulevard. Coordination with the City and the design engineer (L.R. Nelson) has occurred and will continue as necessary. The development intends to discharge runoff directly to the Cedar Avenue Channel, so coordination on hydrology/hydraulics as well as the trail widths and easements in this area will be needed going forward.

1.4.6. Las Vegas Wash Project

The Las Vegas Wash project is ongoing at the downstream end of the Cedar Avenue Channel. At the downstream end of the channel, the Las Vegas Wash project proposed to convey all flow in the Cedar Avenue Channel within an 18' x 12' RCB confluence (based on the 100% QA/QC set, not for construction). Atkins has coordinated with the City the design consultants on several occasions and it was agreed that the proposed RCB should be widened to 22 – 25 feet, instead of 18 feet as was shown on the preliminary plans. This will improve the hydraulics of the channel and make it possible to potentially bring more flow into the channel from Bonanza Road in the future. However, this Las Vegas Wash project at the downstream end of the channel is currently on hold, so the design at the confluence has not been finalized. For the purpose of this preliminary design report and per the direction of the City, it was assumed that the confluence will be at least 22 feet wide. Further information regarding the channel design and confluence at the downstream end of the channel is available in **Section 4**.

1.4.7. Cedar Drainage Trail

The Cedar Drainage Trail was constructed along the north side of the Cedar Avenue Channel, extending from Pecos Road to the pedestrian bridge at the Las Vegas Wash. The project also included installation of light poles and landscaping. The wider channel improvements completed with this project will preserve a functional trail, although the trail width will be reduced in several locations.

1.5. Report Organization

The technical information compiled and presented in this report will facilitate review of the drainage analysis/design and is based on best available data at the time of the 30% milestone submittal. The report has been organized into five main sections: Section 1 serves as an overall introduction; Section 2 and 3 contain detailed information about the hydrologic and hydraulic (H&H) analysis, respectively; Section 4 includes summaries of several other design works and activities, including general design considerations, the geotechnical investigations, survey summary, right-of-way summary, etc.; Section 5 summarizes the utility conflicts and utility coordination effort that has taken place to date; Section 6 is the final section and includes the construction cost estimate.

A technical appendix is included at the end of the report with all supporting documentation and analysis. In addition, an electronic Data CD is also provided at the end of report with a pdf version of the entire report, the 30% design plans in pdf format, and other electronic files related to this submittal. The 30% design plans also accompany this report and include pertinent information for review, such as proposed facility sizes, horizontal/vertical alignments, utility conflicts, lateral locations, etc.

2. Hydrologic Analysis

2.1. General

This section includes information about the criteria and methodology used in the hydrologic analysis of the CAC. The criteria, methodology, and analyses are generally consistent with the Clark County Regional Flood Control District's (CCRFCD) Hydrologic Criteria and Drainage Design Manual (hereafter referred to as the Design Manual). Any deviations from the Design Manual are discussed in more detail later in this section.

2.2. Previous and/or Related Drainage Studies

Several drainage studies, hydrologic models, and reports were reviewed in conjunction with this project. May of the drainage studies were provided to Atkins by the City for small or local developments in the study area. These were all reviewed and incorporated as necessary. The more significant or major drainage studies used as a reference included:

- **2008 Las Vegas Valley Flood Control Master Plan Update**, prepared by PBS&J, September 2008. This study was reviewed and used as a reference for the hydrologic analysis and parameterization (CN methodology, land use, soils, routing, lag time, etc.). The 2008 MPU HEC-1 model developed for the Central Watershed was used as a base model for this project.

- **Central Neighborhood Flood Control Master Plan** prepared by PBS&J, March 2005. This study was used as a reference and to check the overall watershed boundary and to estimate the interim condition flow in the 72-inch RCP in Pecos Road

2.3. Technical Memorandums

After performing data collection, field investigations, survey, and preliminary H&H analysis, Atkins compiled two different technical memorandums to summarize the analysis, results, channel capacities, and recommended drainage plan and assumptions that were used in developing this PDR and the 30% design plans. These memorandums were submitted and reviewed by the City and CCRFCD, who agreed on the overall design concepts and design flows. The two memorandums include:

- **Preliminary Drainage Memorandum.** Atkins submitted the Preliminary Drainage Memorandum on May 5, 2014 to estimate peak flows impacting the intersection of Stewart Ave and Pecos Rd, to determine if revisions to the storm drain extents were warranted, and to make storm drain facility recommendations.

- **Cedar Avenue Channel Capacity Analysis.** Atkins submitted the Cedar Avenue Channel Capacity Analysis on June 13, 2014 to determine the existing channel conveyance capacity and to understand potential project impacts on the downstream channel and adjacent properties.

A copy of both memorandums is provided on the **Data CD** as a reference and to provide background information related to design alternatives that were investigated and decisions that have been made to date.

2.4. Topography Data and Survey

Detailed 1-foot aerial topography data was obtained for the study area with this project. In general, the 1-foot topography data extends to Charleston Boulevard on the south, Maryland Parkway on the west, Pecos Road on the east, and Cedar Avenue on the north. An additional corridor along the Cedar Avenue Channel was also obtained for that portion of the project area. 5-ft contour data from Clark County was used for watershed areas outside of the detailed topography extents.

Detailed field survey (and manhole dipping) was also performed to determine accurate horizontal and vertical information for the manholes, sanitary sewers, storm drains, and other utilities.

2.5. Hydrologic Design Scenarios

Atkins performed hydrologic analysis to determine the peak 100-year design flows in the study area in the ultimate condition. The hydrologic analysis and the storm drain recommendations described in this memo are based on the ultimate condition, which assumes that the project watershed is fully developed and that all proposed regional facilities are built and functioning. This is the condition represented in the HEC-1 model and fully described in this PDR that will be used as the design basis throughout the project.

The main difference between the watershed today and the ultimate condition is the assumption that the proposed regional facility in Bonanza Road (LVBZ0000-0014) will be complete, which will convey the 100-year flow from Bonanza Road to the Cedar Avenue Channel at Marion Drive (see **Section 2.9** for more information about this alternate alignment).

Since the watershed area is more than 95% developed, any other changes in land use, impervious areas, and flow rates between the existing and ultimate (future) condition are considered negligible.

Throughout early design phases of this project, an interim condition model was developed in order to support alternative analysis and decision making, especially with regards to the Cedar Avenue Channel. The interim condition model is identical to the ultimate condition model except that the Bonanza Regional system does not bring flow into the channel at Marion Drive as described above. The interim condition model is provided on the **Data CD** for reference purposes if needed.

Qualitative assessments of the existing condition flow in the Cedar Avenue Channel have also been made based on the Central Neighborhood Study and assumptions that the inflow facilities into the channel are at full flow capacity (normal depth calculations), but detailed HEC-1 modeling of the existing condition was not required for this project.

2.6. Hydrologic Analysis and Parameterization

The methodology used to develop the hydrologic model and input parameters is discussed in detail in **Appendix A** with all supporting information and tables. A brief description of methods is provided as a summary below:

2.6.1. Subbasin Delineation

The 2008/2013 MPU and Central Neighbourhood Flood Control Master Plan (CNS) subbasin delineations were used as a starting point and were modified and subdivided

as necessary based on field investigations, aerial photos, drainage studies, and the detailed 1-ft topography data that was obtained for the project. The subbasins used in this design project were more refined than the MPU subbasins in order to analyze and evaluate detailed roadway drainage patterns, storm drain sizes, and street flow capacities. The subbasins used in the HEC-1 model are shown on the Hydrologic Summary Map (**Figure 6)** at the end of this section of the report.

2.6.2. Hydrologic Parameters

- **Rainfall** – The 6-hour, 100-year and 10-year precipitation depth were used in the model based on the McCarran Airport Rainfall Area from the Design Manual. The SDN3 storm distribution was used since the watershed area is less than 8 square miles.

- **Depth-Area Reduction Factor –** The depth-area reduction factors (DARFs) from Table 503 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area.

- **Soils** – Soils data in the hydrologic analysis was based on the same soils information that was used in the 2008 MPU, which is the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. It should be noted that NRCS has updated the available soils data since that time; however, in an effort to be consistent with the MPU and other design projects that have been completed in the area, the 2008 MPU soils data was used in the CAC hydrologic analysis.

- **Land Use** – Land use data was based on the 2008 MPU and updated as needed. Minor updates and revisions were made to the land use data based on aerial imagery to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

- **Curve Numbers** – Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the Design Manual. Curve number information was compiled for each subbasin using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers.

- **Lag Time** – All subbasins within the project watershed are less than 0.5 square miles. The time of concentration for subbasins of this size is computed with the time of concentration equation (velocity method) from the CCRFCD Design Manual.

- **Routing** – The routings in the HEC-1 model through streets or storm drains were performed using the Muskingum-Cunge method for floodwave routing to be consistent with the 2008 MPU.

Detailed summary tables and supporting calculations for all parameters listed above are provided in **Appendix A**.

2.6.3. Computer Modeling

HEC-1 Version 4.1 (dated June 1998) was used for the CAC hydrologic modeling in order to be consistent with the MPU process. Descriptive information has been included in the HEC-1 input file on the “ID” and “KM” cards. The HEC-1 model is included in **Appendix A** and electronic model files are also provided on the Data CD that accompanies this report.

2.6.4. Concentration Points

Peak flows were combined in HEC-1 using concentration points that were inserted into the HEC-1 model. Several concentration points are located at the Pecos/Stewart intersection and along the Cedar Avenue Channel (as shown in **Figure 6** and **Figure 7**) since these are the main design locations in the study area.

2.6.5. Referenced Portions of the Model (Flow Diversions)

There are a few portions of the model that are based on reference studies/models:

At the intersection of Pecos Road and Charleston Boulevard, 206 cfs is conveyed north in an existing 66” RCP that collects flow from Charleston Boulevard and turns north in Pecos Road (see HEC-1 node CCHAR). The flow of 206 cfs is based on a referenced model from the Central Neighborhood Flood Control Master Plan. It is assumed that this flow of 206 cfs is the same in the interim and ultimate condition, since subbasin CH70-C will still drain to Charleston Boulevard, and there will be still be some bypass flow on Charleston Boulevard even when the future regional facility is built in Boulder Highway. A small inflow hydrograph (see HEC-1 node CHAR) was added to the model to represent existing flow on Charleston Boulevard from upstream watersheds in order to have a total peak flow of 206 cfs at the intersection of Pecos Road and Charleston Boulevard.

In order to account for flows that will enter the Cedar Avenue Channel from Bonanza Road area, portions of the 2008 MPU Central Watershed model (SW3) were copied and included directly in the HEC-1 model. The referenced portions of the model establish the 100-year peak flows in Bonanza Road. At the intersection of Pecos Road and Bonanza Road, the HEC-1 model has a diversion (DBN09) to represent the 202 cfs that is conveyed south in the existing 60” RCP toward the Cedar Avenue Channel (based on full flow capacity normal depth calculations).

Similarly, at Marion Street and Bonanza Road, the referenced 2008 MPU model (at HEC-1 node CBN15-C) represents the flow that will be conveyed south in Marion Drive in the ultimate condition. Refer to **Section 2.9** or the 2008 MPU model for more details if necessary.

Also, it should be noted that the 2008 MPU assumes that the existing 60” RCP in Pecos Road south of Bonanza Road will be abandoned (see **Figure 4**). However, the Cedar Avenue Channel has been designed to accommodate this flow. Therefore, in the future, the 60” RCP can remain in place without any adverse impacts on the channel, which may reduce the size of the future regional facility in Bonanza. This assumption will need to be confirmed during the design of the Bonanza Road regional facility.

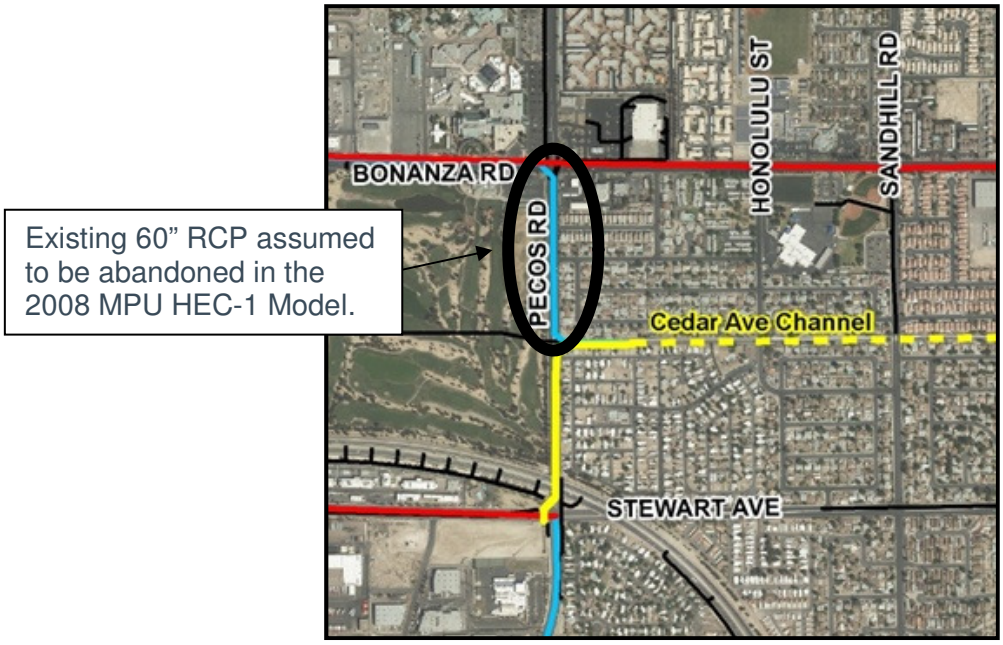


Figure 4. Existing 60" RCP in Pecos Rd

2.7. Hydrologic Analysis Results

The 100-year peak flows from the ultimate condition HEC-1 model for the subbasins, diversions, and combination points are summarized on the Hydrologic Summary Map (**Figure 6**) at the end of this section. **Table 1** below summarizes the main design flows at key locations. The table also includes the MPU Flows from the 2008 MPU for comparison purposes.

Table 1. Summary of Design Flows at Key Locations

Location	HEC-1 Combo Point	Ultimate Flow (cfs)	MPU Flow (cfs)
Pecos/Stewart intersection (total flow in the proposed SD)	CCA05	702	-
Outlet of 2:72" RCP's (at upstream end of channel)	CCA06	1085	1170
Honolulu Street	CCA08	1136	-
Sandhill Road	CCA09	1172	-
Red Bandana Street	CCA10	1196	-
Lamb Blvd	CCA11	1266	1387
Page Street	CCA12	1314	-
Marion Drive (Upstream)	CCA13a	1364	-
Marion Drive (Downstream)	CCA13	2885	-
Las Vegas Wash	CCA14	2916	1544

2.8. Stewart Avenue Collection and Bypass Flow

After the initial HEC-1 model was run, it was subsequently modified through an iterative process in order to represent the flow collected in the proposed drop inlets and storm drains at the intersection of Stewart Avenue and Pecos. In other words, initial hydrologic results were used in the hydraulic analysis to size collection facilities, and then the hydrologic model was updated afterward to divert flows to proposed storm drain facilities and determine the remaining bypass flow on the streets. This provides consistency between the hydrologic and hydraulic analysis and results in a model that is representative of the post-project condition.

As shown in **Figure 7**, 745 cfs flows east on Stewart Avenue towards Pecos road. A portion of that flow (approximately 445 cfs) is collected and conveyed in proposed drop inlets/laterals as well as the existing 24" RCP in Stewart Avenue. An additional 55 cfs enters the storm drain system from the drainage swale and headwall south of Stewart Avenue, for a total peak 100-year flow in the storm drain of 502 cfs (HEC-1 node CCA05-2a).

The existing dual 48" RCP on Pecos Road conveys 210 cfs and will connect with the proposed storm drain system north of Stewart Avenue, resulting in a combined total flow of 688 cfs (HEC-1 node CCA05-4). Some minor existing storm drains will connect to the system downstream of this point and add an additional 14 cfs which increases the total flow in the system to 702 cfs (HEC-1 node CCA05).

When timing is accounted for, the flow bypassing the proposed storm drain system on Stewart Avenue is approximately 315 cfs. There is an additional 79 cfs in the street on Pecos Road that is bypassed east on Stewart Avenue. Thus, the total bypass flow on Stewart Avenue is 357 cfs (HEC-1 node CSTEWBY).

While this is a significant improvement compared to the existing condition, there will still be a flow conveyed eastward on the surface of Stewart Avenue. According to the Central Neighborhood Flood Control Master Plan, there is an additional 300 cfs that drains to Stewart Avenue from tributary areas north of Stewart Avenue between Pecos Road and the Las Vegas Wash. This flow will combine with the bypass flow of 357 cfs at the low point in Stewart Avenue west of Marion Drive, resulting in more than 500 cfs at this location. The existing 48" RCP in Stewart Avenue does not have adequate capacity to convey the flow to the Las Vegas Wash and thus ponding will occur. Atkins recommends that this area be reviewed in more detail and a proposed regional facility in Stewart Avenue (between the low point and the Las Vegas Wash) be considered for inclusion in the Las Vegas Valley MPU.

2.9. Marion Drive Confluence

The Las Vegas Wash CMAR project determined that connecting the proposed regional facility in Bonanza Road to the Las Vegas Wash would be difficult because of the bridge configuration, right-of-way, and other design constraints. As a result, they proposed to re-route the proposed regional facility down Marion Drive to the Cedar Avenue Channel instead of connecting directly to the Las Vegas Wash. This results in increased flow in the Cedar Avenue Channel and a need for a major confluence structure and a larger channel to accommodate the combined flow.

As described previously, this alternative alignment and future regional facility in Marion Drive has been incorporated into the ultimate condition HEC-1 model using the 2008 MPU as a reference. The resulting flows in the area are shown on **Figure 5**.



Figure 5. Future Bonanza Regional Facility and Marion Drive Confluence

As shown above, the 100-year ultimate condition flow in the Bonanza Road regional facility is around 1,783 cfs, while the channel has a 100-year flow of 1,208 cfs. This results in a combined total flow of 2,875 cfs to be conveyed in the Cedar Avenue Channel downstream of Marion Drive. The design of the channel and future confluence to accommodate this increased flow will be described in the next section.

NOTE: In ultimate condition, the proposed regional facility in Bonanza Road will convey flow south in Marion Dr to Cedar Avenue Channel.

See Figure 7 for details

Las Vegas Wash Central
Cedar Avenue Channel

Figure 6: Hydrologic Summary Map

Legend

- Hydrologic Subbasins
- Combination Points
- Flow Arrows
- 5' Contours
- 1' Contours

N

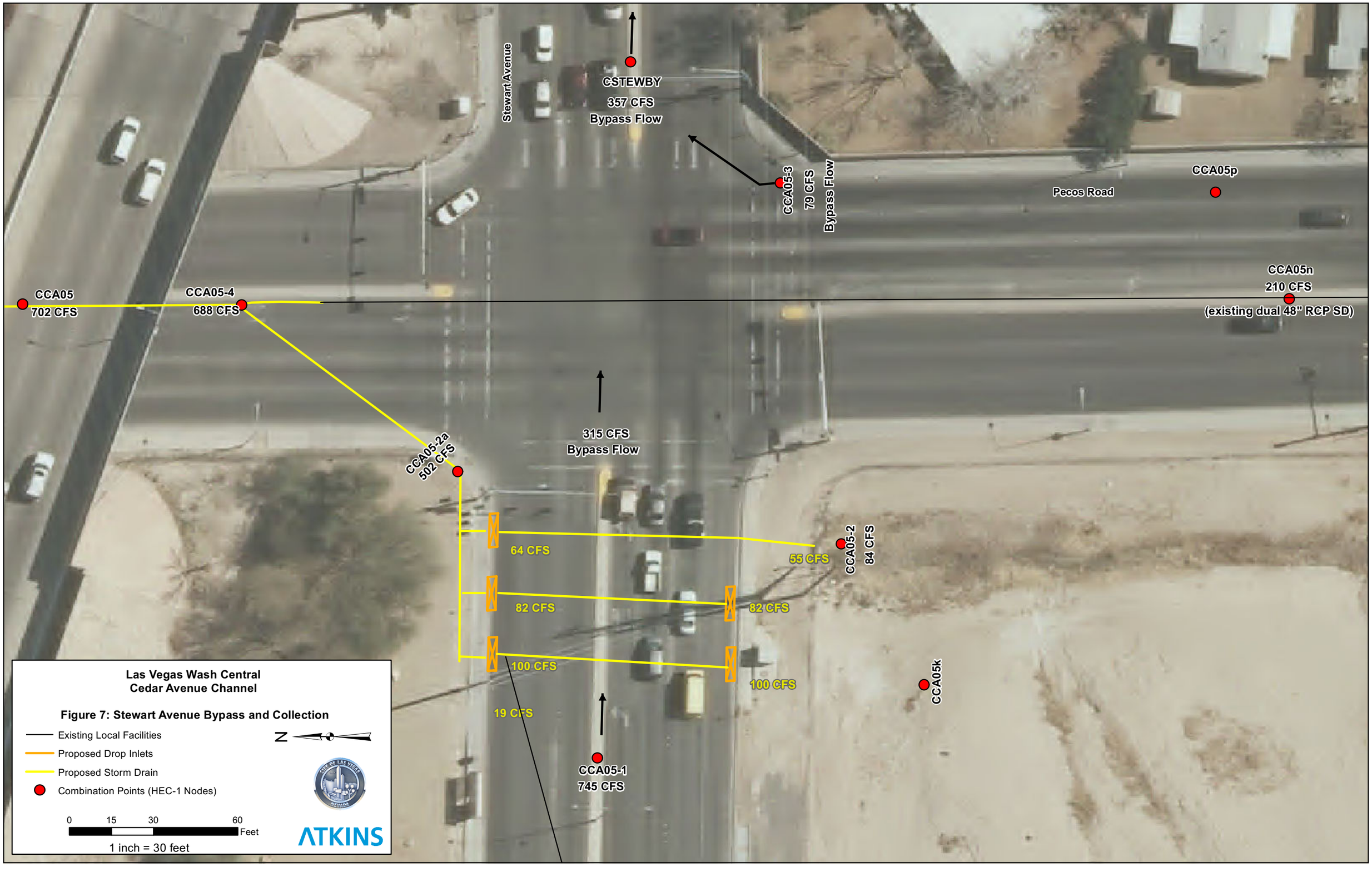
0 300 600 1,200 Feet

1 inch = 600 feet

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ULTIMATE CONDITION				
HEC-1 Node	Type	Area (mile2)	DARF	Flow (cfs)
CA03a	Subbasin	0.09	0.99	107
CA03c	Subbasin	0.02	0.99	25
CCA03c	Combination Point	0.12	0.99	131
CA03b	Subbasin	0.08	0.99	86
CCA03	Combination Point	0.2	0.99	217
CA04b	Subbasin	0.06	0.99	71
CCA04b	Combination Point	0.26	0.99	278
CA04a	Subbasin	0.04	0.99	44
CA04c	Subbasin	0.03	0.99	41
CCA04-1	Combination Point	0.33	0.99	345
CA04g	Subbasin	0.05	0.99	81
CA04d	Subbasin	0.05	0.99	72
CCA04d	Combination Point	0.1	0.99	140
CA04e	Subbasin	0.19	0.99	194
CCA04e	Combination Point	0.29	0.99	333
CA04f	Subbasin	0.05	0.99	61
CCA04f	Combination Point	0.34	0.99	363
CCA04	Combination Point	0.67	0.98	675
CA05a	Subbasin	0.04	0.99	47
CA05b	Subbasin	0.05	0.99	66
CCA05-1	Combination Point	0.75	0.98	745
DSTEWQ	Diversion (out)	0.75	0.98	315
DCCA05	Diversion (remain)	0.75	0.98	430
CA05c	Subbasin	0.02	0.99	36
CA05d	Subbasin	0.04	0.99	58
CA05e	Subbasin	0.003	0.99	5
CCA05e	Combination Point	0.07	0.99	97
DTA05e	Diversion (out)	0.07	0.99	52
DTCCA05e	Diversion (remain)	0.07	0.99	45
CA05f	Subbasin	0.01	0.99	14
DTA05f	Diversion (out)	0.01	0.99	7
DTCCA05f	Diversion (remain)	0.01	0.99	7
CCA05f	Combination Point	0.08	0.99	52
CA05h	Subbasin	0.003	0.99	5
CA05i	Subbasin	0.004	0.99	7
CA05k	Subbasin	0.01	0.99	16
CCA05k	Combination Point	0.09	0.99	77
CA05g	Subbasin	0.01	0.99	12
CA05j	Subbasin	0.005	0.99	9
CA05p	Subbasin	0.01	0.99	8
CCA05p	Combination Point	0.02	0.99	28
DRA05e	Diversion (In)	0.07	0.99	52
DRA05f	Diversion (In)	0.07	0.99	7
CCA05-3	Combination Point	0.02	0.99	86
DTA05-3	Diversion (out)	0.02	0.99	79
DTCCA053	Diversion (out)	0.02	0.99	7
CCA05-2	Combination Point	0.11	0.99	84
CCA05-2a	Combination Point	0.86	0.98	502
CHAR	Subbasin	0.04	0.99	43
CH70-C	Subbasin	0.14	0.99	165
CCHAR	Combination Point	0.17	0.99	206
CA05m	Subbasin	0.005	0.99	8
CCA05n	Combination Point	0.18	0.99	210
CCA05-4	Combination Point	1.04	0.95	688
CA05n	Subbasin	0.004	0.99	6
CA05q	Subbasin	0.01	0.99	12
CCA05q	Combination Point	0.02	0.99	17
CCA05	Combination Point	1.06	0.95	702
CA06-C	Subbasin	0.41	0.99	255
CCBN09*	Combination Point	1.66	0.95	202
CCA06-1	Combination Point	2.07	0.93	428
CCA06	Combination Point	3.13	0.92	1085
CA08	Subbasin	0.07	0.99	71
CCA08	Combination Point	3.2	0.92	1136
CA09	Subbasin	0.05	0.99	58
CCA09	Combination Point	3.25	0.92	1172
CA10	Subbasin	0.03	0.99	44
CCA10	Combination Point	3.28	0.92	1196
CA11	Subbasin	0.09	0.99	103
CCA11	Combination Point	3.38	0.92	1266
CA12	Subbasin	0.06	0.99	86
CCA12	Combination Point	3.44	0.92	1314
CA13a	Subbasin	0.06	0.99	95
CCA13a	Combination Point	3.5	0.92	1364
CBN15-C*	Combination Point	0.86	0.98	1716
CCA13	Combination Point	4.37	0.91	2885
CA14	Subbasin	0.05	0.99	85
CCA14	Combination Point	4.42	0.91	2916
DRDTA05	Diversion (in)	0.02	0.99	79
DRDSTEW	Diversion (in)	0.75	0.98	315
CSTEWBY	Combination Point	0.77	0.98	357

* Total flow from Bonanza System. Referenced from 2008 MPU HEC-1 Model


Stewart Avenue
CSTEWBY
357 CFS
Bypass Flow
CCA05-3
79 CFS
Bypass Flow
Pecos Road
CCA05p
CCA05n
210 CFS
(existing dual 48" RCP SD)
CCA05
702 CFS
CCA05-4
688 CFS
315 CFS
Bypass Flow
CCA05-2a
502 CFS
64 CFS
55 CFS
CCA05-2
84 CFS
82 CFS
82 CFS
100 CFS
100 CFS
19 CFS
CCA05k
CCA05-1
745 CFS
Las Vegas Wash Central
Cedar Avenue Channel
Figure 7: Stewart Avenue Bypass and Collection
Existing Local Facilities
Proposed Drop Inlets
Proposed Storm Drain
Combination Points (HEC-1 Nodes)
N
0 15 30 60
Feet
1 inch = 30 feet
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3. Hydraulic Design and Analysis

3.1. General

This section includes information about the proposed design of the storm drain and channel facilities. It also presents the hydraulic analysis, criteria, and methodology that were used to develop the 30% design of the Cedar Avenue Channel.

3.2. Proposed Design

For the purpose of organizing the information presented in this Section, the project improvements are grouped into two categories: (1) the storm drain system improvements (from Pecos Road/Stewart Avenue to the existing Cedar Avenue Channel and (2) the channel improvements (from the upstream end of the Cedar Avenue Channel to the Las Vegas Wash). The overall design concepts are described below:

3.2.1. Pecos/Stewart Storm Drain System

The proposed storm drain system has been designed to collect as much flow as possible from Stewart Avenue to alleviate downstream flooding.

The proposed storm drain system is comprised of new drop inlets and laterals on Stewart Avenue that collect surface flow and connect to a mainline storm drain on the north side of Stewart Avenue. The mainline storm drain consist of an 18' x 4' RCB north of Stewart Avenue and west of Pecos Road that transitions into a dual 8'X4' RCB at the Pecos Road/Stewart Avenue intersection in order to cross over an existing 36" sewer. After crossing the sewer, the dual 8' x 4' RCB transitions into an 18' x 4' RCB north of the intersection. At this same location, the existing dual 48" RCPs in Pecos Road will connect to the 18' x 4' RCB. The storm drain then transitions to a 12' x 6' RCB that continues north in Pecos Road before turning east and eventually discharging to the Cedar Avenue Channel. The proposed storm drain facilities are shown in a schematic in **Figure 8**.

The above mentioned design of the storm drain system is driven by several constraints:

- There is an existing 36" sewer running through the Pecos Road/Stewart Avenue intersection. The sewer line is not very deep and limits the storm drain to be short and shallow. There is not enough room to cross the sewer line using a mega box (18' x 4' RCB) with a thicker slab. Therefore, the transition of an 18' x 4' RCB to a dual 8' x 4' RCB is required. The total capacity of the storm drain is controlled by the capacity of the dual 8' x 4' RCB, which is around 500 cfs.

- Several alternatives were investigated to relocate the sewer, but the feasibility and costs did not result in suitable alternatives. Additional information is described in project meeting minutes.

- The mainline storm drain is also constrained by the existing invert at the downstream connection point in the Cedar Avenue Channel. Therefore, the slope is relatively flat and governed by crossing over the sewer and tying into the channel.

3.2.2. Cedar Avenue Channel

As discussed in the Cedar Avenue Channel Capacity Analysis, the channel is limited in capacity and has experienced overtopping in the existing condition. Similarly, it does not have adequate capacity to convey the ultimate condition flows. The proposed design is intended to increase the conveyance capacity of the channel in order to improve the existing conveyance and to accommodate the design flows that will be discharged to the channel after the proposed storm drain is complete. From upstream to downstream, the proposed channel improvements include:

- **Upstream of Honolulu Street**: For this section of the channel, no changes have been proposed. The channel will remain a trapezoidal channel with a 10' bottom width, 1.5:1 side slopes, and around 8.25' of depth. The bridge crossing (dual 12' x 5.5' RCB) at Honolulu Street will remain in place.

  Honolulu Street to Sandhill Road: The new channel section between Honolulu Street and Sandhill Road is proposed to be a 25' wide rectangular channel. It will transition to a 36 feet wide channel just upstream of Sandhill Road Crossing. The bridge crossing at Sandhill Road (1: 12' x 4' RCB and 1: 11' x 4' RCB) will remain in place.

  Sandhill Road to Lamb Boulevard: For about 1,200 feet downstream of Sandhill Road, the new channel section is proposed as a 36' wide rectangular section. At this location, it transition into a 30' wide rectangular section, which is necessary because the right-of-way constricts from 60 feet wide to 50 feet wide in this area. Contracting the channel allows for minimum trail widths to be maintained (see **Section 4.1.2**). The 30' wide rectangular channel section then continues for another 1,300 feet where it transitions again down to a 25' wide rectangular channel in order to tie into the dual 12' x 6' RCB culvert crossing at Lamb Boulevard. By doing this, additional RCBs at Lamb are not needed.

  In addition, a 1-foot tall vertical wall on the north side of the channel is proposed to extend 1,500 feet upstream from Lamb Boulevard to provide additional freeboard (see Section 3.4 for freeboard analysis).

- **Lamb Boulevard to Page Street**: In this section the proposed channel expands to be a 31' wide rectangular channel downstream of Lamb Blvd. It remains the same throughout the section.

  Page Street to Marion Drive: The proposed channel is a 31' wide rectangular channel downstream of Page Street. It remains the same throughout the section.

- **Downstream of Marion Drive**: Downstream of Marion Drive, the proposed 31' rectangular channel continues for approximately 200 feet. At this point, there is a channel transition which will accommodate future flow from the Bonanza regional facility while dropping 7 feet in elevation and narrowing into a 22' wide rectangular section. The rectangular channel will be deep (ranging from 15' to 17' deep) and extend at 0.2% slope until connecting to the Las Vegas Wash.

The design of the channel section downstream of Marion Drive assumes that the alternative alignment for the Bonanza Road regional facility will be used as described in Section 2. It was assumed that the future regional facility in Marion Drive would be approximately 20 feet wide in order to accommodate the 100-year flow from Bonanza Road of 1,785 cfs. The future facility will combine with the Cedar Avenue Channel downstream of Marion Drive bridge (which can likely remain in place).

In order to maintain the Cedar Drainage Trail, the future 20 feet wide regional facility coming into the channel from Marion Drive will need to consist of dual, 10-ft wide boxes (or similar geometry with a center pier) in order for the trail to be feasible (i.e., span cannot be 20 feet wide for structural integrity purposes). This conceptual confluence layout is included in the design plans and is subject to review and revision during future design phases.

Figure 9 summarizes the proposed design for the Cedar Avenue Channel.

The channel design was driven by several constraints which are listed below:

- The Cedar Drainage Trail runs alongside the entire length of the channel, making it difficult to widen the channel and still accommodate the trail and access ramps.
- The existing channel profile is very flat and does not provide topographic relief or option to steepen the channel to increase conveyance capacity
- The design intent was to maintain the existing crossings/bridges at the cross street to avoid costs associated replacing the culvert crossings and disturbing traffic.
- Between Sandhill Road and Lamb Boulevard, the right-of-way constricts from 60 feet to 50 feet limiting the corridor even further.
- The downstream end of the channel (past Marion Drive) was constrained by the proposal to bring in more flow from Bonanza Road and by the constraint to tie into the proposed, narrow confluence structure proposed as part of the Las Vegas Wash CMAR project.
- Constructability of the channel in a narrow corridor with the above constraints will require specialized construction methods and caution. Refer to **Section 4.2** for additional information.

Atkins worked with the City during various workshops and progress meetings in order to review alternatives and develop the proposed design described above. The proposed design is the result of the coordination that occurred in order to come up with cost-effective, feasible design concepts that provide maximum flood control in accordance with the regional master plan in the area. The proposed design is still in the process of being reviewed and optimized and is subject to revision as the design phase continues.

Cedar Avenue

Pecos Road

Stewart Avenue

Las Vegas Wash Central
Cedar Avenue Channel

Figure 8: Pecos/Stewart Storm Drain System

Proposed Storm Drain

- 12'x6' RCB
- 18'x4' RCB
- 2:8'x4' RCB
- 5'x3' RCB
- 7'x3' RCB
- 8'x4' RCB

Proposed Drop Inlets

N

0 50 100 200 Feet

1 inch = 100 feet

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Lighthouse Ave

No Proposed Improvements
Existing Trapezoidal Channel
10' W, 1.5:1 SS, 8.25' D

Honolulu St

2:12'x5.5' RCB

Montebello Ave

Buoy St

Transition from
25' BW to 36' BW

Sandhill Rd

1:12'x4' RCB &
2:11'x4' RCB

Montebello Ave

Lehman St

Transition from
36' BW to 30' BW

Montebello Ave

Transition from
30' BW to 25' BW

Lamb Blvd

2:12'x6' RCB

Transition from
25' BW to 31' BW

Prince Cary Ct

2:15'x5' RCB

Montebello Ave

Rhoda St

Page St

Julene Ct

Page St

Montebello Ave

Miratan St

Martha St

Marion Dr

Transition from
31' BW to 22' BW
Channel drops 7 feet with 3.4% Slope

Lancewood Ave

2:15'x5' RCB

Montebello Av

Carlin Ave

Barlow Ln

Las Vegas Wash Central
Cedar Avenue Channel
Figure 9: Proposed Channel Design

- 22' BW Reactangular Channel
- 31' BW Rectangular Channel
- 30' BW Rectangular Channel
- 25' BW Rectangular Channel
- 36' BW Reactangular Channel
- 1-foot Vertical Wall
- Parcels

N

0 100 200 Feet

1 inch = 200 feet

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3.3. Hydraulic Analysis Methodology and Results

3.3.1. Pecos/Stewart Storm Drain System

WSPG Model and Facility Sizing

The Pecos/Stewart Storm Drain mainline was analyzed and sized using the Water Surface Pressure Gradient (WSPG) computer program. The computational procedure used in WSPG is based on solving Bernoulli's equation for the total energy at each section and Manning's equation for friction losses between sections in a reach. The program accounts for energy losses at junctions, angle points, and transitions and uses basic hydraulic principles to calculate hydraulic data such as flow area, wetted perimeter, critical depth, hydraulic grade line, Froude number, momentum, etc. The geometry, slopes, and sizes of the mainline were input into WSPG along with the design flows, and the model was run in order to ensure that the hydraulic grade line (HGL) or depth of flow remained at least 1 foot below final grade at all locations. The mainline WSPG model is included in **Appendix B**.

The hydraulic grade line can be seen for the entire storm drain system on the submitted 30% Design Plans.

At this phase of design, the lateral storm drains and other minor facilities were sized using normal depth calculations. All facilities will be analyzed in WSPG prior to the 70% design submittal.

3.3.2. Cedar Avenue Channel

HEC-RAS Model and Facility Sizing

The hydraulic analysis for Cedar Avenue Channel was performed using the steady state routines within the HEC-RAS computer model, Version 4.1.0 (USACE, 2010) based on the 100-year peak flows for the ultimate condition. A preliminary, existing condition scenario was also analyzed in HEC-RAS to evaluate the current water surface profile today. The parameters used in the hydraulic analysis are described below:

- **Channel Geometry**: Channel geometry is based on detailed field survey obtained by Atkins at several channel cross sections as well as upstream and downstream of all of the bridge crossings. The HEC-RAS 'XS Interpolation' tool was also used to interpolate cross sections every 50 feet between the surveyed cross sections. Detailed 1-foot topography was also obtained and used as necessary in the modeling effort in locations where survey was not available. Channel geometry for cross sections upstream and downstream of structures are provided in **Appendix B**.

- **Manning's Roughness**: Manning's roughness of 0.015 is used for the entire channel reach.

- **Downstream Boundary Condition:** The HEC-RAS model is executed for the subcritical flow regime based on steady-state flow routines. The model utilizes a normal depth boundary condition at the downstream and upstream ends based on the proposed channel design slopes.

- **Expansion and Contraction Coefficients**: Default values of 0.1 and 0.3 for the contraction and expansion coefficients, respectively, are utilized for cross-sections with gradual transitions. However, these coefficients are increased to 0.3 and 0.5 in the vicinity of each structure.

- **Hydraulic Structures**: The five crossings (Honolulu, Sandhill, Lamb, Page and Marion) are modelled as bridges based on the detailed field survey obtained by Atkins. The geometry and hydraulic parameters for each structures were incorporated into the model using 'Bridge Editor' in HEC-RAS.

Results from HEC-RAS can be found in **Appendix B**. The complete HEC-RAS model, which consists of existing and proposed channel geometries, is included on the Data CD. **Figure 10** below summarizes shows the channel profile and WSE and compares the proposed channel invert with the existing channel invert elevation. The proposed channel design is adequate to convey interim and ultimate condition flows.

The hydraulic grade line for the channel can be seen on the 30% Design Plans. Note that 30% Design Plan stations do not match the HEC-RAS stations. Appendix B provides the correlation between 30% Design Plan stations and HEC-RAS stations.

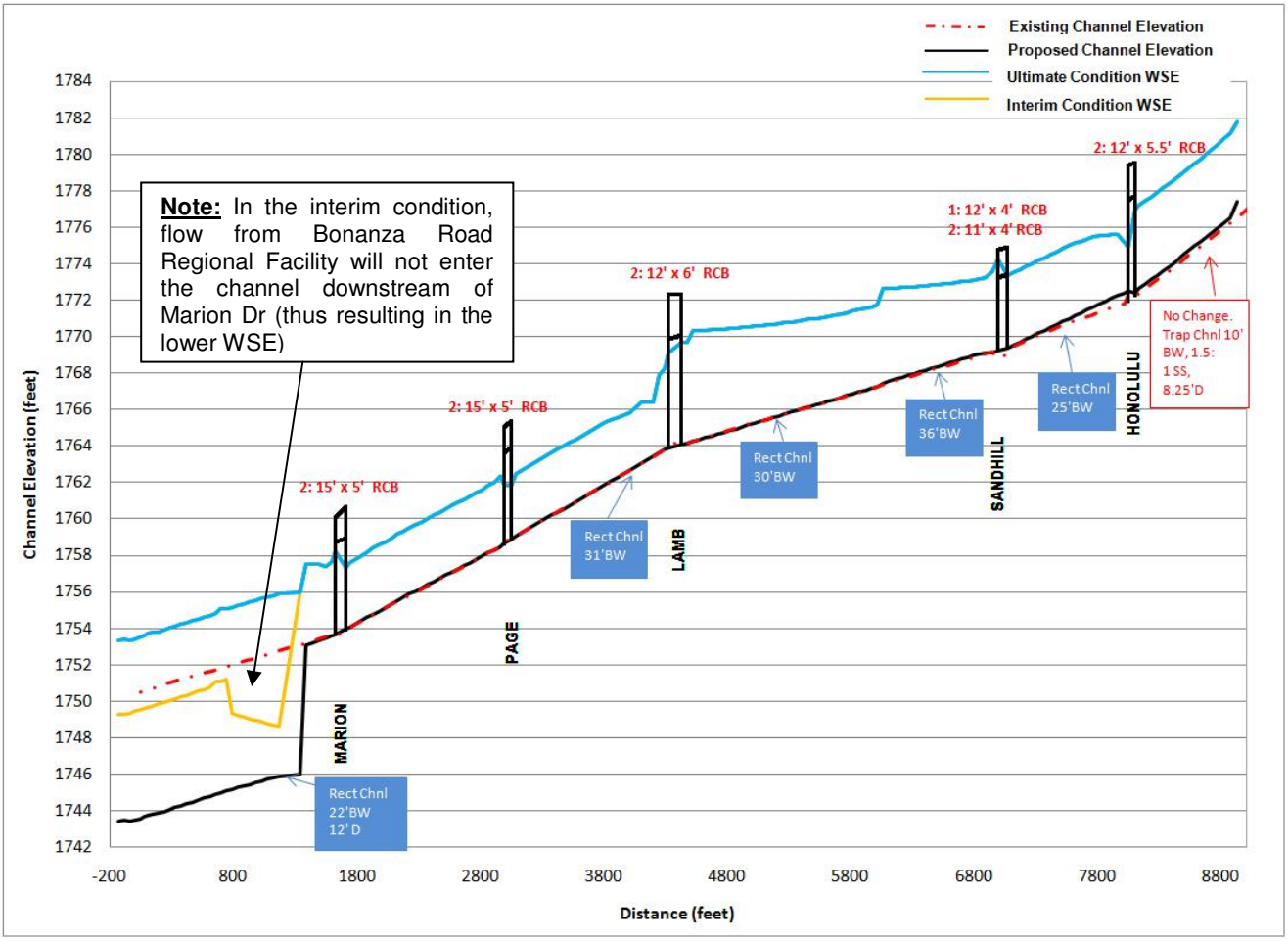


Figure 10. HEC-RAS Profile - Water Surface Elevation (WSE)

The proposed channel design was analyzed to verify if the freeboard criteria presented in HCDDM is met at all model cross sections. The proposed channel has adequate capacity to convey the design flow plus freeboard and an extra tolerance for super-elevation at most channel locations. For a short section upstream of Lamb Blvd, adequate freeboard was not available because the channel transitions from 36 foot wide to 30 foot wide and ultimately to 25 foot wide just upstream of Lamb Blvd. To address this issue, Atkins proposes a 1-foot tall wall along the north side of the channel segment. The proposed 1-foot tall vertical wall provides extra freeboard; however, there will still be a short section where CCRFCD freeboard criteria is not met, but more than a foot of freeboard is available. Detailed freeboard calculations and a summary table are provided in **Appendix B**.

Freeboard criteria is met at every bridge except for the downstream face of Sandhill Road and the upstream face of Lamb Boulevard. However, in both of these cases, the available freeboard is greater than 1 foot.

3.4. Drop Inlets

During the 30% design phase, cursory drop inlet analysis and assessment has been performed to get an overall understanding of the potential inlet locations and capacities. The preliminary drop inlet analysis was done at this phase of the project to identify major obstacles/utility conflicts and to identify impacts on the overall design concept or the main line. Atkins has proposed five drop inlets on Pecos/Stewart intersection based on preliminary analysis. Detailed drop inlet sizing calculations have not been performed nor included in this report, but they will be developed during the 70% design phase and submitted with the Draft Final Design Report.

4. Other Design Works and Considerations

This section has been included in the PDR to summarize key considerations and factors that influenced the 30% design of the CAC. This information has been provided for reference and also to aid with decision making during future design phases. This section also includes a summary of other activities that were performed during the 30% design phase. Pertinent aspects of the project explored to date are included below.

4.1. General Design Considerations

The following is a summary of several design considerations that are pertinent to the overall design of the project now and into the future.

4.1.1. Future Facility in Stewart Avenue

Upstream of the proposed improvements, there is approximately 675 cfs on Stewart Avenue at Mojave Road (see combination point CCA04 in the HEC-1 model). This flow is conveyed east on the surface of Stewart Avenue until it reaches the proposed drop inlets and storm drain at the intersection of Stewart Avenue and Pecos Road.

In the future, the proposed regional facility CNST 0000 should be constructed on Stewart Avenue, upstream of the current project between Pecos Road and Mojave Road. This facility will reduce surface flow on Stewart Avenue in order to meet dry lane criteria and can tie into the upstream end of the 18' x 4' RCB installed with this project (north of Stewart Avenue and west of Pecos Road).

A lateral storm drain extending a quarter-mile to the south in Mojave Road could also be installed to collect surface flow in this area. The proposed regional facility and potential lateral storm drain are shown in **Figure 11**.

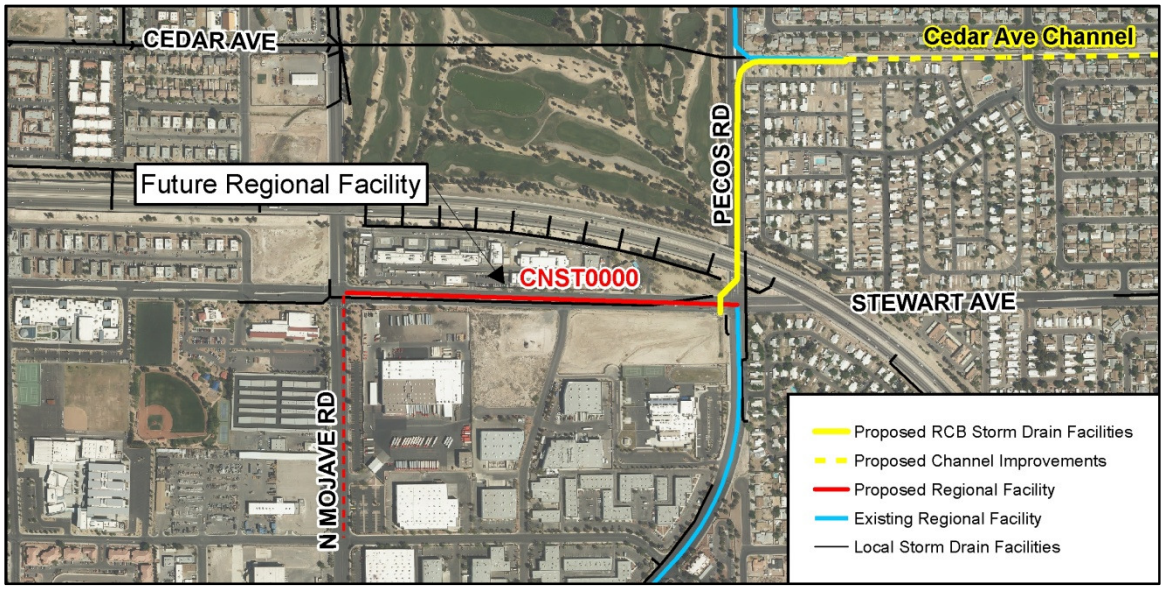


Figure 11. Future Regional Facility in Stewart Avenue

4.1.2. Cedar Drainage Trail

The Cedar Drainage Trail width was kept as wide as possible with the intent to match existing trail widths. The revised trail widths for each section are described below:

- **Honolulu Street to Sandhill Road:** Original trail width maintained
- **Sandhill Road to channel bend:** The trail has been reduced to 8 feet to allow for channel width and for constructability reasons. This also allows the existing trail lighting to be protected-in-place. This section of the trail will not be drivable.
- **Channel bend to Lamb Boulevard:** The channel width is narrower through this section which allows the trail to remain very similar to existing condition with a 10-foot wide trail in spot locations and at the trail light poles.
- **Lamb Boulevard to Page Street:** The trail was reduced but still maintains 13 feet of width.
- **Page Street to Marion Drive:** The trail was reduced but still maintains 12 feet of width.
- **Marion Drive to Las Vegas Wash:** The existing trail width has been maintained. In the future, the trail will need to be shifted to north adjacent to the right-of-way boundary from Marion Drive to the end of the access ramp in order to accommodate the future regional facility that will convey flow from Bonanza Road. The trail would be reduced to 10 feet in the future for that particular section.

4.1.3. Cedar Avenue Channel Access Ramps

Because of proposed widening of the Cedar Avenue channel, the new access ramps into the wider channel section will encroach further into the trail and reduce the existing trail width in these already narrow sections. Effort has been made to provide as much width as possible while still maintaining the required channel and access ramp widths. The minimum amount of trail width remaining adjacent to the access ramps is shown in **Table 2** and a cross-section of the channel/ramp/trail is shown in **Figure 12**. The table and figure are referenced directly from the 30% design plans so refer to those for more information.

Table 2. Minimum Trail Widths at Channel Access Ramps

Access Ramp Location	Paved Trail Width (Adjacent to Access Ramp)
Honolulu Street	8
Sandhill Road	4.58
Lamb Boulevard	10
Page Street	8
Marion Drive	8

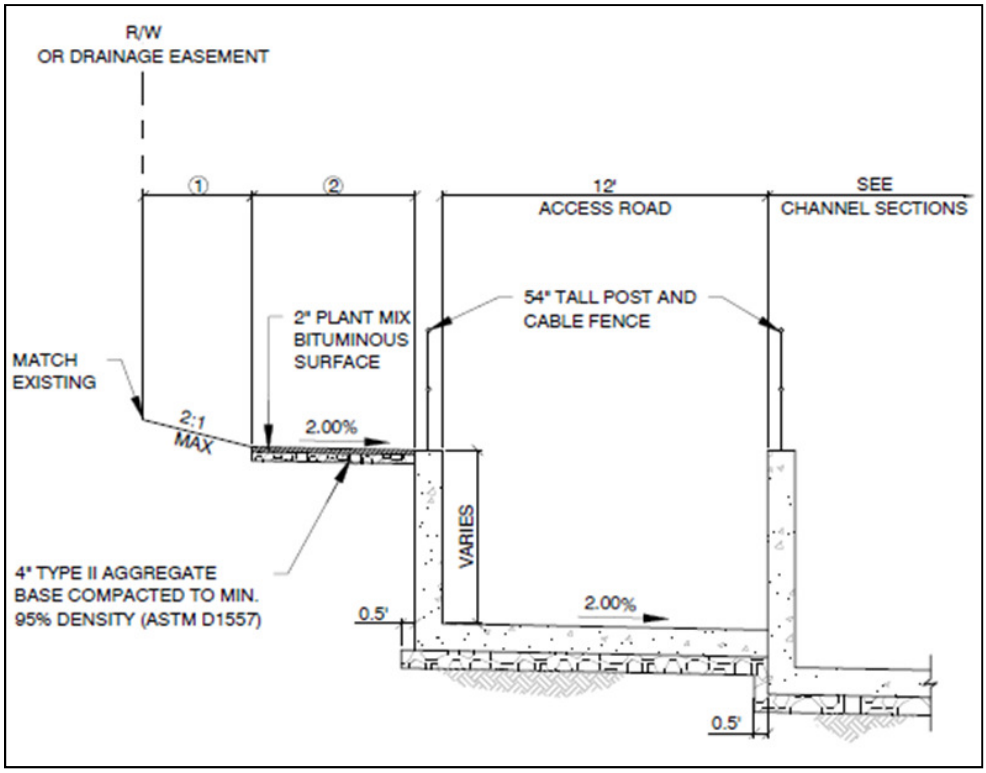


Figure 12. Channel Cross-Section Schematic at Access Ramps

Because of the narrow trail width, an alternate location for the Sandhill Road access ramp is being investigated by Atkins and the City. One potential location is on the south side of the channel on the school property west of Lamb Boulevard. This ramp location will continue to be reviewed and finalized as the design progresses.

4.2. Constructability

4.2.1. RCB Storm Drain Constructability

- There will be minimal cover (about 1 foot) over the dual 8' x 4' RCBs and the junction structure in Pecos Road just north of Stewart Avenue due to crossing over the existing 36" sewer. There will be 6" minimum clearance over the sewer line.

- Installation of the 18'x4' RCB storm drain will require the use of forklifts to set pre-cast boxes or cast-in-place construction under I-515/US 95 due to the existing bridge over Pecos Road.

- Installation of the RCB once it exits Pecos Road and continues east toward the connection point with the channel will require shoring and careful construction as to not impact the existing wall and property on the south side.

- Per the geotechnical report, there is groundwater in the vicinity of the storm drain and when plotted it rises above the invert. Dewatering will likely be required. Refer to geotechnical report for additional constructability considerations related to dewatering. Please refer to Section 4.3.

4.2.2. Concrete Channel Constructability

- Construction on the south side of the channel will be very close to existing fencing and block walls. Typically, there is around 5 to 7 feet of clearance, which will be a small width to excavate the channel and meet OSHA requirements. Additionally, there are some swimming pools adjacent to some of these sections in the backyards of residences. At Sandhill Road and Page Street, construction will be 2.5 – 4 feet away from existing right-of-way boundaries. In all of these areas temporary retaining wall systems, such as driven piles, or permanent retaining walls that can be constructed without impacting the existing properties, will be required. Additional survey is recommended along the south side of the channel to confirm existing tie-ins and verify constructability.

- East of Marion Drive to the end of the channel improvements, the channel becomes very deep (17 feet) and will require the use of a temporary retaining wall, such as driven piles, in order to excavate and construct the channel.

- The entire construction corridor is narrow, and the existing channel is sloping at 0.20%. Constructing the channel at such a flat slope will be difficult.

- Per the geotechnical report, there is groundwater in the area and when plotted it rises above or is at subgrade in the upstream section of the channel and at the downstream section of the channel. Dewatering will likely be required. Refer to geotechnical report for additional constructability considerations related to dewatering. Please refer to Section 4.3.

- Channel wall heights are bound by the existing improvements on each side of the channel.

4.2.3. Project Phasing

The following recommendations were agreed upon with the City with regard to project phasing:

- It is assumed that the Cedar Avenue Channel improvements described in this report will not be installed until the Las Vegas Wash CMAR is complete at the downstream end of the channel. This includes the Cedar Avenue Channel/Las Vegas Wash confluence structure that will be designed and constructed outside of this project.

- It was assumed that once the Las Vegas Wash improvements are complete, the Cedar Avenue Channel will be constructed from the downstream end to the upstream end. In other words, the storm drain proposed in this project should not be built prior to the downstream channel improvements in order to avoid any adverse impacts on properties adjacent to the channel.

- There will be some variability in the future depending on final design configurations and decisions made with respect to the Las Vegas Wash and the alternative alignment of the Bonanza Regional Facility. A Master Plan Amendment will be required to finalize the regional flood control plan for the area.

4.3. Geotechnical Investigations

Ninyo & Moore completed geotechnical investigations during the 30% design phase. The results of these investigations are summarized in the Draft Geotechnical Data Report, Draft Geotechnical Interpretive Report, and Hydrogeologic Aquifer Testing Report. The main sections of these reports are provided in **Appendix C**. All of the supporting data and appendix material is only included on the PDF versions of the reports on the Data CD.

The Geotechnical Data Report includes the findings of the field exploration and laboratory testing, while the Geotechnical Interpretive Report includes the findings of the geologic review, the results of the field exploration and laboratory testing programs, and presents recommendations for design and construction of the proposed project. The Hydrogeologic Aquifer Testing Report includes results of hydrogeologic aquifer testing and a summary of hydrogeologic and groundwater conditions along the project.

It is anticipated that groundwater dewatering will be required in some areas during construction. Based on the Hydrogeologic Aquifer Testing Report, the dewatering flow rate is expected to be lower than the 250 gpm threshold limit for a *DeMinimis* discharge permit. It is anticipated that the construction dewatering groundwater might be discharged to the CLV sanitary sewer system. This will be further coordinated with the City during the next design phase.

During future design phases, additional coordination and planning for dewatering can occur in order to obtain approval from the City's Environmental Division for dewatering and to prepare an application for approval.

4.4. Record of Survey

The Record of Survey (ROS) establishes a record alignment of the project to be used as a basis to assist in locating existing monuments during the field/construction phase of the project. Research of available record information, parcel maps, subdivisions maps, and other records of survey was performed to create the ROS for this project.

The ROS was formally submitted for approval to the City of Las Vegas Surveyor on June 11, 2015, as directed in the project scope. At the time of this 30% design submittal, approval from the City Surveyor has not been received and is still pending. Once approval is received in writing, then the ROS will be submitted to the Clark County Recorder for recordation.

The Record of Survey is included in **Appendix D**.

4.5. Summary of Permits

A draft summary of the permits and approvals needed for this project has been compiled into a summary matrix shown in **Table 3**. This list is preliminary and may be revised as the project moves forward. Further coordination and effort will be required in future design phases to complete permit applications and assist the City in obtaining required permits for the project.

Table 3. Summary Matrix of Required Permits

Permit	Issuing Agency	Regulated Activity	Phase
City of Las Vegas - Excavation Permit	CLV Department of Public Works Land Development Services	Underground construction on private property or within CLV ROW	Construction
City of Las Vegas - Soils Report Submittal	CLV Department of Public Works Land Development Services	Soils associated with construction activity within CLV ROW (required for off-site construction projects)	Construction
City of Las Vegas - Construction Permit	CLV Department of Public Works Land Development Services	Off-site improvements within a City of Las Vegas ROW	Construction
City of Las Vegas - Grading Permit	CLV Department of Building and Safety	On-site grading activities	Construction
City of Las Vegas - Temporary Stock Pile Permit	CLV Department of Building and Safety	Temporary stock piling of earth materials on private or BLM parcels not covered by grading permit	Construction
City of Las Vegas - Traffic Barricade Plan Approval	CLV Construction Services	Traffic barricade plan associated with construction or discharge activity impacting a CLV ROW	Construction
Dust Control Permit	Clark County Department of Air Quality Management (DAQM)	In accordance with DAQM Regulations, dust control permit required for grading or other land-disturbance activities in Clark County.	Construction
NPDES General Storm Water Permit for Construction	NDEP Bureau of Water Pollution Control	Activity that disturbs 1 acre or greater and discharges storm water runoff from the construction site into a municipal separate storm water sewer system, or "waters of the US" as defined by Section 404 of the CWA.	Construction
NPDES Discharge Permit	NDEP Bureau of Water Pollution Control	Point source discharge to surface water, i.e. natural channel, roadway or storm drain. Required for dewatering during construction.	Design
NDOT ROW Encroachment Permit	Nevada Department of Transportation (NDOT)	NDOT requires this permit for construction activities in NDOT ROW.	Design
CCRFCD Section 8 Resource Screening Analysis	Clark County Regional Flood Control District	U.S. BLM requires each new regional facility be reviewed to ensure full compliance with environmental regulatory requirements	Design
OTHER AGENCY APPROVALS AND COORDINATION:			
Entity	**Issuing Agency**	**Regulated Activity**	**Phase**
City of Las Vegas Department of Public Works Flood Control Section	City of Las Vegas	Design Plan/Drainage Study Review/Approval	Design
Clark County Regional Flood Control District	Clark County Regional Flood Control District	Design Plan/Drainage Study Review/Approval, also check of Federal Emergency Management Agency (FEMA) maps	Design
Utility Services Coordination	Various (Refer to Section 5 of this PDR for more information)	Coordination required with utilities and agencies having facilities within the limits of or adjacent to the project. Identify and resolve potential utility conflicts.	Design

4.6. Right-of-Way Summary

Atkins performed a review of the existing right-of-way in the study area and possible acquisition requirements based on the proposed alignment and facilities identified in this report.

Figure 13 and **Figure 14** show the existing right-of-way conditions based on research of available records, including Clark County Assessor Maps, Parcel Maps, and Record of Surveys. The majority of the proposed alignment is contained within the existing public right-of-way located in the jurisdiction of City of Las Vegas. A portion of the project on Pecos Road will be under US95 and within Nevada Department of Transportation (NDOT) right-of-way.

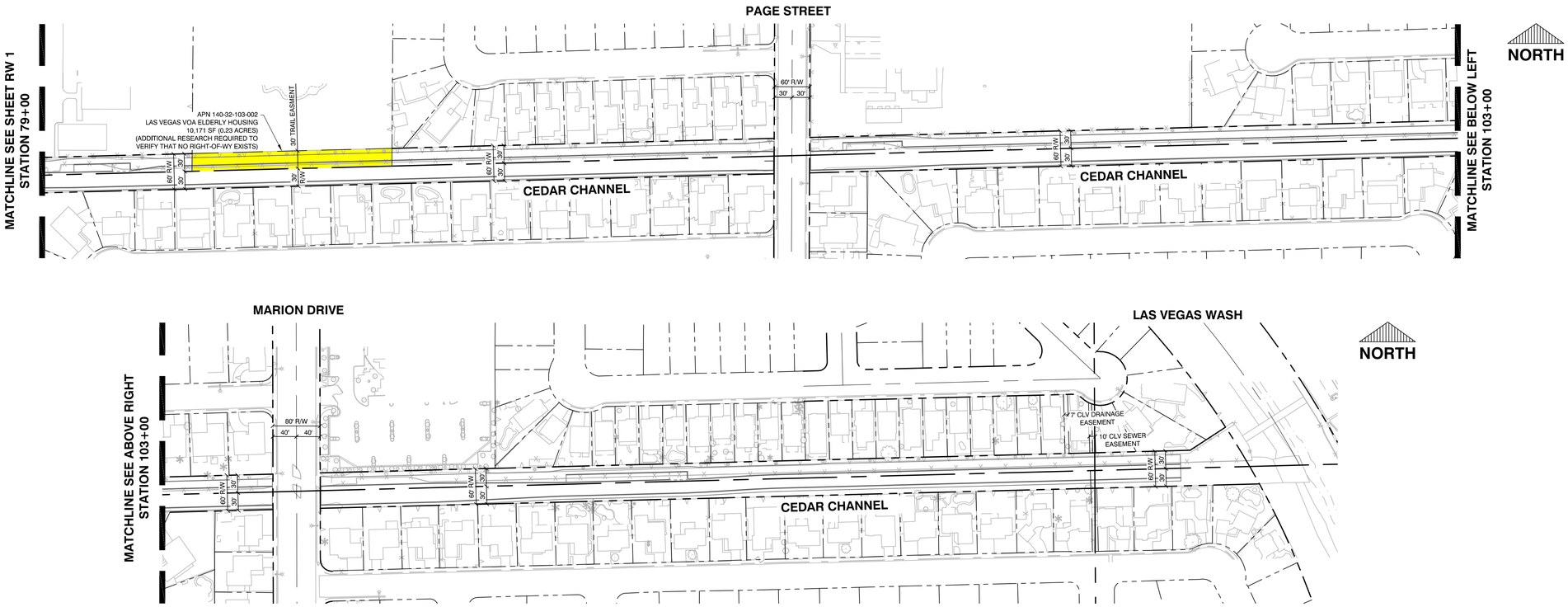
The start of the mainline construction is located on City of Las Vegas owned property. A permanent drainage easement will be required to construct and maintain the facility in the proposed location.

Additionally, a small permanent drainage easement will be required to construct and maintain the 5' x 3' RCB stormdrain and headwall on the south side of Stewart Avenue in APN 139-36-710-019 owned by the School Board of Trustees. There is an existing drainage easement on the School Board property, but it stops short of the Stewart Avenue right-of-way.

A small 5-foot wide permanent drainage easement on the south side of the channel right-of-way at Lamb Boulevard is required for the 5' manway. The easement would be located in parcel 140-31-602-001, which is owned by the School Board of Trustees. At APN 140-32-103-002, owned by the Las Vegas VOA Elderly Housing, 30' of channel right-of-way is required. Currently, records only show that 30' as a trail easement.

The limits of the proposed easements and right-of-way are shown on **Figure 13** and **Figure 14**. At this time it does not appear that any Authorization to Enter Property (AEP) easements will be required. AEP easements will be further evaluated between the 30% and 70% submittals and will be added if required.

Coordination with NDOT and an NDOT Encroachment Permit will be required under US95 in order to construct the proposed facilities within NDOT right-of-way. It is intended that this permit be prepared and submitted with the 90% submittal. In addition, Atkins will coordinate with NDOT after the 30% design submittal has been reviewed by the City and CCRFCD. This coordination will introduce the design to NDOT and provide them with a copy of the 30% plans and PDR and also discuss any changes to the design that resulted from the City and CCRFCD review. Input on the design from NDOT will be requested.



LEGEND

- PERMANENT RIGHT OF WAY
- AUTHORIZATION TO ENTER PROPERTY
- PERMANENT DRAINAGE EASEMENT
- LVVWD EASEMENT

GRAPHIC SCALE

100 0 50 100 200

(IN FEET)

CALL BEFORE CONSTRUCTION ⚠		
BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866

DATE: 6/19/2015

SUBMITTAL STAGE:
30% - PRELIMINARY

BID# XX.XXXX

DESIGNED BY: SMB

DRAWN BY: MM

CHECKED BY: XXX

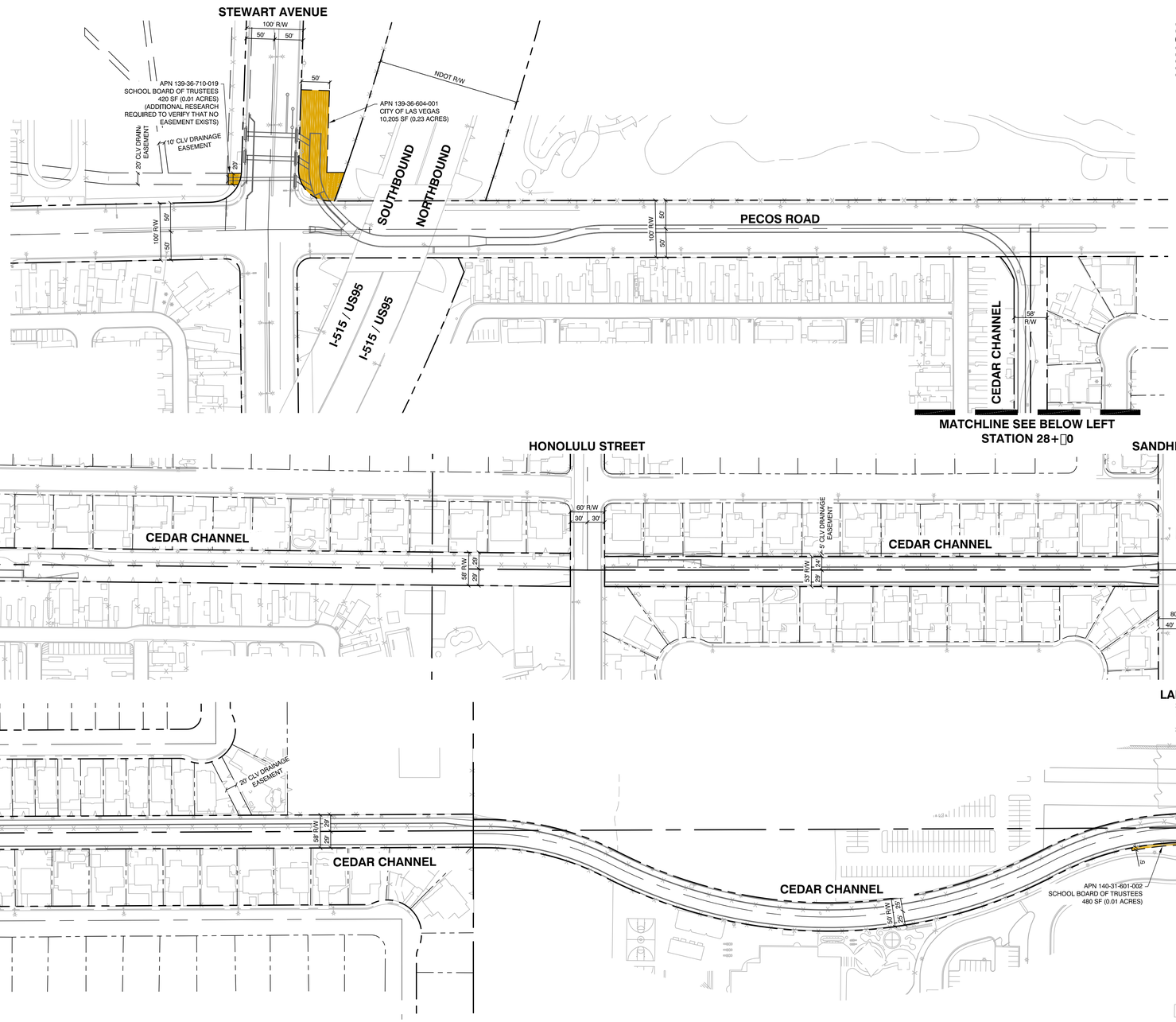
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
RIGHT OF WAY PLAN 2
FIGURE 1

SHEET
RW 2
2 OF **2**

DRAWING NO.
XXX-XXXX

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LEGEND

- PERMANENT RIGHT OF WAY
- PERMANENT DRAINAGE EASEMENT
- AUTHORIZATION TO ENTER PROPERTY
- LVVWD EASEMENT

GRAPHIC SCALE
100 0 50 100 200
(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
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	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
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NO.	DATE	REVISIONS

PREPARED BY
CITY OF LAS VEGAS NEVADA
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866
DATE: 6/19/2015
BID# XX.XXXX
DESIGNED BY: SMB
DRAWN BY: MM
CHECKED BY: HD
SUBMITTAL STAGE:
30% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
RIGHT OF WAY PLAN 1
FIGURE 13

SHEET
RW 1
1 OF 2
DRAWING NO.
XXX-XXXX

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5. Utility Issues and Conflicts Summary

5.1. Utility Data Collection and Conflicts

This section includes discussion regarding the utility research and coordination and recommended test hole locations. The proposed project alignment runs through a well-established area mainly consisting of the existing Cedar Avenue Channel corridor and collector and arterial streets.

Research of the underground utilities was based on survey of surface features, dipping manholes, aerial photography, and obtaining and reviewing design and as-built drawings from utility companies and the City of Las Vegas, which dated as far back as the mid 1950s. As a result, potential utility conflicts identified herein are preliminary and more detailed determination of the location and depth of the existing underground services will continue throughout final design by means of conventional potholing (test holes) and additional coordination with the impacted entities.

The following utilities and agencies were contacted:

- Zayo (formerly American Fiber Systems, Inc.)
- AT&T Cable Maintenance
- Century Link
- City of Las Vegas
- Cox Communications
- Extenet Systems, Inc
- Freeway Arterials System of Transportation (FAST)
- Kern River Gas Transmission Company
- Kinder Morgan Energy Partners
- Level 3 Communications, LLC
- Las Vegas Valley Water District (LVVWD)
- NV Energy (Distribution)
- NV Energy (Transmission)
- Southern Nevada Water Authority (SNWA)
- Southwest Gas Corporation
- Sprint LD
- Sprint Nextel Engineering
- TWT Telecom
- Verizon Business Communications

Existing utilities have been identified from the agencies above and are shown on the 30% design plans. Colored linework is used on the design plans to identify the SUE quality (A, B, C, or D). Please refer to the design plans for detailed information.

The following is an inventory of existing utilities that are anticipated to be in conflict with the proposed storm drain and channel facilities. For the purpose of organizing the information below, the utility conflicts are discussed either by the main trunk line, channel segment or the individual street segment it corresponds to.

Main Trunk Line – Pecos Road north of Stewart Avenue to Cedar Channel

- Existing 60”x38” HE RCP SD will need to be removed for the installation of the proposed 18’x4’ RCB SD and the dual 8’x4’ RCB SD.

- Existing underground power conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x4’ RCB storm drain and will require relocation. The depth of the conduit is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing streetlight conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x4’ RCB storm drain and will require relocation. The depth of the conduit is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing 2” ITS conduit running north from the intersection near the west side Pecos right-of-way is anticipated to be in conflict with the proposed dual 8’x4’ RCB storm drain and will require relocation. The depth of the conduit is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing 10” HP Steel Gas running north/south in Pecos Road on the west side of the street is anticipated to be in conflict with the proposed dual 8’x4’ RCB storm drain and will require relocation. The depth conduit is currently unknown but test hole data received from the CLV from the BOMO project shows the line to be 5.38’ below existing grade on the south side of the Stewart/Pecos intersection. This is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing 36” RCP SS running north/south in Pecos Road is not anticipated to be in conflict based on survey data of the upstream and downstream manholes. Based on the manhole data there will be 6” of clearance between the existing pipe and the proposed dual 8’x4’ RCB SD. It is recommended that a test hole be performed to verify the clearance.

- Existing ITS conduits crossing Pecos Road north of Stewart Avenue are anticipated to be in conflict with the proposed dual 8’x4’ RCB SD and will require relocation. The depth of the conduits is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing 72” RCP SD that runs north/south to the Cedar Channel will need to be removed for the installation of the proposed junction structure, 18’x4’ RCB SD and the 12’x6’ RCB SD.

Channel – Honolulu Drive to Sandhill Road

- Existing trail lighting conduit runs east/west near the north Cedar Channel right-of-way. It is not anticipated that this conduit will be in conflict with the proposed channel access ramp but it is recommended a test hole be performed to verify the horizontal location and clearance from the access ramp.

Channel – Sandhill Road to Lamb Boulevard

- Existing trail lighting conduit runs east/west near the north Cedar Channel right-of-way. It is anticipated that this conduit will be in conflict with the proposed channel access ramp excavation and will need to be removed and replaced.

- Existing 4” underground power conduit runs east/west on the north side of the existing channel starting near Sta 59+50 and continuing to Lamb Boulevard. It is not anticipated that that this conduit will be in conflict with the proposed channel but is recommended a couple test holes be performed to verify the horizontal location of the conduit.

Channel – Lamb Boulevard to Page Street

- Existing 4” underground power conduit runs east/west on the north side of the existing channel from Lamb Boulevard to Page Street. It is not anticipated that that this conduit will be in conflict with the proposed channel but is recommended a test hole be performed to verify the horizontal location of the conduit near the proposed access ramp to verify the horizontal location.

Channel – Page Street to Marion Drive

- Existing 4” underground power conduit runs east/west on the north side of the existing channel from Page Street to Marion Drive. It is not anticipated that that this conduit will be in conflict with the proposed channel but is recommended a test hole be performed to verify the horizontal location of the conduit near the proposed access ramp to verify the horizontal location.

Channel – Marion Drive to Las Vegas Wash

- Existing 6” and 8” SS that crosses the proposed channel near Sta 118+75 will be in conflict with the proposed channel and will need to be relocated.

Stewart Laterals – Stewart Avenue west of Pecos Road

- Existing 18” ACP waterlines will need to be relocated to provide the required horizontal clearance from the proposed drop inlets. The line is not anticipated to be in conflict vertically with the proposed 7’x3’ and 5’x3’ RCB SDs based on test hole data received from CLV from the BOMO project which shows the line 7.97’ from existing grade at the southwest corner of the intersection of Stewart and Pecos. It is recommended that a test hole be performed to verify the horizontal and vertical location.

- Existing traffic signal conduit running east/west in the middle of Stewart Avenue is anticipated to be in conflict with the proposed 7’x3’ and 5’x3’ RCB SDs based on test hole data received from the CLV from the BOM project which shows the line 2.66 below

existing grade at the west side of the intersection. The conduit will require relocation. It is recommended that test holes be performed at the location of the proposed lateral to verify the relocation will be required.

- Existing streetlight conduit running east/west in the middle of Stewart Avenue is anticipated to be in conflict with the proposed 7'x3' and 5'x3' RCB SDs and will require relocation. The depth of the conduit is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing ITS conduit running east/west in the middle of Stewart Avenue is anticipated to be in conflict with the proposed 7'x3' and 5'x3' RCB SDs and will require relocation. The depth of the conduit is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed.

- Existing 8" SS will be in conflict with the proposed 7'x3' and 5'x3' RCB SDs and will require relocation.

- Existing underground power conduit running east/west on the north side of Stewart Avenue is anticipated to be in conflict with the proposed 7'x3' and 5'x3' RCB SDs and will require relocation. The depth of the conduit is currently unknown but is a recommended test hole location. Relocation will be verified once a test hole is performed

The remaining existing utilities, other than those identified above, do not appear to be in conflict with the proposed storm drain system and channel. However, existing underground utilities are required to be protected during the excavation for the placement of the proposed storm drain system. Additionally, more utilities may be indentified for relocations as the final design proceeds and as potholes are completed. A complete list of utility crossings is included in **Appendix E.**

5.2. Utility Potholing

Currently, no test holes have been performed on the project. Following the submittal of the 30% design plans and after addressing any comments received, a pothole plan will be submitted to the City for approval and the first round of potholes will be performed. A total of 50 potholes are anticipated to be performed for this project.

6. Construction Cost Estimate

It is estimated that the project will have a total construction cost of **$16,652,193**.

All of the improvements are shown to be funded by the Clark County Regional Flood Control District.

A 15-percent contingency has been added to the cost estimate to offset the level of detail that has been provided at this stage.

The detailed cost estimate and associated quantities are shown in **Appendix F**.

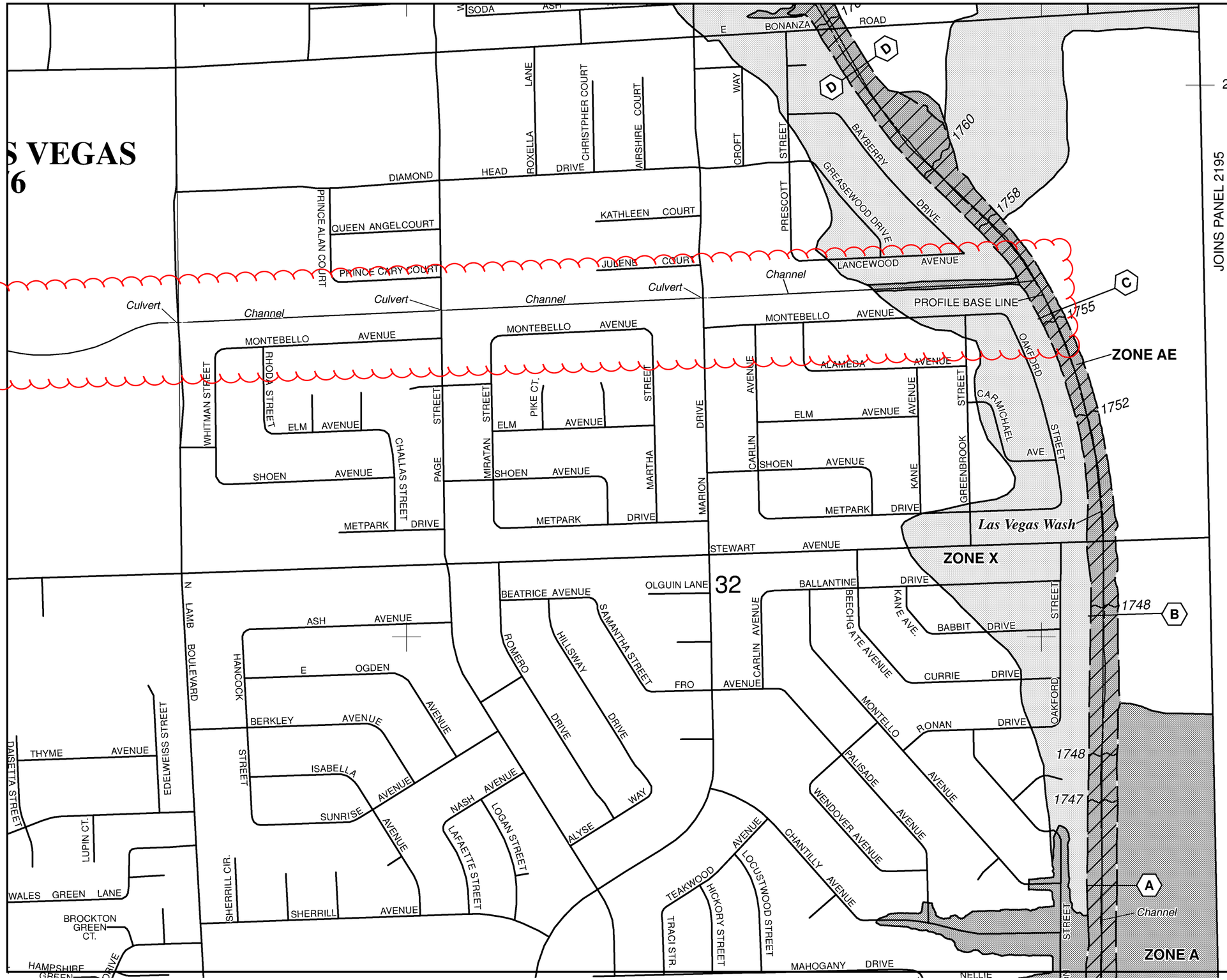
Appendix A

Hydrologic Analysis

- Appendix A-1: FEMA FIRMette
- Appendix A-2: Existing Condition Photo Library
- Appendix A-3: HEC-1 Model
- Appendix A-4: CCRFD Design Manual Tables
- Appendix A-5: Hydrologic Parameters
- Appendix A-6: Land Use Map and Soils Map

Appendix A-1

FEMA FIRMette



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2187F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA

AND INCORPORATED AREAS

PANEL 2187 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2187	F
LAS VEGAS, CITY OF	325276	2187	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2187F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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CITY OF LAS VEGAS
325276

MAP SCALE 1" = 500'
250 0 500 1000 FEET METE

JOINS PANEL 2186

E BONANZA ROAD
TRIEST
N HONOLULU STREET
SANDHILL ROAD
POSSE AVENUE
BED STREET
RIVER
BUFFALO BILL AVENUE
HUDSON BAY AVENUE
LIGHTHOUSE AVENUE
BUFFALO
N
Channel
Culvert
MONTEBELLO AVENUE
ALAMEDA AVENUE
GAVIOTA AVENUE
CENTURA AVENUE
COSTA MESA AVENUE
ANCHOR STREET
GALVESTON STREET
LEHMAN STREET
CENTURY
BANDERA DRIVE
BOLSA DRIVE
ORION AVENUE
TYBO AVENUE
STEWART AVENUE
31
PELHAM COURT
SACRAMENTO DRIVE
SAGUARO LANE
TRABUCO DRIVE
E OGDEN AVENUE
AVENUE
LA BREA COURT
VALLEJO
MIDAS STREET
KATHY JO WAY
DRIVE
SUZY CT.
SACRAMENTO
DEL NORTE CIRCLE
COLUSA CIRCLE
PARK STREET
PARK COURT
HAMPSHIRE GREEN CT.
DRIVE
RONALD LANE
PRINCE LANE
CHELSEANN STREET
DAISETTA STREET
THYME AVENUE
LUPIN CT.
SUNRISE AVENUE
WALES GREEN LANE
BROCKTON GREEN CT.
EDELWEISS STREET
N LAMB BOULEVARD
0m N
N HONOLULU STREE

DIAMOND HEAD DRIVE
ROXELLA LANE
CHRISTPHER COURT
PRINCE ALAN COURT
QUEEN ANGEL COURT
PRINCE CARY COURT
KA
JU
MONTEBELLO AVENUE
WHITMAN STREET
RHODA STREET
ELM AVENUE
SHOEN AVENUE
METPARK DRIVE
CHALLAS STREET
PAGE STREET
MIRATAN STREET
PIKE CT.
ASH AVENUE
E OGDEN AVENUE
HANCOCK AVENUE
BERKLEY AVENUE
ISABELLA AVENUE
SUNRISE AVENUE
NASH AVENUE
LOGAN STREET
LAFAETTE STREET
SHERRILL CIR.
SHERRILL AVENUE
BEATRICE AVENUE
ROMERO DRIVE
HILLSWAY
ALYSE

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2187F

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA
AND INCORPORATED AREAS

PANEL 2187 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2187	F
LAS VEGAS, CITY OF	325276	2187	F

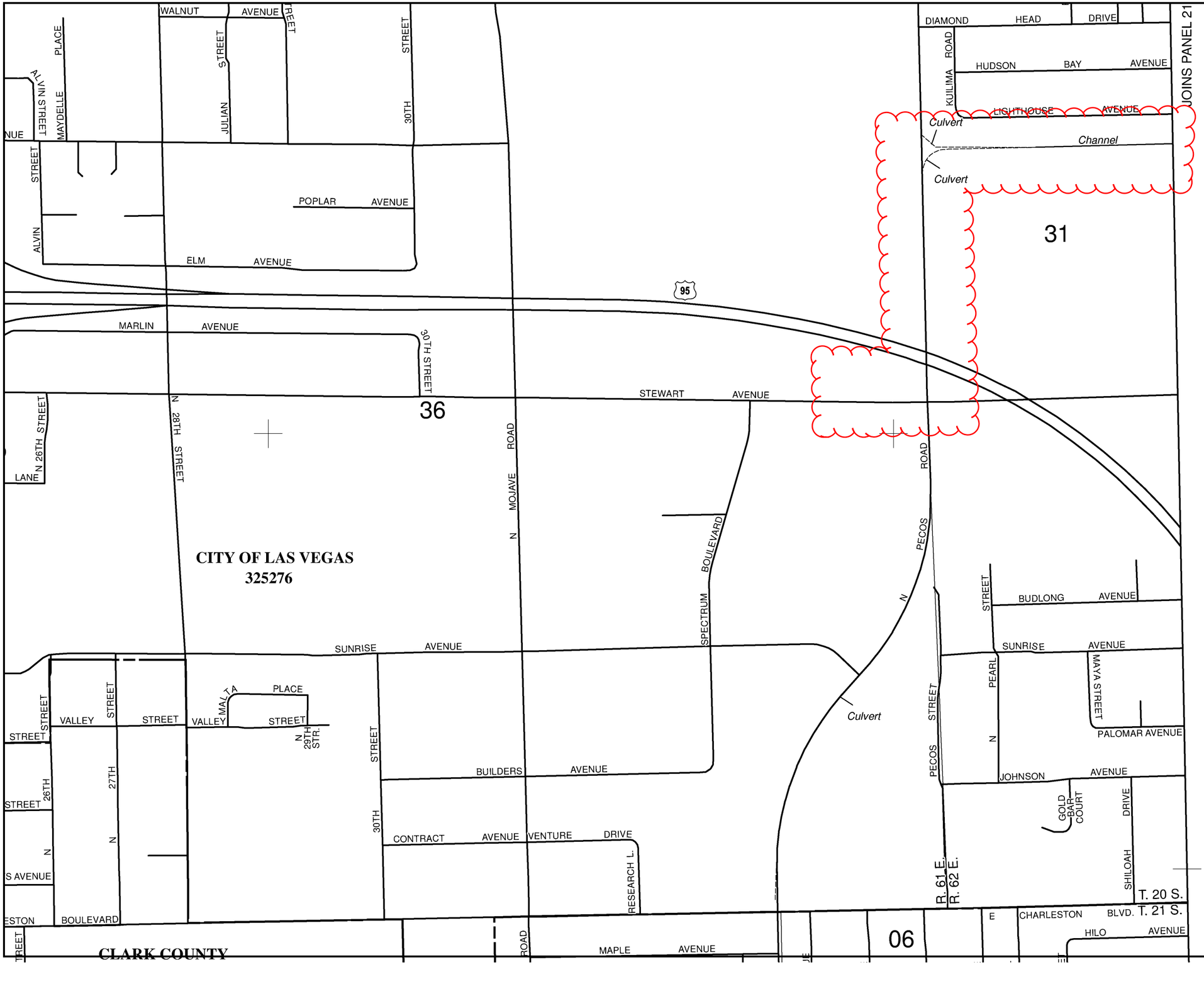
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2187F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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MAP SCALE 1" = 500'

250 0 500 1000 FEET METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2186F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2186 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2186	F
LAS VEGAS, CITY OF	325276	2186	F
NORTH LAS VEGAS, CITY OF	320007	2186	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2186F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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Appendix A-2

Existing Condition Photo Library



Photo 1: Looking at the upstream end of the channel at the two (2) 72-inch RCP's



Photo 2: Looking east at the trail along the Cedar Channel



Photo 3: Looking east at the Cedar channel upstream of Honolulu Street crossing



Photo 4: Looking east at the upstream face of Honolulu Street crossing



Photo 5: Looking west at the downstream face of Honolulu Street crossing



Photo 6: Looking east at the Cedar channel downstream of Honolulu Street crossing



Photo 7: Looking east at the Cedar channel upstream of Sandhill Road crossing



Photo 8: Looking east at the upstream face of Sandhill Road crossing



Photo 9: Looking west at the downstream face of Sandhill Road crossing



Photo 10: Looking east at the Cedar channel downstream of Sandhill Road crossing



Photo 11: Looking east at the Cedar channel upstream of Lamb Boulevard crossing



Photo 12: Looking east at the upstream face of Lamb Boulevard crossing



Photo 13: Looking west at the downstream face of Lamb Boulevard crossing



Photo 14: Looking east at the upstream face of Marion Street crossing



Photo 15: Looking west at the downstream face of Marion Street crossing



Photo 16: Looking east at the upstream face of Page Street crossing



Photo 17: Looking west at the downstream face of Page Street crossing



Photo 18: Looking north at drop inlets on Stewart Ave, west of Pecos Rd



Photo 19:Looking east at drop inlets on south side of Stewart Ave, west of Pecos Rd



Photo 20:Looking east at channel access ramp east of Honolulu St

Appendix A-3

HEC- 1 Model

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   03JUN15  TIME  11:32:48   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X                X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                HEC-1 INPUT                                                PAGE  1

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
 *** FREE ***
              1          ID    LAS VEGAS WASH CENTRAL-CEDAR AVENUE
              2          ID
              3          ID    INPUT FILE = CEDAR_INT.DAT
              4          ID    INPUT FILE DATE =  APRIL 2014
              5          ID    DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
              6          ID    STORM DISTRIBUTION = SDN #3
              7          ID    MODELED BY ATKINS (MANOGYA KHANAL)
              8          ID    CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
              9          ID    NO STORM CENTERING
             10          ID    REFERENCED HYDROLOGIC MODELS:
             11          ID    2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
             12          ID    MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
             13          ID    CENTRAL NEIGHBORHOOD STUDY
             14          ID
             15          ID
             16          ID    JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
             17          ID
             18          ID                        AREA       DARF
             19          ID                        SQ. MI.
             20          ID                        0-0.5     0.990
             21          ID                        0.5-1      0.975
             22          ID                        1-2       0.950
             23          ID                        2-3        0.925
             24          ID                        3-4        0.915
             25          ID                        4-5        0.908
             26          ID                        5-6        0.903
             27          ID
             28          IT       5       0       0     300
             29          IO       5       0       0
             30          IN       5       0       0
             31          JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908   0.903    0.57
                         *
             32          KK   CA03a
             33          BA   0.095
             34          PB    2.77
             35          PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
             36          PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
             37          PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
             38          PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
             39          PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
             40          PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
             41          PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
             42          PC   0.998   0.999   1.000
             43          LS       0    87.8
             44          UD   0.234
                         *
1                                                HEC-1 INPUT                                                PAGE  2

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             45          KK   CA03c
             46          BA   0.022
             47          PB    2.77
```

```
 48          LS       0    87.9
 49          UD   0.238
             *

 50          KK  CCA03c
 51          KM  COMBINE CA03a AND CA03c
 52          KM  EASTERN AND STEWART
 53          HC       2
             *

 54          KK   CA03b
 55          BA   0.079
 56          PB    2.77
 57          LS       0    87.9
 58          UD   0.257
             *

 59          KK   CCA03
 60          KM  COMBINE CCA03c AND CA03b
 61          KM  EASTERN AND STEWART
 62          HC       2
             *

 63          KK  RCCA03
 64          KM  ROUTE CCA03 TO CCA04b
 65          KM  STEWART
 66          RD    1240 0.01371   0.016       0    TRAP       0      50
             *

 67          KK   CA04b
 68          BA   0.060
 69          PB    2.77
 70          LS       0    88.1
 71          UD   0.203
             *

 72          KK  CCA04b
 73          KM  COMBINE RCCA03, CA04a AND CA04b
 74          KM  STEWART AT 28th STREET
 75          HC       2
             *

 76          KK RCCA04b
 77          KM  ROUTE CCA04b TO CCA04
 78          KM  STEWART
 79          RD    1780 0.00955   0.016       0    TRAP       0      50
             *
1                                        HEC-1 INPUT                                                PAGE  3

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 80          KK   CA04a
 81          BA   0.039
 82          PB    2.77
 83          LS       0    87.5
 84          UD   0.224
             *

 85          KK   CA04c
 86          BA   0.031
 87          PB    2.77
 88          LS       0    90.7
 89          UD   0.199
             *

 90          KK CCA04-1
 91          KM  COMBINE RCCA04b, CA04a AND CA04c
 92          KM  STEWART AT MOJAVE
 93          HC       3
             *

 94          KK   CA04g
 95          BA   0.052
 96          PB    2.77
 97          LS       0    92.4
 98          UD   0.156
             *

 99          KK  RCA04g
100          KM  ROUTE CA04g TO CCA04d
101          KM  SUNRISE
102          RD    3500   0.014   0.016       0    TRAP       0      50
             *

103          KK   CA04d
104          BA   0.052
105          PB    2.77
106          LS       0    91.2
107          UD   0.191
             *

108          KK  CCA04d
109          KM  COMBINE RCA04g AND CA04d
110          KM  SUNRISE AND EASTERN
```

```
          111          HC       2
                       *

          112          KK  RCA04d
          113          KM  ROUTE CA04c TO CCA04d
          114          KM  SUNRISE
          115          RD    3050 0.01148   0.016       0    TRAP       0      50
                       *
1                                        HEC-1 INPUT                                                PAGE  4

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          116          KK   CA04e
          117          BA   0.190
          118          PB    2.77
          119          LS       0    90.0
          120          UD   0.349
                       *

          121          KK  CCA04e
          122          KM  COMBINE RCBN03 AND BN08
          123          KM  SUNRISE AND MOJAVE
          124          HC       2
                       *

          125          KK RCCA04e
          126          KM  ROUTE CCA04e TO CCA04f
          127          KM  MOJAVE
          128          RD    1360 0.00368   0.016       0    TRAP       0      50
                       *

          129          KK   CA04f
          130          BA   0.046
          131          PB    2.77
          132          LS       0    91.6
          133          UD   0.209
                       *

          134          KK  CCA04f
          135          KM  COMBINE RCCA04d AND CA04e
          136          KM  MOJAVE AT STEWART
          137          HC       2
                       *

          138          KK   CCA04
          139          KM  COMBINE CCA04 AND CCA04e
          140          KM  STEWART AT MOJAVE
          141          HC       2
                       *

          142          KK  RCCA04
          143          KM  ROUTE CCA04 TO CCA05
          144          KM  STEWART
          145          RD    2130 0.00892   0.016       0    TRAP       0      50
                       *

          146          KK   CA05a
          147          BA   0.036
          148          PB    2.77
          149          LS       0    91.0
          150          UD   0.215
                       *
1                                        HEC-1 INPUT                                                PAGE  5

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


          151          KK   CA05b
          152          BA   0.050
          153          PB    2.77
          154          LS       0    91.9
          155          UD   0.232
                       *

          156          KK CCA05-1
          157          KM  COMBINE RCCA04, CA05a AND CA05b
          158          KM  STEWART AT PECOS
          159          HC       3
                       *

          160          KK  DCCA05
          161          KM  DIVERT BYPASS FLOW ON STEWART THAT CONTINUES EAST ON STEWART
          162          KM  REMAINING FLOW IS THE FLOW COLLECTED IN INLETS
          163          DT  DSTEWQ
          164          DI       0     200     400     430     600     745     900
          165          DQ       0       0       0       0     170     315     470
                       *

          166          KK   CA05c
          167          BA   0.023
          168          PB    2.77
          169          LS       0    91.9
          170          UD   0.146
                       *
```

```
 171          KK  RCA05c
 172          KM  ROUTE CA05c TO CCA05e
 173          KM  SUNRISE
 174          RD     750 0.00933   0.016       0    TRAP       0      50
              *

 175          KK   CA05d
 176          BA   0.043
 177          PB    2.77
 178          LS       0    91.5
 179          UD   0.202
              *

 180          KK   CA05e
 181          BA   0.003
 182          PB    2.77
 183          LS       0    92.0
 184          UD   0.104
              *

 185          KK  CCA05e
 186          KM  COMBINE RCA05d AND CA05c
 187          KM  SUNRISE AT PECOS
 188          HC       3
              *
1                                      HEC-1 INPUT                                          PAGE  6

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 189          KKDTCCA05e
 190          KM  DIVERT FLOW INTO THE STREET.
 191          KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
 192          KM  AT PECOS NORTH OF SUNRISE
 193          DT  DTA05e
 194          DI       0    49.5      99
 195          DQ       0    26.5      53
              *

 196          KK   CA05f
 197          BA   0.009
 198          PB    2.77
 199          LS       0    92.0
 200          UD   0.123
              *

 201          KK DTCAO5f
 202          KM  DIVERT FLOW INTO THE STREET.
 203          KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
 204          KM  AT PECOS NORTH OF SUNRISE
 205          DT  DTA05f
 206          DI       0     3.5       7
 207          DQ       0    1.75     3.5
              *

 208          KK  CCA05f
 209          KM  COMBINE RCA05e AND CA05f
 210          HC       2
              *

 211          KK RCCA05f
 212          KM  ROUTE CCA05f TO CCA05f
 213          KM  PECOS
 214          RD     820 0.00732   0.013       0    CIRC       3       0
              *

 215          KK   CA05h
 216          BA   0.003
 217          PB    2.77
 218          LS       0    92.0
 219          UD   0.101
              *

 220          KK   CA05i
 221          BA   0.004
 222          PB    2.77
 223          LS       0    92.0
 224          UD   0.093
              *
1                                      HEC-1 INPUT                                          PAGE  7

           LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 225          KK   CA05k
 226          BA   0.010
 227          PB    2.77
 228          LS       0    91.9
 229          UD   0.105
              *

 230          KK  CCA05k
 231          KM  COMBINE RCCA05f, CA05h, CA05i AND CA05k
 232          KM  UNDEVELOPED PARCEL AT STEWART AND PECOS
```

```
 233          HC       4
              *

 234          KK   CA05g
 235          BA   0.007
 236          PB    2.77
 237          LS       0    92.0
 238          UD   0.101
              *

 239          KK   CA05j
 240          BA   0.005
 241          PB    2.77
 242          LS       0    92.0
 243          UD   0.083
              *

 244          KK   CA05p
 245          BA   0.006
 246          PB    2.77
 247          LS       0    91.1
 248          UD   0.183
              *

 249          KK  CCA05p
 250          KM  COMBINE CA05g, CA05j AND CA05p
 251          KM  ON PECOS SOUTH OF STEWART
 252          HC       3
              *

 253          KK  DRA05e
 254          KM  RETURN FLOW FROM DIVERTED
 255          KM  FLOW ON THE STREET
 256          DR  DTA05e
              *

 257          KK  DRA05f
 258          KM  RETURN FLOW FROM DIVERTED
 259          KM  FLOW ON THE STREET
 260          DR  DTA05f
              *
```



```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 261          KK CCA05-3
 262          KM  COMBINE DRA05f, DRA05e AND CCA05p
 263          KM  ON PECOS SOUTH OF STEWART
 264          HC       3
              *

 265          KKDTCCA053
 266          KM  DIVERT FLOW INTO THE STREET.
 267          KM  REMIANING WILL FLOW INTO THE DROPINTET
 268          KM  AT PECOS SOUTH OF STEWART, WEST
 269          DT DTA05-3
 270          DI       0    43.5      87
 271          DQ       0      40      80
              *

 272          KK CCA05-2
 273          KM  COMBINE CCA05-1 AND CCA05p
 274          KM  ON PECOS SOUTH OF STEWART
 275          HC       2
              *

 276          KKCCA05-2a
 277          KM  COMBINE CCA05-2 AND CCA05-1
 278          KM  ON STEWART AND PECOS
 279          HC       2
              *

 280          KK    CHAR
 281          BA  0.0365
 282          QI     0.0     0.0     0.0     0.0     0.0     0.3     0.8     1.3     1.8     1.5
 283          QI     1.3     0.8     0.5     0.5     0.5     0.8     1.0     1.3     2.3     2.8
 284          QI     3.1     2.8     2.6     2.1     1.8     1.8     2.3     3.6     3.9     3.6
 285          QI     3.6     3.6     3.6     3.6     3.6     4.6    11.3    18.0    27.0    36.0
 286          QI    42.2    43.0    39.4    33.7    27.3    17.8    14.2    11.3     9.3     8.2
 287          QI     8.5     9.3     9.8    10.0     9.8     9.0     7.7     6.4     4.9     3.9
 288          QI     3.1     2.3     1.8     1.3     1.3     1.0     1.0     0.8     0.5     0.5
 289          QI     0.3     0.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
 290          QI     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 291          KK   RCHAR
 292          KM  ROUTE CHAR TO CH70-C
 293          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 294          RD    4600  0.0098   0.016       0    TRAP       0      50
              *

 295          KK  CH70-C
 296          BA   0.137
 297          PB    2.77
```

```
 298          LS       0    92.7
 299          UD   0.305
              *
1                                        HEC-1 INPUT                                                PAGE  9

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 300          KK   CCHAR
 301          KM  COMBINE CHAR AND CH70-C
 302          HC       2
              *

 303          KK  RCCHAR
 304          KM  ROUTE CCHAR TO CCA05-2
 305          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 306          KM  LINING = RCP
 307          RD    1250  0.0096   0.013       0    CIRC     5.5       0
              *

 308          KK   CA05m
 309          BA   0.005
 310          PB    2.77
 311          LS       0    91.5
 312          UD   0.134
              *

 313          KK  CCA05n
 314          KM  COMBINE CHAR AND CA05m
 315          KM  ON PECOS AND SUNRISE
 316          HC       2
              *

 317          KK RCCA05m
 318          KM  ROUTE CCA05n TO CCA05-2
 319          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 320          KM  LINING = RCP
 321          RD    1580 0.00633   0.013       0    CIRC     5.5       0
              *

 322          KK CCA05-4
 323          KM  COMBINE CCA05n AND CA05m
 324          KM  ON PECOS AND SUNRISE
 325          HC       2
              *

 326          KK   CA05n
 327          BA   0.004
 328          PB    2.77
 329          LS       0    91.4
 330          UD   0.106
              *

 331          KK   CA05q
 332          BA   0.013
 333          PB    2.77
 334          LS       0    82.5
 335          UD   0.215
              *
1                                        HEC-1 INPUT                                                PAGE 10

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 336          KK  CCA05q
 337          KM  COMBINED FLOW IN EXISTING STORM DRAIN
 338          KM  STEWART AND PECOS
 339          HC       2
              *

 340          KK   CCA05
 341          KM  TOTAL FLOW ON SURFACE AND SYSTEM
 342          KM  STEWART AND PECOS
 343          HC       2
              *

 344          KK  RCCA05
 345          KM  ROUTE CCA05 TO CCA08
 346          KM  PROPOSED FACILITY IN PECOS ROAD
 347          KM  LINING = RCB
 348          RD    1310   0.005   0.013       0    TRAP      14       0
              *

 349          KK  CA06-C
 350          BA   0.407
 351          PB    2.77
 352          LS       0    82.5
 353          UD   0.465
              *

 354          KK  CH59-C
 355          BA   0.213
 356          PB    2.77
 357          LS       0    94.4
 358          UD   0.371
```

```
                *

 359            KK DCH58-C
 360            KM  FLOW SPLIT TO CH58-C
 361            KM  SPLIT TO FLAMINGO WASH SYSTEM
 362            KM  DEVELOPED FROM CWH MODEL
 363            KM  CAPACITY = 144 CFS (100 YR STORM DRAIN CAPACITY)
 364            DT   DFLAM
 365            DI       0     144    1000
 366            DQ       0       0     856
                *

 367            KK  RDCH58
 368            KM  ROUTE DCH58-C TO CCH58-C
 369            KM  LAS VEGAS BLVD STORM DRAIN
 370            RD    5900    0.01   0.013       0    CIRC       4       0
                *
1                                       HEC-1 INPUT                                                 PAGE 11

          LINE  ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 371            KK  CH58-C
 372            BA   0.128
 373            PB    2.77
 374            LS       0    93.4
 375            UD   0.312
                *

 376            KK CCH58-C
 377            KM  COMBINE DCH58-C AND CH58-C
 378            KM  US 95
 379            HC       2
                *

 380            KKDDCH59-C
 381            KM  FLOW SPLIT TO BN03-C
 382            KM  DIVERT Q EXCEEDING LAS VEGAS BLVD DRAIN CAPACITY:  48" PIPE, 167 CFS
 383            KM  DBN00 IN CWH
 384            DT   DBN03
 385            DI       0     167    1000
 386            DQ       0       0     833
                *

 387            KK  DDCH59
 388            KM  DIVERT FLOW OUT OF PECOS/BONANZA SYSTEM
 389            DT  DBN03a
 390            DI       0     167    1000
 391            DQ       0     167    1000
                *

 392            KK  BN06-C
 393            BA   0.340
 394            PB    2.77
 395            LS       0    89.1
 396            UD   0.201
                *

 397            KK  BN03-C
 398            BA   0.539
 399            PB    2.77
 400            LS       0    87.3
 401            UD   0.344
                *

 402            KK   DBN03
 403            KM  RETREIVE DBN03
 404            DR   DBN03
                *

 405            KK  RDBN03
 406            KM  ROUTE DBN03 TO CBN03
 407            KM  BONANZA
 408            RD    5900  0.0264   0.016       0    TRAP       0      50
                *
1                                       HEC-1 INPUT                                                 PAGE 12

          LINE  ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 409            KK   CBN03
 410            KM  COMBINE BN06-C, BN03-C, AND RDBN03
 411            KM  BONANZA AND EASTERN
 412            HC       3
                *

 413            KK  RCBN03
 414            KM  ROUTE CBN03 TO CBN08
 415            KM  FACILITY = LAS VEGAS WASH - BONANZA
 416            KM  FACILITY # = LVBZ 0211,0224
 417            KM  LINING = RCB
 418            RD    2980  0.0072   0.015       0    TRAP       8       0
                *

 419            KK    BN08
```

```
 420          BA   0.210
 421          PB    2.77
 422          LS       0    91.8
 423          UD   0.378
              *

 424          KK   CBN08
 425          KM  COMBINE RCBN03 AND BN08
 426          KM  BONANZA AND MOJAVE
 427          HC       2
              *

 428          KK  RCBN08
 429          KM  ROUTE CBN08 TO CBN09
 430          KM  FACILITY = LAS VEGAS WASH - BONANZA
 431          KM  FACILITY # = LVBZ 0167, 0188
 432          KM  LINING = RCB
 433          RD    2330   0.007   0.015       0    TRAP       9       0
              *

 434          KK    BN09
 435          BA   0.233
 436          PB    2.77
 437          LS       0    83.9
 438          UD   0.411
              *

 439          KK   CBN09
 440          KM  COMBINE RCBN08 AND BN09
 441          KM  BONANZA AND PECOS
 442          HC       2
              *

 443          KK   DBN09
 444          KM  FLOW SPLIT TO PECOS
 445          KM  DIVERT Q EXCEEDING 60" PIPE, 202 CFS
 446          DT  DBN09a
 447          DI       0     202    1000    2000
 448          DQ       0       0     798    1798
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 449          KK  CCBN09
 450          KM  COMBINE DDCH59 AND DBN09
 451          KM  SHOULD BE THE SAME AS CBN09
 452          KM  DDCH59 HAS ZERO FLOW
 453          KM  BONANZA AND PECOS
 454          HC       2
              *

 455          KK CCA06-1
 456          KM  BONANZA FLOW AND CA06-C
 457          HC       2
              *

 458          KK   CCA06
 459          KM  CEDAR AND PECOS
 460          HC       2
              *

 461          KK  RCCA06
 462          KM  ROUTE CCA05 TO CCA08
 463          KM  FACILITY = CEDAR AVENUE CHANNEL
 464          KM  FACILITY # = CACH 0127,0129,0146,0148
 465          KM  LINING = CONCRETE
 466          RD    1545  0.0026   0.015       0    TRAP      10     1.5
              *

 467          KK    CA08
 468          BA   0.073
 469          PB    2.77
 470          LS       0    85.4
 471          UD   0.258
              *

 472          KK   CCA08
 473          KM  CEDAR AND HONOLULU
 474          HC       2
              *

 475          KK  RCCA08
 476          KM  ROUTE CCA08 TO CCA09
 477          KM  FACILITY = CEDAR AVENUE CHANNEL
 478          KM  FACILITY # = CACH 0079,0081
 479          KM  LINING = CONCRETE
 480          RD    1050  0.0026   0.015       0    TRAP      10     1.5
              *

 481          KK    CA09
 482          BA   0.048
 483          PB    2.77
 484          LS       0    89.6
```

```
 485          UD   0.225
              *
1                                        HEC-1 INPUT                                        PAGE 14

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 486          KK   CCA09
 487          KM  CEDAR AND SANDHILL
 488          HC       2
              *
 489          KK  RCCA09
 490          KM  ROUTE CCA09 TO CCA10
 491          KM  FACILITY = CEDAR AVENUE CHANNEL
 492          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 493          KM  LINING = CONCRETE
 494          RD     935   0.002   0.015       0    TRAP      12     1.5
              *
 495          KK    CA10
 496          BA   0.032
 497          PB    2.77
 498          LS       0    93.0
 499          UD   0.221
              *
 500          KK   CCA10
 501          KM  CEDAR AVE CHANNEL
 502          HC       2
              *
 503          KK  RCCA10
 504          KM  ROUTE CCA10 TO CCA11
 505          KM  FACILITY = CEDAR AVENUE CHANNEL
 506          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 507          KM  LINING = CONCRETE
 508          RD    1730   0.002   0.015       0    TRAP      12     1.5
              *
 509          KK    CA11
 510          BA   0.092
 511          PB    2.77
 512          LS       0    90.2
 513          UD   0.288
              *
 514          KK   CCA11
 515          KM  CEDAR AND LAMB
 516          HC       2
              *
 517          KK  RCCA11
 518          KM  ROUTE CCA11 TO CCA12
 519          KM  FACILITY = CEDAR AVENUE CHANNEL
 520          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 521          KM  LINING = CONCRETE
 522          RD    1340  0.0038   0.015       0    TRAP      10     1.5
              *
1                                        HEC-1 INPUT                                        PAGE 15

 LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 523          KK    CA12
 524          BA   0.062
 525          PB    2.77
 526          LS       0    94.1
 527          UD   0.245
              *
 528          KK   CCA12
 529          KM  CEDAR AND PAGE
 530          HC       2
              *
 531          KK  RCCA12
 532          KM  ROUTE CCA12 TO CCA13
 533          KM  FACILITY = CEDAR AVENUE CHANNEL
 534          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 535          KM  LINING = CONCRETE
 536          RD    1365  0.0037   0.015       0    TRAP      10     1.5
              *
 537          KK   CA13a
 538          BA   0.065
 539          PB    2.77
 540          LS       0    95.9
 541          UD   0.247
              *
 542          KK  CCA13a
 543          KM  CEDAR AND MARION
 544          HC       2
              *
```

```
 545          KK  BN10-C
 546          BA   0.257
 547          PB    2.77
 548          LS       0    88.8
 549          UD   0.406
              *

 550          KK  DBN09a
 551          KM  RETREIVE DBN09a
 552          DR  DBN09a
              *

 553          KK CBN10-C
 554          KM  COMBINE DBN09a AND BN10-C
 555          KM  BONANZA AND SANDHILL
 556          HC       2
              *
1                                    HEC-1 INPUT                                          PAGE 16

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 557          KKRCBN10-C
 558          KM  ROUTE CBN10-C TO CBN12-C
 559          KM  FACILITY = LAS VEGAS WASH - BONANZA
 560          KM  FACILITY # = LVBZ 0064
 561          KM  LINING = RCB
 562          RD    2630   0.004   0.015       0    TRAP      24       0
              *

 563          KK  BN12-C
 564          BA   0.323
 565          PB    2.77
 566          LS       0    87.4
 567          UD   0.397
              *

 568          KK CBN12-C
 569          KM  COMBINE RCBN10-C AND BN12-C
 570          KM  BONANZA AND LAMB
 571          HC       2
              *

 572          KKRCBN12-C
 573          KM  ROUTE CBN12-C TO CBN15-C
 574          KM  FACILITY = LAS VEGAS WASH - BONANZA
 575          KM  FACILITY # = LVBZ 0000
 576          KM  LINING = RCB
 577          RD    2740   0.004   0.015       0    TRAP      24       0
              *

 578          KK  BN15-C
 579          BA   0.283
 580          PB    2.77
 581          LS       0    87.0
 582          UD   0.414
              *

 583          KK CBN15-C
 584          KM  COMBINE  RCBN12-C AND BN15-C
 585          KM  LAS VEGAS WASH AND BONANZA
 586          HC       2
              *

 587          KKRCBN15-C
 588          KM  ROUTE CCBN15-C TO CCA13a
 589          KM  TO CEDAR CHANNEL FROM MARION DRIVE
 590          KM  LINING = RCB
 591          RD    1371  0.0073   0.015       0    TRAP      20       0
              *
1                                    HEC-1 INPUT                                          PAGE 17

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 592          KK   CCA13
 593          KM  CEDAR CHANNEL AT MARION DRIVE
 594          KM  COMBINES FLOWS FROM CEDAR CHANNEL AND BONANZA
 595          HC       2
              *

 596          KK  RCCA13
 597          KM  ROUTE CCA13 TO CCA14
 598          KM  FACILITY = CEDAR AVENUE CHANNEL
 599          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 600          KM  LINING = CONCRETE
 601          RD    1680   0.002   0.015       0    TRAP      14     1.5
              *

 602          KK    CA14
 603          BA   0.055
 604          PB    2.77
 605          LS       0    97.7
 606          UD   0.233
```

```
                    *

           607      KK   CCA14
           608      KM  CEDAR CHANNEL AT WASH
           609      HC       2
                    *

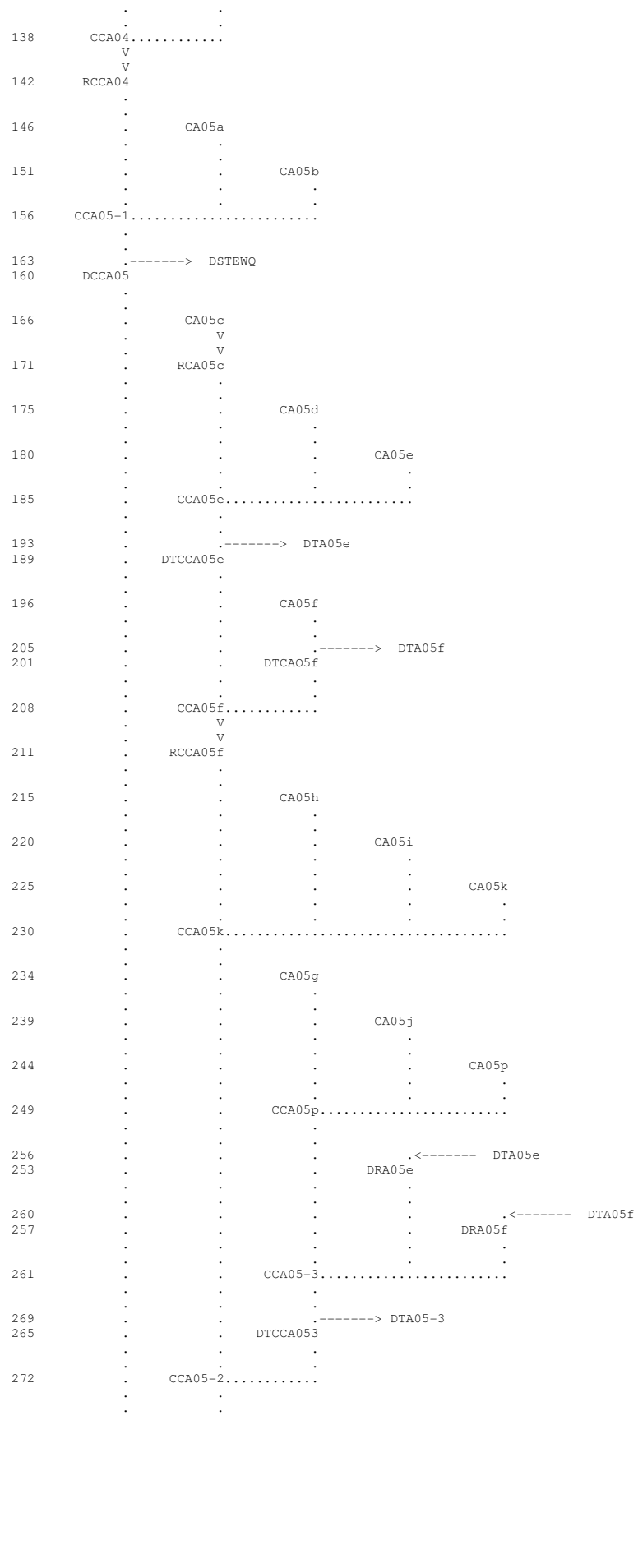
           610      KK DRDTA05
           611      KM  RETURN FLOW FROM DIVERTED
           612      KM  FLOW ON THE STREET FROM PECOS
           613      DR DTA05-3
                    *

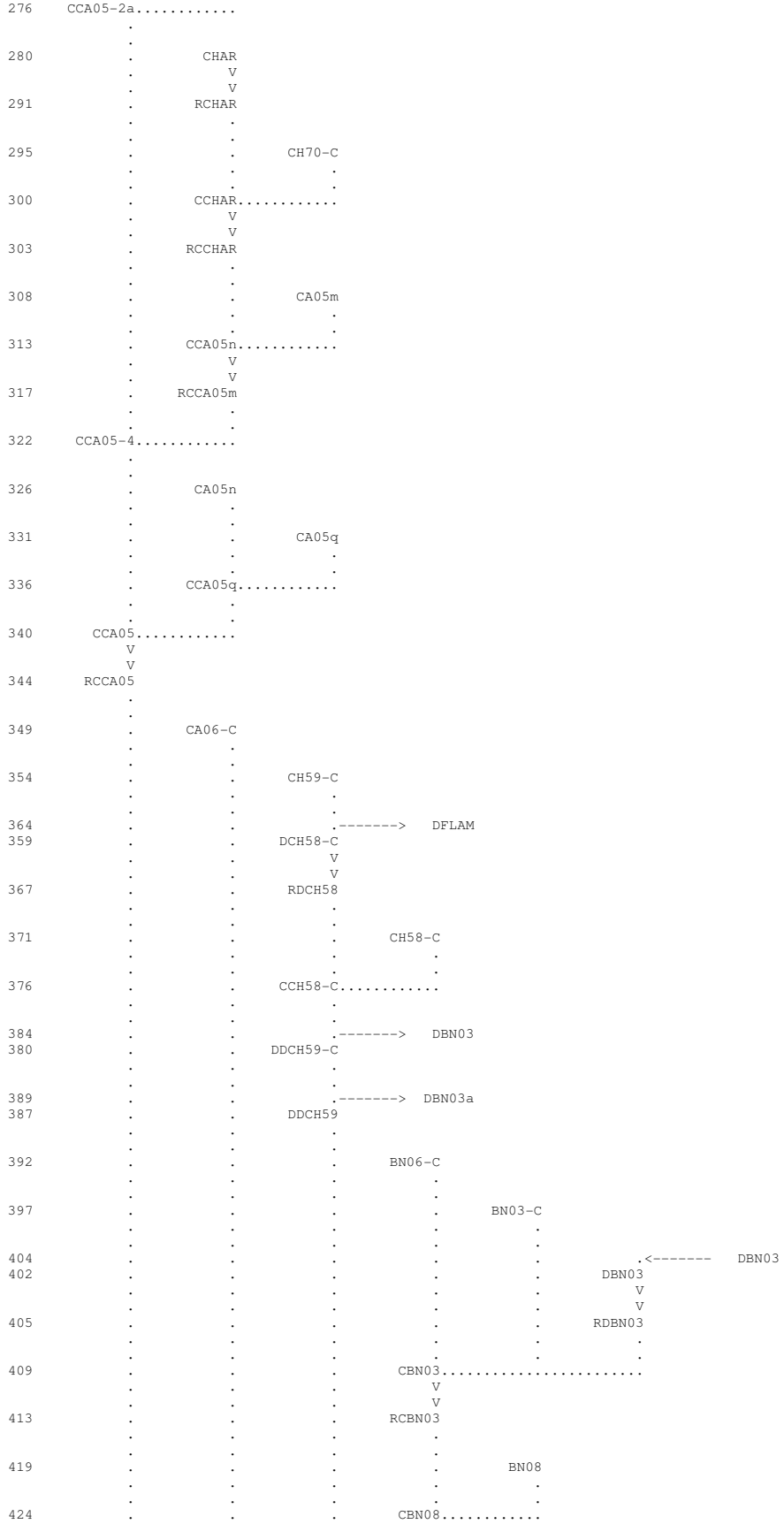
           614      KK DRDSTEW
           615      KM  RETURN FLOW FROM DIVERTED
           616      KM  FLOW ON THE STREET FROM STEWART
           617      DR  DSTEWQ
                    *

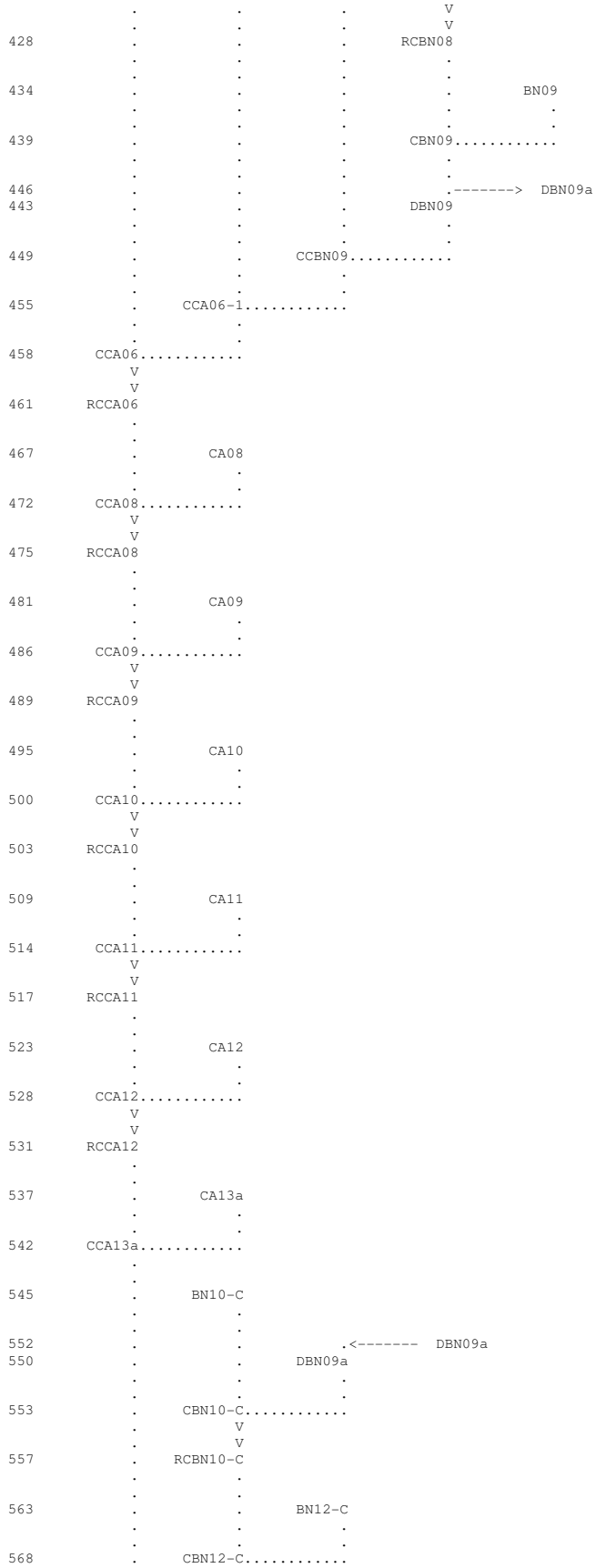
           618      KK CSTEWBY
           619      KM  BYPASS FLOW ON STEWART
           620      HC       2
                    *
           621      ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

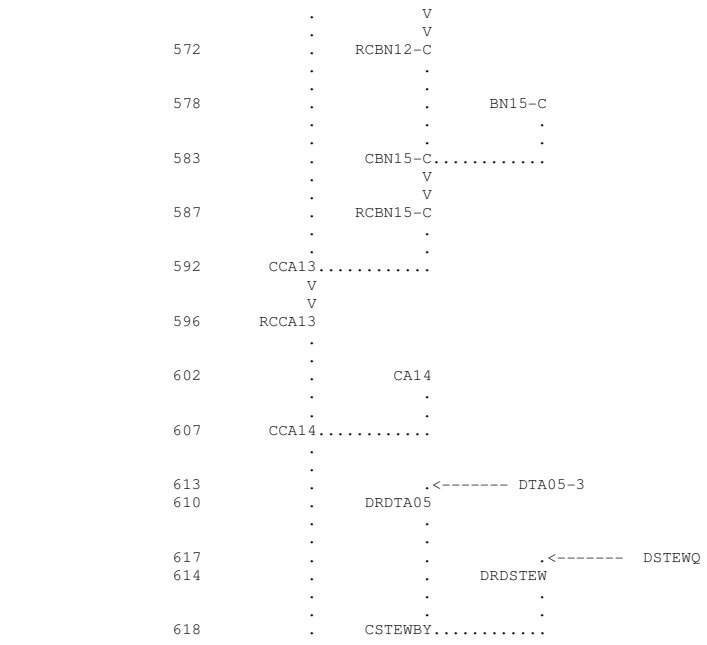
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    32       CA03a
                 .
                 .
    45           .       CA03c
                 .           .
                 .           .
    50      CCA03c............
                 .
                 .
    54           .       CA03b
                 .           .
                 .           .
    59       CCA03............
                 V
                 V
    63      RCCA03
                 .
                 .
    67           .       CA04b
                 .           .
                 .           .
    72      CCA04b............
                 V
                 V
    76     RCCA04b
                 .
                 .
    80           .       CA04a
                 .           .
                 .           .
    85           .           .       CA04c
                 .           .           .
                 .           .           .
    90     CCA04-1.......................
                 .
                 .
    94           .       CA04g
                 .           V
                 .           V
    99           .      RCA04g
                 .           .
                 .           .
   103           .           .       CA04d
                 .           .           .
                 .           .           .
   108           .      CCA04d............
                 .           V
                 .           V
   112           .      RCA04d
                 .           .
                 .           .
   116           .           .       CA04e
                 .           .           .
                 .           .           .
   121           .      CCA04e............
                 .           V
                 .           V
   125           .     RCCA04e
                 .           .
                 .           .
   129           .           .       CA04f
                 .           .           .
                 .           .           .
   134           .      CCA04f............
```


138 CCA04
142 RCCA04
146 CA05a
151 CA05b
156 CCA05-1
163 DSTEWQ
160 DCCA05
166 CA05c
171 RCA05c
175 CA05d
180 CA05e
185 CCA05e
193 DTA05e
189 DTCCA05e
196 CA05f
205 DTA05f
201 DTCAO5f
208 CCA05f
211 RCCA05f
215 CA05h
220 CA05i
225 CA05k
230 CCA05k
234 CA05g
239 CA05j
244 CA05p
249 CCA05p
256 DTA05e
253 DRA05e
260 DTA05f
257 DRA05f
261 CCA05-3
269 DTA05-3
265 DTCCA053
272 CCA05-2


276 CCA05-2a
280 CHAR
291 RCHAR
295 CH70-C
300 CCHAR
303 RCCHAR
308 CA05m
313 CCA05n
317 RCCA05m
322 CCA05-4
326 CA05n
331 CA05q
336 CCA05q
340 CCA05
344 RCCA05
349 CA06-C
354 CH59-C
364
359 DCH58-C
367 RDCH58
371 CH58-C
376 CCH58-C
384
380 DDCH59-C
389
387 DDCH59
392 BN06-C
397 BN03-C
404
402 DBN03
405 RDBN03
409 CBN03
413 RCBN03
419 BN08
424 CBN08
DFLAM
DBN03
DBN03a


RCBN08
BN09
CBN09
DBN09
DBN09a
CCBN09
CCA06-1
CCA06
RCCA06
CA08
CCA08
RCCA08
CA09
CCA09
RCCA09
CA10
CCA10
RCCA10
CA11
CCA11
RCCA11
CA12
CCA12
RCCA12
CA13a
CCA13a
BN10-C
DBN09a
CBN10-C
RCBN10-C
BN12-C
CBN12-C



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   03JUN15  TIME  11:32:48   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

LAS VEGAS WASH CENTRAL-CEDAR AVENUE

INPUT FILE = CEDAR_INT.DAT
INPUT FILE DATE = APRIL 2014
DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY ATKINS (MANOGYA KHANAL)
CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
NO STORM CENTERING
REFERENCED HYDROLOGIC MODELS:
2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
CENTRAL NEIGHBORHOOD STUDY

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA SQ. MI.	DARF
0-0.5	0.990
0.5-1	0.975
1-2	0.950
2-3	0.925
3-4	0.915
4-5	0.908
5-6	0.903

29 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1 0	STARTING DATE
ITIME	0000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2 0	ENDING DATE
NDTIME	0055	ENDING TIME
ICENT	19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 HOURS

ENGLISH UNITS

DRAINAGE AREA	SQUARE MILES
PRECIPITATION DEPTH	INCHES
LENGTH, ELEVATION	FEET
FLOW	CUBIC FEET PER SECOND
STORAGE VOLUME	ACRE-FEET
SURFACE AREA	ACRES
TEMPERATURE	DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.99 .98 .95 .93 .92 .91 .90 .57
1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .99	RATIO 2 .98	RATIO 3 .95	RATIO 4 .93	RATIO 5 .92	RATIO 6 .91	RATIO 7 .90	RATIO 8 .57
HYDROGRAPH AT												
+	CA03a	.09	1	FLOW	107.	104.	100.	96.	95.	94.	93.	43.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03c	.02	1	FLOW	25.	24.	23.	22.	22.	22.	22.	10.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03c	.12	1	FLOW	131.	128.	123.	119.	117.	115.	115.	53.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03b	.08	1	FLOW	86.	84.	81.	77.	76.	75.	75.	35.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03	.20	1	FLOW	217.	212.	204.	196.	193.	191.	189.	88.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO												
+	RCCA03	.20	1	FLOW	211.	205.	199.	191.	188.	185.	183.	86.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04b	.06	1	FLOW	71.	69.	66.	64.	63.	62.	62.	29.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT												
+	CCA04b	.26	1	FLOW	278.	272.	262.	251.	248.	245.	242.	112.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCCA04b	.26	1	FLOW	271.	270.	256.	248.	249.	243.	238.	113.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	CA04a	.04	1	FLOW	44.	43.	41.	40.	39.	38.	38.	18.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA04c	.03	1	FLOW	41.	40.	39.	38.	37.	37.	36.	18.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA04-1	.33	1	FLOW	345.	342.	326.	315.	315.	308.	303.	143.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04g	.05	1	FLOW	81.	79.	77.	74.	73.	73.	72.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO												
+	RCA04g	.05	1	FLOW	79.	77.	75.	71.	70.	69.	69.	38.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04d	.05	1	FLOW	72.	70.	68.	66.	65.	64.	64.	33.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA04d	.10	1	FLOW	140.	137.	133.	129.	127.	125.	123.	65.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCA04d	.10	1	FLOW	142.	139.	135.	129.	128.	126.	125.	64.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92

HYDROGRAPH AT												
+	CA04e	.19	1	FLOW	194.	190.	184.	177.	174.	172.	171.	85.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
2 COMBINED AT												
+	CCA04e	.29	1	FLOW	333.	326.	315.	304.	299.	296.	294.	148.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO												
+	RCCA04e	.29	1	FLOW	321.	319.	306.	294.	293.	293.	291.	147.
				TIME	3.92	3.83	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT												
+	CA04f	.05	1	FLOW	61.	60.	58.	56.	55.	55.	54.	29.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT												
+	CCA04f	.34	1	FLOW	363.	360.	344.	331.	329.	330.	328.	163.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT												
+	CCA04	.67	1	FLOW	683.	675.	648.	623.	620.	617.	611.	292.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO												
+	RCCA04	.67	1	FLOW	669.	664.	637.	609.	607.	602.	601.	292.
				TIME	3.83	3.83	3.92	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA05a	.04	1	FLOW	47.	46.	44.	43.	42.	42.	41.	21.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA05b	.05	1	FLOW	66.	65.	62.	60.	60.	59.	59.	31.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT												
+	CCA05-1	.75	1	FLOW	751.	745.	714.	685.	682.	676.	674.	323.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
DIVERSION TO												
+	DSTEWQ	.75	1	FLOW	321.	315.	284.	255.	252.	246.	244.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
HYDROGRAPH AT												
+	DCCA05	.75	1	FLOW	430.	430.	430.	430.	430.	430.	430.	323.
				TIME	3.58	3.67	3.67	3.67	3.67	3.67	3.67	3.92
HYDROGRAPH AT												
+	CA05c	.02	1	FLOW	36.	35.	34.	33.	32.	32.	32.	17.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO												
+	RCA05c	.02	1	FLOW	34.	33.	32.	31.	30.	30.	30.	16.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT												
+	CA05d	.04	1	FLOW	58.	57.	55.	53.	53.	52.	52.	27.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT												
+	CA05e	.00	1	FLOW	5.	5.	5.	5.	4.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT												
+	CCA05e	.07	1	FLOW	97.	95.	92.	89.	87.	86.	86.	44.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO												
+	DTA05e	.07	1	FLOW	52.	51.	49.	47.	47.	46.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	DTCCA05e	.07	1	FLOW	45.	44.	43.	41.	41.	40.	40.	21.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	CA05f	.01	1	FLOW	14.	14.	14.	13.	13.	13.	13.	7.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO												
+	DTA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	DTCA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05f	.08	1	FLOW	52.	51.	49.	48.	47.	47.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO												
+	RCCA05f	.08	1	FLOW	50.	49.	48.	46.	45.	45.	44.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67

HYDROGRAPH AT													
+	CA05h	.00	1	FLOW	5.	5.	5.	5.	5.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05i	.00	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05k	.01	1	FLOW	16.	16.	16.	15.	15.	15.	15.	8.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
4 COMBINED AT													
+	CCA05k	.09	1	FLOW	77.	75.	73.	70.	69.	69.	68.	36.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	CA05g	.01	1	FLOW	12.	11.	11.	11.	11.	10.	10.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05j	.00	1	FLOW	9.	9.	8.	8.	8.	8.	8.	4.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05p	.01	1	FLOW	8.	8.	8.	8.	8.	8.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT													
+	CCA05p	.02	1	FLOW	28.	27.	26.	25.	25.	25.	25.	13.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	DRA05e	.00	1	FLOW	52.	51.	49.	47.	47.	46.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DRA05f	.00	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT													
+	CCA05-3	.02	1	FLOW	86.	84.	81.	79.	77.	77.	76.	40.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05-3	.02	1	FLOW	79.	77.	75.	72.	71.	71.	70.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCCA053	.02	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05-2	.11	1	FLOW	84.	82.	79.	77.	75.	75.	74.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05-2a	.86	1	FLOW	514.	502.	500.	498.	497.	496.	496.	340.
				TIME	3.58	3.67	3.67	3.67	3.67	3.67	3.67	3.92
HYDROGRAPH AT													
+	CHAR	.04	1	FLOW	43.	43.	43.	43.	43.	43.	43.	43.
				TIME	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42
ROUTED TO													
+	RCHAR	.04	1	FLOW	44.	44.	44.	44.	44.	44.	44.	44.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	CH70-C	.14	1	FLOW	165.	162.	156.	151.	149.	148.	147.	79.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCHAR	.17	1	FLOW	206.	203.	198.	192.	190.	189.	188.	121.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RCCHAR	.17	1	FLOW	205.	202.	197.	192.	190.	188.	187.	120.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT													
+	CA05m	.00	1	FLOW	8.	8.	7.	7.	7.	7.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05n	.18	1	FLOW	210.	206.	201.	196.	194.	192.	191.	122.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO													
+	RCCA05m	.18	1	FLOW	208.	205.	199.	194.	192.	191.	190.	121.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCA05-4	1.04	1	FLOW	699.	695.	688.	681.	678.	676.	674.	450.

				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	CA05n	.00	1	FLOW	6.	6.	6.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05q	.01	1	FLOW	12.	11.	11.	10.	10.	10.	10.	4.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CCA05q	.02	1	FLOW	17.	17.	16.	16.	15.	15.	15.	6.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05	1.06	1	FLOW	715.	710.	702.	694.	692.	689.	687.	454.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.83
ROUTED TO													
+	RCCA05	1.06	1	FLOW	713.	708.	701.	693.	690.	688.	686.	449.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT													
+	CA06-C	.41	1	FLOW	255.	248.	237.	226.	222.	219.	217.	83.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT													
+	CH59-C	.21	1	FLOW	246.	242.	234.	227.	224.	222.	221.	124.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO													
+	DFLAM	.21	1	FLOW	102.	98.	90.	83.	80.	78.	77.	0.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	.00
HYDROGRAPH AT													
+	DCH58-C	.21	1	FLOW	144.	144.	144.	144.	144.	144.	144.	124.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.83
ROUTED TO													
+	RDCH58	.21	1	FLOW	149.	147.	147.	148.	148.	148.	148.	125.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT													
+	CH58-C	.13	1	FLOW	156.	153.	149.	144.	142.	141.	140.	77.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCH58-C	.34	1	FLOW	302.	299.	295.	292.	290.	289.	288.	194.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO													
+	DBN03	.34	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	DDCH59-C	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
DIVERSION TO													
+	DBN03a	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
HYDROGRAPH AT													
+	DDCH59	.34	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	.00	.00	.00	.00	.00	.00	.00	.00
HYDROGRAPH AT													
+	BN06-C	.34	1	FLOW	420.	411.	396.	382.	376.	371.	368.	179.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	BN03-C	.54	1	FLOW	496.	485.	466.	448.	440.	435.	431.	197.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	DBN03	.00	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
ROUTED TO													
+	RDBN03	.00	1	FLOW	139.	144.	148.	119.	121.	122.	123.	27.
				TIME	3.92	3.92	3.83	3.92	3.92	3.92	3.92	4.08
3 COMBINED AT													
+	CBN03	.88	1	FLOW	868.	862.	873.	817.	807.	798.	790.	353.
				TIME	3.67	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO													
+	RCBN03	.88	1	FLOW	861.	853.	852.	803.	794.	783.	778.	353.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT													
+	BN08	.21	1	FLOW	220.	216.	209.	202.	199.	197.	196.	103.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													

+	CBN08	1.09	1	FLOW	1082.	1069.	1061.	1005.	994.	980.	974.	453.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO												
+	RCBN08	1.09	1	FLOW	1080.	1065.	1050.	998.	987.	974.	966.	445.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT												
+	BN09	.23	1	FLOW	167.	163.	156.	149.	146.	144.	143.	59.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT												
+	CBN09	1.32	1	FLOW	1247.	1228.	1206.	1147.	1133.	1118.	1109.	499.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO												
+	DBN09a	1.32	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	DBN09	1.32	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCBN09	1.66	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCA06-1	2.07	1	FLOW	457.	450.	439.	428.	424.	421.	419.	285.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
2 COMBINED AT												
+	CCA06	3.13	1	FLOW	1138.	1128.	1110.	1092.	1085.	1080.	1077.	733.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA06	3.13	1	FLOW	1136.	1126.	1108.	1090.	1083.	1078.	1075.	731.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA08	.07	1	FLOW	71.	69.	66.	63.	62.	61.	61.	26.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
2 COMBINED AT												
+	CCA08	3.20	1	FLOW	1196.	1184.	1164.	1144.	1136.	1131.	1127.	750.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA08	3.20	1	FLOW	1193.	1182.	1162.	1141.	1133.	1127.	1123.	745.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA09	.05	1	FLOW	58.	57.	55.	53.	52.	52.	51.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA09	3.25	1	FLOW	1237.	1224.	1202.	1181.	1172.	1166.	1162.	760.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA09	3.25	1	FLOW	1234.	1221.	1199.	1177.	1167.	1161.	1157.	753.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA10	.03	1	FLOW	44.	43.	42.	41.	40.	40.	39.	22.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA10	3.28	1	FLOW	1265.	1252.	1229.	1206.	1196.	1189.	1185.	765.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA10	3.28	1	FLOW	1256.	1242.	1218.	1194.	1183.	1174.	1170.	760.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA11	.09	1	FLOW	103.	101.	97.	94.	92.	91.	91.	46.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCA11	3.38	1	FLOW	1349.	1333.	1306.	1279.	1266.	1257.	1253.	789.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
ROUTED TO												
+	RCCA11	3.38	1	FLOW	1339.	1323.	1295.	1266.	1254.	1246.	1242.	787.
				TIME	3.83	3.83	3.83	3.83	3.92	3.92	3.92	4.00
HYDROGRAPH AT												
+	CA12	.06	1	FLOW	86.	85.	82.	80.	79.	78.	77.	43.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA12	3.44	1	FLOW	1405.	1389.	1359.	1328.	1314.	1304.	1299.	809.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00

ROUTED TO												
+	RCCA12	3.44	1	FLOW	1394.	1375.	1345.	1316.	1305.	1296.	1291.	806.
				TIME	3.83	3.83	3.83	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT												
+	CA13a	.06	1	FLOW	95.	93.	91.	88.	87.	86.	86.	50.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA13a	3.50	1	FLOW	1467.	1447.	1415.	1381.	1364.	1354.	1350.	830.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	BN10-C	.26	1	FLOW	232.	227.	219.	211.	208.	205.	204.	97.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	DBN09a	.00	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT												
+	CBN10-C	.26	1	FLOW	1278.	1254.	1223.	1156.	1139.	1122.	1111.	394.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO												
+	RCBN10-C	.26	1	FLOW	1267.	1241.	1200.	1141.	1116.	1105.	1089.	392.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	BN12-C	.32	1	FLOW	278.	272.	262.	251.	247.	244.	242.	111.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT												
+	CBN12-C	.58	1	FLOW	1545.	1513.	1462.	1392.	1363.	1349.	1331.	503.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO												
+	RCBN12-C	.58	1	FLOW	1521.	1491.	1444.	1374.	1346.	1339.	1316.	498.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT												
+	BN15-C	.28	1	FLOW	234.	229.	220.	211.	208.	205.	203.	92.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT												
+	CBN15-C	.86	1	FLOW	1753.	1716.	1660.	1582.	1551.	1541.	1516.	589.
				TIME	3.83	3.92	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO												
+	RCBN15-C	.86	1	FLOW	1750.	1715.	1658.	1580.	1549.	1538.	1513.	582.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
2 COMBINED AT												
+	CCA13	4.37	1	FLOW	3201.	3142.	3056.	2949.	2906.	2885.	2856.	1399.
				TIME	3.83	3.83	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO												
+	RCCA13	4.37	1	FLOW	3190.	3135.	3051.	2939.	2895.	2872.	2849.	1388.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT												
+	CA14	.05	1	FLOW	85.	83.	81.	79.	78.	77.	77.	47.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA14	4.42	1	FLOW	3238.	3182.	3096.	2983.	2939.	2916.	2892.	1408.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT												
+	DRDTA05	.00	1	FLOW	79.	77.	75.	72.	71.	71.	70.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	DRDSTEW	.00	1	FLOW	321.	315.	284.	255.	252.	246.	244.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
2 COMBINED AT												
+	CSTEWBY	.00	1	FLOW	364.	357.	325.	294.	290.	285.	283.	37.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.58

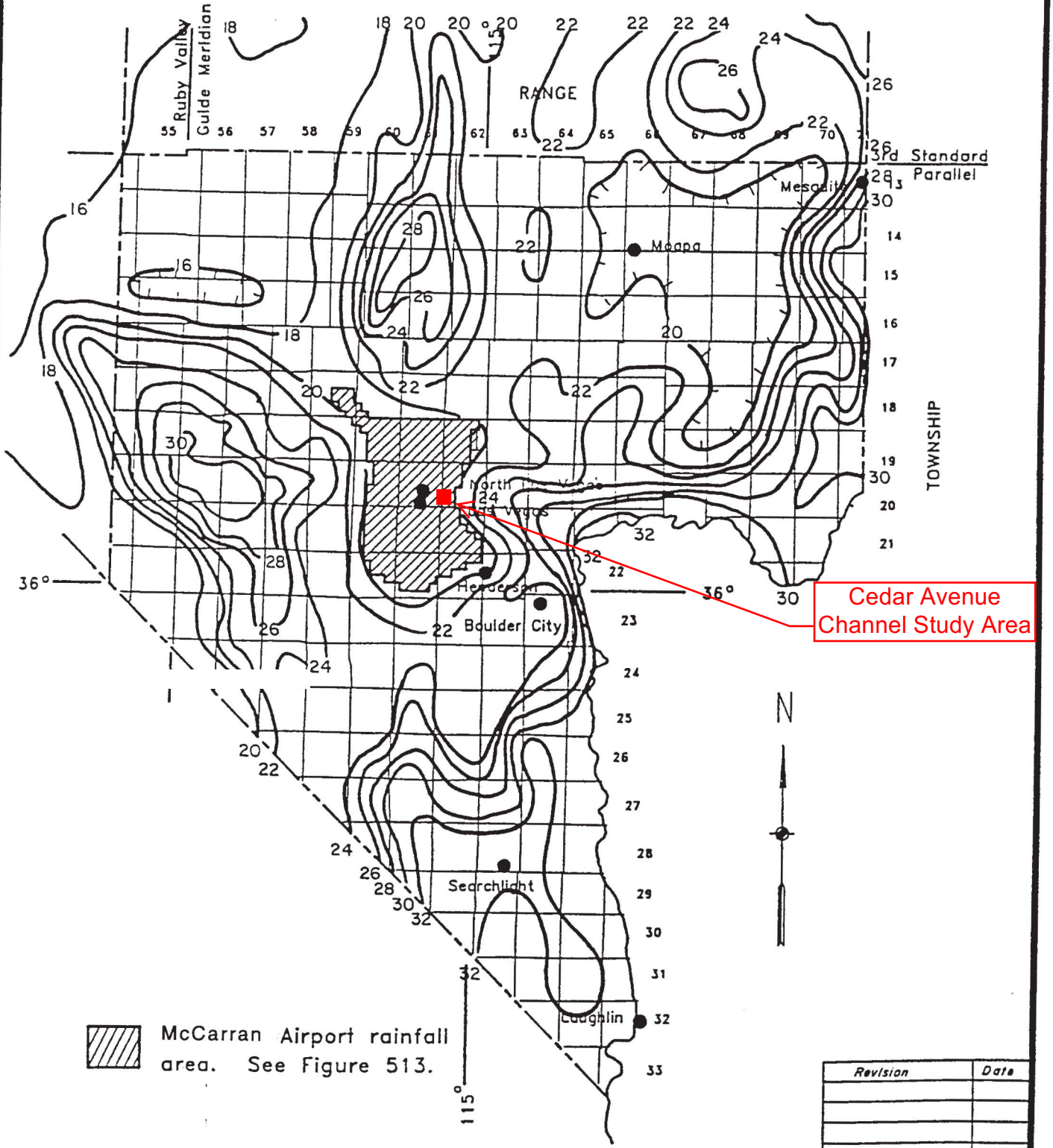
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*** NORMAL END OF HEC-1 ***

Appendix A-4

CCRFCD Design Manual Tables

RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



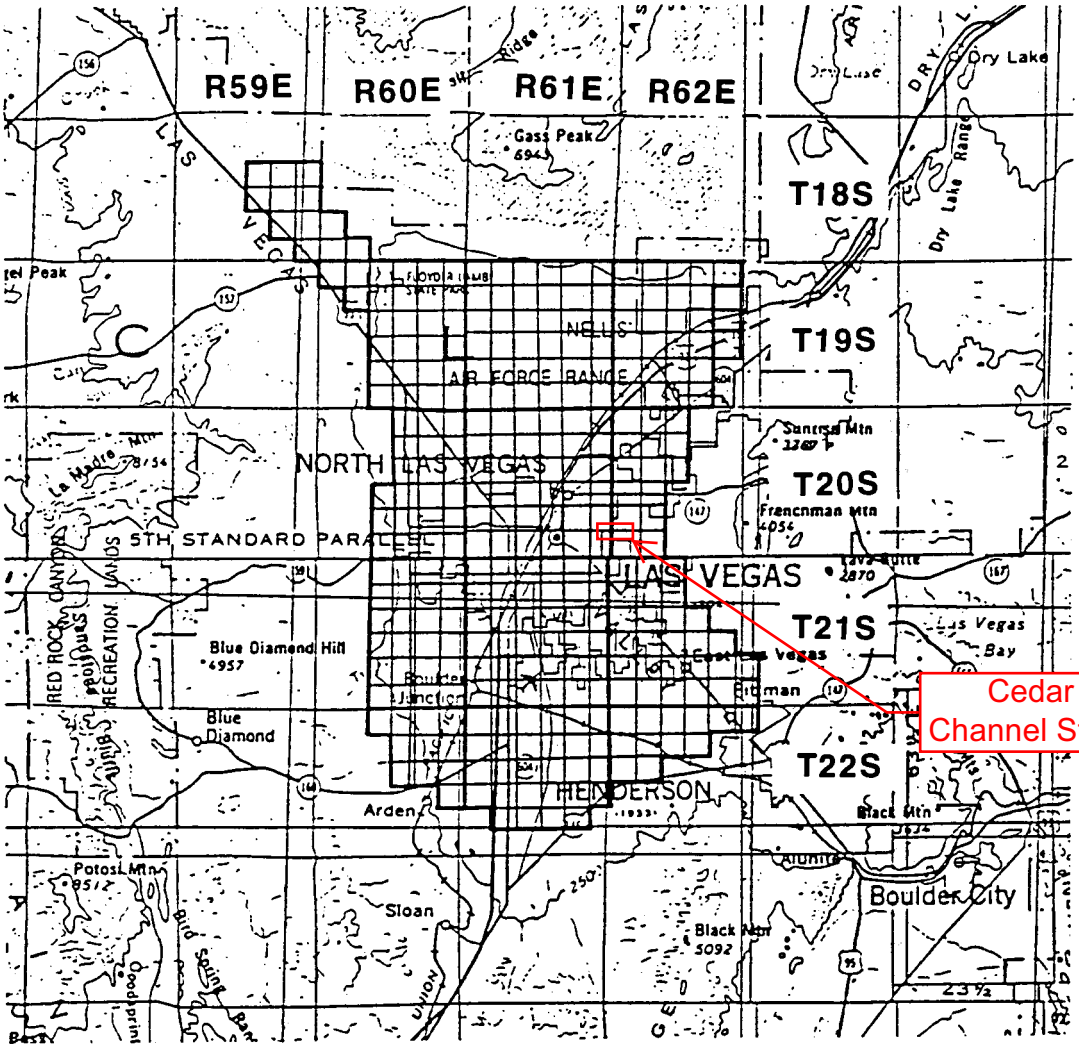
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 506

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP	RANGE	SECTIONS	TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36	20 South	62 East	4-9,16-20,29-32
18 South	60 East	30-32	21 South	60 East	1-4,9-16,21-28,33-36
19 South	60 East	1-6,8-16,21-28,33-36	21 South	61 East	ALL SECTIONS
19 South	61 East	ALL SECTIONS	21 South	62 East	4-9,15-23, 25-36
19 South	62 East	2-11,14-23,27-34	22 South	60 East	1-4,10-15,24
20 South	60 East	1-3,10-15,21-28,33-36	22 South	61 East	1-24,26-29
20 South	61 East	ALL SECTIONS	22 South	62 East	1-10,17-18

Notes:
1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

FIGURE 513

DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA

(IN INCHES)

	RECURRENCE INTERVAL					
TIME	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5 min.	0.15	0.27	0.35	0.46	0.54	0.63
10 min.	0.25	0.44	0.57	0.74	0.89	1.02
15 min.	0.33	0.57	0.74	0.97	1.15	1.32
30 min.	0.44	0.78	1.01	1.31	1.55	1.79
1 hour	0.52	0.89	1.15	1.50	1.78	2.06
2 hour	0.59	1.01	1.30	1.70	2.01	2.30
3 hour	0.64	1.08	1.39	1.82	2.15	2.48
6 hour	0.72	1.22	1.58	2.05	2.41	2.77
24 hour (TR-55)	1.20	1.60	1.80	2.40	2.70	2.96

NOTE: 1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.

2. The 24 hour values presented above are for use with TR-55 only.

3. Table 501 adjustments not required.

Revision	Date

SIX-HOUR STORM DISTRIBUTIONS

Storm Time (In Minutes)	Percent of Total Storm Depth SDN3	SDN4	SDN5
0	0.0	0.0	0.0
5	2.0	2.0	2.0
10	5.7	5.8	5.9
15	7.0	7.5	8.0
20	8.7	9.9	11.0
25	10.8	12.6	14.4
30	12.4	13.7	15.0
35	13.0	14.5	16.0
40	13.0	14.9	16.8
45	13.0	15.1	17.1
50	13.0	15.5	18.0
55	13.0	15.6	18.2
60	13.0	15.9	18.7
65	13.3	16.2	19.0
70	14.0	16.9	19.7
75	14.2	17.2	20.2
80	14.8	17.9	21.0
85	15.8	18.9	22.0
90	17.2	20.1	23.0
95	18.1	21.1	24.1
100	19.0	22.0	25.0
105	19.7	22.8	25.9
110	19.9	23.2	26.5
115	20.0	24.0	28.0
120	20.1	24.6	29.0
125	20.4	25.2	30.0
130	21.4	26.0	30.5
135	22.9	26.9	30.9
140	24.1	27.6	31.0
145	24.9	28.3	31.7
150	25.1	28.6	32.1
155	25.6	29.2	32.7
160	27.0	30.2	33.3
165	27.8	31.2	34.6
170	28.1	32.1	36.1
175	28.3	33.2	38.1
180	29.5	35.2	40.8
185	32.2	37.6	43.0
190	35.2	41.5	47.7
195	40.9	46.2	51.4
200	49.9	53.0	56.1
205	59.0	61.0	63.0
210	71.0	71.0	71.0
215	74.4	73.2	72.0
220	78.1	75.6	73.1
225	81.2	78.2	75.2
230	81.9	79.9	77.9
235	83.5	81.3	79.0
240	85.1	82.3	79.5
245	85.6	83.0	80.4
250	86.0	83.5	81.0
255	86.8	84.4	82.0
260	87.6	85.1	82.6
265	88.8	86.4	84.0
270	91.0	88.5	85.9
275	92.6	90.8	88.9
280	93.7	92.4	91.0
285	95.0	94.4	93.8
290	97.0	96.8	96.6
295	97.6	97.3	97.0
300	98.2	97.8	97.4
305	98.5	98.2	97.9
310	98.7	98.4	98.1
315	98.9	98.6	98.3
320	99.0	98.8	98.5
325	99.3	99.1	98.9
330	99.3	99.2	99.0
335	99.4	99.3	99.2
340	99.5	99.4	99.3
345	99.8	99.7	99.6
350	99.8	99.8	99.7
355	99.9	99.9	99.9
360	100.0	100.0	100.0

Notes:
1. For drainage areas less than 8 square miles in size, use SDN 3.
2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
4. A graphical representation of these values is presented on **Figure 515**.

Revision	Date

REFERENCE:

TABLE 503

SIX HOUR DEPTH-AREA REDUCTION FACTORS

Drainage Area (Square Miles)	Six-Hour Depth-Area Reduction Factor
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

NOTES: 1. A graphical representation of these factors is presented in Figure 514.

2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

Revision	Date

Appendix A-5

Hydrologic Parameters

Design Storm

The rainfall values used in the hydrologic model are intended to produce runoff discharges for 100-year recurrence interval events. The 100-year recurrence interval is defined as having a 1-percent chance of being equalled or exceeded in any given year. Storm duration of six hours was used in accordance with the Design Manual.

Precipitation Depths

All subbasins contributing runoff to the study area are within the McCarran Airport rainfall area as defined in the Design Manual. Therefore, the 100-year, 6-hour rainfall depth is 2.77 inches for all subbasins (see Figure 506, Figure 513, and Table 505 of the Design Manual in this Appendix).

Storm Distribution

The 100-year, 6-hour rainfall depth was distributed over the 6-hour design storm period using the SDN 3 storm distribution (see Table 503 of the Design Manual in this Appendix). According to established CCRFCD methodology, SDN 3 is used for drainage areas less than 8 square miles which is all combination points and subbasins in the Cedar Avenue Channel analysis.

Depth-Area Reduction Factors

The precipitation depths obtained for the McCarran Airport Rainfall Area from the Design Manual represent rainfall frequency at isolated points. Storms, however, cause rainfall to occur over widespread areas simultaneously, with the most intense rainfall typically occurring near the center of the storm. To account for the rainfall variation, standard precipitation analysis methods require adjusting point precipitation depths downward in order to better represent the average depth of rainfall over the entire storm area. This is done using depth-area reduction curves that relate point precipitation reduction factors to storm area and duration. The reduction factors cause the rainfall depth to decrease as the tributary area increases.

The six hour depth-area reduction factors (DARFs) from Table 502 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area. Rather than interpolating precise reduction factors at every concentration point, an average DARF value was used for a range of tributary areas to be consistent with the 2008 MPU models and methodology. The DARF values applied to the model are shown below. The depth-area reduction factor table from the Design Manual is included in this Appendix**.**

Depth-Area Reduction Factors

Tributary Area (sq mi)	DARF
0 ≤ Area < 0.5	0.99
0.5 ≤ Area < 1	0.975
1 ≤ Area < 2	0.95
2 ≤ Area < 3	0.925
3 ≤ Area < 4	0.915
4 ≤ Area < 5	0.908

Land Use

Land use information was based on the land use data that was compiled for the 2008 MPU. The land use is based on the ultimate condition and assumes that the full "build out" condition has been reached and that available land within the watershed is fully developed. Minor updates and revisions were made to the land use data based on aerial imagery and coordination with the City to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

The land use data consists of 13 categories of land use as defined in table below. Each category is defined by a specified percentage of impervious area, percentage of ground cover in good hydrologic condition, and percentage of desert shrub in poor hydrologic condition. Land use data was obtained in GIS format, with polygon areas delineated to represent specific land use categories in the study area. The land use data is shown in **Figure A-1.**

It should be noted that in the 2008 MPU, land use categories were adjusted to reflect restrictions on the amount of allowable grass landscaping per the Southern Nevada Water Authority drought ordinance. The drought ordinance requirements are only applied to certain areas as determined by CCRFCD. The Cedar Avenue Channel study area does not fall within the drought ordinance area, and therefore, the nine additional land use categories from the 2008 MPU representing the drought ordinance revision are not included in this analysis.

Land Use Categories

Land Use Index Number	Description - Typical Land Uses	Directly Connected Impervious (%)	Open Landscaped Good Condition (%)	Open Desert Shrub Poor Condition (%)
1	Undeveloped Land, Open Desert	0	0	100
2	Parks, Golf Courses	5	85	10
5	Medium Density Residential, 2-4 units per acre	29	71	0
6	High Density Residential, 4-8 units per acre	62	38	0
7	Public Facility and Residential, 8-12 units/acre	72	28	0
8	Very High Density Residential, 12 units/acre or more	85	15	0
9	Commercial, Retail, Casino, High Rise Condominiums	90	10	0
10	Light Industrial	70	15	15

Soils

Soils data for the Cedar Avenue Channel hydrologic analysis comes from the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. Soils data was obtained in GIS format for the study area, and the limits of each soil type are delineated in the GIS layer and assigned a soil map unit number. NRCS methodology divides soils into four hydrological groups, as defined below:

A. High infiltration rate, low runoff potential

B. Moderate infiltration rate, moderately low runoff potential

C. Slow infiltration rate, moderately high runoff potential

D. Very slow infiltration rate, high runoff potential

Each soil map unit number is made up of a certain percentage of hydrologic soil group A, B, C, and D. Curve number calculations for each of the subbasins were based on the individual breakdown of each soil type into the percentages of the minor hydrologic soil group components (A, B, C, or D). Detailed soils data and the soil boundaries are shown on **Figure A-2**.

Curve Numbers

Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the Design Manual. The curve number method is a function of soil type, land cover, and antecedent moisture condition. Based on the Design Manual, the average antecedent moisture condition (AMC II) is used for computing losses. Curve number information was compiled using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers. To calculate a curve number for a given subbasin, the following procedure was used:

1. Base curve numbers are taken from the CCRFCD Design Manual for the three assumed land cover conditions (directly connected impervious area, open landscaped area in good condition, open desert shrub in poor condition) for each of the four Hydrologic Soil Groups. In addition, a curve number of 90 is assumed for rock outcrop, and directly connected impervious is assumed to have a curve number of 98 for all soil types.
2. A curve number matrix is compiled to calculate a base curve number for a given combination of soil map unit and land use type.
3. The land use, soils, and subbasin polygons were overlaid in GIS to subdivide each subbasin into polygons (subareas) of unique land use and soil type combinations.
4. The curve number matrix is then used to assign a curve number for each subarea, and an area-weighted composite curve number is calculated for the whole subbasin based on the areas of the subdivided polygons and their associated curve numbers. The curve number and total area of each subbasin is then used in the hydrologic models input files.

Supporting information for the curve number calculations (including the curve number matrix) is included in this Appendix**.**

Lag Time

All subbasins within the Cedar Avenue Channel watershed are less than 0.5 square miles. The time of concentration for subbasins of this size was computed with the time of concentration equation (velocity method) from the Design Manual. This method is explained below. Note that initial length (overland flow) was set to 100 feet for all subbasins to represent urbanized drainage patterns and to be consistent with the 2008 MPU.

The lag time is related to the time of concentration by the following empirical relationship:

$$T_{lag} = 0.6T_c$$

Where:

T_{lag}	=	Lag Time
T_c	=	Time of concentration

The time of concentration is calculated as follows:

$$T_c = T_i + T_t$$

Where:

T_c	=	Time of concentration
T_i	=	Initial, inlet, or overland flow time
T_t	=	Travel time in the ditch, gutter, etc.

Initial flow time is calculated as follows:

$$T_i = 1.8(1.1 - K)L_o^{1/2}/S^{1/3}$$

Where:

T_i	=	Initial overland flow time (minutes)
K	=	0.0132 * CN - 0.39
CN	=	Curve number
L_o	=	Length of overland flow (ft, maximum 500 feet)
S	=	Average basin slope (percent)

Travel time is calculated as follows:

$$T_t = 500/(60\ V_1) + (L_t - 500)/(60\ V_2)$$

Where:

T_t	=	Travel time in the ditch, gutter, etc. (minutes)
L_t	=	Travel length (feet)
V_1	=	Average velocity of flow for the first 500 feet of travel distance (feet/second)
V_2	=	Average velocity of flow for the remaining travel distance (feet/second)

V_1 and V_2 are calculated as follows:

$$V_1 = C_1 * (S/100)^{1/2}$$
$$V_2 = C_2 * (S/100)^{1/2}$$

Where:

C1	=	20.2 for developed areas and 14.8 for undeveloped areas

C2	=	30.6 for developed areas and 29.4 for undeveloped areas
S	=	Average slope for the flow path (percent)

In urbanized areas, the time of concentration calculated above should not exceed the time of concentration calculated by the following equation:

$$T_c = (L / 180) + 10$$

Where:

T_c	=	Time of concentration at the first design point in an urban watershed (minutes)
L	=	Watershed length (feet)

The smaller of the two calculations for time of concentration controls minimum T_c for any watershed and should not be less than 5 minutes. Standard Form 4 from the Design Manual was used to compute lag times and is included in this Appendix.

Routing

In this study all routings in the model were through streets or storm drains, and therefore, only Muskingum-Cunge method for floodwave routing was used in the HEC-1 model to be consistent with the 2008 MPU. Muskingum-Cunge routing requires the following input parameters: roughness coefficient, base width, side-slope, slope, and reach length.

LAS VEGAS WASH CENTRAL
Cedar Avenue Channel

PERVIOUS AREA CURVE NUMBERS

CONDITION 1: ----------> DESERT SHRUB POOR HYDROLOGIC CONDITION
CONDITION 2: ----------> LANDSCAPED, LAWNS, TREES, GOOD HYDROLOGIC CONDITION

CN VALUES

	HYDROLOGIC SOIL GROUP				
CONDITION	A	B	C	D	ROCK
1 ---------->	63	77	85	88	90
2 ---------->	39	61	74	80	90

						CONDITION	CONDITION
MAP	HYDROLOGIC SOIL GROUP					1	2
UNIT	%A	%B	%C	%D	%ROCK	CN	CN
200	3	88	9	0	0	77	62
270	0	100	0	0	0	77	61
282	0	10	90	0	0	84	73
325	5	90	0	5	0	77	61
326	0	100	0	0	0	77	61
341	0	0	100	0	0	85	74
615	0	0	100	0	0	85	74

LAS VEGAS WASH CENTRAL
Cedar Avenue Channel

Curve Number Matrix												
MAP #	COMPONENTS			LAND USE CLASSIFICATION INDEX NUMBER								
	OPEN DESERT	OPEN GOOD	% IMP	1	2	5	6	7	8	9	10	12
	% --->			100	10	0	0	0	0	0	15	0
		% --->		0	85	71	38	28	15	10	15	50
			% --->	0	5	29	62	72	85	90	70	50
	CN	CN	CN	SOIL TYPE COMPOSITE CN FOR LAND USE TYPE								
200	77	62	98	77.0	65.0	72.0	84.0	88.0	93.0	94.0	89.0	80.0
270	77	61	98	77.0	64.0	72.0	84.0	88.0	92.0	94.0	89.0	80.0
282	84	73	98	84.0	75.0	80.0	89.0	91.0	94.0	96.0	92.0	86.0
325	77	61	98	77.0	64.0	72.0	84.0	88.0	92.0	94.0	89.0	80.0
326	77	61	98	77.0	64.0	72.0	84.0	88.0	92.0	94.0	89.0	80.0
341	85	74	98	85.0	76.0	81.0	89.0	91.0	94.0	96.0	92.0	86.0
615	85	74	98	85.0	76.0	81.0	89.0	91.0	94.0	96.0	92.0	86.0

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	1401035	2651085	52.8%	52.8%	44.39	44.39	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	11703	2651085	0.4%	53.3%	0.39	44.78	
7	Public Facility and Residential, 8-12 units/acre	270	88	448715	2651085	16.9%	70.2%	14.89	59.68	
7	Public Facility and Residential, 8-12 units/acre	615	91	42035	2651085	1.6%	71.8%	1.44	61.12	
8	Very High Density Residential, 12 units/acre or more	270	92	191074	2651085	7.2%	79.0%	6.63	67.75	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	125038	2651085	4.7%	83.7%	4.43	72.19	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	431485	2651085	16.3%	100.0%	15.62	87.81	**87.8**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	1026874	2206782	46.5%	46.5%	39.09	39.09	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7656	2206782	0.3%	46.9%	0.31	39.40	
7	Public Facility and Residential, 8-12 units/acre	270	88	581794	2206782	26.4%	73.2%	23.20	62.60	
7	Public Facility and Residential, 8-12 units/acre	615	91	87076	2206782	3.9%	77.2%	3.59	66.19	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	209423	2206782	9.5%	86.7%	8.92	75.11	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	293959	2206782	13.3%	100.0%	12.79	87.90	**87.9**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	359884	605203	59.5%	59.5%	49.95	49.95	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7569	605203	1.3%	60.7%	1.11	51.06	
7	Public Facility and Residential, 8-12 units/acre	270	88	17295	605203	2.9%	63.6%	2.51	53.58	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	198962	605203	32.9%	96.4%	30.90	84.48	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	21493	605203	3.6%	100.0%	3.41	87.89	**87.9**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	1098617	1266640	86.7%	86.7%	72.86	72.86	
7	Public Facility and Residential, 8-12 units/acre	270	88	11123	1266640	0.9%	87.6%	0.77	73.63	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	156900	1266640	12.4%	100.0%	11.64	85.27	**85.3**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	340883	1095013	31.1%	31.1%	26.15	26.15	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	84704	1095013	7.7%	38.9%	6.88	33.03	
7	Public Facility and Residential, 8-12 units/acre	270	88	424871	1095013	38.8%	77.7%	34.14	67.18	
7	Public Facility and Residential, 8-12 units/acre	282	91	243620	1095013	22.2%	99.9%	20.25	87.42	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	934	1095013	0.1%	100.0%	0.08	87.50	**87.5**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	149	1669105	0.0%	0.0%	0.01	0.01	
7	Public Facility and Residential, 8-12 units/acre	270	88	1610638	1669105	96.5%	96.5%	84.92	84.92	
7	Public Facility and Residential, 8-12 units/acre	282	91	23313	1669105	1.4%	97.9%	1.27	86.20	
8	Very High Density Residential, 12 units/acre or more	270	92	19243	1669105	1.2%	99.1%	1.06	87.26	
8	Very High Density Residential, 12 units/acre or more	282	94	15762	1669105	0.9%	100.0%	0.89	88.14	**88.1**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	5801	873595	0.7%	0.7%	0.56	0.56	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	5092	873595	0.6%	1.2%	0.52	1.08	
7	Public Facility and Residential, 8-12 units/acre	270	88	93711	873595	10.7%	12.0%	9.44	10.52	
7	Public Facility and Residential, 8-12 units/acre	282	91	737858	873595	84.5%	96.4%	76.86	87.38	
8	Very High Density Residential, 12 units/acre or more	282	94	31133	873595	3.6%	100.0%	3.35	90.73	**90.7**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	129415	1458124	8.9%	8.9%	7.46	7.46	
7	Public Facility and Residential, 8-12 units/acre	270	88	564058	1458124	38.7%	47.6%	34.04	41.50	
7	Public Facility and Residential, 8-12 units/acre	615	91	35216	1458124	2.4%	50.0%	2.20	43.69	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	379303	1458124	26.0%	76.0%	24.45	68.15	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	350132	1458124	24.0%	100.0%	23.05	91.20	**91.2**

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	883487	5294449	16.7%	16.7%	14.02	14.02	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	21346	5294449	0.4%	17.1%	0.36	14.38	
7	Public Facility and Residential, 8-12 units/acre	270	88	662010	5294449	12.5%	29.6%	11.00	25.38	
7	Public Facility and Residential, 8-12 units/acre	282	91	126488	5294449	2.4%	32.0%	2.17	27.55	
7	Public Facility and Residential, 8-12 units/acre	325	88	310298	5294449	5.9%	37.8%	5.16	32.71	
7	Public Facility and Residential, 8-12 units/acre	615	91	58612	5294449	1.1%	39.0%	1.01	33.72	
8	Very High Density Residential, 12 units/acre or more	270	92	844166	5294449	15.9%	54.9%	14.67	48.39	
8	Very High Density Residential, 12 units/acre or more	282	94	298373	5294449	5.6%	60.5%	5.30	53.68	
8	Very High Density Residential, 12 units/acre or more	325	92	55083	5294449	1.0%	61.6%	0.96	54.64	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	858166	5294449	16.2%	77.8%	15.24	69.88	
9	Commercial, Retail, Casino, High Rise Condominiums	325	94	75017	5294449	1.4%	79.2%	1.33	71.21	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	80339	5294449	1.5%	80.7%	1.46	72.67	
10	Light Industrial	270	89	18407	5294449	0.3%	81.1%	0.31	72.98	
10	Light Industrial	282	92	215939	5294449	4.1%	85.1%	3.75	76.73	
10	Light Industrial	325	89	786716	5294449	14.9%	100.0%	13.22	89.95	**90.0**
7	Public Facility and Residential, 8-12 units/acre	282	91	554550	1290284	43.0%	43.0%	39.11	39.11	
8	Very High Density Residential, 12 units/acre or more	282	94	6609	1290284	0.5%	43.5%	0.48	39.59	
10	Light Industrial	282	92	729125	1290284	56.5%	100.0%	51.99	91.58	**91.6**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	228689	1452065	15.7%	15.7%	13.23	13.23	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	107532	1452065	7.4%	23.2%	6.59	19.82	
7	Public Facility and Residential, 8-12 units/acre	270	88	13797	1452065	1.0%	24.1%	0.84	20.66	
7	Public Facility and Residential, 8-12 units/acre	615	91	317347	1452065	21.9%	46.0%	19.89	40.54	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	1588	1452065	0.1%	46.1%	0.10	40.65	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	783112	1452065	53.9%	100.0%	51.77	92.42	**92.4**
7	Public Facility and Residential, 8-12 units/acre	282	91	995364	995364	100.0%	100.0%	91.00	91.00	**91.00**
7	Public Facility and Residential, 8-12 units/acre	282	91	197771	1381174	14.3%	14.3%	13.03	13.03	
10	Light Industrial	282	92	1183403	1381174	85.7%	100.0%	78.83	91.86	**91.9**
7	Public Facility and Residential, 8-12 units/acre	282	91	95114	642952	14.8%	14.8%	13.46	13.46	
10	Light Industrial	282	92	547786	642952	85.2%	100.0%	78.38	91.84	
10	Light Industrial	325	89	52	642952	0.0%	100.0%	0.01	91.85	**91.9**
7	Public Facility and Residential, 8-12 units/acre	282	91	129453	1206589	10.7%	10.7%	9.76	9.76	
7	Public Facility and Residential, 8-12 units/acre	325	88	14783	1206589	1.2%	12.0%	1.08	10.84	
10	Light Industrial	282	92	931143	1206589	77.2%	89.1%	71.00	81.84	
10	Light Industrial	325	89	131210	1206589	10.9%	100.0%	9.68	91.52	**91.5**
7	Public Facility and Residential, 8-12 units/acre	282	91	177	83379	0.2%	0.2%	0.19	0.19	
10	Light Industrial	282	92	83202	83379	99.8%	100.0%	91.80	92.00	**92.0**
7	Public Facility and Residential, 8-12 units/acre	282	91	1122	238847	0.5%	0.5%	0.43	0.43	
10	Light Industrial	282	92	237725	238847	99.5%	100.0%	91.57	92.00	**92.0**
7	Public Facility and Residential, 8-12 units/acre	282	91	805	199861	0.4%	0.4%	0.37	0.37	
10	Light Industrial	282	92	199056	199861	99.6%	100.0%	91.63	92.00	**92.0**

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
10	Light Industrial	282	92	83909	83909	100.0%	100.0%	92.00	92.00	**92.0**
7	Public Facility and Residential, 8-12 units/acre	282	91	581	98074	0.6%	0.6%	0.54	0.54	
10	Light Industrial	282	92	97493	98074	99.4%	100.0%	91.46	91.99	**92.0**
7	Public Facility and Residential, 8-12 units/acre	282	91	3036	131463	2.3%	2.3%	2.10	2.10	
10	Light Industrial	282	92	128427	131463	97.7%	100.0%	89.88	91.98	**92.0**
7	Public Facility and Residential, 8-12 units/acre	282	91	14198	278126	5.1%	5.1%	4.65	4.65	
10	Light Industrial	282	92	263927	278126	94.9%	100.0%	87.30	91.95	**91.9**
7	Public Facility and Residential, 8-12 units/acre	282	91	123082	147734	83.3%	83.3%	75.81	75.81	
8	Very High Density Residential, 12 units/acre or more	282	94	24637	147734	16.7%	100.0%	15.68	91.49	
10	Light Industrial	282	92	15	147734	0.0%	100.0%	0.01	91.50	**91.5**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	26896	98113	27.4%	27.4%	24.40	24.40	
7	Public Facility and Residential, 8-12 units/acre	282	91	40038	98113	40.8%	68.2%	37.14	61.53	
8	Very High Density Residential, 12 units/acre or more	282	94	31179	98113	31.8%	100.0%	29.87	91.41	**91.4**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	6607	165859	4.0%	4.0%	3.55	3.55	
7	Public Facility and Residential, 8-12 units/acre	282	91	148182	165859	89.3%	93.3%	81.30	84.85	
8	Very High Density Residential, 12 units/acre or more	282	94	11070	165859	6.7%	100.0%	6.27	91.12	**91.1**
2	Parks, Golf Courses	282	75	362597	680958	53.2%	53.2%	39.94	39.94	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	29	680958	0.0%	53.3%	0.00	39.94	
7	Public Facility and Residential, 8-12 units/acre	282	91	318331	680958	46.7%	100.0%	42.54	82.48	**82.5**
2	Parks, Golf Courses	282	75	3906784	11023434	35.4%	35.4%	26.58	26.58	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	268927	11023434	2.4%	37.9%	2.05	28.63	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	90200	11023434	0.8%	38.7%	0.73	29.36	
7	Public Facility and Residential, 8-12 units/acre	270	88	1621882	11023434	14.7%	53.4%	12.95	42.31	
7	Public Facility and Residential, 8-12 units/acre	282	91	1439354	11023434	13.1%	66.5%	11.88	54.19	
8	Very High Density Residential, 12 units/acre or more	270	92	1784633	11023434	16.2%	82.7%	14.89	69.08	
8	Very High Density Residential, 12 units/acre or more	282	94	990757	11023434	9.0%	91.6%	8.45	77.53	
9	Commercial, Retail, Casino, High Rise Condominiums	270	94	820957	11023434	7.4%	99.1%	7.00	84.53	
9	Commercial, Retail, Casino, High Rise Condominiums	282	96	99941	11023434	0.9%	100.0%	0.87	85.40	**85.4**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	632998	2023089	31.3%	31.3%	27.85	27.85	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	341	89	243973	2023089	12.1%	43.3%	10.73	38.58	
7	Public Facility and Residential, 8-12 units/acre	282	91	265594	2023089	13.1%	56.5%	11.95	50.53	
7	Public Facility and Residential, 8-12 units/acre	341	91	494869	2023089	24.5%	80.9%	22.26	72.79	
8	Very High Density Residential, 12 units/acre or more	282	94	194379	2023089	9.6%	90.5%	9.03	81.82	
9	Commercial, Retail, Casino, High Rise Condominiums	282	96	187523	2023089	9.3%	99.8%	8.90	90.72	
12	Schools	341	86	3752	2023089	0.2%	100.0%	0.16	90.88	**90.9**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	69502	1343561	5.2%	5.2%	4.60	4.60	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	341	89	284548	1343561	21.2%	26.4%	18.85	23.45	
7	Public Facility and Residential, 8-12 units/acre	282	91	140990	1343561	10.5%	36.8%	9.55	33.00	
7	Public Facility and Residential, 8-12 units/acre	341	91	88523	1343561	6.6%	43.4%	6.00	39.00	
12	Schools	282	86	455375	1343561	33.9%	77.3%	29.15	68.15	
12	Schools	341	86	304623	1343561	22.7%	100.0%	19.50	87.64	**87.6**

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	665843	901919	73.8%	73.8%	65.70	65.70	
7	Public Facility and Residential, 8-12 units/acre	282	91	235656	901919	26.1%	100.0%	23.78	89.48	
9	Commercial, Retail, Casino, High Rise Condominiums	282	96	420	901919	0.0%	100.0%	0.04	89.53	**89.5**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	413258	2562276	16.1%	16.1%	14.35	14.35	
7	Public Facility and Residential, 8-12 units/acre	282	91	157109	2562276	6.1%	22.3%	5.58	19.93	
8	Very High Density Residential, 12 units/acre or more	282	94	413586	2562276	16.1%	38.4%	15.17	35.11	
9	Commercial, Retail, Casino, High Rise Condominiums	282	96	1578323	2562276	61.6%	100.0%	59.13	94.24	**94.2**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	396478	1736783	22.8%	22.8%	20.32	20.32	
7	Public Facility and Residential, 8-12 units/acre	282	91	326946	1736783	18.8%	41.7%	17.13	37.45	
8	Very High Density Residential, 12 units/acre or more	282	94	536473	1736783	30.9%	72.5%	29.04	66.48	
9	Commercial, Retail, Casino, High Rise Condominiums	282	96	476886	1736783	27.5%	100.0%	26.36	92.84	**92.8**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	859672	1822470	47.2%	47.2%	41.98	41.98	
7	Public Facility and Residential, 8-12 units/acre	282	91	826266	1822470	45.3%	92.5%	41.26	83.24	
9	Commercial, Retail, Casino, High Rise Condominiums	282	96	136531	1822470	7.5%	100.0%	7.19	90.43	**90.4**
1	Undeveloped Land, Open Desert	200	77	121689	1542930	7.9%	7.9%	6.07	6.07	
1	Undeveloped Land, Open Desert	282	84	27562	1542930	1.8%	9.7%	1.50	7.57	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	200	84	347890	1542930	22.5%	32.2%	18.94	26.51	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	700972	1542930	45.4%	77.7%	40.43	66.95	
7	Public Facility and Residential, 8-12 units/acre	200	88	110372	1542930	7.2%	84.8%	6.29	73.24	
7	Public Facility and Residential, 8-12 units/acre	282	91	234444	1542930	15.2%	100.0%	13.83	87.07	**87.1**
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	497604	3814154	13.0%	13.0%	11.61	11.61	
6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	15002	3814154	0.4%	13.4%	0.35	11.96	
7	Public Facility and Residential, 8-12 units/acre	282	91	241707	3814154	6.3%	19.8%	5.77	17.73	
7	Public Facility and Residential, 8-12 units/acre	325	88	557610	3814154	14.6%	34.4%	12.87	30.59	
7	Public Facility and Residential, 8-12 units/acre	615	91	125282	3814154	3.3%	37.7%	2.99	33.58	
8	Very High Density Residential, 12 units/acre or more	282	94	699248	3814154	18.3%	56.0%	17.23	50.82	
9	Commercial, Retail, Casino, High Rise Condominiums	325	94	653160	3814154	17.1%	73.1%	16.10	66.91	
9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1023306	3814154	26.8%	100.0%	25.76	92.67	
10	Light Industrial	282	92	1235	3814154	0.0%	100.0%	0.03	92.70	**92.7**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

PBS&J — **Las Vegas Wash Central Cedar Avenue Channel**

File: FORM4.XLS — **Ultimate Condition**

BY: BR

DATE: 3/24/14

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	Min (13)	Min (14)	Tlag= 0.6Tc/60 Hours	RAINFALL Q_{100} Inches
CA03a	D	87.8	0.7691	60.86	0.095	100	1.0	6.0	5010	2.7	3.3	5.0	17.4	23.4	38.4	**0.234**	2.77
CA03b	D	87.9	0.7702	50.66	0.079	100	1.0	5.9	4000	1.4	2.4	3.6	19.8	25.7	32.8	**0.257**	2.77
CA03c	D	87.9	0.7702	13.89	0.022	100	1.0	5.9	5000	2.6	3.2	4.9	17.9	23.8	38.3	**0.238**	2.77
CA03d	D	85.3	0.7356	29.08	0.045	100	1.0	6.6	4220	3.0	3.5	5.3	14.0	20.6	34.0	**0.206**	2.77
CA04a	D	87.5	0.7651	25.14	0.039	100	1.0	6.0	2930	1.1	2.1	3.2	16.4	22.4	26.8	**0.224**	2.77
CA04b	D	88.1	0.7735	38.32	0.060	100	1.0	5.9	2360	1.0	2.0	3.0	14.4	20.3	23.7	**0.203**	2.77
CA04c	D	90.7	0.8076	20.06	0.031	100	1.0	5.3	2460	1.0	2.0	3.1	14.7	19.9	24.2	**0.199**	2.77
CA04d	D	91.2	0.8138	33.47	0.052	100	1.0	5.2	2640	1.3	2.3	3.5	13.9	19.1	25.2	**0.191**	2.77
CA04e	D	90.0	0.7974	121.54	0.190	100	1.0	5.4	5100	1.0	2.0	3.0	29.5	34.9	38.9	**0.349**	2.77
CA04f	D	91.6	0.8189	29.62	0.046	100	1.0	5.1	2160	0.7	1.7	2.6	15.8	20.9	22.6	**0.209**	2.77
CA04g	D	92.4	0.8300	33.34	0.052	100	1.0	4.9	3030	2.8	3.4	5.1	10.7	15.6	27.4	**0.156**	2.77
CA05a	D	91.0	0.8112	22.85	0.036	100	1.0	5.2	2450	0.8	1.8	2.8	16.3	21.5	24.2	**0.215**	2.77
CA05b	D	91.9	0.8225	31.71	0.050	100	1.0	5.0	2870	0.9	1.9	2.9	18.3	23.2	26.5	**0.232**	2.77
CA05c	D	91.9	0.8224	14.76	0.023	100	1.0	5.0	1380	0.9	1.9	2.9	9.6	14.6	18.2	**0.146**	2.77
CA05d	D	91.5	0.8180	27.70	0.043	100	1.0	5.1	2440	0.9	2.0	3.0	15.1	20.2	24.1	**0.202**	2.77
CA05e	D	92.0	0.8244	1.91	0.003	100	1.0	5.0	760	1.1	2.1	3.1	5.4	10.4	14.8	**0.104**	2.77
CA05f	D	92.0	0.8243	5.48	0.009	100	1.0	5.0	1130	1.1	2.1	3.2	7.3	12.3	16.8	**0.123**	2.77
CA05g	D	92.0	0.8243	4.59	0.007	100	1.0	5.0	690	1.0	2.0	3.1	5.1	10.1	14.4	**0.101**	2.77
CA05h	D	92.0	0.8244	1.93	0.003	100	1.0	5.0	650	0.9	1.9	2.9	5.1	10.1	14.2	**0.101**	2.77
CA05i	D	92.0	0.8243	2.25	0.004	100	1.0	5.0	520	1.0	2.0	3.0	4.3	9.3	13.4	**0.093**	2.77
CA05j	D	92.0	0.8241	3.02	0.005	100	1.0	5.0	540	1.7	2.6	4.0	3.4	8.3	13.6	**0.083**	2.77
CA05k	D	91.9	0.8237	6.38	0.010	100	1.0	5.0	961	1.5	2.4	3.7	5.5	10.5	15.9	**0.105**	2.77
CA05m	D	91.5	0.8178	3.39	0.005	100	1.0	5.1	1240	1.0	2.0	3.0	8.3	13.4	17.4	**0.134**	2.77
CA05n	D	91.4	0.8165	2.25	0.004	100	1.0	5.1	690	0.9	1.9	2.9	5.5	10.6	14.4	**0.106**	2.77
CA05p	D	91.1	0.8128	3.81	0.006	100	1.0	5.2	1630	0.6	1.6	2.4	13.1	18.3	19.6	**0.183**	2.77
CA05q	D	82.5	0.6987	15.63	0.024	100	1.0	7.2	2380	1.0	2.0	3.1	14.3	21.5	23.8	**0.215**	2.77
CA06-C	D	82.5	0.6987	253.06	0.395	100	1.0	7.2	6470	0.6	1.6	2.4	46.0	53.3	46.5	**0.465**	2.77
CA08	D	85.4	0.7373	46.44	0.073	100	1.0	6.5	2750	0.6	1.5	2.3	21.5	28.0	25.8	**0.258**	2.77
CA09	D	89.6	0.7923	30.84	0.048	100	1.0	5.5	2150	0.6	1.5	2.3	17.6	23.1	22.5	**0.225**	2.77
CA10	D	93.0	0.8379	20.71	0.032	100	1.0	4.7	2080	0.5	1.4	2.1	18.4	23.1	22.1	**0.221**	2.77
CA11	D	90.2	0.8013	58.82	0.092	100	1.0	5.4	3280	0.5	1.4	2.1	28.5	33.9	28.8	**0.288**	2.77
CA12	D	94.1	0.8515	39.87	0.062	100	1.0	4.5	2510	0.4	1.3	2.0	22.8	27.2	24.5	**0.245**	2.77
CA13	D	95.9	0.8753	41.84	0.065	100	1.0	4.0	2545	0.5	1.4	2.2	21.4	25.4	24.7	**0.247**	2.77
CA14	D	97.7	0.8990	35.42	0.055	100	1.0	3.6	2290	0.5	1.4	2.1	20.0	23.6	23.3	**0.233**	2.77
CH70-C	D	92.7	0.8336	87.56	0.137	100	1.0	4.8	4300	0.9	1.9	3.0	25.7	30.5	34.4	**0.305**	2.77

Tc = Ti + Tt Tlag = 0.6 Tc

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing V1 = 14.8*(S/100)^1/2 Developed V1 = 20.2*(S/100)^1/2

Existing V2 = 29.4*(S/100)^1/2 Developed V2 = 30.6*(S/100)^1/2

REFERENCE : **STANDARD FORM 4**

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

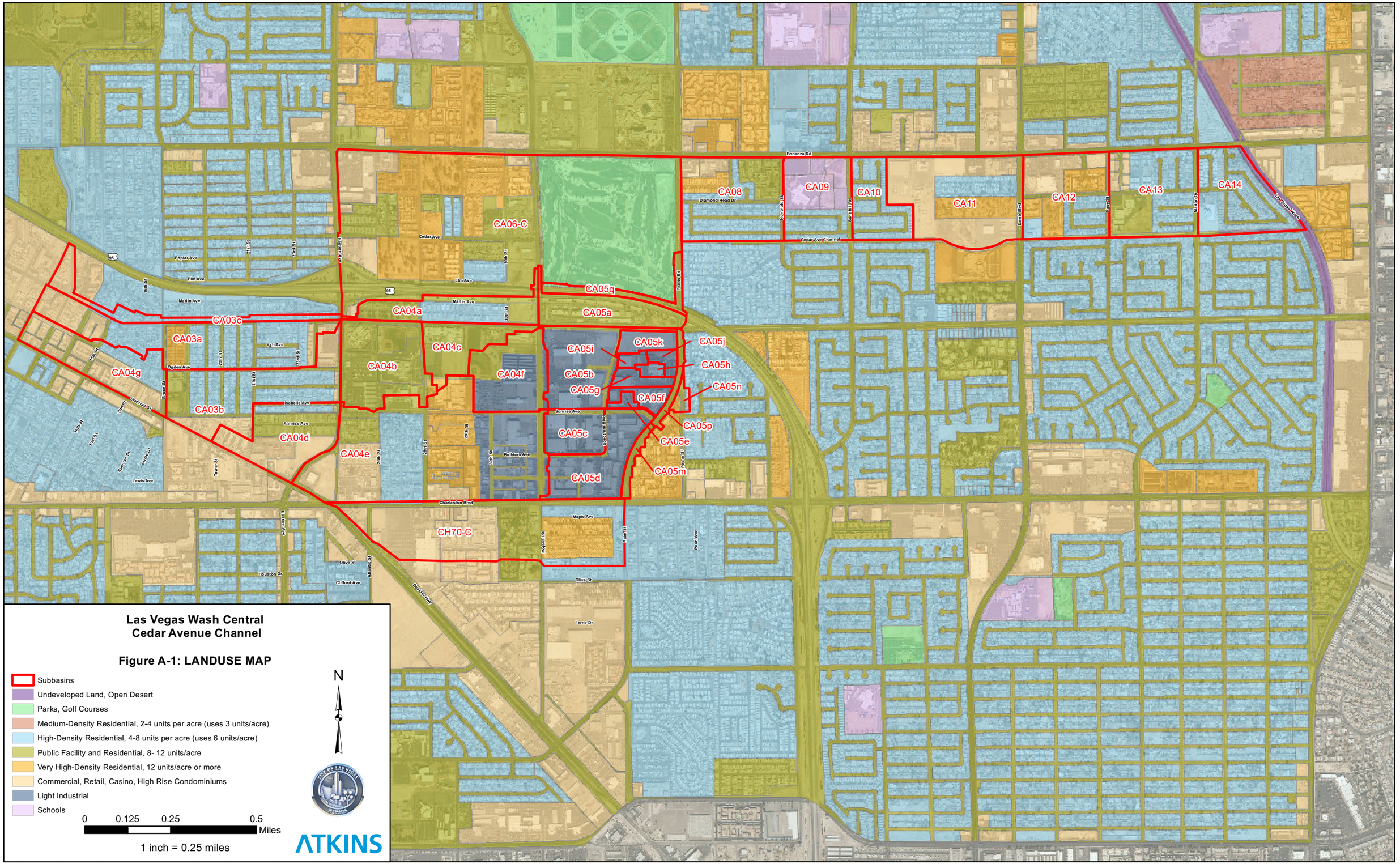
Muskingum-Cunge Routing Summary

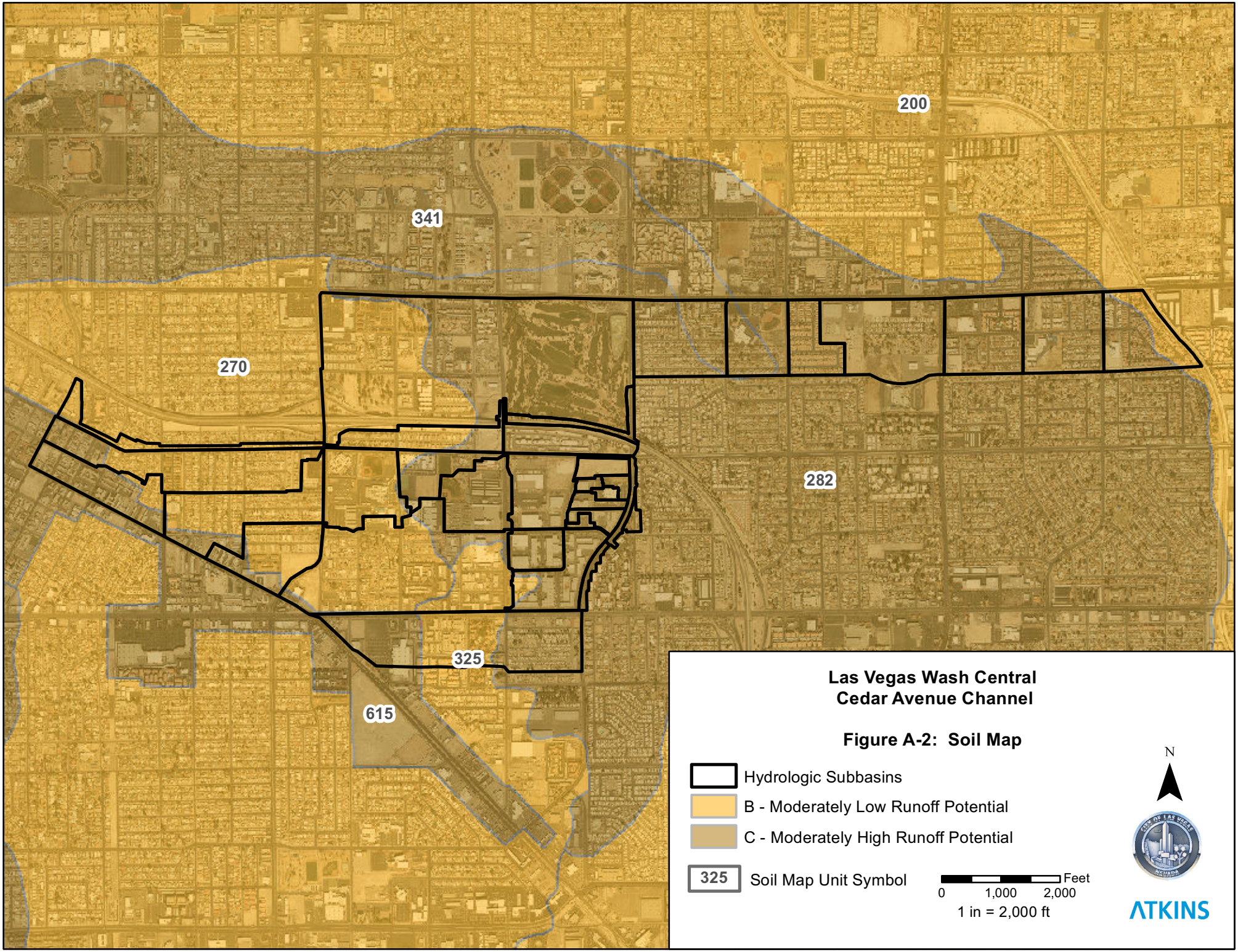
Ultimate Model

Reach ID	Length (ft)	Slope (ft/ft)	Manning's n	Shape	Bottom Width (ft)	Side Slope (H:V, X:1)
RCCA04b	1780	0.00955	0.016	TRAP	50	0
RCA04g	3500	0.0140	0.016	TRAP	50	0
RCA04d	3050	0.01148	0.016	TRAP	50	0
RCCA04e	1360	0.00368	0.016	TRAP	50	0
RCCA04	2130	0.00892	0.016	TRAP	50	0
RCA05c	750	0.00933	0.016	TRAP	50	0
RCCA05f	820	0.00732	0.013	CIRC	3	-
RCHAR	4600	0.0098	0.016	TRAP	50	0
RCCHAR	1250	0.0096	0.013	CIRC	5.5	-
RCCA05m	1580	0.00633	0.013	CIRC	5.5	-
RCCA05	1310	0.0050	0.013	TRAP	14	-
RCCA06	1545	0.0026	0.015	TRAP	10	1.5
RCCA08	1050	0.0026	0.015	TRAP	10	1.5
RCCA09	935	0.002	0.015	TRAP	12	1.5
RCCA10	1730	0.0020	0.015	TRAP	12	1.5
RCCA11	1340	0.0038	0.015	TRAP	10	1.5
RCCA12	1365	0.0037	0.015	TRAP	10	1.5
RCCA13	1680	0.002	0.015	TRAP	14	1.5

Appendix A-6

Land Use Map and Soils Map


CA03a
CA03b
CA03c
CA04a
CA04b
CA04c
CA04d
CA04e
CA04f
CA04g
CA05a
CA05b
CA05c
CA05d
CA05e
CA05f
CA05g
CA05h
CA05i
CA05j
CA05k
CA05m
CA05n
CA05p
CA05q
CA06-C
CA08
CA09
CA10
CA11
CA12
CA13
CA14
CH70-C
Las Vegas Wash Central
Cedar Avenue Channel
Figure A-1: LANDUSE MAP
Subbasins
Undeveloped Land, Open Desert
Parks, Golf Courses
Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)
High-Density Residential, 4-8 units per acre (uses 6 units/acre)
Public Facility and Residential, 8- 12 units/acre
Very High-Density Residential, 12 units/acre or more
Commercial, Retail, Casino, High Rise Condominiums
Light Industrial
Schools
0 0.125 0.25 0.5 Miles
1 inch = 0.25 miles
N
ATKINS
Bonanza Rd
Cedar Ave Channel
Elm Ave
Martin Ave
Ash Ave
Ogden Ave
Isabelle Ave
Sunrise Ave
Lewis Ave
Builders Ave
Charleston Blvd
Maple Ave
Olive St
Houston Dr
Clifford Ave
Ferrie Dr
Diamond Head Dr
Pecos Rd
Boulder Hwy


200
341
270
282
325
615
Las Vegas Wash Central
Cedar Avenue Channel
Figure A-2: Soil Map
Hydrologic Subbasins
B - Moderately Low Runoff Potential
C - Moderately High Runoff Potential
325 Soil Map Unit Symbol
N
0 1,000 2,000 Feet
1 in = 2,000 ft
ATKINS

Appendix B

Hydraulic Analysis

- Appendix B-1: WSPG Model
- Appendix B-2: HEC-RAS Model
- Appendix B-3: Channel Freeboard Analysis

Appendix B-1

WSPG Model

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node13"
Reach            "Link12"
Reach            "Link11"
Reach            "Link10"
Reach            "Link14"
Transition       "Link9"
Reach            "Link31"
Junction         "Node32"
Reach            "Link8"
Join             "Node8"
Reach            "Link7"
Transition       "Link6"
Reach            "Link5"
Reach            "Link4"
Transition       "Link3"
Join             "Node3"
Reach            "Link2"
Reach            "Link1"
Join             "Node1"
Reach            "Link15"
WallExit         "Node16"
Reach            "Link26"
Reach            "Link18"
Junction         "Node19"
Reach            "Link22"
Junction         "Node23"
Reach            "Link24"
Headwork         "Node25"

**BRANCH DEFINITIONS


"Node1_Branch1"
Join             "Node1"
Reach            "Link19"
Reach            "Link28"
Junction         "Node29"
Reach            "Link27"
Headwork         "Node28"


"Node3_Branch1"
Join             "Node3"
Reach            "Link20"
Reach            "Link30"
Junction         "Node31"
Reach            "Link29"
Headwork         "Node30"


"Node8_Branch1"
Join             "Node8"
Reach            "Link25"
Headwork         "Node26"

[OUTLET]
**NAME              STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                             ELEV       ELEV       ID          ELEV (opt.)
**------------      ---------  ---------- ---------- ----------  ----------
"Node13"            -3125.16   1777.39    1787       "12X6"      1781.57

[HEADWORK]
**NAME              INVERT     GROUND     CHANNEL     FLOW        WATER SURFACE
**                  ELEV       ELEV       ID                      ELEV (opt.)
**------------      ---------  ---------- ----------  ----------  ----------
"Node25"            1788.35    1794.5     "7X3"       100         0
"Node26"            1787.11    1792.5     "8X4"       186         0
"Node28"            1788.19    1793.7     "7X3"       82          0
"Node30"            1788.08    1793.5     "5X3"       55          0

[WALLENTRANCE]
**NAME              INVERT     GROUND     CHANNEL     LOSS
**                  ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------      ---------  ---------- ----------  --------------

[WALLEXIT]
**NAME              INVERT     GROUND     CHANNEL     LOSS
**                  ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------      ---------  ---------- ----------  --------------
```

```
"Node16"            1787.78    1795       "8X4"       0

[BRIDGEENTRANCE]
**NAME              INVERT     GROUND     CHANNEL     REDUCTION
**                  ELEV       ELEV       ID          FACTOR(opt.)
**------------      ---------  ---------- ----------  --------------

[BRIDGEEXIT]
**NAME              INVERT     GROUND     CHANNEL     REDUCTION
**                  ELEV       ELEV       ID          FACTOR(opt.)
**------------      ---------  ---------- ----------  --------------

[JOIN]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                  ELEV       ELEV       ID                                BRANCHES   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ----------
"Node1"             1787.61    1795       "18X4"      0          0          1
"Node1_Branch1"     1787.61               "8X4"                                        30

"Node3"             1787.47    1795.5     "18X4"      0          0          1
"Node3_Branch1"     1787.47               "7X3"                                        30

"Node8"             1786.56    1793       "18X4"      0          0          1
"Node8_Branch1"     1786.54               "8X4"                                        30


[JUNCTION]
**Name              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                  ELEV       ELEV       ID                                LATERALS   ANGLE
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Node19"            1787.93    1794       "7X3"       4          0.015      1
"Node19_Lateral1"   1787.98               "8X4"                                        0          100

"Node23"            1787.97    1794       "7X3"       2          0.015      1
"Node23_Lateral1"   1788.5                "24"                                         90         19

"Node29"            1787.76    1793.7     "7X3"       4          0          1
"Node29_Lateral1"   1787.76               "8X4"                                        0          82

"Node31"            1787.65    1793.5     "5X3"       4          0.015      1
"Node31_Lateral1"   1787.65               "7X3"                                        0          64

"Node32"            1785.32    1793       "18X4"      10         0.015      1
"Node32_Lateral1"   1785.32               "24"                                         90         14


[TRANSITION]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                  ELEV       ELEV       ID
**------------      ---------  ---------- ----------  ---------- ----------
"Link3"             1787.43    1795       "18X4"      2          0.015
"Link6"             1787.18    1793       "2:8X4"     10.69      0.015
"Link9"             1785.02    1793.5     "18X4"      30         0.015

[REACH]
**NAME              INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                  ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**------------      ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"             1787.57    1795       "18X4"      8.55       0.015      0          0          0
"Link2"             1787.53    1795.5     "18X4"      21         0.015      0          0          0
"Link4"             1787.42    1795       "2:8X4"     39.55      0.015      0          0          0
"Link5"             1787.27    1793       "2:8X4"     22.17      0.015      0          0          0
"Link7"             1787.14    1793       "18X4"      11.31      0.015      0          0          0
"Link8"             1786.04    1793       "18X4"      143.99     0.015      0          0          0
"Link10"            1782.54    1790       "12X6"      623.14     0.015      0          0          0
"Link11"            1780.04    1797       "12X6"      176.4      0.015      0          0          0
"Link12"            1779.34    1794       "12X6"      487.18     0.015      0          0          0
"Link14"            1783.37    1793.5     "12X6"      208        0.015      0          0          0
"Link15"            1787.78    1795       "18X4"      50         0.015      0          0          0
"Link18"            1787.91    1794       "8X4"       12.8       0.015      0          15         0
"Link19"            1787.68    1793.7     "8X4"       12.8       0.015      0          0          0
"Link20"            1787.54    1793.5     "7X3"       16.545     0.015      0          15         0
"Link22"            1787.96    1794       "7X3"       8          0.015      0          0          0
"Link24"            1788.35    1794.5     "7X3"       75.67      0.015      0          0          0
"Link25"            1787.11    1792.5     "8X4"       66.53      0.015      0          0          0
"Link26"            1787.84    1795       "8X4"       12.8       0.015      0          15         0
"Link27"            1788.19    1793.7     "7X3"       85.65      0.015      0          0          0
"Link28"            1787.74    1793.7     "8X4"       12.8       0.015      0          15         0
"Link29"            1788.08    1793.5     "5X3"       85.67      0.015      0          0          0
"Link30"            1787.63    1793.5     "7X3"       16.545     0.015      0          15         0
"Link31"            1785.27    1793       "18X4"      50         0.015      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"12X6"        3   6          12          0          0          0          0          0
"7X3"         3   3          7           0          0          0          0          0
"8X4"         3   4          8           0          0          0          0          0
```

```
"5X3"          3   3          5          0          0          0          0          0
"18X4"         3   4          18         0          0          0          0          0
"24"           4   2          2
"2:8X4"        3   4          18         0          0          1          2          0

**IRREGULAR TYPES 5-6
**ID        TYPE NUMBER     AVG PIER   PIER1      PIER2      PIER3      PIER4      PIER5      PIER6      PIER7      PIER8
PIER9      PIER10
**              PIERS      WIDTH      ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV
ELEV       ELEV
**------   ---- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- --
-------- ----------


[POINT]
**ID          XCOORD     YCOORD
**----------- ---------- ----------
```

```
************************************
Water Surface Profile Gradient (WSPG)
XP WSPG
Engine Version 1.3         06/09/2010
XP Software        www.xpsoftware.com
************************************

INPUT FILE
************************************
X:\Projects\100039014_Cedar\Drainage\H&H\Hydraulics\WSPG\PDR\StormDrain.wsx
Computed  06/15/15  10:38:06

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction Node19 has a different channel than its direct downstream element.
 WARNING 47: Junction Node29 has a different channel than its direct downstream element.
 WARNING 49: Manning's n for open flow of element Node29 not in recommended range 0.01 - 0.06.
 WARNING 47: Junction Node31 has a different channel than its direct downstream element.
 WARNING 49: Manning's n for open flow of element Node1 not in recommended range 0.01 - 0.06.
 WARNING 49: Manning's n for open flow of element Node3 not in recommended range 0.01 - 0.06.
 WARNING 45: One of the elevations of junction's Node8 laterals is less than the U/S elevation.
 WARNING 49: Manning's n for open flow of element Node8 not in recommended range 0.01 - 0.06.
 WARNING 25: Link type element Link1 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link8 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link18 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link22 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link28 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link30 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link31 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link3 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node23 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node19 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node1 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node3 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node8 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node32 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node29 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node31 because critical momentum is greater than maximum momentum.

RESULTS
************************************


============================================================
   Main Line
============================================================

 Composite Profile:
```

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Node13"	Outlet	-3125.16	1777.39	1787.00	1782.128	4.738	702.00	12.35	2.37	1784.50	0.000	4.738	0.000	0.00000	0.000	Tr./Rect.closed
"i.p."		-3097.69	1777.50	1787.11	1782.339	4.839	702.00	12.09	2.27	1784.61	0.000	4.738	0.968	0.00400	4.839	Tr./Rect.closed
"Link12"	Reach	-2637.98	1779.34	1794.00	1784.179	4.839	702.00	12.09	2.27	1786.45	0.000	4.738	0.968	0.00400	4.839	Tr./Rect.closed
"i.p."		-2569.13	1779.61	1794.27	1784.468	4.854	702.00	12.05	2.26	1786.72	0.000	4.738	0.964	0.00397	4.854	Tr./Rect.closed
"Link11"	Reach	-2461.58	1780.04	1797.00	1784.894	4.854	702.00	12.05	2.26	1787.15	0.000	4.738	0.964	0.00397	4.854	Tr./Rect.closed
"i.p."		-2409.46	1780.25	1797.21	1785.084	4.835	702.00	12.10	2.27	1787.36	0.000	4.738	0.970	0.00401	4.835	Tr./Rect.closed
"Link10"	Reach	-1838.44	1782.54	1790.00	1787.375	4.835	702.00	12.10	2.27	1789.65	0.000	4.738	0.970	0.00401	4.835	Tr./Rect.closed
"i.p."		-1767.79	1782.82	1790.28	1787.666	4.845	702.00	12.08	2.26	1789.93	0.000	4.738	0.967	0.00399	4.845	Tr./Rect.closed
"Link14"	Reach	-1630.44	1783.37	1793.50	1788.215	4.845	702.00	12.08	2.26	1790.48	0.000	4.738	0.967	0.00399	4.845	Tr./Rect.closed
"Link9"	Transition	-1600.44	1785.02	1793.50	1789.206	4.186	702.00	9.78	1.49	1790.69	0.000	3.616	0.864	0.05500	0.000	Tr./Rect.closed
"Link31"	Reach	-1550.44	1785.27	1793.00	1789.460	4.190	702.00	9.78	1.49	1790.95	0.000	3.616	0.864	0.00500	3.160	Tr./Rect.closed
"Node32"	Junction	-1540.44	1785.32	1793.00	1789.628	4.308	688.00	9.59	1.43	1791.06	0.000	3.567	0.000	0.00500	0.000	Tr./Rect.closed

"Link8"	Reach	-1396.45	1786.04	1793.00	1790.330	4.290	688.00	9.59	1.43	1791.76	0.000	3.567	0.846	0.00500	3.117	Tr./Rect.closed
"Node8"	Join	-1396.45	1786.56	1793.00	1791.257	4.697	502.00	7.00	0.76	1792.02	0.000	2.891	0.000	0.00000	0.000	Tr./Rect.closed
"Link7"	Reach	-1385.14	1787.14	1793.00	1791.287	4.147	502.00	7.00	0.76	1792.05	0.000	2.891	0.618	0.05128	1.198	Tr./Rect.closed
"Link6"	Transition	-1374.45	1787.18	1793.00	1791.144	3.964	502.00	7.92	0.97	1792.12	0.000	3.127	0.701	0.00374	0.000	Tr./Rect.closed
"Link5"	Reach	-1352.28	1787.27	1793.00	1791.169	3.899	502.00	8.05	1.01	1792.17	0.000	3.127	0.718	0.00406	3.336	Tr./Rect.closed
"Link4"	Reach	-1312.73	1787.42	1795.00	1791.230	3.810	502.00	8.23	1.05	1792.28	0.000	3.127	0.743	0.00379	3.420	Tr./Rect.closed
"Link3"	Transition	-1310.73	1787.43	1795.00	1791.558	4.128	502.00	7.00	0.76	1792.32	0.000	2.891	0.618	0.00500	0.000	Tr./Rect.closed
"Node3"	Join	-1310.73	1787.47	1795.50	1791.937	4.467	383.00	5.34	0.44	1792.38	0.000	2.414	0.000	0.00000	0.000	Tr./Rect.closed
"Link2"	Reach	-1289.73	1787.53	1795.50	1791.969	4.439	383.00	5.34	0.44	1792.41	0.000	2.414	0.471	0.00286	2.545	Tr./Rect.closed
"Link1"	Reach	-1281.18	1787.57	1795.00	1791.982	4.412	383.00	5.34	0.44	1792.42	0.000	2.414	0.471	0.00468	2.166	Tr./Rect.closed
"Node1"	Join	-1281.18	1787.61	1795.00	1792.260	4.650	219.00	3.05	0.14	1792.40	0.000	1.663	0.000	0.00000	0.000	Tr./Rect.closed
"Link15"	Reach	-1231.18	1787.78	1795.00	1792.285	4.505	219.00	3.05	0.14	1792.43	0.000	1.663	0.269	0.00340	1.674	Tr./Rect.closed
"Node16"	WallExt	-1231.18	1787.78	1795.00	1792.285	4.505	219.00	6.90	0.74	1793.02	0.000	2.856	0.000	0.00000	0.000	Tr./Rect.closed
"Link26"	Reach	-1218.38	1787.84	1795.00	1792.364	4.524	219.00	6.90	0.74	1793.10	0.000	2.856	0.610	0.00469	2.867	Tr./Rect.closed
"Link18"	Reach	-1205.58	1787.91	1794.00	1792.443	4.533	219.00	6.90	0.74	1793.18	0.000	2.856	0.610	0.00547	2.713	Tr./Rect.closed
"Node19"	Junction	-1201.58	1787.93	1794.00	1793.063	5.133	119.00	5.73	0.51	1793.57	0.000	2.078	0.000	0.00500	0.000	Tr./Rect.closed
"Link22"	Reach	-1193.58	1787.96	1794.00	1793.089	5.129	119.00	5.73	0.51	1793.60	0.000	2.078	0.587	0.00375	2.266	Tr./Rect.closed
"Node23"	Junction	-1191.58	1787.97	1794.00	1793.395	5.425	100.00	4.82	0.36	1793.76	0.000	1.851	0.000	0.00500	0.000	Tr./Rect.closed
"Link24"	Reach	-1115.91	1788.35	1794.50	1793.565	5.215	100.00	4.82	0.36	1793.93	0.000	1.851	0.493	0.00502	1.809	Tr./Rect.closed
"Node25"	Headwrk	-1115.91	1788.35	1794.50	1793.565	5.215	100.00	4.82	0.36	1793.93	0.000	1.851	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

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Node1_Branch1

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Composite Profile:

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet/N"	Outlet	-1281.18	1787.61	1795.00	1792.141	4.531	164.00	5.17	0.41	1792.56	0.000	2.355	0.000	0.00000	0.000	Tr./Rect.closed
"Link19"	Reach	-1268.38	1787.68	1793.70	1792.165	4.485	164.00	5.17	0.41	1792.58	0.000	2.355	0.457	0.00547	2.211	Tr./Rect.closed
"Link28"	Reach	-1255.58	1787.74	1793.70	1792.209	4.469	164.00	5.17	0.41	1792.62	0.000	2.355	0.457	0.00469	2.334	Tr./Rect.closed
"Node29"	Junction	-1251.58	1787.76	1793.70	1792.578	4.818	82.00	3.95	0.24	1792.82	0.000	1.621	0.000	0.00500	0.000	Tr./Rect.closed
"Link27"	Reach	-1165.93	1788.19	1793.70	1792.707	4.517	82.00	3.95	0.24	1792.95	0.000	1.621	0.404	0.00502	1.578	Tr./Rect.closed
"Node28"	Headwrk	-1165.93	1788.19	1793.70	1792.707	4.517	82.00	3.95	0.24	1792.95	0.000	1.621	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

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Node3_Branch1

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Composite Profile:

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet/N"	Outlet	-1310.73	1787.47	1795.50	1791.767	4.297	119.00	5.73	0.51	1792.28	0.000	2.078	0.000	0.00000	0.000	Tr./Rect.closed
"Link20"	Reach	-1294.18	1787.54	1793.50	1791.846	4.306	119.00	5.73	0.51	1792.36	0.000	2.078	0.587	0.00423	2.171	Tr./Rect.closed
"Link30"	Reach	-1277.64	1787.63	1793.50	1791.924	4.294	119.00	5.73	0.51	1792.43	0.000	2.078	0.587	0.00544	1.987	Tr./Rect.closed
"Node31"	Junction	-1273.64	1787.65	1793.50	1792.423	4.773	55.00	3.73	0.22	1792.64	0.000	1.555	0.000	0.00500	0.000	Tr./Rect.closed
"Link29"	Reach	-1187.97	1788.08	1793.50	1792.558	4.478	55.00	3.73	0.22	1792.77	0.000	1.555	0.383	0.00502	1.595	Tr./Rect.closed
"Node30"	Headwrk	-1187.97	1788.08	1793.50	1792.558	4.478	55.00	3.73	0.22	1792.77	0.000	1.555	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

==========

Node8_Branch1

Composite Profile:

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet/N"	Outlet	-1396.45	1786.54	1793.00	1791.054	4.514	186.00	5.86	0.53	1791.59	0.000	2.561	0.000	0.00000	0.000	Tr./Rect.closed
"Link25"	Reach	-1329.92	1787.11	1792.50	1791.214	4.104	186.00	5.86	0.53	1791.75	0.000	2.561	0.518	0.00857	2.064	Tr./Rect.closed
"Node26"	Headwrk	-1329.92	1787.11	1792.50	1791.214	4.104	186.00	5.86	0.53	1791.75	0.000	2.561	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

Appendix B-2

HEC-RAS Model

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

Staion Conversion

HEC-RAS Station	30% Drainage Plan Station
9063.206	3125.88
8922.776	3266.88
8873.57	3316.08
8824.36	3365.28
8775.16	3414.48
8725.96	3463.68
8676.75	3512.88
8627.55	3562.08
8578.35	3611.28
8529.14	3660.48
8479.94	3709.68
8430.738	3758.89
8380.9	3808.73
8331.07	3858.57
8281.24	3908.41
8231.4	3958.25
8181.57	4008.09
8131.743	4057.93
8103.225	4086.45
8070	4086.95
8041.023	4148.45
8010.899	4178.57
7961.26	4228.22
7911.62	4277.87
7861.98	4327.52
7812.34	4377.17
7762.7	4426.82
7713.06	4476.47
7663.42	4526.12
7613.79	4575.77
7564.15	4625.42
7514.51	4675.07
7464.87	4724.72
7415.23	4774.37
7365.59	4824.02
7315.95	4873.67
7266.31	4923.32
7216.68	4972.97
7167.04	5022.62
7117.403	5072.27
7068.177	5121.5
7030	5122
6988.652	5201
6936.664	5252.99
6887.95	5301.7
6839.24	5350.41

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

Staion Conversion

HEC-RAS Station	30% Drainage Plan Station
6790.53	5399.12
6741.82	5447.83
6693.11	5496.54
6644.4	5545.25
6595.69	5593.96
6546.98	5642.67
6498.27	5691.38
6449.56	5740.09
6400.85	5788.8
6352.14	5837.51
6303.43	5886.22
6254.72	5934.93
6206.01	5983.64
6157.3	6032.35
6108.59	6081.06
6059.88	6129.77
6010.11	6179.53
5960.34	6229.29
5910.58	6279.05
5860.81	6328.81
5811.04	6378.57
5761.28	6428.33
5711.51	6478.09
5661.75	6527.85
5611.98	6577.61
5562.21	6627.37
5512.45	6677.13
5462.68	6726.89
5412.91	6776.65
5363.15	6826.41
5313.38	6876.17
5263.62	6925.93
5213.85	6975.69
5164.08	7025.45
5114.32	7075.21
5064.55	7124.97
5014.78	7174.73
4965.02	7224.49
4915.25	7274.25
4865.49	7324.01
4815.72	7373.77
4765.95	7423.53
4716.19	7473.29
4666.42	7523.05
4616.65	7572.81
4566.89	7622.57

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

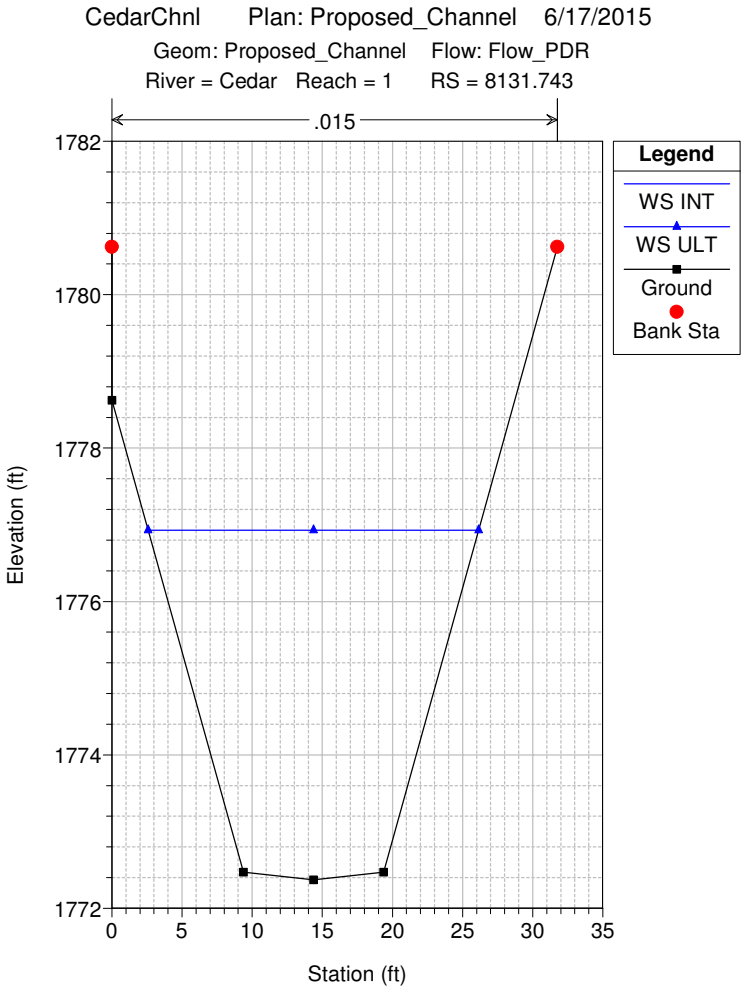
Staion Conversion

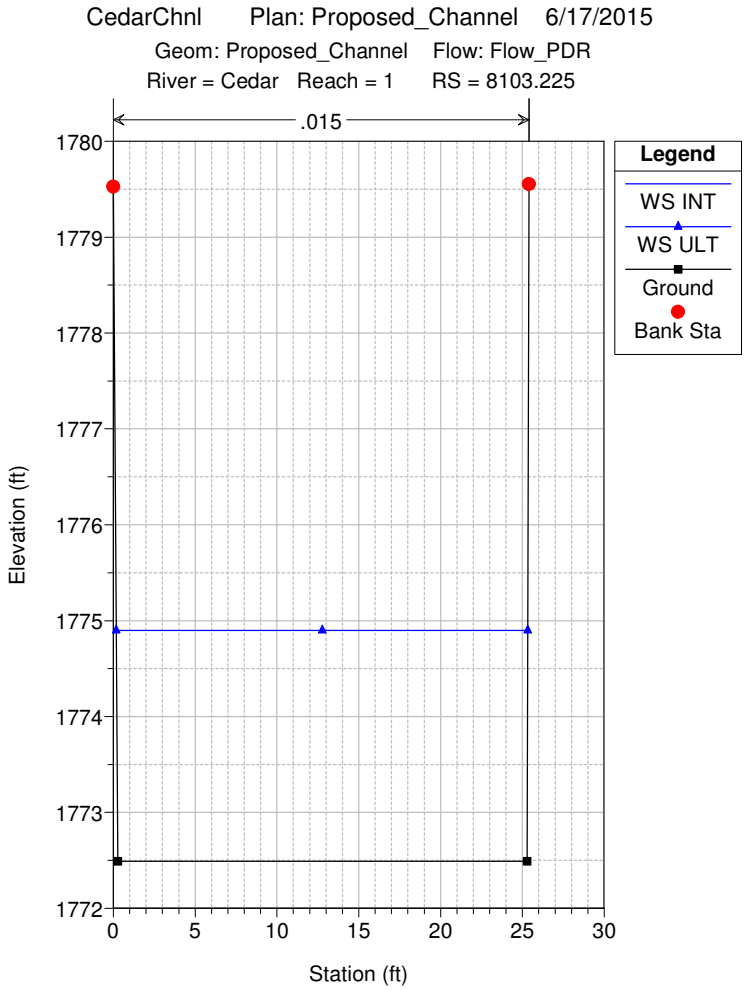
HEC-RAS Station	30% Drainage Plan Station
4517.12	7672.33
4467.36	7722.09
4425.682	7763.77
4380	7764.27
4322.957	7866.27
4293.287	7895.94
4244.75	7944.48
4196.21	7993.02
4147.67	8041.56
4099.14	8090.1
4002.07	8187.18
3953.53	8235.72
3904.99	8284.26
3856.46	8332.8
3807.92	8381.34
3759.38	8429.88
3710.85	8478.42
3662.31	8526.96
3613.78	8575.5
3565.24	8624.04
3516.7	8672.58
3468.17	8721.12
3419.63	8769.66
3371.1	8818.2
3322.56	8866.74
3274.02	8915.28
3225.49	8963.82
3176.95	9012.36
3128.41	9060.9
3079.883	9109.44
3049.332	9139.99
3020	9140.49
2985.898	9202.99
2956.266	9232.62
2907.31	9281.57
2858.36	9330.52
2809.42	9379.47
2760.47	9428.42
2711.52	9477.37
2662.57	9526.32
2613.62	9575.27
2564.67	9624.22
2515.72	9673.17
2466.78	9722.12
2417.83	9771.07
2368.88	9820.02

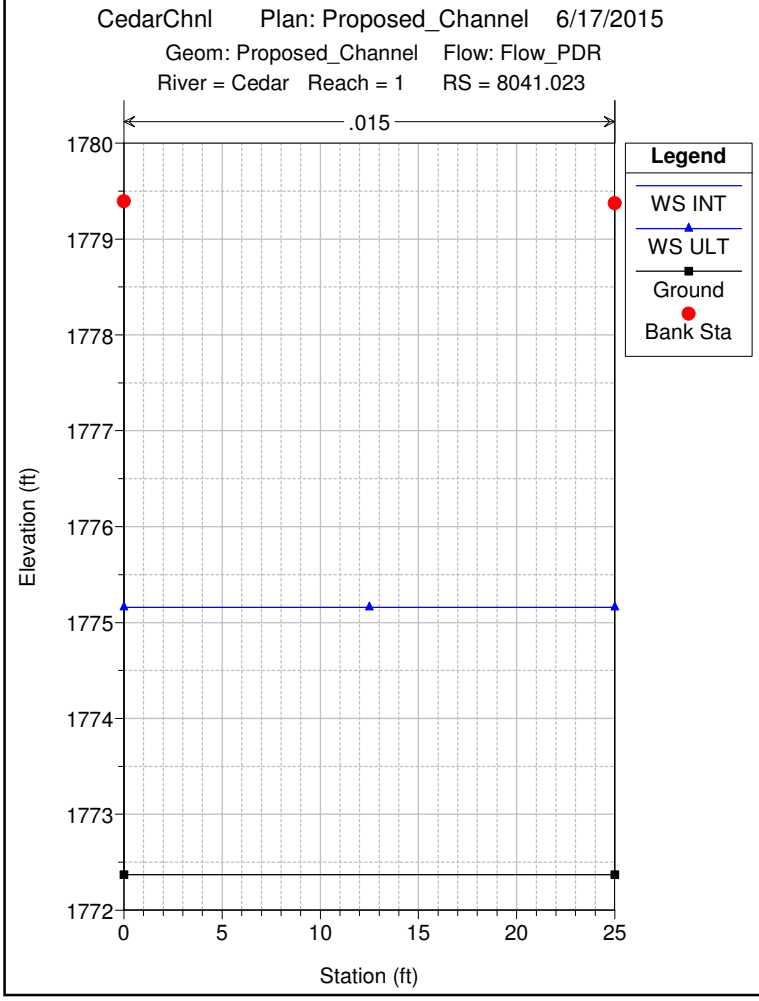
LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

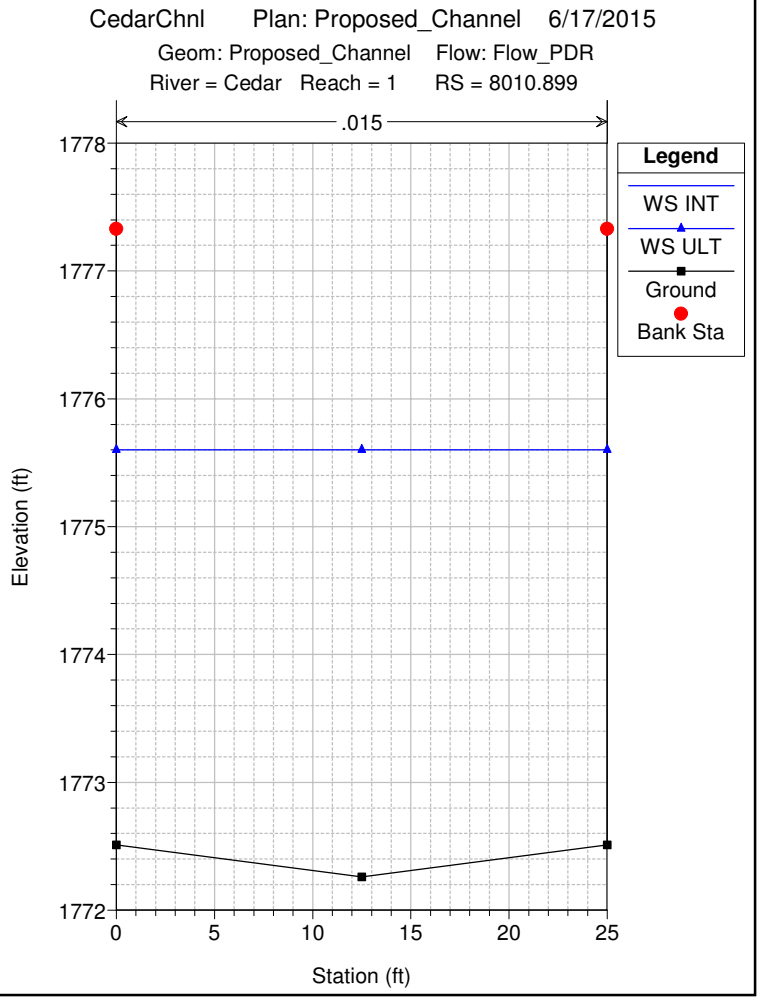
Staion Conversion

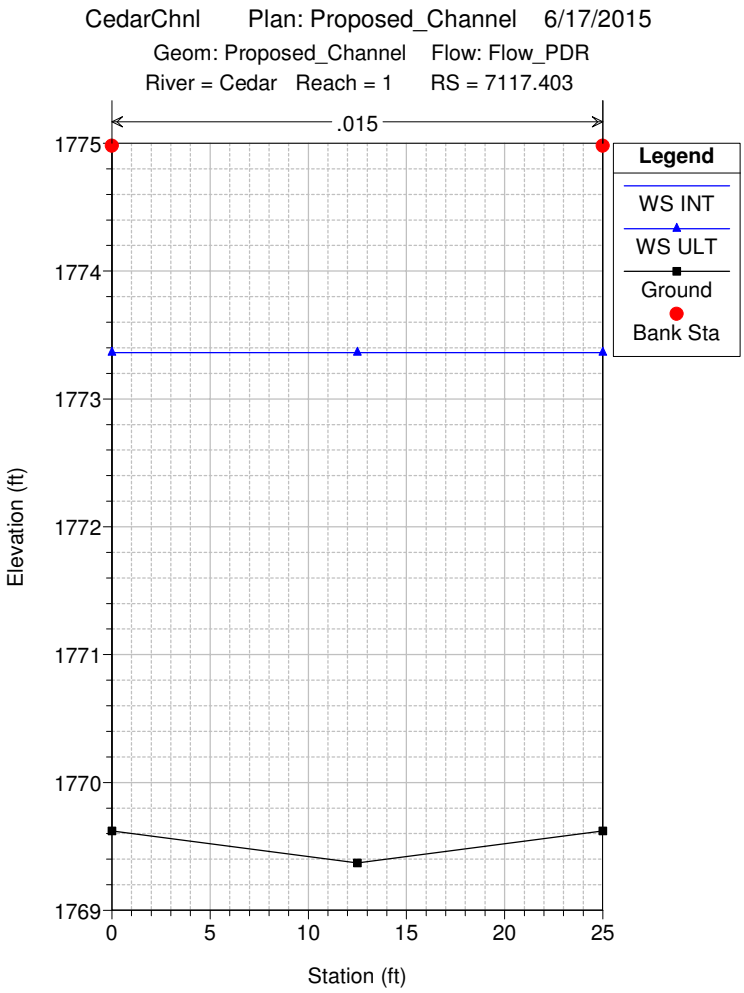
HEC-RAS Station	30% Drainage Plan Station
2319.93	9868.97
2270.98	9917.92
2222.04	9966.87
2172.99	10015.91
2123.94	10064.95
2075.01	10113.88
2026.09	10162.81
1977.17	10211.74
1928.25	10260.67
1879.32	10309.6
1830.4	10358.53
1781.48	10407.46
1732.559	10456.39
1703.273	10485.69
1660	10486.19
1620.75	10568.19
1590.431	10598.51
1532.01	10641.01
1473.59	10683.51
1415.17	10726.01
1356.76	10768.51
1151.76	10973.51
1105.9	11019.36
1060.04	11065.21
1014.18	11111.06
968.328	11156.91
922.47	11202.76
876.612	11248.61
830.754	11294.46
784.896	11340.31
739.038	11386.16
693.18	11432.01
643.624	11481.57
594.067	11531.13
544.512	11580.69
494.955	11630.25
445.399	11679.81
395.843	11729.37
346.287	11778.93
296.731	11828.49
247.175	11878.05
197.619	11927.61
148.063	11977.17
98.5078	12026.73

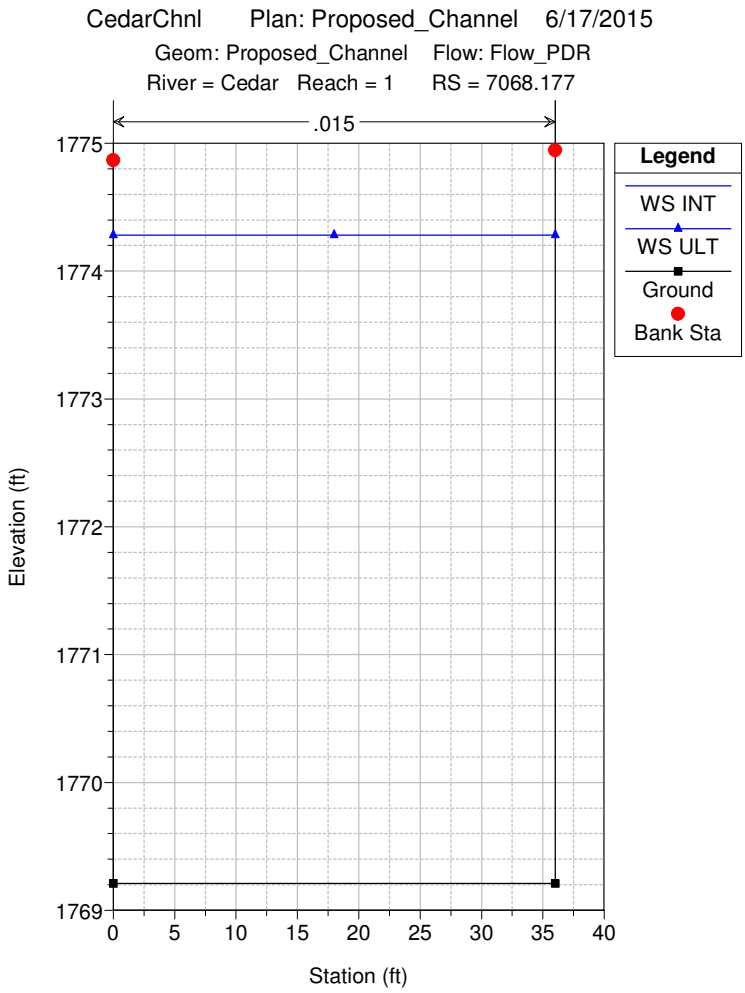

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 8131.743
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Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

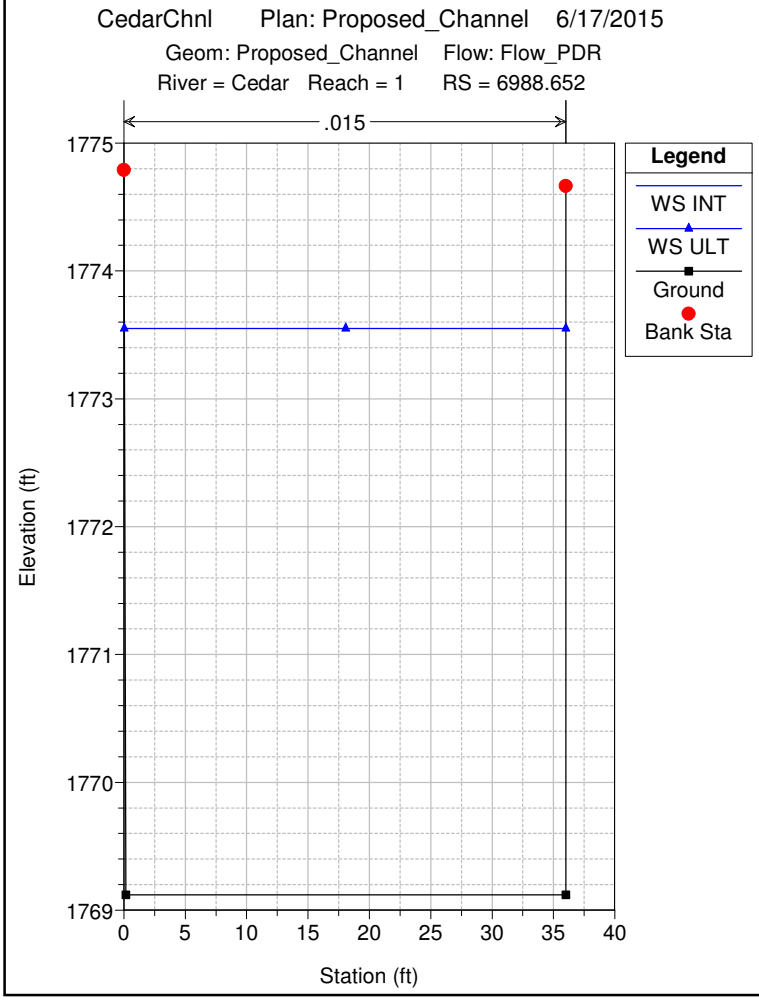

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 8103.225
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

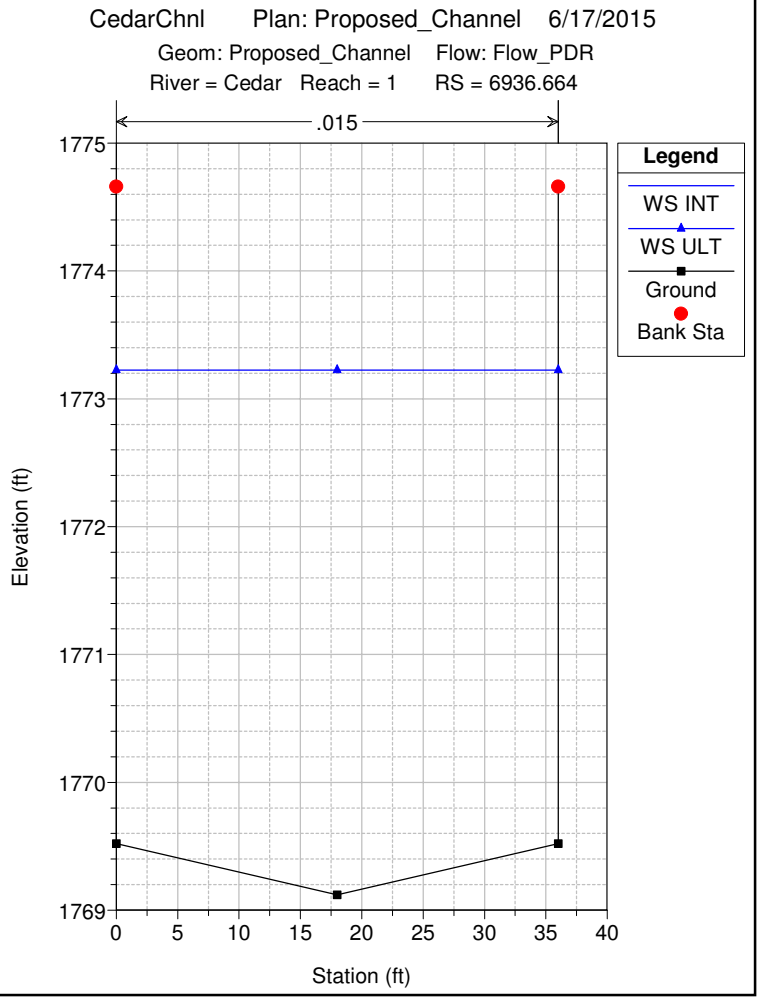

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
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Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

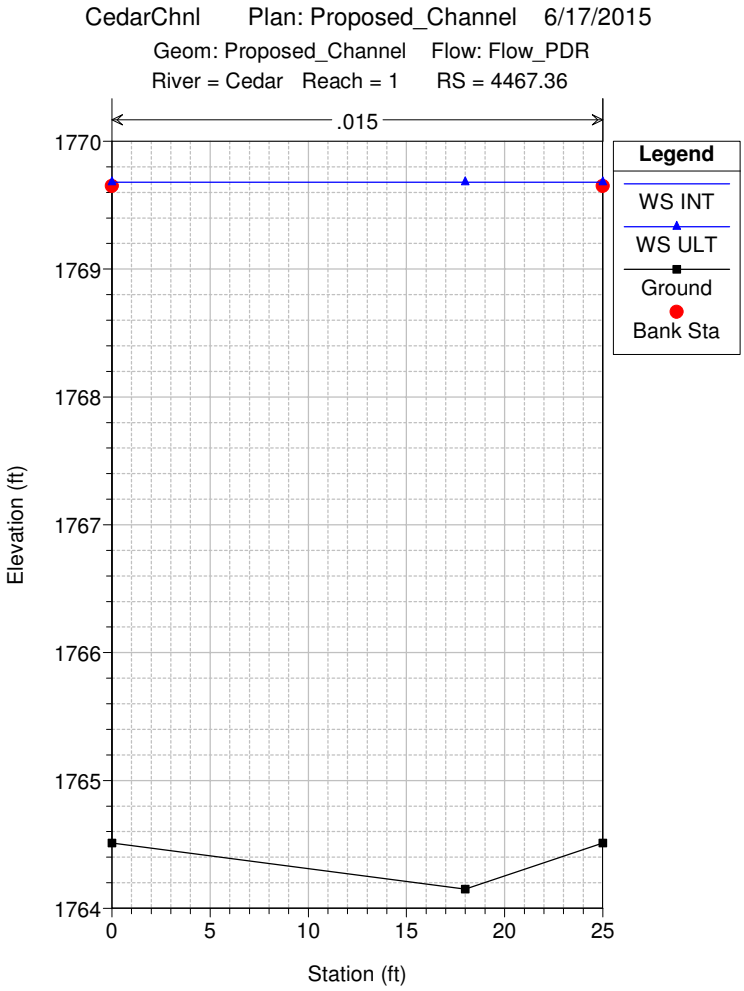

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 8010.899
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

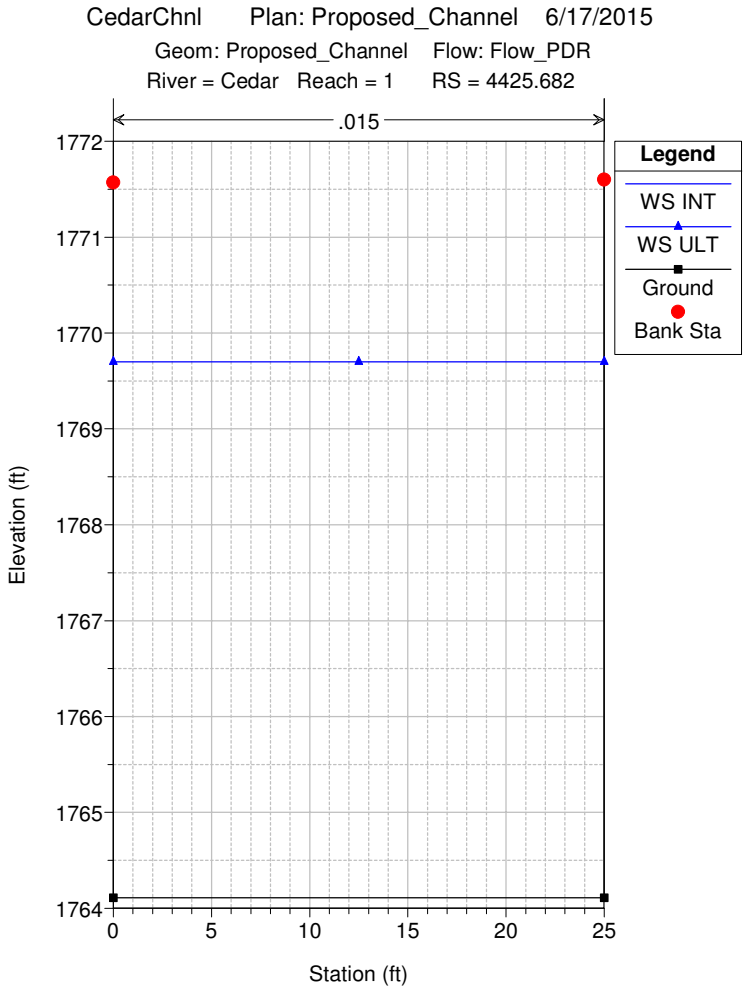

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 7117.403
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Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

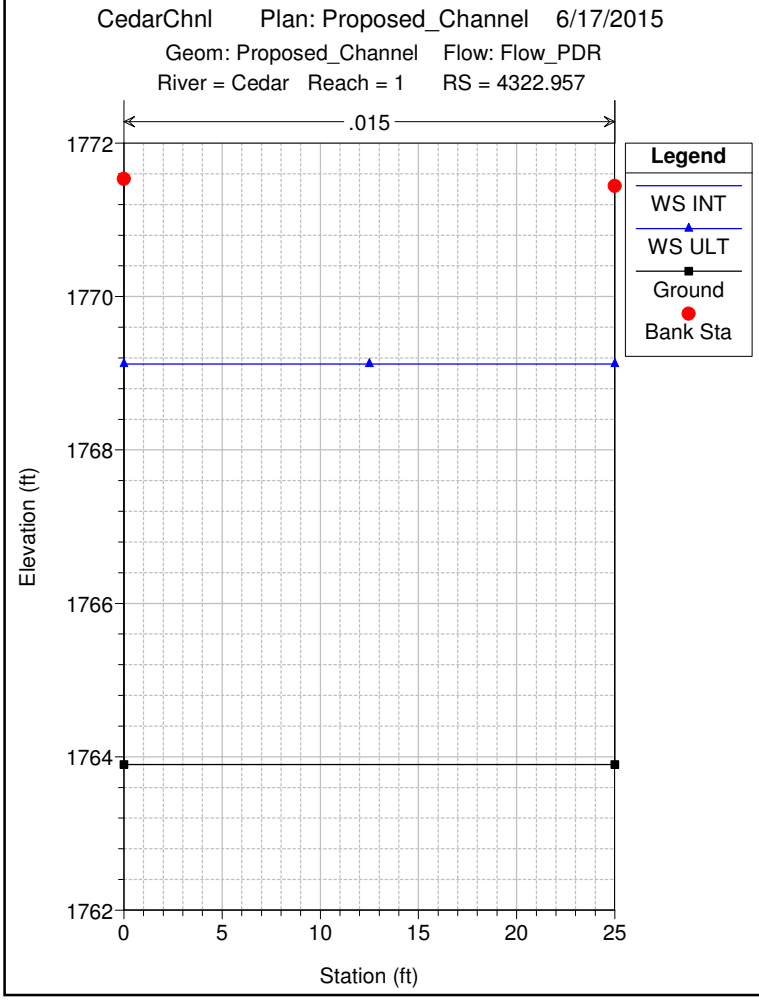

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
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Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

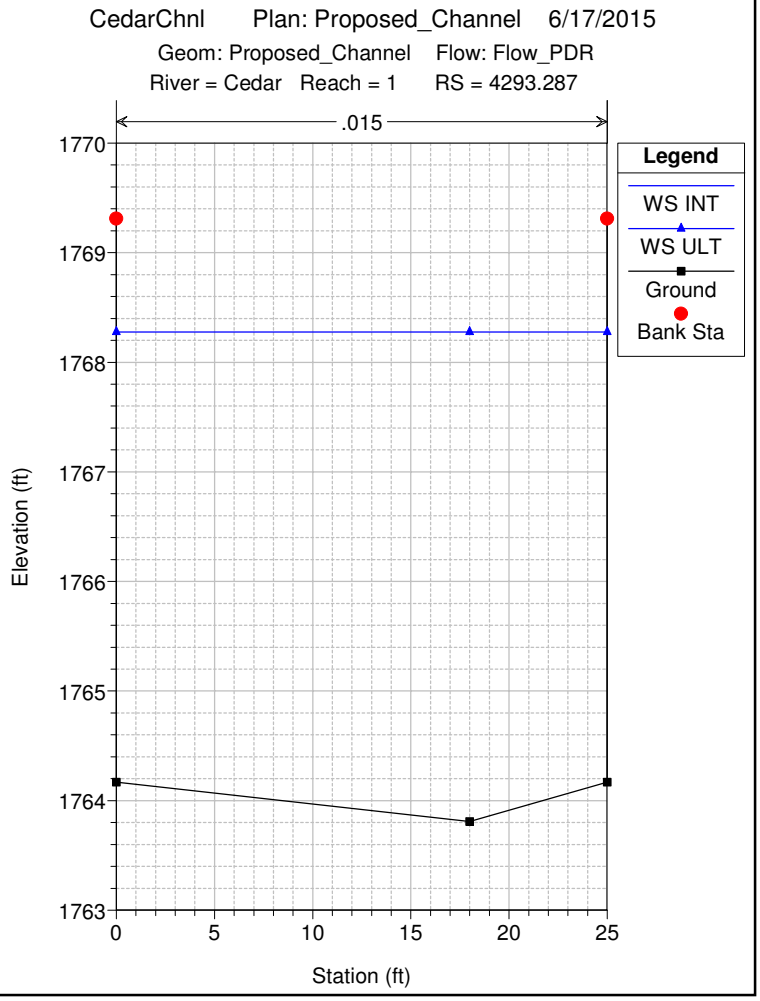

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 6988.652
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

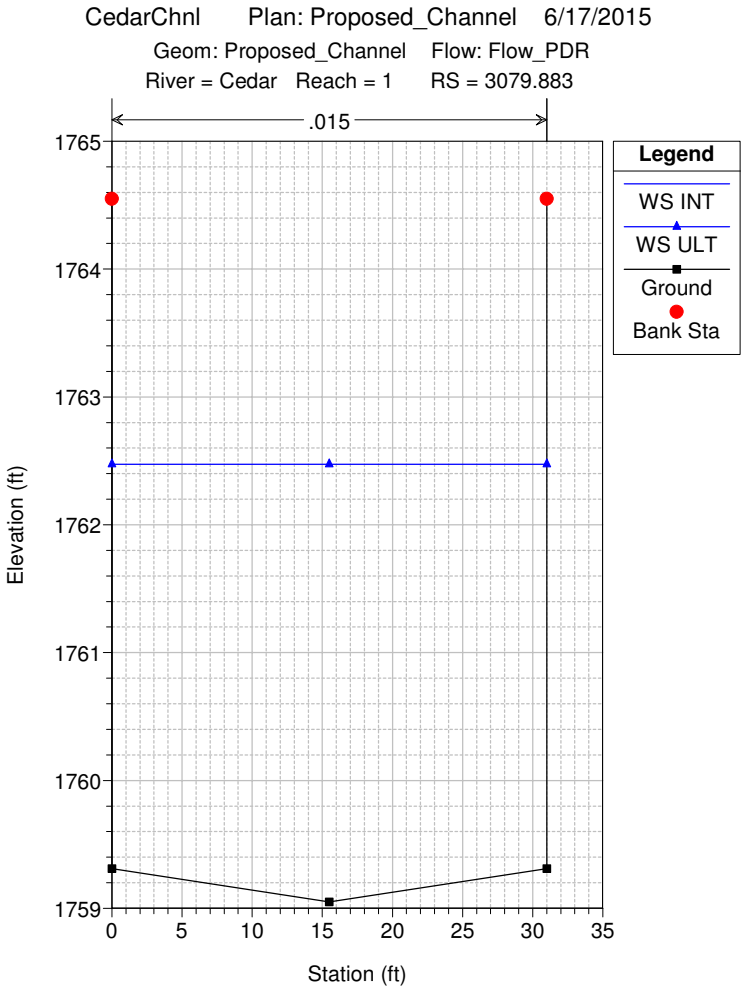

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 6936.664
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

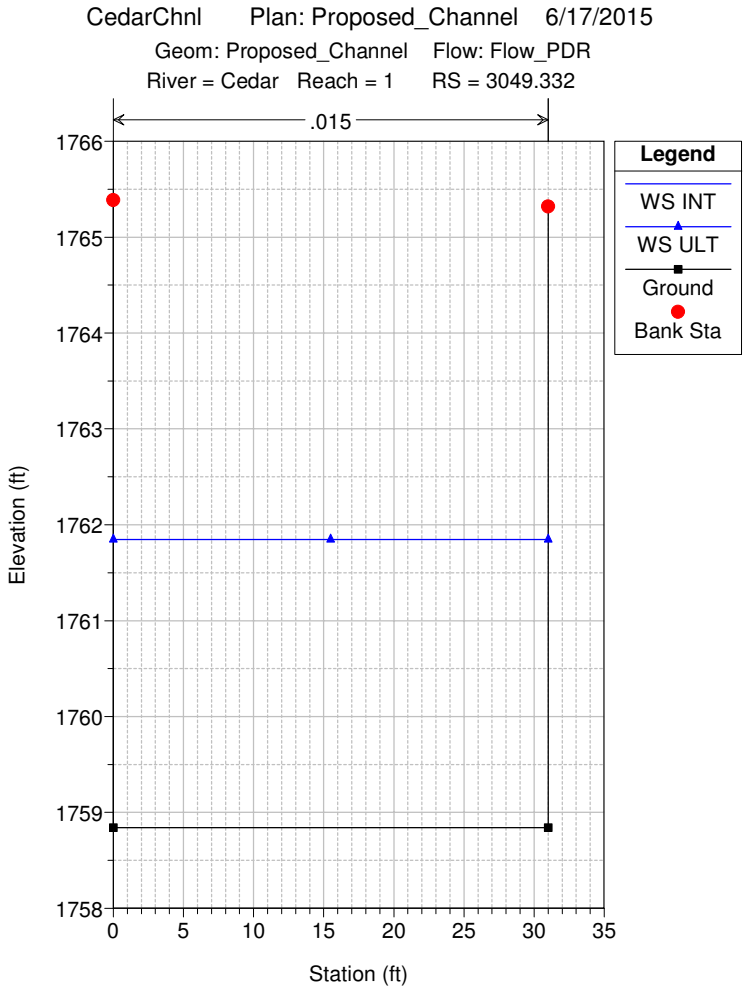

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 4467.36
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

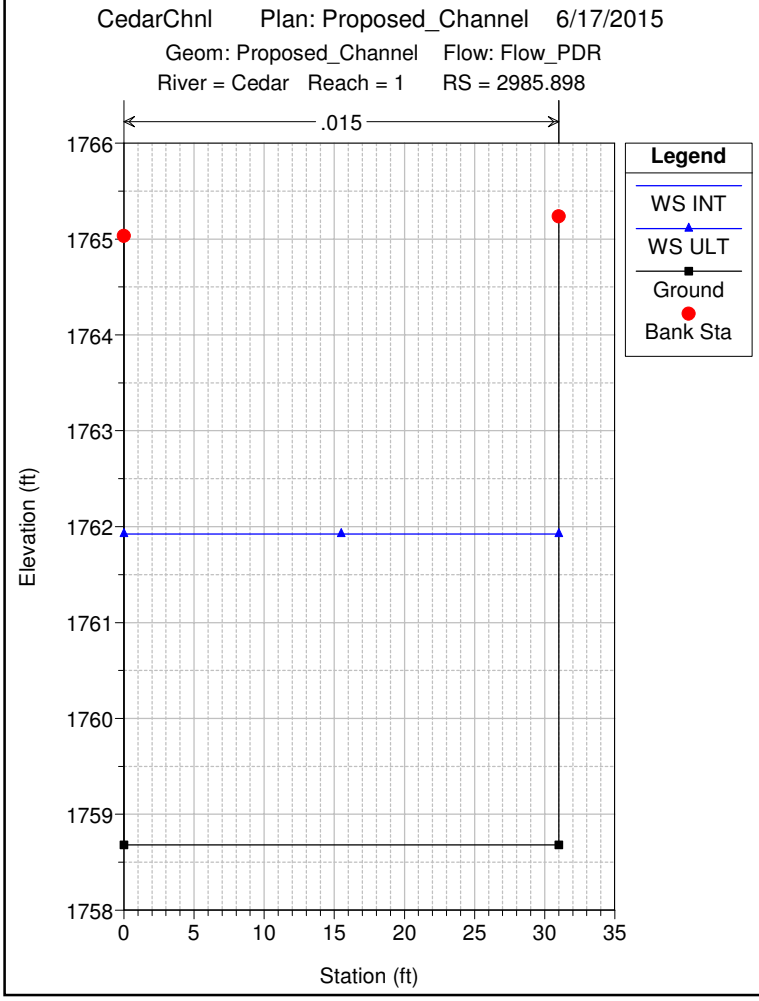

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 4425.682
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

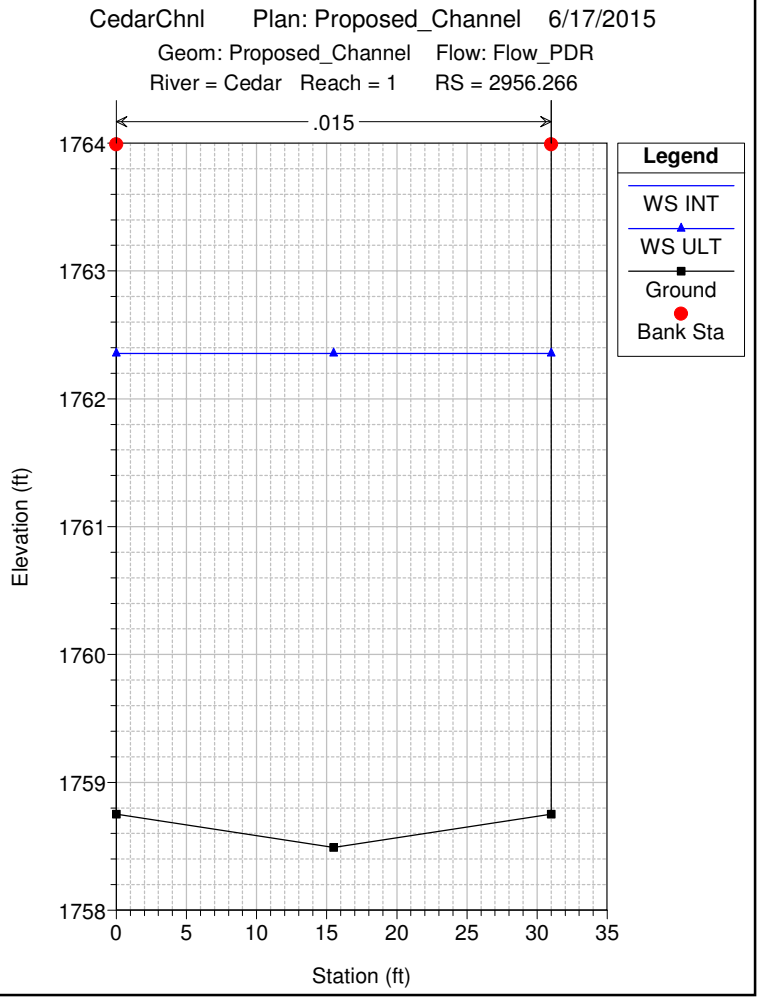

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 4322.957
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

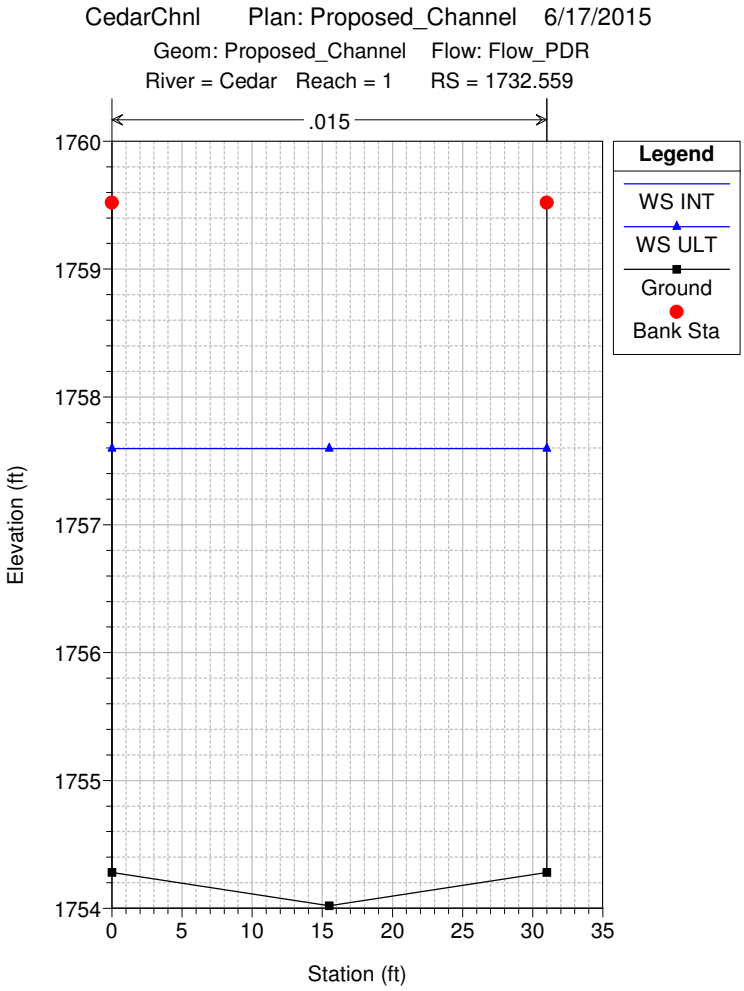

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 4293.287
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

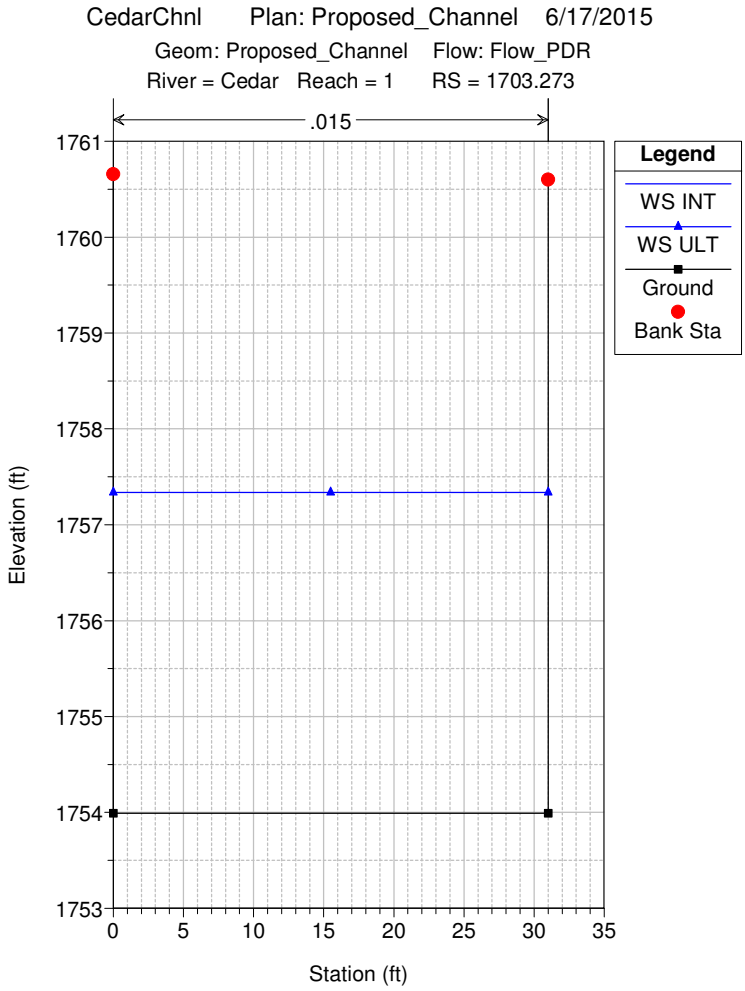

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 3079.883
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

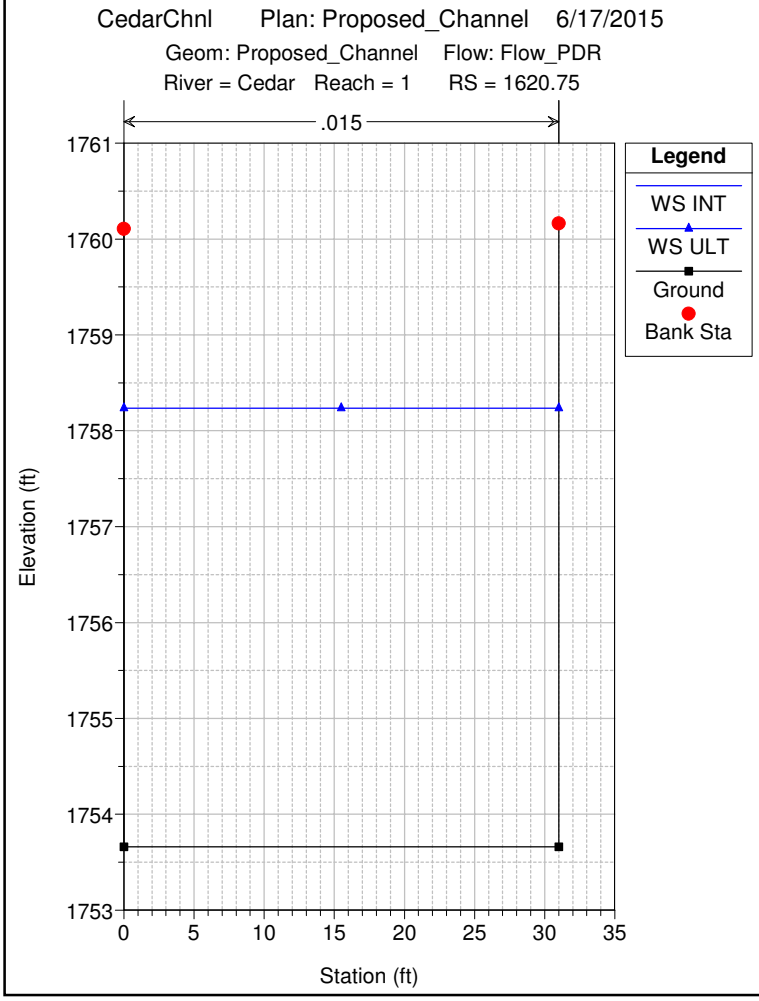

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 3049.332
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

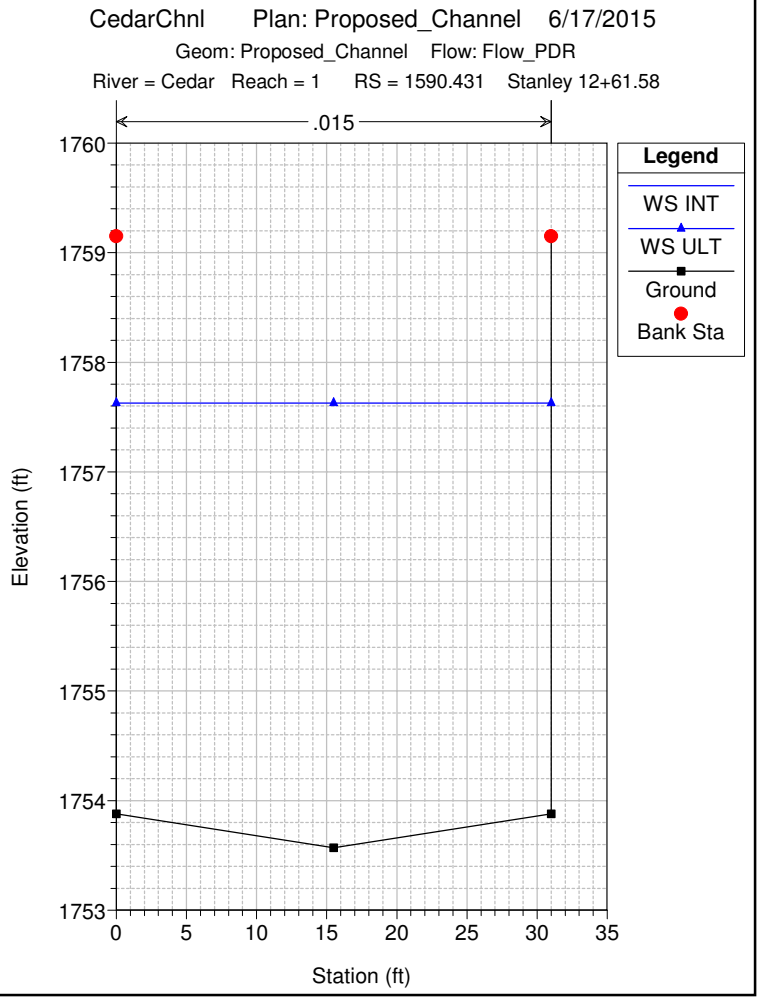

CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 2985.898
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)


CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 2956.266
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)


CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 1732.559
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)


CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 1703.273
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)


CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 1620.75
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)


CedarChnl Plan: Proposed_Channel 6/17/2015
Geom: Proposed_Channel Flow: Flow_PDR
River = Cedar Reach = 1 RS = 1590.431 Stanley 12+61.58
.015
Legend
WS INT
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

Appendix B-3

Channel Freeboard Analysis

Channel Freeboard Analysis

Freeboard required is calculated by the following equation for supercritical flow regime (Equation 747 in HCDDM).

$$F_b = 1.0 + 0.025\, V\, (d)^{1/3}$$

Where F_b = Freeboard height (ft)

V = velocity (ft/s)

D = depth of flow (ft)

Freeboard required is calculated by the following equation for subcritical flow regime (Equation 741 in HCDDM).

$$F_b = 0.5 + V^2/2g$$

Where F_b = Freeboard height (ft)

V = velocity (ft/s)

g = acceleration of gravity (ft/s^2)

Super-elevation is calculated by the following equation (Equation 748 in HCDDM).

$$S_e = C\, V^2\, T_w / g\, r$$

Where S_e = super-elevation (ft)

C = 1.0 for all other Channel Section, with or without Spiral Transition Curves

V = velocity (ft/s)

T_w = Normal channel flow top width (ft)

r = channel centerline radius (ft)

g = acceleration of gravity (ft/s^2)

The maximum allowable super-elevation per HCDDM is 2 feet.

Super-elevation for subcritical flow is taken as 0.5 feet.

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL
Freeboard Calculation

River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Top of Wall (ft)		Available Freeboard (ft)		Minimum Available FB	Criteria
30% Design Plans	HEC-RAS Model	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)	(ft)	Supercritical flow(ft)	SubCritical flow (ft)	(Depth+Calc FB+super evev)	Left	Right	Left	Right	(ft)	
3125.88	9063.206	1085	1777.39	1781.81	1782.73	1784.96	0.005263	14.23	76.22	25.03	1.44	4.42	Super	1.58	6.00			1.58	1785.00	1786.90	3.19	5.09	3.19	Met
3266.88	8922.776	1085	1776.52	1781.15	1782.02	1784.23	0.004854	14.06	77.14	23.8	1.38	4.63	Super	1.59	6.22			1.59	1784.90	1785.10	3.75	3.95	3.75	Met
3316.08	8873.57	1085	1776.26	1780.87	1781.76	1783.99	0.004949	14.17	76.6	23.73	1.39	4.61	Super	1.59	6.20			1.59	1784.80	1785.00	3.93	4.13	3.93	Met
3365.28	8824.36	1085	1775.99	1780.57	1781.49	1783.75	0.005083	14.3	75.86	23.64	1.41	4.58	Super	1.59	6.17			1.59	1784.50	1785.00	3.93	4.43	3.93	Met
3414.48	8775.16	1085	1775.73	1780.3	1781.23	1783.5	0.005127	14.35	75.61	23.6	1.41	4.57	Super	1.60	6.17			1.60	1784.10	1785.80	3.80	5.50	3.80	Met
3463.68	8725.96	1085	1775.47	1780.03	1780.97	1783.25	0.005161	14.38	75.43	23.58	1.42	4.56	Super	1.60	6.16			1.60	1783.90	1785.70	3.87	5.67	3.87	Met
3512.88	8676.75	1085	1775.2	1779.75	1780.7	1782.99	0.005234	14.46	75.05	23.53	1.43	4.55	Super	1.60	6.15			1.60	1783.63	1785.43	3.88	5.68	3.88	Met
3562.08	8627.55	1085	1774.94	1779.49	1780.44	1782.73	0.005214	14.44	75.15	23.54	1.42	4.55	Super	1.60	6.15			1.60	1783.37	1785.17	3.88	5.68	3.88	Met
3611.28	8578.35	1085	1774.68	1779.23	1780.18	1782.46	0.005201	14.42	75.22	23.55	1.42	4.55	Super	1.60	6.15			1.60	1783.10	1784.90	3.87	5.67	3.87	Met
3660.48	8529.14	1085	1774.42	1778.98	1779.92	1782.2	0.005184	14.41	75.31	23.56	1.42	4.56	Super	1.60	6.16			1.60	1782.84	1784.64	3.86	5.66	3.86	Met
3709.68	8479.94	1085	1774.15	1778.69	1779.65	1781.95	0.005251	14.47	74.96	23.52	1.43	4.54	Super	1.60	6.14			1.60	1782.57	1784.37	3.88	5.68	3.88	Met
3758.89	8430.738	1085	1773.89	1778.44	1779.39	1781.68	0.005232	14.46	75.06	23.53	1.43	4.55	Super	1.60	6.15			1.60	1782.31	1784.11	3.87	5.67	3.87	Met
3808.73	8380.9	1085	1773.64	1778.2	1779.14	1781.42	0.005188	14.41	75.29	23.56	1.42	4.56	Super	1.60	6.16			1.60	1782.04	1783.84	3.84	5.64	3.84	Met
3858.57	8331.07	1085	1773.38	1777.94	1778.88	1781.16	0.005187	14.41	75.3	23.56	1.42	4.56	Super	1.60	6.16			1.60	1781.77	1783.57	3.83	5.63	3.83	Met
3908.41	8281.24	1085	1773.13	1777.69	1778.63	1780.91	0.005187	14.41	75.3	23.56	1.42	4.56	Super	1.60	6.16			1.60	1781.50	1783.30	3.81	5.61	3.81	Met
3958.25	8231.4	1085	1772.88	1777.44	1778.38	1780.66	0.005187	14.41	75.3	23.56	1.42	4.56	Super	1.60	6.16			1.60	1781.23	1783.03	3.79	5.59	3.79	Met
4008.09	8181.57	1085	1772.63	1777.19	1778.13	1780.41	0.005187	14.41	75.3	23.56	1.42	4.56	Super	1.60	6.16			1.60	1780.96	1782.76	3.77	5.57	3.77	Met
4057.93	8131.743	1085	1772.37	1776.93	1777.87	1780.15	0.005187	14.41	75.3	23.56	1.42	4.56	Super	1.60	6.16			1.60	1780.69	1782.49	3.76	5.56	3.76	Met
4086.45	8103.225	1085	1772.49	1774.9	1776.37	1779.92	0.01287	17.98	60.35	25.14	2.05	2.41	Super	1.60	4.01			1.60	1779.50	1779.50	4.60	4.60	4.60	Met
4086.95	8070	Honolulu Street Bridge																						
4148.45	8041.023	1085	1772.37	1775.16	1776.24	1778.92	0.008229	15.57	69.71	25	1.64	2.79	Super	1.55	4.34			1.55	1779.40	1779.40	4.24	4.24	4.24	Met
4178.57	8010.899	1136	1772.26	1775.6	1776.37	1778.7	0.005754	14.13	80.4	25	1.39	3.34	Super	1.53	4.87			1.53	1779.79	1779.79	4.19	4.19	4.19	Met
4228.22	7961.26	1136	1772.1	1775.58	1776.21	1778.43	0.005078	13.56	83.76	25	1.31	3.48	Super	1.51	4.99			1.51	1779.57	1779.57	3.99	3.99	3.99	Met
4277.87	7911.62	1136	1771.94	1775.55	1776.05	1778.19	0.004522	13.05	87.02	25	1.23	3.61	Super	1.50	5.11			1.50	1779.62	1779.62	4.07	4.07	4.07	Met
4327.52	7861.98	1136	1771.78	1775.51	1775.9	1777.98	0.004067	12.61	90.11	25	1.17	3.73	Super	1.49	5.22			1.49	1779.46	1779.46	3.95	3.95	3.95	Met
4377.17	7812.34	1136	1771.62	1775.46	1775.74	1777.78	0.003704	12.22	92.93	25	1.12	3.84	Super	1.48	5.32			1.48	1779.29	1779.29	3.83	3.83	3.83	Met
4426.82	7762.7	1136	1771.46	1775.36	1775.58	1777.61	0.003534	12.04	94.39	25	1.09	3.9	Super	1.47	5.37			1.47	1779.13	1779.13	3.77	3.77	3.77	Met
4476.47	7713.06	1136	1771.3	1775.23	1775.42	1777.44	0.00345	11.94	95.14	25	1.08	3.93	Super	1.47	5.40			1.47	1778.97	1778.97	3.74	3.74	3.74	Met
4526.12	7663.42	1136	1771.14	1775.16	1775.26	1777.27	0.00321	11.66	97.45	25	1.04	4.02	Super	1.46	5.48			1.46	1778.81	1778.81	3.65	3.65	3.65	Met
4575.77	7613.79	1136	1770.98	1775	1775.1	1777.11	0.00321	11.66	97.45	25	1.04	4.02	Super	1.46	5.48			1.46	1778.64	1778.64	3.64	3.64	3.64	Met
4625.42	7564.15	1136	1770.81	1774.8	1774.93	1776.95	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1778.48	1778.48	3.68	3.68	3.68	Met
4675.07	7514.51	1136	1770.65	1774.64	1774.77	1776.79	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1778.32	1778.32	3.68	3.68	3.68	Met
4724.72	7464.87	1136	1770.49	1774.48	1774.61	1776.63	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1778.16	1778.16	3.68	3.68	3.68	Met
4774.37	7415.23	1136	1770.33	1774.32	1774.45	1776.47	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.99	1777.99	3.67	3.67	3.67	Met
4824.02	7365.59	1136	1770.17	1774.16	1774.29	1776.31	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.83	1777.83	3.67	3.67	3.67	Met
4873.67	7315.95	1136	1770.01	1774	1774.13	1776.15	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.67	1777.67	3.67	3.67	3.67	Met
4923.32	7266.31	1136	1769.85	1773.84	1773.97	1775.99	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.51	1777.51	3.67	3.67	3.67	Met
4972.97	7216.68	1136	1769.69	1773.68	1773.81	1775.83	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.35	1777.35	3.66	3.66	3.66	Met
5022.62	7167.04	1136	1769.53	1773.52	1773.65	1775.67	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.18	1777.18	3.66	3.66	3.66	Met
5072.27	7117.403	1136	1769.37	1773.36	1773.49	1775.51	0.003287	11.75	96.68	25	1.05	3.99	Super	1.47	5.46			1.47	1777.02	1777.02	3.66	3.66	3.66	Met
5121.5	7068.177	1136	1769.21	1774.29	1772.34	1774.89	0.000627	6.21	182.93	36	0.49	5.08	Sub	1.10	6.18			1.10	1776.27	1776.27	1.98	1.98	1.98	Met
5122	7030	Sandhill Road Bridge																						
5201	6988.652	1172	1769.12	1773.56	1772.32	1774.4	0.001012	7.35	159.43	35.97	0.62	4.44	Sub	1.34	5.78			1.34	1774.74	1774.79	1.18	1.23	1.18	>1
5252.99	6936.664	1172	1769.12	1773.24	1772.52	1774.31	0.001462	8.31	141.09	36	0.74	4.12	Sub	1.57	5.69			1.57	1775.59	1776.13	2.35	2.89	2.35	Met
5301.7	6887.95	1172	1769.06	1773.17	1772.43	1774.24	0.001449	8.28	141.57	36	0.74	4.11	Sub	1.56	5.67			1.56	1775.53	1776.03	2.36	2.86	2.36	Met
5350.41	6839.24	1172	1768.96	1773.12	1772.33	1774.16	0.001394	8.18	143.33	36	0.72	4.16	Sub	1.54	5.70			1.54	1775.43	1775.93	2.31	2.81	2.31	Met
5399.12	6790.53	1172	1768.86	1773.07	1772.23	1774.09	0.001339	8.07	145.21	36	0.71	4.21	Sub	1.51	5.72			1.51	1775.34	1775.84	2.27	2.77	2.27	Met
5447.83	6741.82	1172	1768.76	1773.03	1772.13	1774.01	0.001285	7.96	147.19	36	0.69	4.27	Sub	1.48	5.75			1.48	1775.24	1775.74	2.21	2.71	2.21	Met
5496.54	6693.11	1172	1768.66	1772.99	1772.03	1773.94	0.00123	7.85	149.27	36	0.68	4.33	Sub	1.46	5.79			1.46	1775.14	1775.64	2.15	2.65	2.15	Met
5545.25	6644.4	1172	1768.56	1772.95	1771.93	1773.88	0.001177	7.74	151.44	36	0.66	4.39	Sub	1.43	5.82			1.43	1775.05	1775.55	2.10	2.60	2.10	Met
5593.96	6595.69	1172	1768.46	1772.91	1771.83	1773.81	0.001124	7.62	153.71	36	0.65	4.45	Sub	1.40	5.85			1.40	1774.95	1775.45	2.04	2.54	2.04	Met
5642.67	6546.98	1172	1768.36	1772.88	1771.73	1773.75	0.001073	7.51	156.07	36	0.64	4.52	Sub	1.38	5.90			1.38	1774.85	1775.35	1.97	2.47	1.97	Met
5691.38	6498.27	1172	1768.26	1772.84	1771.63	1773.69	0.001023	7.39	158.51	36	0.62	4.58	Sub	1.35	5.93			1.35	1774.77	1774.96	1.93	2.12	1.93	Met
5740.09	6449.56	1172	1768.16	1772.81	1771.53	1773.64	0.000975	7.28	161.02	36	0.61	4.65	Sub	1.32	5.97			1.32	1774.67	1774.86	1.86	2.05	1.86	Met

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL
Freeboard Calculation

River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Top of Wall (ft)		Available Freeboard (ft)		Minimum Available FB	Criteria
30% Design Plans	HEC-RAS Model	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)	(ft)	Supercritical flow(ft)	SubCritical flow (ft)	(Depth+Calc FB+super evev)	Left	Right	Left	Right	(ft)	
5788.8	6400.85	1172	1768.06	1772.78	1771.43	1773.58	0.000928	7.16	163.59	36	0.59	4.72	Sub	1.30	6.02			1.30	1774.58	1774.77	1.80	1.99	1.80	Met
5837.51	6352.14	1172	1767.96	1772.76	1771.33	1773.53	0.000884	7.05	166.24	36	0.58	4.8	Sub	1.27	6.07			1.27	1774.48	1774.67	1.72	1.91	1.72	Met
5886.22	6303.43	1172	1767.86	1772.73	1771.23	1773.48	0.000841	6.94	168.95	36	0.56	4.87	Sub	1.25	6.12			1.25	1774.38	1774.57	1.65	1.84	1.65	Met
5934.93	6254.72	1172	1767.76	1772.71	1771.13	1773.43	0.000801	6.83	171.71	36	0.55	4.95	Sub	1.22	6.17			1.22	1774.28	1774.47	1.57	1.76	1.57	Met
5983.64	6206.01	1172	1767.66	1772.69	1771.03	1773.39	0.000762	6.72	174.52	36	0.54	5.03	Sub	1.20	6.23			1.20	1774.19	1774.38	1.50	1.69	1.50	Met
6032.35	6157.3	1172	1767.56	1772.67	1770.93	1773.35	0.000725	6.61	177.38	36	0.52	5.11	Sub	1.18	6.29			1.18	1774.20	1773.95	1.53	1.28	1.28	Met
6081.06	6108.59	1172	1767.46	1772.65	1770.84	1773.3	0.00069	6.5	180.29	36	0.51	5.19	Sub	1.16	6.35			1.16	1774.11	1773.86	1.46	1.21	1.21	Met
6129.77	6059.88	1196	1767.36	1771.88	1771.2	1773.19	0.001688	9.19	130.08	30	0.78	4.52	Sub	1.81	6.33			1.81	1774.02	1773.77	2.14	1.89	1.89	Met
6179.53	6010.11	1196	1767.26	1771.8	1771.1	1773.1	0.001659	9.14	130.83	30	0.77	4.54	Sub	1.80	6.34			1.80	1773.92	1773.67	2.12	1.87	1.87	Met
6229.29	5960.34	1196	1767.16	1771.73	1771	1773.01	0.001629	9.09	131.64	30	0.76	4.57	Sub	1.78	6.35			1.78	1774.50	1773.70	2.77	1.97	1.97	Met
6279.05	5910.58	1196	1767.06	1771.66	1770.9	1772.92	0.001597	9.03	132.51	30	0.76	4.6	Sub	1.77	6.37			1.77	1774.45	1773.65	2.79	1.99	1.99	Met
6328.81	5860.81	1196	1766.96	1771.59	1770.8	1772.84	0.001558	8.95	133.58	30	0.75	4.63	Sub	1.74	6.37			1.74	1774.30	1773.40	2.71	1.81	1.81	Met
6378.57	5811.04	1196	1766.86	1771.53	1770.7	1772.75	0.001519	8.88	134.72	30	0.74	4.67	Sub	1.72	6.39			1.72	1774.15	1773.25	2.62	1.72	1.72	>1
6428.33	5761.28	1196	1766.76	1771.47	1770.6	1772.67	0.001478	8.8	135.94	30	0.73	4.71	Sub	1.70	6.41			1.70	1774.00	1773.25	2.53	1.78	1.78	Met
6478.09	5711.51	1196	1766.66	1771.42	1770.5	1772.59	0.001436	8.71	137.24	30	0.72	4.76	Sub	1.68	6.44	0.15	0.50	2.18	1774.01	1774.01	2.59	2.59	2.59	Met
6527.85	5661.75	1196	1766.56	1771.36	1770.4	1772.52	0.001394	8.63	138.61	30	0.71	4.8	Sub	1.66	6.46	0.14	0.50	2.16	1773.91	1773.91	2.55	2.55	2.55	Met
6577.61	5611.98	1196	1766.46	1771.31	1770.3	1772.44	0.001351	8.54	140.06	30	0.7	4.85	Sub	1.63	6.48	0.14	0.50	2.13	1773.81	1773.81	2.50	2.50	2.50	Met
6627.37	5562.21	1196	1766.36	1771.26	1770.2	1772.37	0.001307	8.45	141.58	30	0.69	4.9	Sub	1.61	6.51	0.14	0.50	2.11	1773.71	1773.71	2.45	2.45	2.45	Met
6677.13	5512.45	1196	1766.26	1771.21	1770.1	1772.3	0.001264	8.35	143.18	30	0.67	4.95	Sub	1.58	6.53	0.14	0.50	2.08	1773.61	1773.61	2.40	2.40	2.40	Met
6726.89	5462.68	1196	1766.16	1771.17	1770	1772.23	0.001221	8.26	144.84	30	0.66	5.01	Sub	1.56	6.57	0.13	0.50	2.06	1773.51	1773.51	2.34	2.34	2.34	Met
6776.65	5412.91	1196	1766.06	1771.13	1769.9	1772.16	0.001178	8.16	146.57	30	0.65	5.07	Sub	1.53	6.60	0.13	0.50	2.03	1773.41	1773.41	2.28	2.28	2.28	Met
6826.41	5363.15	1196	1765.96	1771.09	1769.8	1772.1	0.001136	8.06	148.37	30	0.64	5.13	Sub	1.51	6.64	0.13	0.50	2.01	1773.31	1773.31	2.22	2.22	2.22	Met
6876.17	5313.38	1196	1765.86	1771.05	1769.7	1772.03	0.001094	7.96	150.23	30	0.63	5.19	Sub	1.48	6.67	0.12	0.50	1.98	1773.21	1773.21	2.16	2.16	2.16	Met
6925.93	5263.62	1196	1765.76	1771.01	1769.59	1771.97	0.001049	7.85	152.35	30	0.61	5.25	Sub	1.46	6.71	0.12	0.50	1.96	1773.11	1773.11	2.10	2.10	2.10	Met
6975.69	5213.85	1196	1765.65	1770.98	1769.49	1771.91	0.001005	7.74	154.53	30	0.6	5.33	Sub	1.43	6.76	0.12	0.50	1.93	1773.01	1773.01	2.03	2.03	2.03	Met
7025.45	5164.08	1196	1765.55	1770.95	1769.39	1771.86	0.000967	7.64	156.56	30	0.59	5.4	Sub	1.41	6.81	0.11	0.50	1.91	1772.92	1772.92	1.97	1.97	1.97	Met
7075.21	5114.32	1196	1765.45	1770.92	1769.28	1771.8	0.00093	7.54	158.64	30	0.58	5.47	Sub	1.38	6.85	0.11	0.50	1.88	1772.82	1772.82	1.90	1.90	1.90	Met
7124.97	5064.55	1196	1765.35	1770.89	1769.19	1771.75	0.000893	7.44	160.77	30	0.57	5.54	Sub	1.36	6.90	0.11	0.50	1.86	1772.72	1772.72	1.83	1.83	1.83	>1
7174.73	5014.78	1196	1765.25	1770.86	1769.09	1771.7	0.000858	7.34	162.94	30	0.56	5.61	Sub	1.34	6.95	0.10	0.50	1.84	1772.62	1772.62	1.76	1.76	1.76	>1
7224.49	4965.02	1196	1765.15	1770.84	1768.99	1771.65	0.000825	7.24	165.15	30	0.54	5.69	Sub	1.31	7.00	0.10	0.50	1.81	1772.52	1772.52	1.68	1.68	1.68	>1
7274.25	4915.25	1196	1765.05	1770.81	1768.89	1771.6	0.000792	7.14	167.4	30	0.53	5.76	Sub	1.29	7.05	0.10	0.50	1.79	1772.42	1772.42	1.61	1.61	1.61	>1
7324.01	4865.49	1196	1764.95	1770.79	1768.78	1771.56	0.000761	7.05	169.69	30	0.52	5.84	Sub	1.27	7.11	0.10	0.50	1.77	1772.32	1772.32	1.53	1.53	1.53	>1
7373.77	4815.72	1196	1764.85	1770.76	1768.69	1771.51	0.000731	6.95	172.01	30	0.51	5.91	Sub	1.25	7.16	0.09	0.50	1.75	1772.22	1772.22	1.46	1.46	1.46	>1
7423.53	4765.95	1196	1764.75	1770.74	1768.59	1771.47	0.000702	6.86	174.37	30	0.5	5.99	Sub	1.23	7.22	0.09	0.50	1.73	1772.12	1772.12	1.38	1.38	1.38	>1
7473.29	4716.19	1196	1764.65	1770.72	1768.49	1771.43	0.000674	6.77	176.75	30	0.49	6.07	Sub	1.21	7.28	0.09	0.50	1.71	1772.02	1772.02	1.30	1.30	1.30	>1
7523.05	4666.42	1196	1764.55	1770.7	1768.39	1771.39	0.000648	6.68	179.16	30	0.48	6.15	Sub	1.19	7.34	0.09	0.50	1.69	1771.92	1771.92	1.22	1.22	1.22	>1
7572.81	4616.65	1196	1764.45	1770.68	1768.29	1771.36	0.000623	6.59	181.6	30	0.47	6.23	Sub	1.17	7.40	0.08	0.50	1.67	1771.82	1771.82	1.14	1.14	1.14	>1
7622.57	4566.89	1196	1764.35	1770.67	1768.19	1771.32	0.000598	6.5	184.07	30	0.46	6.32	Sub	1.16	7.48	0.08	0.50	1.66	1771.80	1771.80	1.13	1.13	1.13	>1
7672.33	4517.12	1196	1764.25	1770.65	1768.09	1771.29	0.000575	6.41	186.55	30	0.45	6.4	Sub	1.14	7.54	0.08	0.50	1.64	1771.80	1771.80	1.15	1.15	1.15	>1
7722.09	4467.36	1196	1764.15	1770.16	1768.46	1771.21	0.001075	8.2	145.8	25	0.6	6.01	Sub	1.54	7.55			1.54	1771.52	1771.52	1.36	1.36	1.36	>1
7763.77	4425.682	1196	1764.11	1770.17	1768.24	1771.14	0.000972	7.89	151.61	25	0.56	6.06	Sub	1.47	7.53			1.47	1771.60	1771.60	1.43	1.43	1.43	>1
7764.27	Lamb Blvd Bridge																							
7866.27	4322.957	1266	1763.9	1769.12	1768.19	1770.58	0.001687	9.7	130.48	25	0.75	5.22	Sub	1.96	7.18			1.96	1771.48	1771.48	2.36	2.36	2.36	Met
7895.94	4293.287	1266	1763.81	1768.28	1768.28	1770.44	0.002984	11.81	107.17	25	1.01	4.47	Super	1.49	5.96			1.49	1770.10	1770.85	1.82	2.57	1.82	Met
7944.48	4244.75	1266	1763.62	1767.87	1768.09	1770.27	0.003479	12.43	101.82	25	1.09	4.25	Super	1.50	5.75			1.50	1769.90	1770.65	2.03	2.78	2.03	Met
7993.02	4196.21	1266	1763.43	1766.42	1767.41	1769.93	0.00723	15.04	84.16	30	1.58	2.99	Super	1.54	4.53			1.54	1769.71	1770.46	3.29	4.04	3.29	Met
8041.56	4147.67	1266	1763.23	1766.4	1767.21	1769.49	0.005918	14.11	89.75	30	1.44	3.17	Super	1.52	4.69			1.52	1769.52	1770.27	3.12	3.87	3.12	Met
8090.1	4099.14	1266	1763.04	1766.41	1767.02	1769.13	0.004842	13.22	95.74	30	1.3	3.37	Super	1.50	4.87			1.50	1769.32	1770.07	2.91	3.66	2.91	Met
8187.18	4002.07	1266	1762.66	1765.83	1766.51	1768.63	0.00523	13.41	94.37	31	1.35	3.17	Super	1.49	4.66			1.49	1768.93	1769.68	3.10	3.85	3.10	Met
8235.72	3953.53	1266	1762.47	1765.72	1766.32	1768.38	0.004855	13.1	96.66	31	1.31	3.25	Super	1.49	4.74			1.49	1768.74	1769.49	3.02	3.77	3.02	Met
8284.26	3904.99	1266	1762.28	1765.58	1766.13	1768.16	0.004609	12.88	98.29	31	1.27	3.3	Super	1.48	4.78			1.48	1768.55	1769.30	2.97	3.72	2.97	Met
8332.8	3856.46	1266	1762.09	1765.44	1765.94	1767.94	0.004416	12.7	99.65	31	1.25	3.35	Super	1.48	4.83			1.48	1768.35	1769.10	2.91	3.66	2.91	Met
8381.34	3807.92	1266	1761.9	1765.28	1765.75	1767.73	0.004269	12.57	100.75	31	1.23	3.38	Super	1.47	4.85			1.47	1768.16	1768.91	2.88	3.63	2.88	Met
8429.88	3759.38	1266	1761.71	1765.12	1765.56	1767.53	0.004166	12.47	101.55	31	1.21	3.41	Super	1.47	4.88			1.47	1767.96	1768.71	2.84	3.59	2.84	Met

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL
Freeboard Calculation

River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Top of Wall (ft)		Available Freeboard (ft)		Minimum Available FB	Criteria
30% Design Plans	HEC-RAS Model	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)	(ft)	Supercritical flow(ft)	SubCritical flow (ft)	(Depth+Calc FB+super evev)	Left	Right	Left	Right	(ft)	
8478.42	3710.85	1266	1761.52	1764.94	1765.37	1767.33	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1767.77	1768.52	2.83	3.58	2.83	Met
8526.96	3662.31	1266	1761.33	1764.75	1765.18	1767.14	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1767.57	1768.32	2.82	3.57	2.82	Met
8575.5	3613.78	1266	1761.14	1764.56	1764.99	1766.95	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1767.38	1768.13	2.82	3.57	2.82	Met
8624.04	3565.24	1266	1760.95	1764.37	1764.8	1766.76	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1767.19	1767.94	2.82	3.57	2.82	Met
8672.58	3516.7	1266	1760.76	1764.18	1764.61	1766.57	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1766.99	1767.74	2.81	3.56	2.81	Met
8721.12	3468.17	1266	1760.57	1763.99	1764.42	1766.38	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1766.80	1767.55	2.81	3.56	2.81	Met
8769.66	3419.63	1266	1760.38	1763.8	1764.23	1766.19	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1766.60	1767.35	2.80	3.55	2.80	Met
8818.2	3371.1	1266	1760.19	1763.61	1764.04	1766	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1766.41	1767.16	2.80	3.55	2.80	Met
8866.74	3322.56	1266	1760	1763.42	1763.85	1765.81	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1766.22	1766.97	2.80	3.55	2.80	Met
8915.28	3274.02	1266	1759.81	1763.23	1763.65	1765.62	0.004093	12.4	102.13	31	1.2	3.42	Super	1.47	4.89			1.47	1766.02	1766.77	2.79	3.54	2.79	Met
8963.82	3225.49	1266	1759.62	1763.04	1763.47	1765.43	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1765.83	1766.58	2.79	3.54	2.79	Met
9012.36	3176.95	1266	1759.43	1762.85	1763.27	1765.24	0.004093	12.4	102.13	31	1.2	3.42	Super	1.47	4.89			1.47	1765.63	1766.38	2.78	3.53	2.78	Met
9060.9	3128.41	1266	1759.24	1762.66	1763.09	1765.05	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1765.44	1766.19	2.78	3.53	2.78	Met
9109.44	3079.883	1266	1759.05	1762.47	1762.9	1764.86	0.004094	12.4	102.12	31	1.2	3.42	Super	1.47	4.89			1.47	1765.27	1766.09	2.80	3.62	2.80	Met
9139.99	3049.332	1266	1758.84	1761.85	1762.56	1764.71	0.005493	13.59	93.18	31	1.38	3.01	Super	1.49	4.50			1.49	1765.38	1765.38	3.53	3.53	3.53	Met
9140.49	3020	Page Street Bridge																						
9202.99	2985.898	1266	1758.68	1761.92	1762.4	1764.39	0.004332	12.59	100.57	31	1.23	3.24	Super	1.47	4.71			1.47	1765.14	1765.14	3.22	3.22	3.22	Met
9232.62	2956.266	1314	1758.49	1762.36	1762.44	1764.36	0.002993	11.35	115.8	31	1.03	3.87	Super	1.45	5.32			1.45	1765.32	1766.82	2.96	4.46	2.96	Met
9281.57	2907.31	1314	1758.31	1762.03	1762.26	1764.2	0.003395	11.82	111.15	31	1.1	3.72	Super	1.46	5.18			1.46	1765.21	1766.71	3.18	4.68	3.18	Met
9330.52	2858.36	1314	1758.13	1761.81	1762.07	1764.02	0.003488	11.93	110.17	31	1.11	3.68	Super	1.46	5.14			1.46	1765.03	1766.53	3.22	4.72	3.22	Met
9379.47	2809.42	1314	1757.95	1761.59	1761.89	1763.86	0.003636	12.09	108.7	31	1.14	3.64	Super	1.46	5.10			1.46	1764.85	1766.35	3.26	4.76	3.26	Met
9428.42	2760.47	1314	1757.78	1761.42	1761.72	1763.69	0.003636	12.09	108.7	31	1.14	3.64	Super	1.46	5.10			1.46	1764.67	1766.17	3.25	4.75	3.25	Met
9477.37	2711.52	1314	1757.6	1761.24	1761.54	1763.51	0.00363	12.08	108.76	31	1.14	3.64	Super	1.46	5.10			1.46	1764.49	1765.99	3.25	4.75	3.25	Met
9526.32	2662.57	1314	1757.43	1761.07	1761.37	1763.34	0.003629	12.08	108.76	31	1.14	3.64	Super	1.46	5.10			1.46	1764.31	1765.81	3.24	4.74	3.24	Met
9575.27	2613.62	1314	1757.26	1760.9	1761.2	1763.17	0.00363	12.08	108.76	31	1.14	3.64	Super	1.46	5.10			1.46	1764.13	1765.63	3.23	4.73	3.23	Met
9624.22	2564.67	1314	1757.08	1760.72	1761.02	1762.98	0.003622	12.07	108.84	31	1.14	3.64	Super	1.46	5.10			1.46	1764.10	1765.45	3.38	4.73	3.38	Met
9673.17	2515.72	1314	1756.91	1760.55	1760.85	1762.81	0.003622	12.07	108.84	31	1.14	3.64	Super	1.46	5.10			1.46	1764.07	1765.27	3.52	4.72	3.52	Met
9722.12	2466.78	1314	1756.74	1760.38	1760.68	1762.64	0.003622	12.07	108.84	31	1.14	3.64	Super	1.46	5.10			1.46	1764.04	1765.09	3.66	4.71	3.66	Met
9771.07	2417.83	1314	1756.57	1760.21	1760.51	1762.47	0.003622	12.07	108.84	31	1.14	3.64	Super	1.46	5.10			1.46	1764.02	1764.92	3.81	4.71	3.81	Met
9820.02	2368.88	1314	1756.4	1760.04	1760.34	1762.3	0.003622	12.07	108.84	31	1.14	3.64	Super	1.46	5.10			1.46	1763.99	1764.74	3.95	4.70	3.95	Met
9868.97	2319.93	1314	1756.22	1759.86	1760.16	1762.12	0.003613	12.06	108.92	31	1.13	3.64	Super	1.46	5.10			1.46	1763.81	1764.56	3.95	4.70	3.95	Met
9917.92	2270.98	1314	1756.05	1759.69	1759.99	1761.95	0.003613	12.06	108.92	31	1.13	3.64	Super	1.46	5.10			1.46	1763.63	1764.38	3.94	4.69	3.94	Met
9966.87	2222.04	1314	1755.88	1759.52	1759.82	1761.78	0.003613	12.06	108.92	31	1.13	3.64	Super	1.46	5.10			1.46	1763.45	1764.20	3.93	4.68	3.93	Met
10015.91	2172.99	1314	1755.71	1759.35	1759.65	1761.61	0.003613	12.06	108.92	31	1.13	3.64	Super	1.46	5.10			1.46	1763.27	1764.02	3.92	4.67	3.92	Met
10064.95	2123.94	1314	1755.53	1759.18	1759.48	1761.45	0.003633	12.09	108.7	31	1.14	3.65	Super	1.47	5.12			1.47	1763.09	1763.84	3.91	4.66	3.91	Met
10113.88	2075.01	1314	1755.34	1758.95	1759.29	1761.27	0.003765	12.23	107.46	31	1.16	3.61	Super	1.47	5.08			1.47	1762.91	1763.66	3.96	4.71	3.96	Met
10162.81	2026.09	1314	1755.15	1758.77	1759.1	1761.08	0.003735	12.2	107.74	31	1.15	3.62	Super	1.47	5.09			1.47	1762.73	1763.48	3.96	4.71	3.96	Met
10211.74	1977.17	1314	1754.96	1758.58	1758.91	1760.88	0.003713	12.17	107.94	31	1.15	3.62	Super	1.47	5.09			1.47	1762.55	1763.30	3.97	4.72	3.97	Met
10260.67	1928.25	1314	1754.78	1758.4	1758.72	1760.7	0.003698	12.16	108.1	31	1.15	3.62	Super	1.47	5.09			1.47	1762.37	1763.12	3.97	4.72	3.97	Met
10309.6	1879.32	1314	1754.59	1758.16	1758.53	1760.52	0.003864	12.33	106.58	31	1.17	3.57	Super	1.47	5.04			1.47	1762.19	1762.94	4.03	4.78	4.03	Met
10358.53	1830.4	1314	1754.4	1757.97	1758.34	1760.33	0.003846	12.31	106.74	31	1.17	3.57	Super	1.47	5.04			1.47	1762.01	1762.76	4.04	4.79	4.04	Met
10407.46	1781.48	1314	1754.21	1757.79	1758.15	1760.14	0.003841	12.31	106.78	31	1.17	3.58	Super	1.47	5.05			1.47	1761.95	1762.70	4.16	4.91	4.16	Met
10456.39	1732.559	1314	1754.02	1757.6	1757.96	1759.95	0.003835	12.3	106.84	31	1.17	3.58	Super	1.47	5.05			1.47	1761.77	1762.52	4.17	4.92	4.17	Met
10485.69	1703.273	1314	1753.99	1757.34	1757.8	1759.83	0.004235	12.66	103.77	31	1.22	3.35	Super	1.47	4.82			1.47	1760.63	1760.63	3.29	3.29	3.29	Met
10486.19	1660	Marion Drive Bridge																						
10568.19	1620.75	1314	1753.66	1758.24	1757.47	1759.57	0.001626	9.26	141.83	31	3.22	4.58	Super	1.4	6.0			1.4	1760.1	1760.1	1.9	1.9	1.9	Met
10598.51	1590.431	1364	1753.57	1757.63	1757.63	1759.6	0.002814	11.27	120.99	31	1.01	4.06	Super	1.4	5.5			1.4	1761.5	1761.5	3.9	3.9	3.9	Met
10641.01	1532.01	1364	1753.44	1757.39	1757.5	1759.48	0.003077	11.61	117.51	31	1.05	3.95	Super	1.5	5.4			1.5	1762.6	1762.6	5.2	5.2	5.2	Met
10683.51	1473.59	1364	1753.31	1757.53	1757.37	1759.35	0.002484	10.82	126.03	31	0.95	4.22	Sub	2.3	6.5			2.3	1762.7	1762.7	5.2	5.2	5.2	Met
10726.01	1415.17	1364	1753.19	1757.5	1757.24	1759.24	0.002313	10.57	129.03	31	0.91	4.31	Sub	2.2	6.5			2.2	1762.7	1762.7	5.2	5.2	5.2	Met
10768.51	1356.76	1364	1753.06	1757.5	1757.12	1759.13	0.002105	10.25	133.07	31	0.87	4.44	Sub	2.1	6.6			2.1	1762.8	1762.8	5.3	5.3	5.3	Met
10973.51	1151.76	2885	1745.97	1756	1754.19	1758.71	0.001955	13.22	218.27	22	0.74	10.03	Sub	3.2	13.2			3.2	1762.9	1762.9	6.9	6.9	6.9	Met
11019.36	1105.9	2885	1745.88	1755.9	1754.1	1758.62	0.001958	13.23	218.11	22	0.74	10.02	Sub	3.2	13.2			3.2	1763.2	1763.2	7.3	7.3	7.3	Met
11065.21	1060.04	2885	1745.79	1755.81	1754.01	1758.53	0.001958	13.23	218.11	22	0.74	10.02	Sub	3.2	13.2			3.2	1763.1	1763.1	7.3	7.3	7.3	Met

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

Freeboard Calculation

River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Top of Wall (ft)		Available Freeboard (ft)		Minimum Available FB	Criteria
30% Design Plans	HEC-RAS Model	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)	(ft)	Supercritical flow(ft)	SubCritical flow (ft)	(Depth+Calc FB+super evev)	Left	Right	Left	Right	(ft)	
11111.06	1014.18	2885	1745.71	1755.72	1753.93	1758.44	0.001967	13.25	217.76	22	0.74	10.01	Sub	3.2	13.2			3.2	1762.8	1762.8	7.1	7.1	7.1	Met
11156.91	968.328	2885	1745.62	1755.63	1753.84	1758.35	0.001967	13.25	217.76	22	0.74	10.01	Sub	3.2	13.2			3.2	1762.6	1762.6	7.0	7.0	7.0	Met
11202.76	922.47	2885	1745.53	1755.54	1753.76	1758.27	0.001971	13.26	217.58	22	0.74	10.01	Sub	3.2	13.2			3.2	1762.5	1762.5	6.9	6.9	6.9	Met
11248.61	876.612	2885	1745.44	1755.44	1753.67	1758.18	0.001975	13.27	217.39	22	0.74	10	Sub	3.2	13.2			3.2	1762.3	1762.3	6.8	6.8	6.8	Met
11294.46	830.754	2885	1745.35	1755.35	1753.58	1758.09	0.001975	13.27	217.37	22	0.74	10	Sub	3.2	13.2			3.2	1762.1	1762.1	6.8	6.8	6.8	Met
11340.31	784.896	2885	1745.27	1755.25	1753.5	1758	0.001984	13.3	216.99	22	0.75	9.98	Sub	3.2	13.2			3.2	1761.9	1761.9	6.7	6.7	6.7	Met
11386.16	739.038	2885	1745.18	1755.16	1753.41	1757.91	0.001985	13.3	216.95	22	0.75	9.98	Sub	3.2	13.2			3.2	1761.7	1761.7	6.6	6.6	6.6	Met
11432.01	693.18	2885	1745.09	1755.07	1753.32	1757.82	0.00199	13.31	216.75	22	0.75	9.98	Sub	3.3	13.2			3.3	1761.6	1761.6	6.5	6.5	6.5	Met
11481.57	643.624	2885	1744.99	1755.05	1753.08	1757.69	0.001896	13.04	221.31	22	0.72	10.06	Sub	3.1	13.2			3.1	1761.4	1761.4	6.3	6.3	6.3	Met
11531.13	594.067	2916	1744.89	1754.8	1753.06	1757.58	0.002018	13.38	217.96	22	0.75	9.91	Sub	3.3	13.2			3.3	1761.2	1761.2	6.4	6.4	6.4	Met
11580.69	544.512	2916	1744.78	1754.7	1752.95	1757.47	0.002011	13.36	218.25	22	0.75	9.92	Sub	3.3	13.2			3.3	1761.0	1761.0	6.3	6.3	6.3	Met
11630.25	494.955	2916	1744.68	1754.6	1752.85	1757.37	0.002011	13.36	218.25	22	0.75	9.92	Sub	3.3	13.2			3.3	1760.9	1760.9	6.3	6.3	6.3	Met
11679.81	445.399	2916	1744.58	1754.5	1752.75	1757.27	0.002011	13.36	218.27	22	0.75	9.92	Sub	3.3	13.2			3.3	1760.8	1760.8	6.3	6.3	6.3	Met
11729.37	395.843	2916	1744.47	1754.41	1752.64	1757.17	0.002003	13.34	218.56	22	0.75	9.94	Sub	3.3	13.2			3.3	1760.7	1760.7	6.3	6.3	6.3	Met
11778.93	346.287	2916	1744.37	1754.31	1752.54	1757.07	0.002003	13.34	218.58	22	0.75	9.94	Sub	3.3	13.2			3.3	1760.6	1760.6	6.3	6.3	6.3	Met
11828.49	296.731	2916	1744.27	1754.21	1752.44	1756.97	0.002002	13.34	218.6	22	0.75	9.94	Sub	3.3	13.2			3.3	1760.5	1760.5	6.3	6.3	6.3	Met
11878.05	247.175	2916	1744.17	1754.11	1752.34	1756.87	0.002002	13.34	218.61	22	0.75	9.94	Sub	3.3	13.2			3.3	1760.4	1760.4	6.3	6.3	6.3	Met
11927.61	197.619	2916	1744.06	1754.01	1752.23	1756.77	0.001994	13.32	218.92	22	0.74	9.95	Sub	3.3	13.2			3.3	1760.3	1760.3	6.3	6.3	6.3	Met
11977.17	148.063	2916	1743.96	1753.91	1752.13	1756.67	0.001994	13.32	218.95	22	0.74	9.95	Sub	3.3	13.2			3.3	1760.2	1760.2	6.3	6.3	6.3	Met
12026.73	98.5078	2916	1743.86	1753.81	1752.03	1756.57	0.001993	13.32	218.98	22	0.74	9.95	Sub	3.3	13.2			3.3	1760.1	1760.1	6.3	6.3	6.3	Met

Appendix C

Geotechnical Investigations

- Appendix C-1: Draft Geotechnical Data Report
- Appendix C-2: Draft Geotechnical Interpretive Report
- Appendix C-3: Draft Hydrogeologic Aquifer Testing Report

Appendix C-1

Draft Geotechnical Data Report

GEOTECHNICAL DATA REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

DRAFT

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 10, 2015
Project No. 303710001

April 10, 2015
Project No. 303710001

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074-7755

Subject: Geotechnical Data Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith are the data results of Ninyo & Moore's geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide our findings. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

DRAFT

Naik Banavathu, P.E.
Principal Engineer

Brad L. Olsen, PE
Principal Engineer

NB/BLO/dh

Distribution: (1) Addressee (via e-mail)

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1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment. This report presents the findings of our subsurface exploration, results of our background review and laboratory testing.

This study was performed concurrently with a hydrogeologic study, also performed by Ninyo & Moore. A report presenting the results of our hydrogeologic study will be submitted under separate cover.

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. This evaluation included preparation of a geotechnical interpretive report. Data from this report, including two exploratory borings (B-108 and B-109) that were performed along Pecos Road approximately between Stewart Avenue and Bonanza Road, were used to the extent possible for this evaluation.

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2. SCOPE OF SERVICES

The scope of our services included the following:

- Review of pertinent background data listed in the References section of this report. The data reviewed included drawings, in-house geotechnical and soils data, aerial photographs, and published soils and geologic maps and literature.
- Coordination and mobilization for subsurface exploration. Markout of existing utilities in areas of our exploratory borings was conducted through Underground Service Alert (USA).
- Drilling, logging, and sampling of 20 exploratory borings, which were advanced to depths ranging from approximately 10 to 25 feet. The borings were performed to evaluate subsurface conditions along the proposed alignment and to obtain soil samples for laboratory testing.

- Performance of laboratory tests on selected soil samples obtained from the exploratory borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts).
- Compilation and analysis of accumulated data.
- Preparation of this data report presenting results of our background review, subsurface exploration and laboratory testing.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

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4. GENERAL ALIGNMENT CONDITIONS

The proposed alignment will extend along portions of Pecos Road and existing Cedar Avenue Channel ROW. At the time of our geotechnical reconnaissance, Pecos Road extended in a north-to-south direction and was generally bordered by residential properties to the east and a golf course to the west. The existing concrete-lined trapezoidal channel extended in an east-to-west

direction and was generally bordered by residential properties to the north and south. An elementary school was located to the south of the channel near the Lamb Boulevard crossing and north of the channel near Page Street crossing. Chain-link fencing and concrete block screen walls were located on the north and south sides of the channel.

The existing channel was up to approximately 30 feet wide and up to approximately 10 feet deep. An asphalt-concrete paved trail, up to approximately 15 feet wide, was located to the north of the existing channel. The existing trail is at an elevation of approximately 1,792 feet above mean sea level (AMSL) near Pecos Road and at an elevation of approximately 1,760 feet AMSL near Las Vegas Wash. Water, several inches deep, was observed flowing in the channel bottom. The existing channel crosses under numerous streets, including Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive. At the time of our geotechnical reconnaissance, all these streets were paved with asphalt concrete and extended in a north-south direction. All these streets in the vicinity of the project alignment were fully improved with curb, gutter, and sidewalks. Honolulu Street and Page Street included one lane each way, Marion Drive and Sandhill Road included one lane each way with a turn lane, and Lamb Boulevard included three lanes each way with a two-way left turn lane

Indications of underground utilities observed in the vicinity of the alignment included gas, water, storm drain, and electric lines. Other underground utilities may be present in the vicinity of the project.

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5. GEOLOGY

Based on our field observations, subsurface exploration, and review of referenced geologic and soils data, the project alignment is underlain primarily by relatively shallow fill, which is in turn underlain by Quaternary-age alluvium (native soil). Ninyo & Moore's findings regarding the geologic setting, potential geologic hazards and problematic soils, and ground motions are provided in the following sections.

5.1. Geologic Setting

The project alignment is located in the eastern portion of Las Vegas Valley, which lies in the southwestern portion of the Great Basin, within the Basin and Range physiographic province. Las Vegas Valley is a naturally formed structural basin as a result of block faulting, a fundamental characteristic of the Basin and Range physiographic province.

Las Vegas Valley extends in a northwest-southeast direction and drains generally toward the southeast through Las Vegas Wash into Lake Mead. Bordering the alluvium-filled valley are relatively steep mountain ranges, including the Spring Mountains to the west; the Desert, Sheep, and Las Vegas ranges to the north; the McCullough Range to the south; and Sunrise Mountain, Frenchman Mountain, and River Mountains to the east.

Las Vegas Valley is underlain at depth by Proterozoic-age igneous and metamorphic basement rock, which is overlain by thick layers of Paleozoic- and Mesozoic-age sedimentary rock, and Tertiary-age volcanic rock. The lower lying areas of Las Vegas Valley generally contain relatively fine-grained alluvial, aeolian, and playa deposits. Extending outward into the valley from the bordering mountain fronts, are sloping alluvial aprons, or fans, comprised primarily of poorly sorted gravel and sand deposits with cobbles and boulders. The soils are up to approximately 5,000 feet thick in some areas of the valley.

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5.2. Potential Geologic Hazards and Problematic Soils

Ninyo & Moore's geotechnical study included an evaluation of the possible presence of geologic hazards, such as faults and ground fissures, in the project alignment area. This evaluation included visual observation of the alignment for indications of adverse geologic features and review of published geologic and soils maps and literature, and other data listed in the References section of this report. Referenced geologic data were also reviewed to evaluate seismic activity levels, and associated potential earthquake hazards, for faults in the alignment vicinity. It should be noted that the fault seismic activity levels provided in this section were obtained/interpreted primarily from United States Geological Survey (USGS, 2015b) data.

Review of referenced geologic data indicates that the nearest active fault (i.e., a fault that has experienced ground surface rupture within the past 11,000 years) to the alignment is the Black Hills fault. The Frenchman Mountain fault and the Eglington fault, which are considered potentially active (i.e., faults that have experienced ground surface rupture within the past 1.6 million years) are also located in the alignment vicinity. The distances from the alignment to these active and potentially active faults are provided in Table 1.

Review of referenced geologic data also indicates that an unnamed Las Vegas Valley fault extends through the western portion of the alignment (Figure 2). Referenced USGS data indicate that this fault is of uncertain origin and that its seismic activity level has not been established. During our geologic field reconnaissance along the project alignment, surficial indications of previous faulting were not observed. The origin of this geologic feature, and other similar features in southern Nevada, which have been previously referred to as "compaction faults." Differing proposed origins for these faults include:

- Differential consolidation or compaction over time of the thick alluvial and lakebed sediments in valley areas.
- Tectonic factors associated with faults that may extend into the basement bedrock beneath the valley sediment.
- A combination of differential consolidation and tectonic factors.

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Table 1 – Faults in Project Alignment Vicinity

Fault Name	Seismic Activity Level *	Approximate Distance From Project Alignment to Fault (miles)
Black Hills fault	Active	16
Eglington fault	Potentially Active	8
Frenchman Mountain fault	Potentially Active	3
Unnamed Las Vegas Valley fault	Not Established	Extends through alignment (see Figure 2)
*From United States Geological Survey (USGS, 2015b) data.		

Ground fissures, generally believed to be caused by erosion and differential stress resulting from regional subsidence due primarily to withdrawal of groundwater, are known to occur near faults in southern Nevada. Review of the referenced geologic data does not indicate the

presence of ground fissures along the project alignment and no ground fissures were observed during our field activities. However, it should be noted that the ground surface had been disturbed/obscured by previous development.

As part of this study, Ninyo & Moore evaluated whether the project alignment is located in a Special Geotechnical Considerations Area, as shown on the referenced Clark County Soil Guidelines Map (Clark County Building Department, 1998). This map indicates important aspects of near-surface soils and geologic features in the Las Vegas Valley. Review of the Clark County Soil Guidelines Map indicates that the portion of the project alignment between Stewart Avenue and Sandhill Road is located in a *Special Geotechnical Considerations Area - Subsidence and 2,000-Foot Compaction or Seismic Fault Buffer Zone*. This buffer zone is considered to contain 90 percent of mapped ground fissures. These potential ground fissure areas extend approximately 1,000 feet to each side of faults. The portion of the project alignment between Sandhill Road and Marion Drive is located in a *Special Geotechnical Considerations Area - Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*: This area is indicative of potentially moisture-sensitive and corrosive soils. The portion of the alignment located between Marion Drive and Las Vegas Wash is located in a *Special Geotechnical Considerations Area - Potential Drainage Areas or Recent Sediment Deposits, which may also have Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*. This area is in the vicinity of major drainages and may also contain potentially moisture-sensitive and corrosive soils.

The Clark County Expansive Soil Guidelines Map (Clark County Development Services Department, 2006) indicates general trends of near-surface soils in the Las Vegas Valley. This map shows areas of the valley where previous geotechnical studies have indicated the presence of moderately, highly, and critically expansive soils. Based on review of this map, the portion of the project alignment between Stewart Avenue and Honolulu Street is located in an area prone to moderately expansive soil and the remaining portion of the alignment is located in an area prone to highly expansive soil.

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5.3. Ground Motions

Using the referenced United States Geological Survey database (USGS, 2015a), estimated maximum considered earthquake spectral response accelerations for short (0.2 second) and long (1.0 second) periods were obtained for the project alignment, which is located at approximately 36.1699 degrees north latitude and -115.0891 degrees west longitude. Based on the referenced International Building Code (ICC, 2012) and due to a detailed seismic site class evaluation not being performed for the project, Seismic Site Class D is appropriate for the project alignment and the parameters in the following table are characteristic of the project alignment for design purposes.

Table 2 – Seismic Design Parameters

Parameters	Value		Reference (ICC, 2012)
	Short Period	Long Period	
Mapped Maximum Considered Earthquake Spectral Response Acceleration, S_S and S_1	0.495g	0.164g	Figure 1613.3.1 and referenced database (USGS, 2015a)
Site Coefficient, F_a and F_v	1.40	2.14	Table 1613.3.3
Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Class Effects, S_{MS} and S_{M1}	0.695g	0.352g	Equations 16-37 and 16-38
Design Spectral Response Acceleration, S_{DS} and S_{D1}	0.463g	0.235g	Equations 16-39 and 16-40

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6. FIELD EXPLORATION, LABORATORY TESTING, AND SUBSURFACE CONDITIONS

Ninyo & Moore's subsurface exploration along the project alignment was performed from March 5 through March 16, 2015. This exploration consisted of drilling, logging, and sampling of 20 small-diameter exploratory borings. The borings were advanced to depths ranging from approximately 10 to 25 feet with a truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The purpose of the borings was to evaluate subsurface conditions along the project alignment, as well as to collect bulk and relatively undisturbed soil samples for laboratory testing. The approximate locations of the borings along with the pertinent borings from the other study previously discussed are shown on Figure 2.

Laboratory tests were performed on representative soil samples collected from the borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts). The results of the in-place moisture content and dry density tests are provided on the boring logs in Appendix A. Ground surface elevations at boring locations surveyed by Atkins personnel are also provided on the boring logs. Descriptions of the laboratory testing procedures utilized and the other test results are presented in Appendix B and Appendix C.

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6.1. Subsurface Soils Encountered

Generalized descriptions of the subsurface soils (fill and native soil) encountered in the exploratory borings are provided in the following sections.

6.1.1. Fill

Fill material, up to approximately 1.8 feet deep, was encountered in our exploratory borings. In addition, fill material approximately 7.0 feet deep was encountered in boring B-17. The encountered fill soils were comprised primarily of medium dense to dense, silty gravel with sand. A dense, clayey sand with gravel layer was also encountered in boring B-17. Much of the fill encountered in our borings was likely associated with channel sidewall backfill and/or roadway fill material.

Asphalt concrete pavement and underlying aggregate base material was penetrated in all of our 20 borings drilled during our subsurface evaluation for the subject project. The approximate thicknesses of asphalt concrete and underlying aggregate base material encountered in these borings are summarized in the following table.

Table 3 – Existing Asphalt Concrete Pavement and Aggregate Base Thicknesses

Boring	Approximate Thickness of Asphalt Concrete (inches)	Approximate Thickness of Aggregate Base Material (inches)
B-1	9-1/8	12 to 13
B-2	2	3-1/2
B-3	2	4-1/2
B-4	2-1/2	5-1/2
B-5	1-1/2	5-1/2
B-6	1-7/8	5
B-7	2-1/2	4
B-8	2-1/2	4
B-9	2-3/4	4
B-10	2-1/2	5-1/2
B-11	3	4
B-12	2-7/8	5-1/2
B-13	2-3/4	4-1/2
B-14	2-5/8	4-3/4
B-15	2-1/2	11
B-16	2-1/2	12 to 13
B-17	2-5/8	12 to 13
B-18	3-1/2	12 to 13
B-19	3	12 to 13
B-20	3-1/4	8-1/2
B-108*	8-3/4	5
B-109*	8-1/4	7
* Boring from previous evaluation		

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6.1.2. Native Soil

Native soil was encountered beneath the noted fill and extended to the total depths of our exploratory borings. The encountered native soil consisted primarily of firm to very stiff lean clay and fat clay with varying amounts of sand and gravel. An approximately 5-foot thick layer of stiff to very stiff silt with sand was encountered at a depth of approximately 12 and 15 feet in borings B-19 and B-20, respectively.

Layers of hard to very hard, strongly cemented soil (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Caliche is a naturally occurring cemented soil with rock-like characteristics. The following describes typical properties of caliche encountered in southern Nevada.

- Generally occurs in layers a few inches to several feet thick.

- Layers typically vary significantly in thickness, degree of cementation, and hardness over relatively short distances.
- Varies in composition from primarily fine-grained material to primarily coarse-grained material.
- Moderately hard, moderately cemented caliche can generally be gouged with a knife with difficulty and broken with a few hammer blows.
- Hard and very hard, strongly cemented caliche is difficult to scratch with a knife and breaks with difficulty with repeated hammer blows.
- Impedes earthwork operations, including grading and utility line trenching. Rock excavation methods are generally needed.

Laboratory tests were performed on representative samples of native soil obtained from the exploratory borings. Results of these tests are summarized in the following table.

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Table 4 – Summary of Laboratory Test Results

Test Type	Test Results	Remarks
Atterberg Limits Liquid Limit Plastic Limit Plasticity Index	 24 to 64 16 to 32 7 to 42	Low to high plasticity
Expansion Index	41 to 140	Low to very high
Sodium Sulfate Content	0.03 to 0.70 percent	Negligible to moderate chemical heave (salt heave) potential
Sodium Content	0.03 to 0.42 percent	--
Sulfate Content	0.02 to 0.47 percent	Negligibly to severely deleterious to concrete
Total Salts (Solubility)	0.15 to 1.86 percent	Low to high solubility potential

6.2. Selected and Granular Backfill Suitability

As a part of this study, Ninyo & Moore evaluated the suitability of encountered soils for use as trench backfill material. Clark County gradation and plasticity requirements (Clark County, 2003) for Selected and Granular Backfill (USSPWC Sections 207.02.01 and 207.02.02, respectively), along with the results of gradation and Atterberg limits tests performed by Ninyo & Moore, are presented in the following table.

Table 5 – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-1 5.0-6.5	B-3 2.0-3.5	B-5 2.0-3.5	B-6 5.0-6.5	B-9 5.0-6.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	82	100	100	100
No. 16	--	25-100	100	73	100	100	100
No. 200	--	5-15	86.1	61.6	88.8	84.3	93.8
Plasticity Index	15 max	15 max.	42	34	31	23	17
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

Table 5 (continued) – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-12 5.0-6.5	B-14 5.0-6.5	B-17 5.0-6.5	B-18 10.0-11.5	B-20 15.0-16.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	100	58	99	100
No. 16	--	25-100	98	100	41	99	100
No. 200	--	5-15	95.0	96.6	19.0	82.3	81.8
Plasticity Index	15 max	15 max.	8	12	14	7	20
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

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6.3. Groundwater

Groundwater was encountered in 12 of our 20 exploratory borings. Borings B-1, B-2, B-6, and B-20 were converted to temporary monitoring wells for the hydrogeologic study. The approximate depths to groundwater levels measured in the exploratory borings are presented in the following table. Depths to groundwater are also included on the boring logs in Appendix A.

Table 6 – Measured Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Approximate Time Measured After Drilling (days)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)
B-1	1,795.4	3	12.2	1,783.2
B-2	1,791.6	4	12.7	1,778.9
B-3	1,783.9	1	8.2	1,775.7
B-4	1,781.9	1	8.4	1,773.5
B-5	1,779.6	4	6.9	1,772.7
B-6	1,778.2	4	8.4	1,769.8
B-10	1,772.5	4	13.6	1,758.9
B-16	1,764.1	4	13.6	1,750.5
B-17	1,761.7	4	15.4	1,746.3
B-18	1,762.3	1	18.4	1,743.9
B-19	1,761.7	3	18.7	1,743.0
B-20	1760.5	3	18.4	1,742.1

*Measured from top of ground surface (top of channel bank) adjacent to boring.

Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this study.

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7. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical data report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the findings presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that

our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for data purposes only. It does not provide sufficient data to prepare an accurate bid by some contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

If geotechnical conditions different from those described in this report are encountered, our office should be notified. It should be understood that the conditions along the project alignments could change with time as a result of natural processes or the activities of man along the subject alignments or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings of this report by parties other than the client is undertaken at said parties' sole risk.

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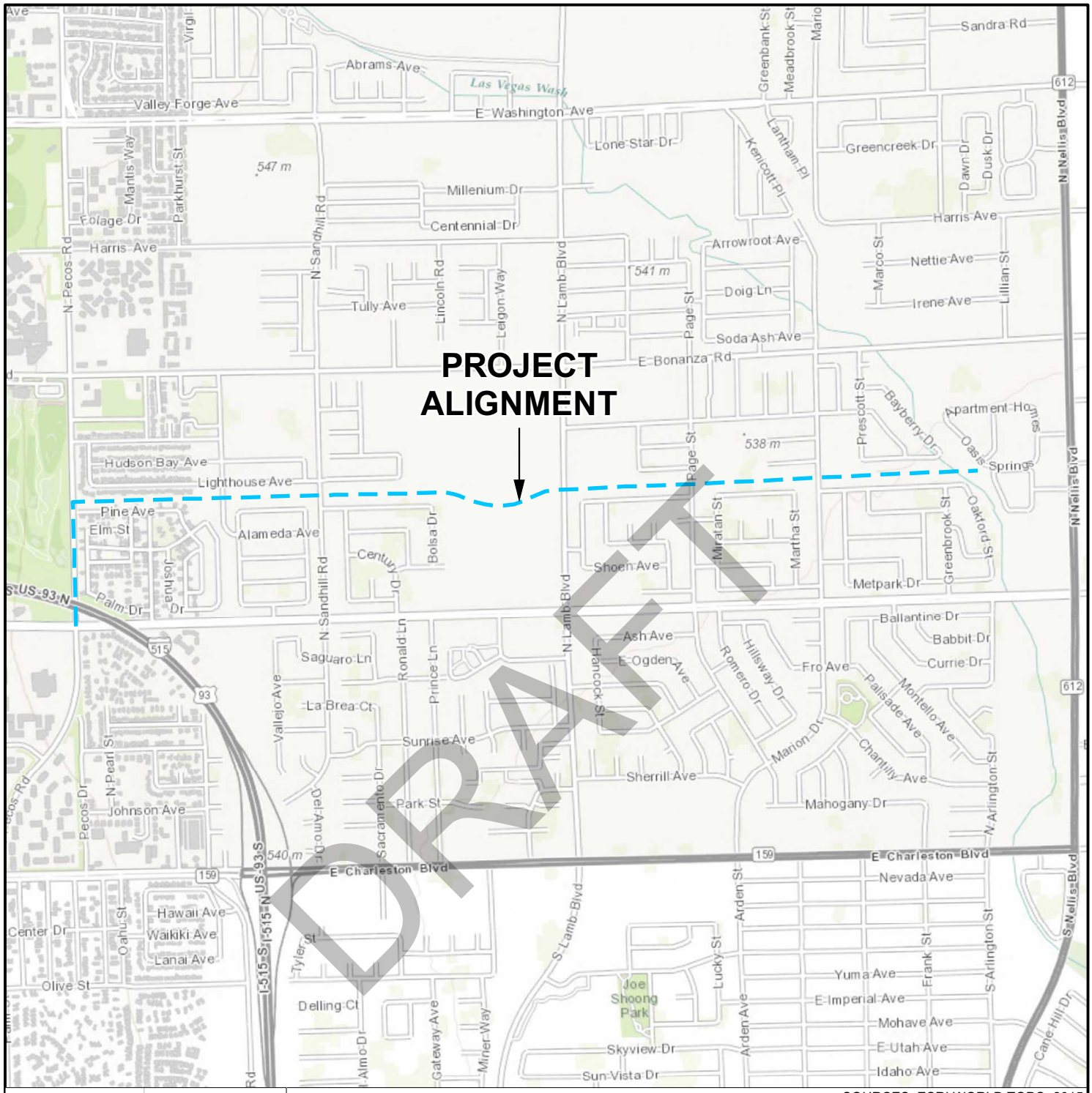
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SOURCES: ESRI WORLD TOPO, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710001_SL.mxd 4/7/2015 3:32:13 PM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2
303710001	4/15		

2_303710001_BL.mxd 4/10/2015 JDL

Appendix C-2

Draft Geotechnical Interpretive Report

GEOTECHNICAL INTERPRETIVE REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

DRAFT

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 10, 2015
Project No. 303710001

April 10, 2015
Project No. 303710001

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074-7755

Subject: Geotechnical Interpretive Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith is the Geotechnical Interpretive Report, which is based on the results of Ninyo & Moore's geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide design and construction recommendations regarding geotechnical aspects of the project. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

DRAFT

Naik Banavathu, P.E.
Principal Engineer

Brad L. Olsen, PE
Principal Engineer

NB/BLO/dh

Distribution: (1) Addressee (via e-mail)

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Appendix B – Laboratory Testing
Appendix C – Chemical Test Results
Appendix D – Exploratory Boring logs From Our Previous Evaluation

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1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide design and construction recommendations regarding geotechnical aspects of the project. This report presents the findings of our subsurface exploration, results of our laboratory testing, conclusions regarding the subsurface soil conditions along the alignment, and geotechnical recommendations for the design and construction of this project.

This study was performed concurrently with a hydrogeologic study, also performed by Ninyo & Moore. A report presenting the results of our hydrogeologic study will be submitted under separate cover.

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. This evaluation included preparation of a geotechnical interpretive report. Data from this report, including two exploratory borings (B-108 and B-109) that were performed along Pecos Road approximately between Stewart Avenue and Bonanza Road, were used to the extent possible for this evaluation.

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2. SCOPE OF SERVICES

The scope of our services included the following:

- Review of pertinent background data listed in the References section of this report. The data reviewed included drawings, in-house geotechnical and soils data, aerial photographs, and published soils and geologic maps and literature.
- Coordination and mobilization for subsurface exploration. Markout of existing utilities in areas of our exploratory borings was conducted through Underground Service Alert (USA).

- Drilling, logging, and sampling of 20 exploratory borings, which were advanced to depths ranging from approximately 10 to 25 feet. The borings were performed to evaluate subsurface conditions along the proposed alignment and to obtain soil samples for laboratory testing.

- Performance of laboratory tests on selected soil samples obtained from the exploratory borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts).

- Compilation and analysis of accumulated data.

- Preparation of this geotechnical interpretive report presenting our findings, conclusions, and recommendations regarding the subject project.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

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4. GENERAL ALIGNMENT CONDITIONS

The proposed alignment will extend along portions of Pecos Road and existing Cedar Avenue Channel ROW. At the time of our geotechnical reconnaissance, Pecos Road extended in a north-to-south direction and was generally bordered by residential properties to the east and a golf course to the west. The existing concrete-lined trapezoidal channel extended in an east-to-west direction and was generally bordered by residential properties to the north and south. An elementary school was located to the south of the channel near the Lamb Boulevard crossing and north of the channel near Page Street crossing. Chain-link fencing and concrete block screen walls were located on the north and south sides of the channel.

The existing channel was up to approximately 30 feet wide and up to approximately 10 feet deep. An asphalt-concrete paved trail, up to approximately 15 feet wide, was located to the north of the existing channel. The existing trail is at an elevation of approximately 1,792 feet above mean sea level (AMSL) near Pecos Road and at an elevation of approximately 1,760 feet AMSL near Las Vegas Wash. Water, several inches deep, was observed flowing in the channel bottom. The existing channel crosses under numerous streets, including Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive. At the time of our geotechnical reconnaissance, all these streets were paved with asphalt concrete and extended in a north-south direction. All these streets in the vicinity of the project alignment were fully improved with curb, gutter, and sidewalks. Honolulu Street and Page Street included one lane each way, Marion Drive and Sandhill Road included one lane each way with a turn lane, and Lamb Boulevard included three lanes each way with a two-way left turn lane

Indications of underground utilities observed in the vicinity of the alignment included gas, water, storm drain, and electric lines. Other underground utilities may be present in the vicinity of the project.

5. GEOLOGY

Based on our field observations, subsurface exploration, and review of referenced geologic and soils data, the project alignment is underlain primarily by relatively shallow fill, which is in turn

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underlain by Quaternary-age alluvium (native soil). Ninyo & Moore's findings regarding the geologic setting, potential geologic hazards and problematic soils, and ground motions are provided in the following sections.

5.1. Geologic Setting

The project alignment is located in the eastern portion of Las Vegas Valley, which lies in the southwestern portion of the Great Basin, within the Basin and Range physiographic province. Las Vegas Valley is a naturally formed structural basin as a result of block faulting, a fundamental characteristic of the Basin and Range physiographic province.

Las Vegas Valley extends in a northwest-southeast direction and drains generally toward the southeast through Las Vegas Wash into Lake Mead. Bordering the alluvium-filled valley are relatively steep mountain ranges, including the Spring Mountains to the west; the Desert, Sheep, and Las Vegas ranges to the north; the McCullough Range to the south; and Sunrise Mountain, Frenchman Mountain, and River Mountains to the east.

Las Vegas Valley is underlain at depth by Proterozoic-age igneous and metamorphic basement rock, which is overlain by thick layers of Paleozoic- and Mesozoic-age sedimentary rock, and Tertiary-age volcanic rock. The lower lying areas of Las Vegas Valley generally contain relatively fine-grained alluvial, aeolian, and playa deposits. Extending outward into the valley from the bordering mountain fronts, are sloping alluvial aprons, or fans, comprised primarily of poorly sorted gravel and sand deposits with cobbles and boulders. The soils are up to approximately 5,000 feet thick in some areas of the valley.

5.2. Potential Geologic Hazards and Problematic Soils

Ninyo & Moore's geotechnical study included an evaluation of the possible presence of geologic hazards, such as faults and ground fissures, in the project alignment area. This evaluation included visual observation of the alignment for indications of adverse geologic features and review of published geologic and soils maps and literature, and other data listed in the References section of this report. Referenced geologic data were also reviewed to evaluate seismic activity levels, and

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associated potential earthquake hazards, for faults in the alignment vicinity. It should be noted that the fault seismic activity levels provided in this section were obtained/interpreted primarily from United States Geological Survey (USGS, 2015b) data.

Review of referenced geologic data indicates that the nearest active fault (i.e., a fault that has experienced ground surface rupture within the past 11,000 years) to the alignment is the Black Hills fault. The Frenchman Mountain fault and the Eglington fault, which are considered potentially active (i.e., faults that have experienced ground surface rupture within the past 1.6 million years) are also located in the alignment vicinity. The distances from the alignment to these active and potentially active faults are provided in Table 1.

Review of referenced geologic data also indicates that an unnamed Las Vegas Valley fault extends through the western portion of the alignment (Figure 2). Referenced USGS data indicate that this fault is of uncertain origin and that its seismic activity level has not been established. During our geologic field reconnaissance along the project alignment, surficial indications of previous faulting were not observed. The origin of this geologic feature, and other similar features in southern Nevada, which have been previously referred to as "compaction faults." Differing proposed origins for these faults include:

- Differential consolidation or compaction over time of the thick alluvial and lakebed sediments in valley areas.
- Tectonic factors associated with faults that may extend into the basement bedrock beneath the valley sediment.
- A combination of differential consolidation and tectonic factors.

Table 1 – Faults in Project Alignment Vicinity

Fault Name	Seismic Activity Level *	Approximate Distance From Project Alignment to Fault (miles)
Black Hills fault	Active	16
Eglington fault	Potentially Active	8
Frenchman Mountain fault	Potentially Active	3
Unnamed Las Vegas Valley fault	Not Established	Extends through alignment (see Figure 2)
*From United States Geological Survey (USGS, 2015b) data.		

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Ground fissures, generally believed to be caused by erosion and differential stress resulting from regional subsidence due primarily to withdrawal of groundwater, are known to occur near faults in southern Nevada. Review of the referenced geologic data does not indicate the presence of ground fissures along the project alignment and no ground fissures were observed during our field activities. However, it should be noted that the ground surface had been disturbed/obscured by previous development.

As part of this study, Ninyo & Moore evaluated whether the project alignment is located in a Special Geotechnical Considerations Area, as shown on the referenced Clark County Soil Guidelines Map (Clark County Building Department, 1998). This map indicates important aspects of near-surface soils and geologic features in the Las Vegas Valley. Review of the Clark County Soil Guidelines Map indicates that the portion of the project alignment between Stewart Avenue and Sandhill Road is located in a *Special Geotechnical Considerations Area - Subsidence and 2,000-Foot Compaction or Seismic Fault Buffer Zone*. This buffer zone is considered to contain 90 percent of mapped ground fissures. These potential ground fissure areas extend approximately 1,000 feet to each side of faults. The portion of the project alignment between Sandhill Road and Marion Drive is located in a *Special Geotechnical Considerations Area - Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*: This area is indicative of potentially moisture-sensitive and corrosive soils. The portion of the alignment located between Marion Drive and Las Vegas Wash is located in a *Special Geotechnical Considerations Area - Potential Drainage Areas or Recent Sediment Deposits, which may also have Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*. This area is in the vicinity of major drainages and may also contain potentially moisture-sensitive and corrosive soils.

The Clark County Expansive Soil Guidelines Map (Clark County Development Services Department, 2006) indicates general trends of near-surface soils in the Las Vegas Valley. This map shows areas of the valley where previous geotechnical studies have indicated the presence of moderately, highly, and critically expansive soils. Based on review of this map, the portion of the project alignment between Stewart Avenue and Honolulu Street is located

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in an area prone to moderately expansive soil and the remaining portion of the alignment is located in an area prone to highly expansive soil.

5.3. Ground Motions

Using the referenced United States Geological Survey database (USGS, 2015a), estimated maximum considered earthquake spectral response accelerations for short (0.2 second) and long (1.0 second) periods were obtained for the project alignment, which is located at approximately 36.1699 degrees north latitude and -115.0891 degrees west longitude. Based on the referenced International Building Code (ICC, 2012) and due to a detailed seismic site class evaluation not being performed for the project, Seismic Site Class D is appropriate for the project alignment and the parameters in the following table are characteristic of the project alignment for design purposes.

Table 2 – Seismic Design Parameters

Parameters	Value		Reference (ICC, 2012)
	Short Period	Long Period	
Mapped Maximum Considered Earthquake Spectral Response Acceleration, S_S and S_1	0.495g	0.164g	Figure 1613.3.1 and referenced database (USGS, 2015a)
Site Coefficient, F_a and F_v	1.40	2.14	Table 1613.3.3
Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Class Effects, S_{MS} and S_{M1}	0.695g	0.352g	Equations 16-37 and 16-38
Design Spectral Response Acceleration, S_{DS} and S_{D1}	0.463g	0.235g	Equations 16-39 and 16-40

6. FIELD EXPLORATION, LABORATORY TESTING, AND SUBSURFACE CONDITIONS

Ninyo & Moore's subsurface exploration along the project alignment was performed from March 5 through March 16, 2015. This exploration consisted of drilling, logging, and sampling of 20 small-diameter exploratory borings. The borings were advanced to depths ranging from approximately 10 to 25 feet with a truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The purpose of the borings was to evaluate subsurface conditions

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along the project alignment, as well as to collect bulk and relatively undisturbed soil samples for laboratory testing. The approximate locations of the borings along with the pertinent borings from the other study previously discussed are shown on Figure 2.

Laboratory tests were performed on representative soil samples collected from the borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts). The results of the in-place moisture content and dry density tests are provided on the boring logs in Appendix A. Ground surface elevations at boring locations surveyed by Atkins personnel are also provided on the boring logs. Descriptions of the laboratory testing procedures utilized and the other test results are presented in Appendix B and Appendix C.

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6.1. Subsurface Soils Encountered

Generalized descriptions of the subsurface soils (fill and native soil) encountered in the exploratory borings are provided in the following sections.

6.1.1. Fill

Fill material, up to approximately 1.8 feet deep, was encountered in our exploratory borings. In addition, fill material approximately 7.0 feet deep was encountered in boring B-17. The encountered fill soils were comprised primarily of medium dense to dense, silty gravel with sand. A dense, clayey sand with gravel layer was also encountered in boring B-17. Much of the fill encountered in our borings was likely associated with channel sidewall backfill and/or roadway fill material.

Asphalt concrete pavement and underlying aggregate base material was penetrated in all of our 20 borings drilled during our subsurface evaluation for the subject project. The approximate thicknesses of asphalt concrete and underlying aggregate base material encountered in these borings are summarized in the following table.

Table 3 – Existing Asphalt Concrete Pavement and Aggregate Base Thicknesses

Boring	Approximate Thickness of Asphalt Concrete (inches)	Approximate Thickness of Aggregate Base Material (inches)
B-1	9-1/8	12 to 13
B-2	2	3-1/2
B-3	2	4-1/2
B-4	2-1/2	5-1/2
B-5	1-1/2	5-1/2
B-6	1-7/8	5
B-7	2-1/2	4
B-8	2-1/2	4
B-9	2-3/4	4
B-10	2-1/2	5-1/2
B-11	3	4
B-12	2-7/8	5-1/2
B-13	2-3/4	4-1/2
B-14	2-5/8	4-3/4
B-15	2-1/2	11
B-16	2-1/2	12 to 13
B-17	2-5/8	12 to 13
B-18	3-1/2	12 to 13
B-19	3	12 to 13
B-20	3-1/4	8-1/2
B-108*	8-3/4	5
B-109*	8-1/4	7
* Boring from previous evaluation		

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6.1.2. Native Soil

Native soil was encountered beneath the noted fill and extended to the total depths of our exploratory borings. The encountered native soil consisted primarily of firm to very stiff lean clay and fat clay with varying amounts of sand and gravel. An approximately 5-foot thick layer of stiff to very stiff silt with sand was encountered at a depth of approximately 12 and 15 feet in borings B-19 and B-20, respectively.

Layers of hard to very hard, strongly cemented soil (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Caliche is a naturally occurring cemented soil with rock-like characteristics. The following describes typical properties of caliche encountered in southern Nevada.

- Generally occurs in layers a few inches to several feet thick.

- Layers typically vary significantly in thickness, degree of cementation, and hardness over relatively short distances.
- Varies in composition from primarily fine-grained material to primarily coarse-grained material.
- Moderately hard, moderately cemented caliche can generally be gouged with a knife with difficulty and broken with a few hammer blows.
- Hard and very hard, strongly cemented caliche is difficult to scratch with a knife and breaks with difficulty with repeated hammer blows.
- Impedes earthwork operations, including grading and utility line trenching. Rock excavation methods are generally needed.

Laboratory tests were performed on representative samples of native soil obtained from the exploratory borings. Results of these tests are summarized in the following table.

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Table 4 – Summary of Laboratory Test Results

Test Type	Test Results	Remarks
Atterberg Limits Liquid Limit Plastic Limit Plasticity Index	 24 to 64 16 to 32 7 to 42	Low to high plasticity
Expansion Index	41 to 140	Low to very high
Sodium Sulfate Content	0.03 to 0.70 percent	Negligible to moderate chemical heave (salt heave) potential
Sodium Content	0.03 to 0.42 percent	--
Sulfate Content	0.02 to 0.47 percent	Negligibly to severely deleterious to concrete
Total Salts (Solubility)	0.15 to 1.86 percent	Low to high solubility potential

6.2. Selected and Granular Backfill Suitability

As a part of this study, Ninyo & Moore evaluated the suitability of encountered soils for use as trench backfill material. Clark County gradation and plasticity requirements (Clark County, 2003) for Selected and Granular Backfill (USSPWC Sections 207.02.01 and 207.02.02, respectively), along with the results of gradation and Atterberg limits tests performed by Ninyo & Moore, are presented in the following table.

Table 5 – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-1 5.0-6.5	B-3 2.0-3.5	B-5 2.0-3.5	B-6 5.0-6.5	B-9 5.0-6.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	82	100	100	100
No. 16	--	25-100	100	73	100	100	100
No. 200	--	5-15	86.1	61.6	88.8	84.3	93.8
Plasticity Index	15 max	15 max.	42	34	31	23	17
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

Table 5 (continued) – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-12 5.0-6.5	B-14 5.0-6.5	B-17 5.0-6.5	B-18 10.0-11.5	B-20 15.0-16.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	100	58	99	100
No. 16	--	25-100	98	100	41	99	100
No. 200	--	5-15	95.0	96.6	19.0	82.3	81.8
Plasticity Index	15 max	15 max.	8	12	14	7	20
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

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6.3. Groundwater

Groundwater was encountered in 12 of our 20 exploratory borings. Borings B-1, B-2, B-6, and B-20 were converted to temporary monitoring wells for the hydrogeologic study. The approximate depths to groundwater levels measured in the exploratory borings are presented in the following table. Depths to groundwater are also included on the boring logs in Appendix A.

Table 6 – Measured Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Approximate Time Measured After Drilling (days)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)
B-1	1,795.4	3	12.2	1,783.2
B-2	1,791.6	4	12.7	1,778.9
B-3	1,783.9	1	8.2	1,775.7
B-4	1,781.9	1	8.4	1,773.5
B-5	1,779.6	4	6.9	1,772.7
B-6	1,778.2	4	8.4	1,769.8
B-10	1,772.5	4	13.6	1,758.9
B-16	1,764.1	4	13.6	1,750.5
B-17	1,761.7	4	15.4	1,746.3
B-18	1,762.3	1	18.4	1,743.9
B-19	1,761.7	3	18.7	1,743.0
B-20	1760.5	3	18.4	1,742.1

*Measured from top of ground surface (top of channel bank) adjacent to boring.

Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this study.

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7. FINDINGS AND CONCLUSIONS

Based on the findings of this study, there are no known geotechnical or geologic conditions that would preclude construction of the proposed project, provided the recommendations presented herein are implemented and appropriate construction practices are followed. Geotechnical design and construction considerations for the proposed project include the following:

- Based on the results of our field and laboratory evaluation, it is our opinion that proposed improvements may be founded on medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils).

- Groundwater was measured at relatively shallow depths in our borings. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Therefore, potentially unstable and pumping subgrade conditions should be anticipated in excavation bottoms.

- Based on the results of our subsurface evaluation, we anticipate that groundwater will be encountered at or above the invert elevation along the project alignment. Accordingly, dewatering utilizing sump pumps, well points, and/or other appropriate dewatering methods will likely be needed to facilitate construction operations. During dewatering, existing structures within the limits of the resulting drawdown may be at risk of experiencing settlement. Therefore, existing structures should be monitored for possible movement associated with the dewatering operations.

- Fill material was encountered to a depth of up to approximately 1.8 feet in the exploratory borings. In addition, approximately 7 feet of fill encountered was encountered in boring B-17. This fill material is likely associated with channel sidewall backfill material. Contractors for this project should anticipate that fill will be encountered during excavation operations. The full depth of any undocumented fill material, and any loose, disturbed, or otherwise unsuitable soil should be removed from beneath proposed improvement areas and replaced with structural fill and/or appropriate backfill.

- The findings of our study indicate that some of the native soils encountered in our exploratory borings should generally be suitable for use as structural fill and backfill material for the project. However, our laboratory test results indicated that some of the on-site soils have very high expansion potential and a high solubility potential. These soils will not be suitable for use as structural fill and backfill. Additional soil sampling and laboratory testing should be performed during earthwork operations to evaluate whether on-site soils meet recommendations provided in this report for use as structural fill/backfill.

- Chemical test results performed on selected soil samples from the exploratory borings indicate that some of the on-site soils should be considered severely deleterious to concrete.

- Review of referenced geologic data indicates that a previously mapped fault traverses the western portion of the alignment (Figure 2). Published geologic data does not provide an activity level for this fault. During our field activities, surficial indications of previous faulting were not observed. A qualified geologist/geotechnical consultant should be present during trenching and excavation operations in the area of the mapped fault to assess subsurface conditions and provide recommendations as needed.

- Water, several inches deep, was observed flowing in the channel bottom. In addition, flash flooding is known to occur in Las Vegas Valley. Accordingly, the contractor for this project should be aware of the potential for adverse affects of flash flooding on construction activities and take adequate precautions.

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- Layers of hard to very hard, strongly cemented soils (caliche) were not encountered in our exploratory borings performed along the project alignment. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Due to its variable nature, caliche may be encountered in areas between and beyond our boring locations during earthwork operations. Grading activities and excavations may be impeded due to the presence of cemented soils. Rock excavation techniques should be anticipated during grading and excavation operations.

- As indicated in the referenced International Building Code, the seismic parameters provided in Table 2 are characteristic of the alignment and may be considered where appropriate in the design of structures.

8. RECOMMENDATIONS

We anticipate that the Clark County Regional Flood Control District, Hydrological Criteria and Drainage Design Manual (CCRFCD, 1999) will be used in design of the proposed channel improvements for this project. The following sections provide geotechnical recommendations for design and construction of proposed project improvements.

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8.1. Construction Dewatering

Groundwater was encountered in 12 of our 20 exploratory borings. The depths below the existing ground surface of the measured groundwater levels are provided on Table 6. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Accordingly, dewatering of excavations should be anticipated during earthwork operations. The purpose of dewatering is to improve excavation wall and bottom stability, as well as subgrade stability, and to allow installation of subsurface improvements and compaction of structural fill, trench backfill, and RCB and channel bottoms. Dewatering measures may include installation of well points, deep wells, and other devices. Disposal of groundwater should be performed in accordance with guidelines of the Nevada Division of Environmental Protection (NDEP).

Existing structures within the limits of groundwater drawdown resulting from dewatering may be at risk of experiencing settlement. The amount of settlement, if it occurs, will depend primarily on the amount and duration of the dewatering and subsurface soil conditions.

Consideration should be given to monitoring nearby structures for possible movement and associated damage during dewatering operations. If significant movement/damage occurs, dewatering operations should be temporarily suspended and the project's geotechnical consultant/owner's representative should be informed. Recommendations for mitigating settlement and associated distress should be provided by the geotechnical consultant/owner's representative.

8.2. Earthwork

Specifications for construction materials to be used and construction practices to be followed when excavating and backfilling trenches within paved and unpaved ROW are provided in the referenced USSPWC. The following subsections provide additional earthwork recommendations for the project including RCB and channel excavation, subgrade stabilization, mapped fault considerations, structural fill and backfill, import soils, and stability of temporary excavations.

8.2.1. RCB and Channel Excavation

Prior to excavation, the existing concrete for the trapezoidal channel side slopes should be removed and any ground surface along the proposed channel excavation areas should be cleared of any surface and subsurface obstructions, debris, organics (including vegetation), and other deleterious material. Materials generated from clearing operations should be removed from the project area and disposed of at a legal landfill.

Fill material, including existing channel sidewall backfill material was encountered to a depth of up to approximately 7 feet in the exploratory borings. Contractors for this project should anticipate that fill will be encountered during excavation operations, particularly below or behind existing channel side slopes. The full depth of any undocumented fill material, and any loose, disturbed, or otherwise unsuitable soil should be removed from beneath proposed improvement areas and replaced with structural fill and/or appropriate backfill.

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The proposed channel and RCB excavations for the proposed project should extend to the full depth and width, as specified in the project plans, or to a greater depth or width where needed, as evaluated in the field by the project's geotechnical consultant. Excavations should be deep enough to provide an approximately 8-inch thick layer of aggregate base beneath concrete channel and RCB bottoms. Excavations should be wide enough to provide an adequate work zone and trenching for the proposed structures should provide a 12-inch or more clearance on either side of the RCB for structural fill material placement and compaction. The 12-inch side clearance should be the clear distance between the RCB and shoring system where present.

Care should be taken not to overexcavate trench/channel bottoms. In the event that overexcavation occurs, the overexcavated area should be backfilled with Type II Aggregate Base compacted to 90 percent relative compaction, as evaluated by ASTM D 1557 or Controlled Low-Strength Material (CLSM) as described in the referenced USSPWC Section 208.02.07. Excavated bottoms should be cleaned of loose material generated by the excavation process. If the exposed surficial soils at the base of the excavations are loose, soft, or disturbed by excavation operations, these soils should be scarified to a depth of approximately 6 inches, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557. When the bottom of the excavation contains rocks larger than 6 inches nominal diameter, protruding above the bottom of the excavation, these protrusions should be removed and the area leveled prior to the compaction of the subgrade and placement of structural fill materials.

Consideration should be given to existing buried pipeline utilities running parallel to the planned excavation. Trench excavations within two pipe diameters of existing pipelines and extending below the springline of, and running parallel to, existing pipeline utilities may need to be supported by properly designed trench shoring and bracing to prevent damage to existing pipeline facilities.

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Layers of hard to very hard, strongly cemented soils (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Due to the highly variable nature of caliche, this rock-like cemented soil may be encountered along the project alignment in areas between and beyond our exploratory boring locations. If caliche is encountered, rock excavation techniques, such as use of heavy-duty ripping equipment, heavy-duty backhoe, headache ball, hoe-ram, rock bits, etc., should be anticipated during earthwork operations. The contractor should be aware of the potential for (and take adequate precautions to reduce the potential for) vibrational damage to adjacent or nearby structures, and take appropriate precautions, when using heavy impact equipment during removal of caliche.

Some shrinkage should be anticipated when on-site soils are excavated, processed, and compacted. For planning purposes, an estimated shrinkage factor of approximately 25 percent may be used for native soils.

8.2.2. Subgrade Stabilization

As previously indicated, groundwater was measured at relatively shallow depths in some of our exploratory borings. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Accordingly, pumping subgrade should be anticipated during excavation and earthwork operations. Subgrade stabilization will be needed where pumping subgrade conditions are encountered.

Stabilization methods should be provided by the grading contractor, as needed, and may include the use of a geogrid, such as Tensar TX160, or a woven geotextile fabric, such as Mirafi 600X, placed on unstable subgrade and overlain by 12 inches of crushed rock in accordance with Section 704.03.06 of Uniform Standard Specifications for Public Works Construction (USSPWC) or Type II Aggregate Base (USSPWC 704.03.04). Pushing oversized angular rock, up to approximately 6 inches in nominal diameter, into

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exposed unstable subgrade soils may also be an appropriate stabilization alternative. The volume of rock needed will vary based upon factors including the moisture content of the native soil, soil type, depth to groundwater, and total affected area. Placement of angular rock should continue until the area exhibits a relatively non-yielding behavior as observed or tested by the geotechnical consultant.

If conditions (e.g. excavations extending below groundwater) are observed that indicate additional stabilization efforts may be needed, a combination of overexcavation, rock fill, and geogrid placement should be considered. Dewatering and use of relatively light or tracked equipment may also be needed. The geotechnical consultant/engineer during construction should evaluate proposed subgrade stabilization methods prior to their implementation.

8.2.3. Mapped Fault Considerations

As previously mentioned, a mapped fault transects the western portion of the project alignment. The approximate location of this fault is shown on Figure 2. Review of referenced USGS data does not provide an activity level for this fault. Published geologic data and our professional experience in the project area indicate that previous subsurface evaluation, such as fault trenching, has not been performed to confirm the fault's location, activity level, or whether it is in the mapped location. During excavation operations for this project, indications of faulting, such as off-set or deformation of soil layers, may or may not be observed. Ninyo & Moore recommends that a qualified geologist/geotechnical consultant be present during trenching/excavation operations in the area of the mapped fault to assess subsurface conditions and provide recommendations for fault mitigation as needed.

If indications of faulting, or associated potential instability, are encountered, mitigation measures may include vertical overexcavation of the trench, placement of geofabric and gravel, or a layer of geogrid across the fault prior to placement of structural fill.

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8.2.4. Structural Fill and Backfill

Structural fill soils should not contain organic matter, debris, other deleterious matter, or rocks or hard chunks larger than approximately 3 inches nominal diameter. These soils should have a low solubility potential of 1.0 percent or less, as evaluated by Technical Guideline TG-19-2007 (Clark County Development Services Department, 2007), and a very low to low expansion potential (EI less than 50, as evaluated by ASTM D 4829).

Soils used as structural fill or backfill should be moisture-conditioned to approximately optimum moisture content and placed and compacted in uniform horizontal lifts to a relative compaction of 90 percent, as evaluated by ASTM D 1557. The optimal lift thickness of fill will depend on the type of soil and compaction equipment used, but should generally not exceed approximately 8 inches in loose thickness. Placement and compaction of structural fill should be performed in accordance with the referenced USSPWC (Clark County, 2003).

Earthwork operations should be observed and compaction of structural fill materials should be tested by the project's geotechnical consultant. Typically, one field test should be performed per lift for each approximately 500 cubic yards of fill placement in structural areas. Additional field tests may also be performed in structural and non-structural areas at the discretion of the geotechnical consultant.

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8.2.5. Import Soils

Import soil for backfill or structural fill should consist of coarse-grained material (50 percent or more retained on the No. 200 sieve), with a low solubility potential of 1.0 percent or less, as evaluated by Technical Guideline TG-19-2007 (Clark County Development Services Department, 2007), a low sulfate content (less than 0.1 percent), and a very low to low expansion potential (EI less than 50, as evaluated by ASTM D 4829). Import soil should not contain organic matter, debris, other deleterious matter, or rocks or hard chunks larger than approximately 3 inches nominal diameter. We further recommend that proposed import material be evaluated by the project's

geotechnical consultant at the borrow source for its suitability prior to importation to the project site. Import soil should be moisture-conditioned and placed and compacted in accordance with the recommendations set forth in the previous section.

8.2.6. Stability of Temporary Excavations

Temporary excavations should be performed in accordance with the requirements and recommendations of the referenced Occupational Safety and Health Administration's Construction Industry Regulations (OSHA, 2005). Excavations deeper than 5 feet should be appropriately shored or laid back at a slope no steeper than 1:1 (horizontal to vertical) per OSHA recommendations. On-site safety of personnel is the responsibility of the contractor. Worker protection, such as trench boxes, may be needed for protection against rolling or falling particles.

Excavations for the proposed RCB and channel are anticipated to be up to approximately 15 feet deep. Spoils from excavations, heavy construction equipment, and other surcharge loads should not be placed above the excavations within a 1:1 (horizontal to vertical) plane extending up and back from the base of the excavation. In addition, surface drainage should be channeled away from the top edge of excavations and traffic should be routed as far away from the excavation as practicable during construction.

As an alternative to laying back the sides of the excavations, temporary excavations may be rigidly braced. Temporary earth retaining systems will be subjected to lateral loads resulting from earth pressures. As a guideline, lateral earth pressures presented in this report may be used in the design of internally braced excavation shoring for temporary excavations. A structural engineer experienced in retaining systems for temporary excavations should be consulted by the contractor during the design of the shoring system. The project's geotechnical engineer should review the design plans for a temporary retaining system prior to its implementation.

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8.3. Vertical Loads and RCB Foundations

For calculation of overburden loads, Type II Aggregate Base and trench backfill soils, when placed and compacted as specified, may be assumed to have a unit weight of approximately 130 pounds per cubic foot (pcf). This value is based on soils being compacted to a relative compaction of 90 percent of the maximum dry density, as evaluated by ASTM D 1557. We have assumed that CLSM used as pipe zone and trench backfill material will have a unit weight of approximately 120 pcf.

The base of RCB sections should be founded on 8 inches or more of Type II Aggregate Base overlying medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils). The Type II Aggregate Base should be in conformance with referenced USSPWC Subsection 704.03.04, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557. An allowable bearing pressure of 2,000 pounds per square foot (psf) may be used for RCB/structure foundations. The allowable bearing capacity, which was developed considering a factor of safety of 2.5, may be increased by one-third for short duration loads, such as seismic.

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8.4. Concrete-Lined Channel Invert Slabs and Sidewalls

We recommend that concrete channel walls, invert slabs-on-grade and access ramps be founded on 8 inches or more of Type II Aggregate Base overlying medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils). The Type II Aggregate Base should be in conformance with referenced USSPWC Subsection 704.03.04, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557.

We recommend that the concrete channel lining be provided with construction joints in accordance with Section 705.7.1.3 of the Clark County Regional Flood Control District, Hydrological Criteria and Drainage Design Manual (CCRFCD, 1999). For continuously reinforced concrete channel construction, we recommend that longitudinal and transverse

cutoff walls be constructed in accordance with Section 705.7.1.12 of the CCRFCD design manual. Slab reinforcement should be in accordance with Section 705.7.1.6 of the CCRFCD design manual. Additional reinforcement and control joint recommendations may be provided by a qualified structural engineer. Recommendations regarding concrete utilized for construction of the proposed channel are provided in Section 8.7.

In order to drain accumulated water below invert slabs, we recommend that 3-inch diameter weep holes be installed in the channel bottom approximately 1 foot upstream of transverse cutoff walls and at the approximate midpoint between cutoff walls. These weep holes should be protected against clogging by installation of 1 square-foot of non-woven geotextile fabric such as Trevira 1135 (or approved equivalent) between weep holes and underlying aggregate base.

In order to reduce the potential for build-up of hydrostatic pressures and to drain possible accumulated water behind concrete channel sidewalls, 3-inch diameter weep holes should be installed in the channel sidewalls at a spacing of approximately 10 feet on-center and approximately 3 inches from the channel bottom. Drainage measures should also include the placement of free-draining granular backfill over weep hole areas encased in a non-woven filter fabric such as Trevira 1135 (or approved equivalent).

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8.5. Lateral Earth Pressures

Below grade walls that are not restrained from movement at the top and having level backfill behind the wall may be designed using an "active" lateral earth pressure as indicated on Figure 3. Restrained subsurface walls having a horizontal ground surface behind the wall, may be designed using an "at-rest" lateral earth pressure as indicated on Figure 4. These lateral earth pressure values assume compaction within about 5 feet of the wall will be accomplished with relatively light compaction equipment and that very low to low expansive backfill will be placed behind the wall. These values also assume that below grade walls will have a height of approximately 15 feet or less.

We understand that dynamic lateral earth pressures induced from a seismic event may be considered in the design of subsurface structures along the alignment. Ninyo & Moore has evaluated the "active" and "at-rest" seismic earth pressure coefficient based on the Mononobe-Okabe equation for an active driving wedge. Based on our calculations, Ninyo & Moore recommends that below grade walls, which are not restrained from movement at the top, be designed using an additional inverted triangular "active" equivalent fluid unit weight as indicated on Figure 3, where appropriate. Subsurface walls, which are restrained from movement at the top, be designed using an additional inverted triangular "at-rest" equivalent fluid unit weight as indicated on Figure 4.

Below grade walls should also be designed to resist an "active" and "at-rest" surcharge pressure as shown on Figure 3 and Figure 4. The value for "q" represents the pressure induced by adjacent light loads, uniform slab, or traffic loads plus any adjacent footing loads.

Measures should be taken so that hydrostatic pressure does not build up behind retaining walls. Drainage measures, as indicated on Figure 5, should include free-draining granular backfill material and perforated drain pipes, or weepholes lined with polyvinyl chloride (PVC) pipe. Drain pipes should outlet away from structures and retaining walls should be waterproofed in accordance with the recommendations of a qualified civil engineer or architect.

For passive resistance to lateral loads, we recommend that a passive lateral earth pressure of 300 psf/ft above groundwater and 130 psf/ft below groundwater be used up to a value of 2,000 psf. This value assumes that the ground surface is horizontal for a distance of 10 feet, or three times the height generating the passive pressure, whichever is more. We recommend that the upper 12 inches of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance. For frictional resistance to lateral loads, we recommend that a coefficient of friction of 0.53 be used between soil and soil contacts and/or between soil and cast-against-grade concrete contacts. A coefficient of friction of 0.35 may be used between soil and formed concrete contacts. Passive and frictional resistances may be used in combination, provided the passive resistance does not exceed one-half of the total allowable resistance.

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8.6. Pavement Replacement

Pavement patching in trench areas for this project should be performed in accordance with the USSPWC (Clark County, 2003), which provides specifications for thickness of pavement and underlying aggregate base/CLSM depending on the width of the roadway ROW. The existing asphalt concrete pavement thickness measured in our exploratory borings is provided in Section 6.1.

In areas of pavement removal and patching, pavement saw-cuts should be linear and vertical. The pavement should be saw-cut a few inches beyond the soil excavation as shown on Drawing No. 503AF of the referenced Uniform Standard Drawings for Public Works Construction (Clark County, 2001). Saw-cuts should be adequately cleaned and then coated with an appropriate tack-coat prior to placement of new pavement.

8.7. Concrete and Corrosion Considerations

The corrosion potential of on-site soils to concrete was evaluated in the laboratory using representative samples obtained from the exploratory borings. Laboratory testing was performed to assess the effects of sulfate content on concrete. Results of these tests are presented in Appendix C. Recommendations regarding concrete to be utilized in construction of proposed improvements and for buried metal pipes are provided in the following sections.

8.7.1. Concrete

Chemical tests performed on selected samples of on-site soils indicated sulfate contents ranging from 0.02 to 0.47 percent by weight. Based on review of the referenced International Building Code (ICC, 2012) and American Concrete Institute manual (ACI, 2005), the tested soil is considered negligibly to severely deleterious to concrete. Accordingly, we recommend that concrete in contact with on-site soils, along with subsurface walls up to 12 inches above finished grade, contain Type V cement and have a design compressive strength of 4,500 pounds per square inch (psi). In accordance with Section 501 of the referenced USSPWC, concrete in contact with on-site soils should

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have a water-cement ratio of 0.45 by weight. In addition, it is recommended that reinforcing bars in cast-against-grade concrete be covered by approximately 3 inches or more of concrete. Concrete should be placed with an approximate 4-inch slump and good densification procedures should be used during placement to reduce the potential for honeycombing. Concrete samples should be obtained, as indicated by ACI manual Section 318 (ACI, 2005), and the slump should be tested at the site by the project's geotechnical consultant. Structural concrete should be placed in accordance with American Concrete Institute (ACI, 2005) and project specifications.

8.7.2. Buried Metal Pipes

Ninyo & Moore recommends that corrosion reduction methods be implemented for this project for buried metal pipes. These corrosion reduction methods may include utilization of protective coatings, pipe sleeving, and/or appropriate cathodic protection as recommended by a qualified corrosion engineer. Where permitted by jurisdictional building codes, the use of plastic pipes for buried utilities should also be considered.

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9. PLAN REVIEW

The recommendations presented in this report are based on preliminary design information for the proposed project, as provided by Atkins personnel, and on the findings of our geotechnical evaluation. When finished, project plans and specifications should be reviewed by the geotechnical consultant prior to submitting the plans and specifications for bid. Additional field exploration and laboratory testing may be needed upon review of the project design plans.

10. PRE-CONSTRUCTION MEETING

We recommend that a pre-construction meeting be held. The owner or the owner's representative, the civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the plans and the project.

11. OBSERVATION AND TESTING

A qualified geotechnical consultant should perform appropriate observation and testing services during earthwork and construction operations. These services should include observation of removal of soft, loose, or otherwise unsuitable soils, evaluation of subgrade conditions where soil removals are performed, and performance of observation and testing services during placement and compaction of structural fill and backfill soils. The geotechnical consultant should also perform observation and testing services during placement of concrete, mortar, grout, asphalt concrete, and steel reinforcement.

12. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

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This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent

evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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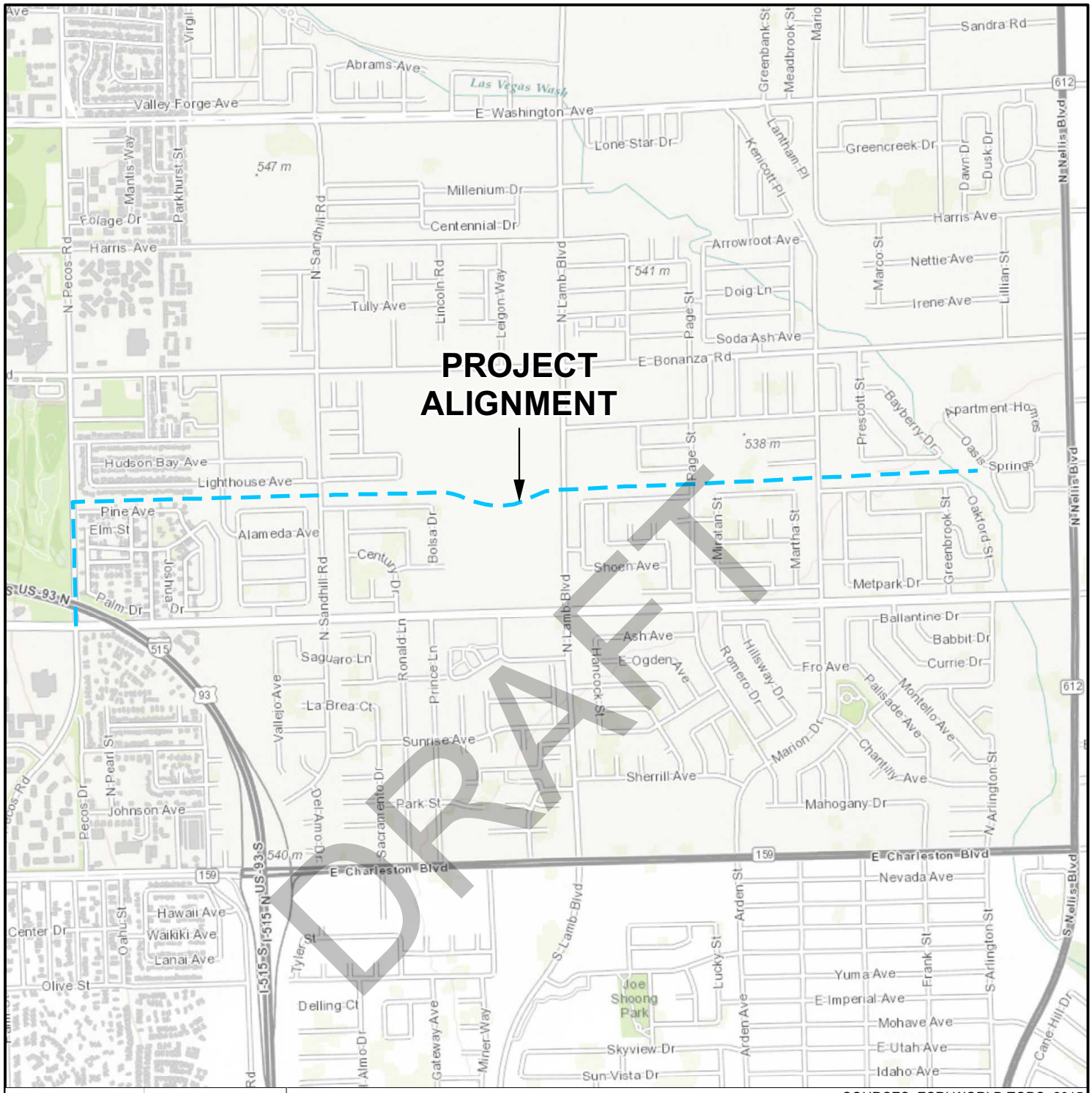
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SOURCES: ESRI WORLD TOPO, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710001_SL.mxd 4/7/2015 3:32:13 PM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

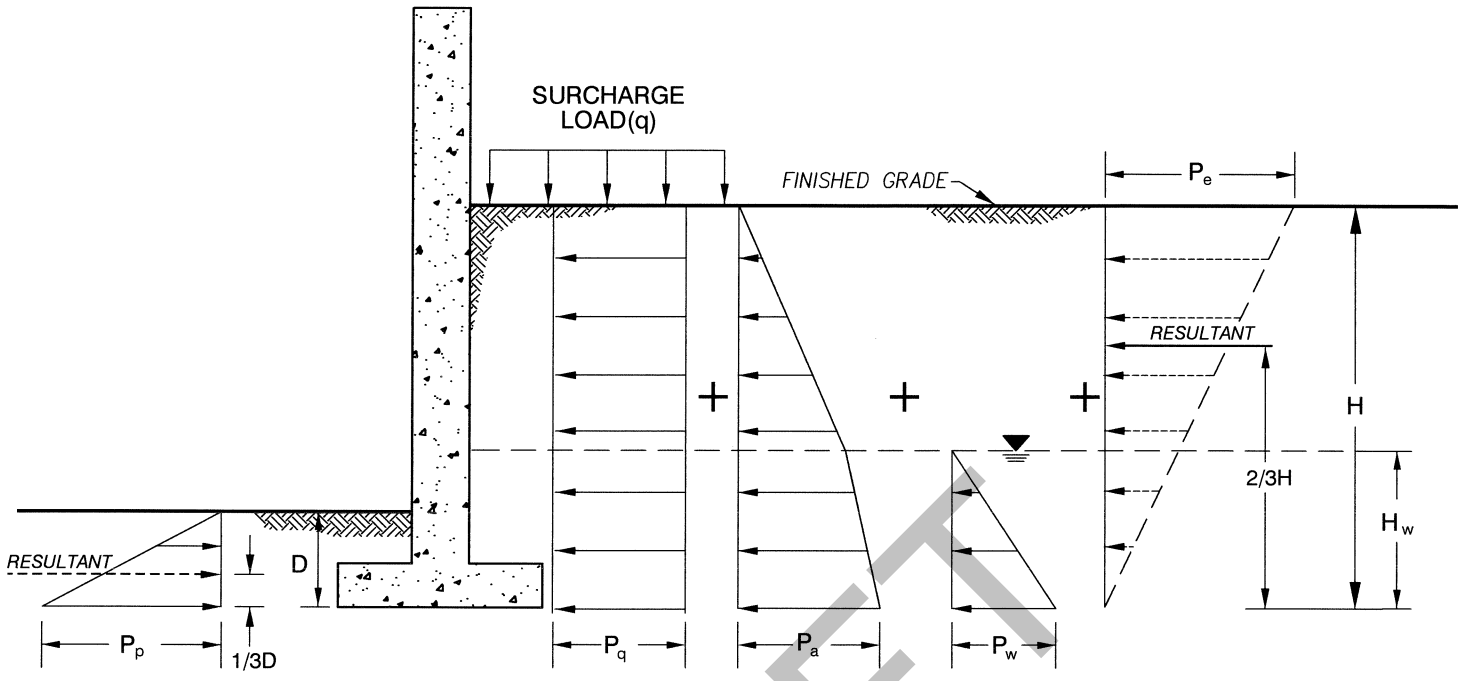
NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2
303710001	4/15		

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NOTES:

1. ASSUMES NON-EXPANSIVE BACKFILL MATERIALS
2. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON AN EFFECTIVE PEAK GROUND ACCELERATOR OF 0.20g
3. H, H_w, AND D ARE IN FEET

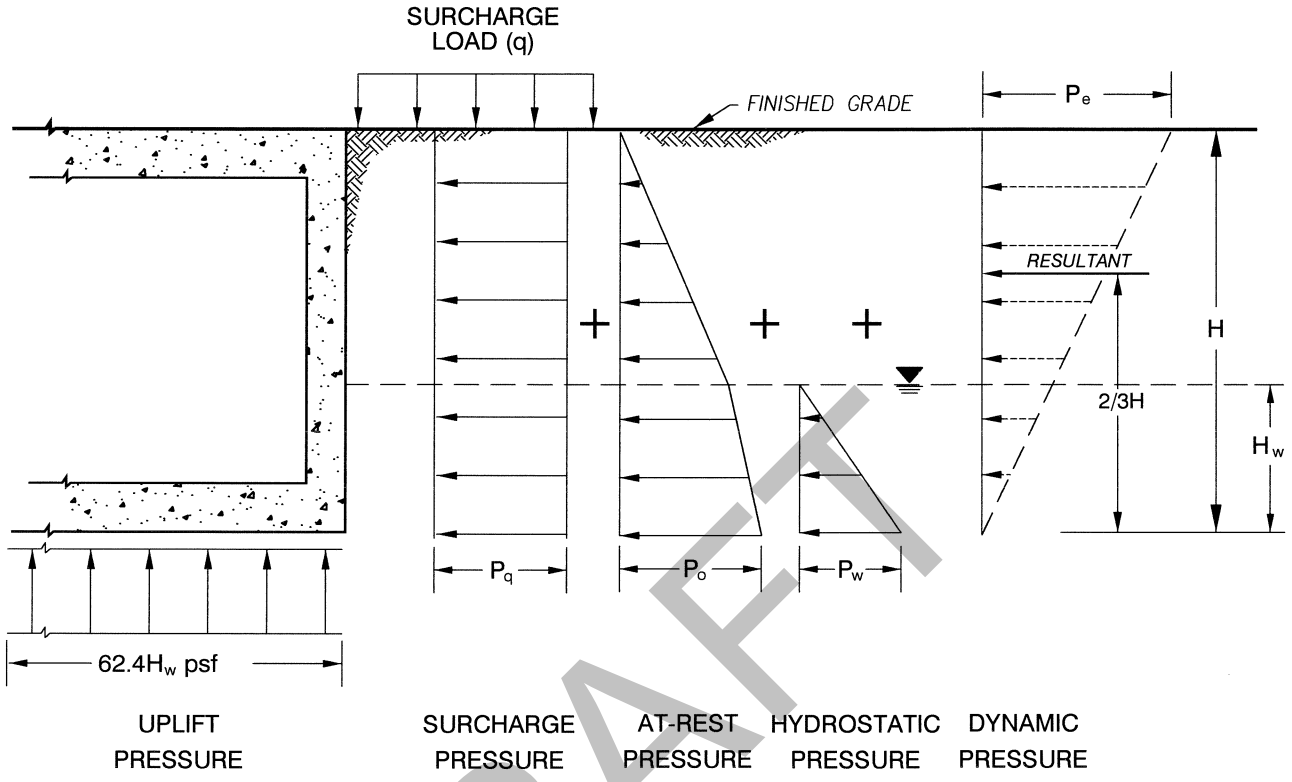
RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

Lateral Earth Pressure	Equivalent Fluid Pressure (psf/ft)	
	Level Backfill with Granular Soils	Below Groundwater
P_p	300D	130D
P_q	0.36q	0.36q
P_a	43H	$43(H-H_w)+21H_w$
P_w	--	$62.4H_w$
Resultant	Force per unit of wall	
P_e	8H	8H

NOT TO SCALE

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Ninyo & Moore	LATERAL EARTH PRESSURES FOR YIELDING RETAINING WALLS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	3



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NOTES:

1. ASSUMES NON-EXPANSIVE BACKFILL MATERIALS
2. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON AN EFFECTIVE PEAK GROUND ACCELERATOR OF 0.20g
3. H, H_w, AND D ARE IN FEET

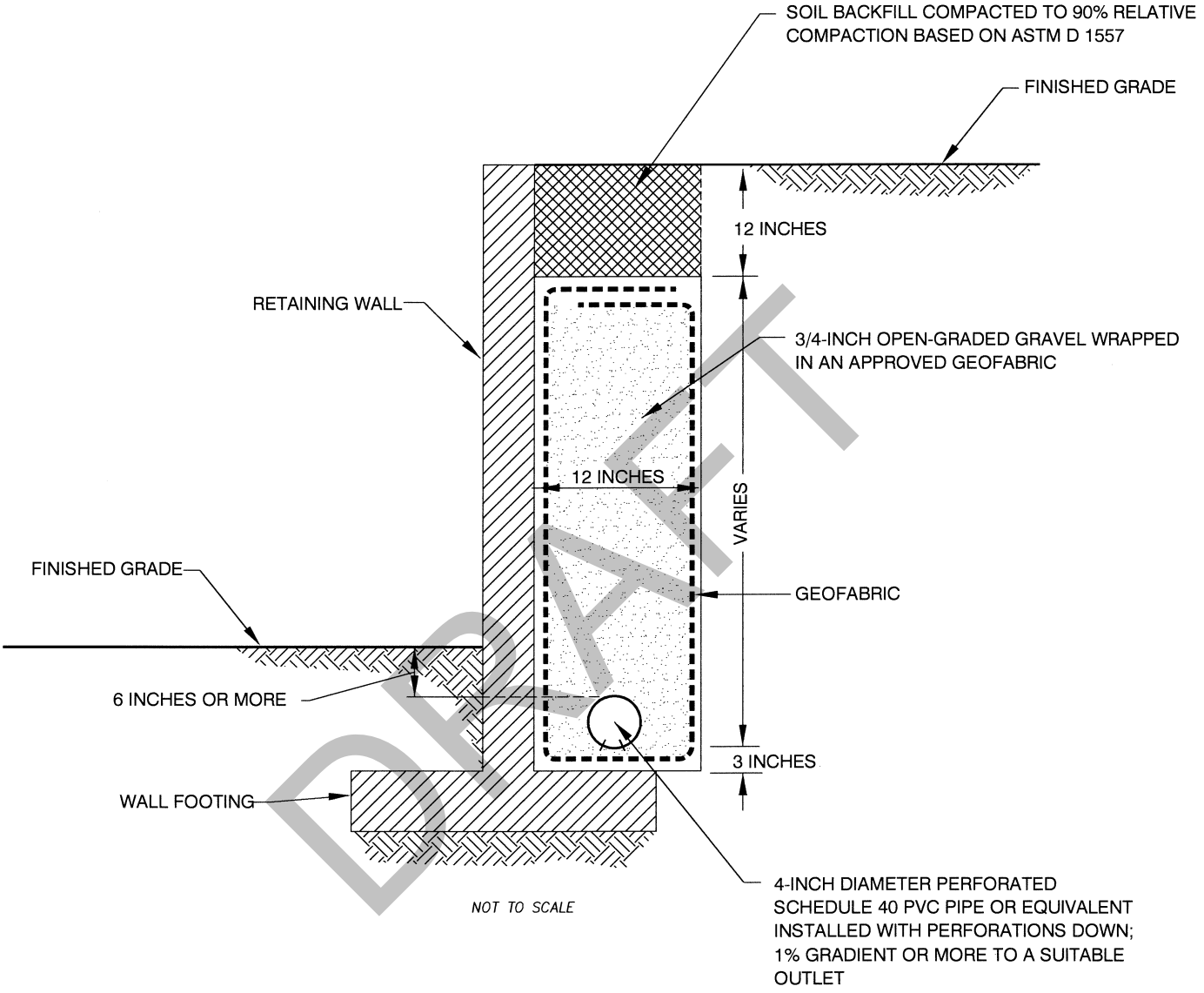
RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

Lateral Earth Pressure	Equivalent Fluid Pressure (psf/ft)	
	Level Backfill with Granular Soils	Below Groundwater
P_p	300D	130D
P_q	0.53q	0.53q
P_o	64H	$64(H-H_w)+31H_w$
P_w	--	$62.4H_w$
Resultant	Force per unit of wall	
P_e	18H	18H

NOT TO SCALE

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Ninyo & Moore		LATERAL EARTH PRESSURES FOR RESTRAINED RETAINING WALLS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	4
303710001	4/15		



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NOTES: AS AN ALTERNATIVE, AN APPROVED GEOCOMPOSITE DRAIN SYSTEM MAY BE USED.

AS AN ALTERNATIVE TO USE OF 4" DIAMETER PVC BACKDRAINAGE PIPES, WEEP HOLES CAN BE CORED THROUGH THE WALL AND LINED WITH PVC PIPE. WEEP HOLES SHOULD BE 3" DIAMETER AND PLACED APPROXIMATELY 3" ABOVE THE LOWEST ADJACENT FINISHED GRADE AT APPROXIMATELY 10' ON-CENTER.

Ninyo & Moore	RETAINING WALL DRAINAGE DETAIL	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	5

Apr 08, 2015 - 6:26pm
303710001 d-rwdd.dwg

Appendix C-3

Draft Hydrogeologic Aquifer Testing Report

Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

HYDROGEOLOGIC AQUIFER TESTING REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 15, 2015
Project No. 303710002

April 15, 2015
Project No. 303710002

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

Subject: Hydrogeologic Aquifer Testing Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith are the results of Ninyo & Moore's hydrogeologic aquifer testing for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purpose of this testing was to estimate the hydrogeologic conditions present along the project alignment which will be utilized in preparation of a National Pollutant Discharge Elimination System (NPDES) discharge permit application for proposed dewatering associated with the project. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

Courtney J. Brooks, CEM
Senior Hydrogeologist

Robert M. Troisi, CEM
Managing Principal
Environmental Sciences Division

CB/NB/RMT/dh

Distribution: (1) Addressee (via e-mail)

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Appendix C – Hydrogeologic Aquifer Test Analyses and Modeling

1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed preliminary hydrogeologic testing for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purpose of this testing was to estimate the hydrogeologic conditions present along the project alignment which will be utilized in preparation of a National Pollutant Discharge Elimination System (NPDES) discharge permit application for proposed dewatering associated with the project. This report presents the methodologies, findings, opinions, conclusions, and recommendations regarding the hydrogeologic conditions along the project alignment.

This study was performed concurrently with a geotechnical evaluation, also performed by Ninyo & Moore. A report presenting the results of the geotechnical evaluation (Ninyo & Moore, 2015) was submitted under separate cover.

2. SCOPE OF SERVICES

In accordance with our approved scope of work, Ninyo & Moore performed the following tasks.

- Coordinated the installation and development of four temporary groundwater monitoring wells collocated in geotechnical borings B-1, B-2, B-6, and B-20 advanced along the project alignment.
- Collected groundwater samples from temporary monitoring wells to measure groundwater quality. The water samples were submitted to an NDEP-certified analytical laboratory in accordance with chain-of-custody procedures.
- The groundwater samples were analyzed for the following NDEP Profile I parameters and General *DeMinimis* groundwater discharge application Category 4 parameters, as well as perchlorate and fecal coliform bacteria.
- Multiple falling head and rising head tests were performed in the temporary monitoring wells to estimate the aquifer conditions at each location. The aquifer test data was analyzed to estimate the hydraulic conductivity values in the vicinity of the proposed excavations.
- Hydrogeologic data derived from this study was utilized to create multiple finite difference groundwater models, which simulated various well configurations and pumping scenarios to estimate the expected pumping rates capable of dewatering the excavations to target levels.

- The hydrogeologic data and groundwater model output from this study may be utilized to prepare an NDEP NPDES discharge permit application for the proposed dewatering program.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

4. FINDINGS

Ninyo & Moore performed hydrogeologic testing to obtain information to prepare a General *DeMinimus* groundwater discharge permit application for submittal to the NDEP. Our findings are summarized in the sections below.

4.1. Monitoring Well Installation

Beginning on March 6, 2015, Ninyo & Moore observed the installation of four temporary groundwater monitoring wells collocated in geotechnical borings B-1, B-2, B-6 and B-20. The monitoring well boring depths ranged from approximately 15 to 25 feet below existing

grade with truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The temporary groundwater monitoring wells consist of 2-inch diameter, 0.02-inch factory-machine slotted screens flush-threaded to 2-inch diameter schedule 40 polyvinyl chloride blank casing to the existing grade. Clean silica sand filter material was placed in the annulus around the perforated section of each casing. Upon completion, Ninyo & Moore staff utilized a submersible development pump with clean, dedicated tubing to remove the fine materials from the well casings and filter packs. The temporary monitoring wells were abandoned upon completion of testing. The approximate locations of the temporary monitoring wells are shown on Figure 2.

It is anticipated that the target of dewatering will be to lower the groundwater level to approximately 3 feet below the estimated maximum design depth of the planned channel excavations. Based on preliminary design specifications and our conversations with Atkins personnel, it is our understanding that the channel invert elevations along the alignment will range from approximately 1,745.5 feet above mean sea level (AMSL) near B-20 to 1,780 feet AMSL near B-1.

Subsurface geotechnical and hydrologic conditions observed as part of Ninyo & Moore's geotechnical study (Ninyo & Moore, 2015), which was submitted under separate cover, were reviewed as part of this study.

4.2. Groundwater

Groundwater was encountered in 12 of 20 exploratory borings advanced as part of Ninyo & Moore's geotechnical evaluation for the subject project. Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, surface water seepage through expansion joints in the existing channel, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this

study. Table 1 summarizes the groundwater and invert elevations observed in our borings performed as part of Ninyo & Moore's geotechnical evaluation for the subject project.

4.3. Groundwater Sampling and Analysis

Following development and purging, the temporary monitoring well was sampled utilizing clean disposable polyethylene bailers. The groundwater samples were placed in clean, laboratory-supplied containers and labeled according to the sample location, date, analysis requested, and the name of the person collecting the sample. The samples were stored in an insulated cooler, preserved on ice, and delivered under chain-of-custody protocol to an NDEP-certified laboratory for water quality analysis. The groundwater samples were analyzed for NDEP Profile I and General DeMinimis groundwater discharge Category 4 parameters, as well as for fecal coliform bacteria and perchlorate by EPA Method 331.

Tables 2 through Table 4 summarize the sample analytical results for the parameters. The analyte concentrations are printed in bold for samples that are reported above the NDEP Profile 1 and/or Category 4 recommended discharge limits. These include Sulfate and Total Dissolved Solids (TDS) in B-1, B-2, B-6 and B-20, and Chloride in B-1 and B-20. Copies of the complete laboratory report and chain-of-custody record are presented in Appendix B.

4.4. Hydrogeologic Aquifer Testing

Multiple hydraulic displacement (slug) tests were performed in the temporary monitoring well to estimate aquifer characteristics in the vicinity of the proposed excavations. The procedure involved the sudden introduction of a mechanical slug into (falling head), or the sudden removal of the mechanical slug from (rising head) the well casing. These actions caused the groundwater level to rise or fall, respectively. The water level displacement and subsequent rate of recovery was recorded and later analyzed utilizing the hydrogeologic software, Aqtesolv™, to estimate the hydraulic conditions of the aquifer in the vicinity of the monitoring well. The data analysis included the Hvorslev method (1951) and the Bouwer and Rice method (1976 and 1989), two comparable techniques for estimating the hydraulic

conductivity (K) from slug displacement test data (rising and falling head) in unconfined aquifers.

The displacement test analyses for the temporary monitoring wells, which are summarized in Appendix C, ranged from 0.8 feet per day (ft/d) to 33.2 ft/d. Data for the full hydrogeologic analysis is presented in Appendix C.

It is our understanding that the target dewatering depth for the channel excavations is approximately 3 feet below the deepest expected invert depth along the alignment.

4.4.1. Assumptions

It is assumed that no more than 500 linear feet of excavation will be open at one time during construction operations. It is expected that groundwater discharged from the dewatering systems will be pumped to one or more settling tanks, as necessary, prior to discharge to the same wash down gradient from the dewatering operations.

4.4.2. Finite Modeling

The hydraulic conductivity values were incorporated into numerical, finite difference, groundwater models to simulate the expected water level changes caused by various pumping scenarios under the modeled conditions.

The groundwater model processing platform, Groundwater Vistas, was utilized to create groundwater simulations utilizing the Modflow method (2007). Computerized finite difference groundwater models were set out on a grid with uniform 10 feet row and column spacings. The models assume that homogeneous and isotropic aquifer conditions exist horizontally across the grid similar to those ascertained from lithologic drill log and aquifer tests obtained from the temporary monitoring wells. The models' general head boundaries create a slight west to east trending water table gradient, mimicking the regional gradient across that portion of the Las Vegas Valley. The models were run until steady-state groundwater conditions were achieved. Multiple simulations

were performed with varying numbers and configurations of wells to estimate the desired water-table changes.

Groundwater was measured in our geotechnical borings at elevations ranging from approximately 1,742.1 to 1,783.2 feet AMSL, which is approximately 3.6 to 5.8 feet above the anticipated target dewatering depths in the western portion of the alignment. As the water in the lined channel could possibly be feeding the shallow alluvial aquifer due to seepage via expansion joints, depth to groundwater may decrease with closer proximity to the existing channel base, thereby increasing the potential need for additional dewatering during construction of the proposed channel improvements. However, this study cannot confirm this assumption. . In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, it is not likely to require dewatering of more than 3 feet. Ninyo & Moore prepared three groundwater models to simulate the effect of 6 dewatering wells set at 100-foot intervals along a 500-foot transect near B-1, B-6, and B-20 which simulate 500-linear foot cut and fill trenches.

The simulated wells in each model were assumed to be 10 inches in diameter and screened to 10 feet below the target dewatering elevations. The wells were programmed to pump at a constant rate for the duration of each simulation until steady state conditions were achieved.

Based on the hydrogeologic conditions and assumptions described above, the model simulations were performed utilizing the highest estimated hydraulic conductivity values for each end of the proposed excavation (near Pecos Road and near Las Vegas Wash). Based on our hydrogeologic analysis, a combined flow rate ranging from approximately 6 gallons per minute (gpm) to 18 gpm could be expected to lower the water table approximately 5 to 6 feet within an adjacent 500 linear foot trench in the western portion of the alignment. In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, a flow rate of approximately 120 gpm could be expected to lower the water

table approximately 3 feet within an adjacent 500 linear foot trench. These combined flow rates would be less than the 250 gpm threshold limit for a *DeMinimis* discharge permit.

Due to the very limited number of field tests relative to the length of the proposed alignment, the predicted dewatering flow rates should be treated as estimates only and not considered a dewatering design plan. Aquifer conditions may vary across the approximately 10,400 linear feet alignment where hydrogeologic testing was not performed. The hydrogeologic aquifer testing and analyses and modeling are summarized in Appendix C.

5. SUMMARY

A summary of our findings are presented as follows:

- Groundwater was measured in our geotechnical borings at elevations ranging from approximately 1,742.1 to 1,783.2 feet AMSL, which is approximately 3.6 to 5.8 feet above the anticipated target dewatering depths along the western portion of the project alignment. Ninyo & Moore recommends that the client apply for a *DeMinimis* discharge permit.

- As the water in the existing lined channel could possibly be feeding the shallow alluvial aquifer in the area, depth to groundwater may decrease with closer proximity to the channel base, thereby increasing the potential need for additional dewatering during construction of proposed channel improvements.

- Based on our hydrogeologic analysis, a combined flow rate ranging from approximately 6 gpm to 18 gpm could be expected to lower the water table approximately 5 to 6 feet within an adjacent 500 linear foot trench in the western portion of the alignment. In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, a flow rate of approximately 120 gpm could be expected to lower the water table approximately 3 feet within an adjacent 500 linear foot trench. These flow rates would be less than the 250 gpm threshold limit for a *DeMinimis* discharge permit. Due to the relatively tight hydraulic conditions measured during this study, a modeled interval of 100-feet between wells was modeled instead of the typical 50-feet interval. If field conditions are found to require a more robust pumping operation, additional wells set at a shorter interval may be necessary.

- Based upon a review of the laboratory results for the groundwater samples collected from the temporary monitoring wells B-1, B-2, B-6 and B-20, the following parameters reported

concentrations above the NDEP recommended discharge limits: Sulfate and Total Dissolved Solids (TDS) in B-1, B-2, B-6 and B-20, and Chloride in B-1 and B-20. Treatment of the discharge waters would not likely be required for a *DeMinimis* permit.

6. OPERATIONAL MONITORING RESPONSIBILITIES

Ninyo & Moore recommends that the following bulleted list of issues be considered prior to commencing with the proposed dewatering operation:

- The NDEP General *DeMinimis* discharge permits, when approved, will be issued to the owner, along with a list of limitations and a compliance reporting schedule. Ninyo & Moore recommends that the owner require the dewatering contractor to fully comply with permit conditions, and be responsible for any violations and penalties incurred due to non-compliance.

- Based on the results of this study, to adequately dewater the proposed excavations as planned, the discharge rate is not likely to exceed the 250 gpm limit for a NDEP *DeMinimis* discharge permit for each outfall.

- During the planned construction, the operation of the dewatering wells should be closely monitored to ensure that all compliance monitoring and testing are performed, as will be required by the NDEP General *DeMinimis* groundwater discharge permit.

- Existing structures within the limits of groundwater drawdown resulting from dewatering may be at risk of experiencing settlement. The amount of settlement, if it occurs, would depend primarily on the depth and duration of the dewatering, as well as subsurface soil conditions. It is recommended that survey points be installed and monitored to evaluate potential settlement of nearby structures and that a photographic survey of the adjacent structures be conducted to monitor evidence of distress prior to the beginning of dewatering operations. If significant movement/damage occurs, dewatering operations should be temporarily suspended and the project's geotechnical consultant/owner's representative should be informed. Recommendations for mitigating settlement and associated distress should be provided by the geotechnical consultant/owner's representative.

- There is a potential for hydrogeologic conditions to be encountered that might require additional dewatering wells, deeper dewatering wells, and/or increased groundwater pumping and increased discharge rates to achieve the dewatering goal for the planned excavations. If an increased discharge rate is required, the NDEP might require from 6 to 9 months for issuing a new permanent NPDES permit for an increased discharge rate for this project.

7. LIMITATIONS

The dewatering discharge estimates provided in this report have been estimated from limited hydrogeologic testing performed at one location. The estimates presented in this report should be used for initial planning purposes and completion of the discharge permit only. The estimates are not presented, nor should they be construed, as a dewatering design plan.

The environmental and hydrological services described in this report have been conducted in general accordance with current regulatory guidelines and the standard of care exercised by consultants performing similar work in the project area. No other warranty, expressed or implied, is made regarding the professional opinions presented in this report. Please note that this study is based on a limited scope of work, and it did not include an extensive evaluation of geotechnical conditions or potential geologic hazards.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires any additional information or has questions regarding the content, interpretations presented, or completeness of this document.

The findings, opinions, and conclusions are based on an analysis of the observed site conditions and the referenced literature. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control. Ninyo & Moore cannot warrant or guarantee that not finding indicators of any particular hazardous material means that this particular hazardous material or any other hazardous materials do not exist in the groundwater below the site. Additional research, including additional chemical and hydrological testing, can reduce the uncertainty, but no techniques now commonly employed can eliminate the uncertainty altogether.

8. NEVADA CERTIFIED ENVIRONMENTAL MANAGER

In accordance with the Nevada Revised Statutes 459.500, Section 1, a holder of a certificate who is responsible for a service requiring certification shall ensure that each document relating to the service includes the following language:

> *I, Robert M. Troisi, hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state, and local statutes, regulations, and ordinances.*

Robert M. Troisi, CEM
Certified Environmental Manager
No. 1247
Expires: January 15, 2017

4/15/15
Date

9. REFERENCES

Bouwer, Herman and R.C. Rice, 1976, A Slug Test for determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, v. 12, pp 423-428.

Bouwer, Herman, 1989, The Bouwer and Rice Slug Test – An Update, Ground Water, vol. 27 No.3, pp 304-309.

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HydroSOLV, 2007, Aquifer Test SOLVer (AQTESOLV), ver 4.50, August 2007.

Hvorselv, M.J., 1951, Time Lag and Soil Permeability in Groundwater Observations, Bull, 36, Waterways Experimental Station, U.S. Army Corps of Engineers, Vicksburg, Mississippi, pp 1-50

Ninyo & Moore, 2015, Geotechnical Interpretive Report, Las Vegas Wash Central Cedar Avenue Channel Facility, Las Vegas, Nevada: dated April 10.

Ninyo & Moore, proprietary in-house data.

TABLES

Table 1 –Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Invert Elevation (feet-amsl)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)	Dewatering Target Depth below Static Groundwater (feet)
B-1	1795.4	1,780.4	12.2	1,783.2	5.8
B-2	1791.6	1,776.6	12.7	1,778.9	5.3
B-3	1783.9	1,773.9	8.2	1,775.7	4.8
B-4	1781.9	1,771.9	8.4	1,773.5	4.6
B-5	1779.6	1,771.6	6.9	1,772.7	4.1
B-6	1778.2	1,769.2	8.4	1,769.8	3.6
B-10	1772.5	1,764.5	13.6	1,758.9	0
B-16	1764.1	1,755.1	13.6	1,750.5	0
B-17	1761.7	1,752.7	15.4	1,746.3	0
B-18	1762.3	1,748.3	18.4	1,743.9	0
B-19	1761.7	1,748.7	18.7	1,743.0	0
B-20	1760.5	1,745.5	18.4	1,742.1	0

*Measured from top of ground surface adjacent to borings.

Table 2 - Groundwater Analytical Results - Metals							
Analyte						Groundwater Standards	
	B-1	B-2	B-6	B-20	Reporting Limit	Federal	RSL
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Alluminum	3.2	0.12	<0.25	<0.25	0.25		
Antimony	<.0005	<.0005	<.0005	<.0005	0.0005	0.006	0.015
Arsenic	0.0064	0.0047	0.0058	0.0019	0.0001	0.010	0.000045
Barium	0.12	0.012	0.0057	<0.001	0.0010	2	2.6
Beryllium	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.004	0.073
Boron	2.2	0.4	0.78	1.7	0.05		7.3
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.005	0.018
Calcium	310	140	230	260	0.5		
Chromium	0.0047	0.0011	0.0012	<0.001	0.0010	0.1	55
Copper	<0.001	<0.001	<0.001	<0.001	0.0010	1.3	1.5
Iron	1.3	<0.5	<0.5	<0.0005	0.0005	0.30	26
Lead	<0.005	<0.001	<0.001	<0.001	0.001	0.015	
Manganese	0.039	<0.0005	<0.0005	0.0068	0.0005	0.05	0.88
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.002	0.011
Magnesium	370	200	290	410	0.1		
Molybdenum	0.005	0.012	0.0022	0.094	0.0005		0.18
Nickel	0.0019	<0.001	<0.001	<0.001	0.0010		0.73
Potassium	61	19	39	50	5		
Selenium	0.0068	0.0021	0.0075	0.024	0.001	0.05	0.18
Silver	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.1	0.18
Sodium	320	110	220	390	25		
Thallium	<0.0025	<0.0005	<0.0005	<0.0005	0.0005	0.002	0.0024
Zinc	<0.01	<0.01	<0.01	<0.01	0.010	5	11
Chloride	**480**	94	240	**390**	50	250	
Fluoride	1.3	0.96	1.4	2.4	0.5	4	2.20
Nitrogen, Nitrite (as N)	<0.5	<0.5	<0.5	<0.5	0.5	1	1
Nitrogen, Nitrate (as N)	4.5	1	4.4	6.3	0.5	10	10
Sulfate	**2400**	**880**	**1400**	**2200**	200	250	
Sulfur	820	370	630	920	50		
Hardness, Calcium (As $CaCO_3$)	780	340	580	650	0.5		
Hardness, Total	2300	1200	1800	2300	1		
pH (pH units)	7.6	7.6	7.6	7.4			
Suspended Solids (Residue-Non Filterable)	260	21	15	19	10		
Total Disolved Solids (Residue, Filterable)	**4400**	**1700**	**2700**	**4200**	33	500	
Phosphorus, Total	0.047	<0.02	<0.02	0.048	0.020		
Alkalinity, Bicarbonate (As $CaCO_3$)	440	230	240	290	5		
Alkalinity, Carbonate (As $CaCO_3$)	<5	<5	<5	<5	5		
Alkalinity, Hydroxide (As $CaCO_3$)	<5	<5	<5	<5	5		
Alkalinity, Total (As $CaCO_3$)	440	230	240	290	5		
Bio.Oxygen Demand (BOD) - field measurement	2.31	6.24	6.12	0.96			

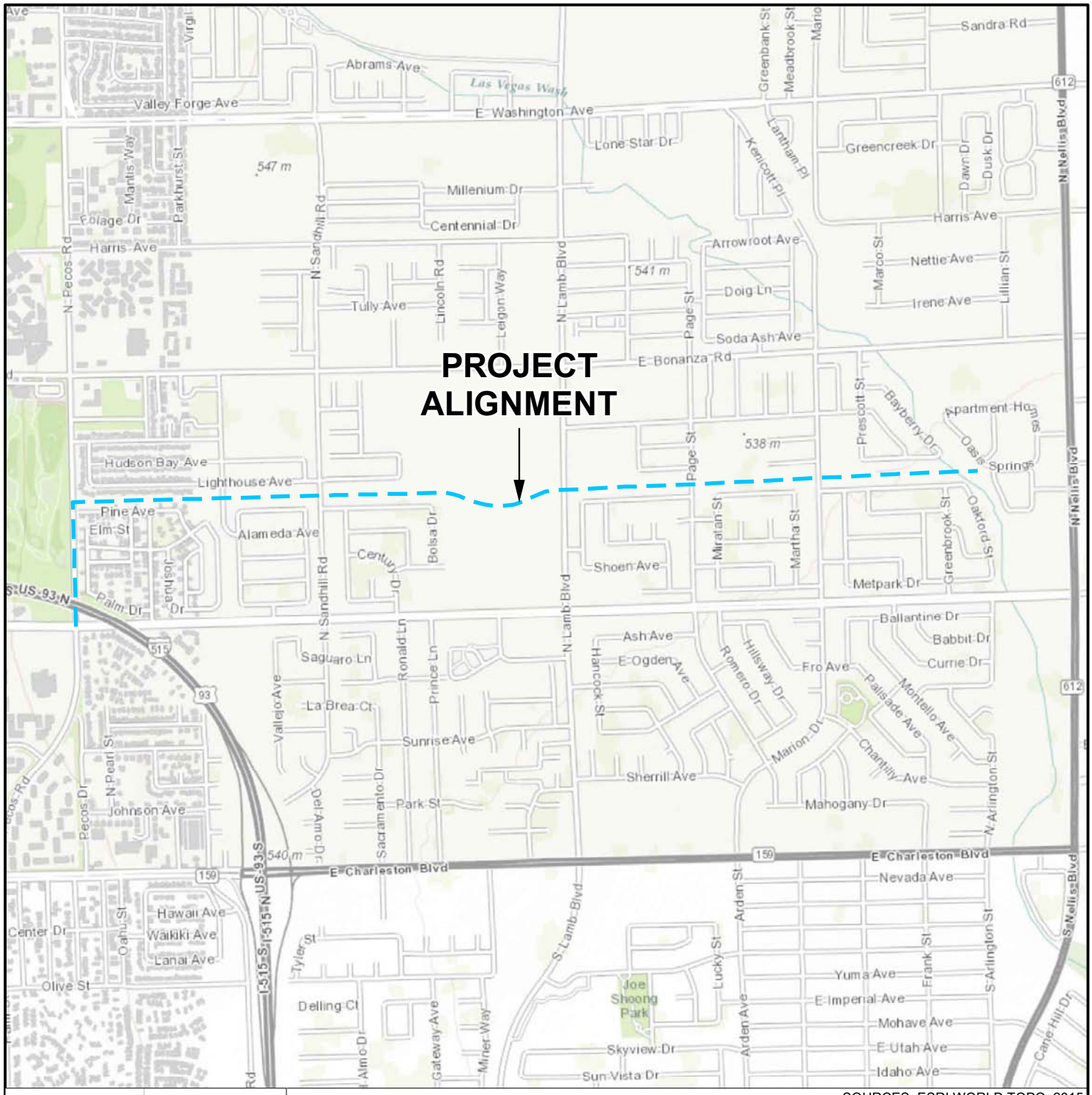
Notes:
RSL - Regional Screening Level

Table 3 - Groundwater Analytical Results - Organics and Biological							
Analyte						Groundwater Standards	
	B-1 (µg/L)	B-2 (µg/L)	B-6 (µg/L)	B-20 (µg/L)	Reporting Limit (µg/L)	Federal (µg/L)	MCL (µg/L)
Benzene	<0.50	<0.50	<0.50	<0.50	0.50	0.39	5.0
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	0.50	1.3	700
m,p-Xylene	<1.0	<1.0	<1.0	<1.0	1.0	190	
Methylene chloride	<2.0	<2.0	<2.0	<2.0	2.0	9.9	5.0
MTBE	<0.50	<0.50	<0.50	<0.50	0.50	12	
o-Xylene	<0.50	<0.50	<0.50	<0.50	0.50	190	
Xylenes, Total	<1.5	<1.5	<1.5	<1.5	1.50		
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	0.50		
Toluene	<0.50	<0.50	<0.50	<0.50	0.50	860.00	1,000
Trichloroethene	<0.50	<0.50	<0.50	<0.50	0.50		

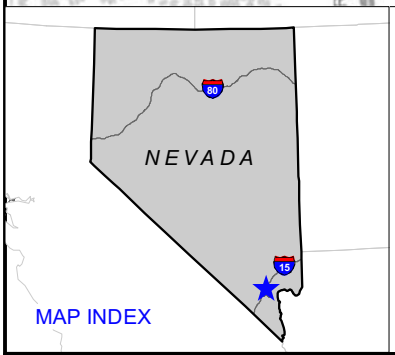
Table 4 - Organochlorine Pesticides and Herbicides							
Analyte						Groundwater Standards	
	B-1	B-2	B-6	B-20	Reporting Limit	Federal	MCL
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
4,4'-DDD (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.027	
4,4'-DDE (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.2	
4,4'-DDT (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.2	
Aldrin (1)	<0.027	<0.027	<0.027	<0.027	0.027	0.004	
alpha-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
alpha-Chlordane (1)	<0.027	<0.027	<0.027	<0.027	0.027		
beta-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Chlordane (1)	<0.27	<0.27	<0.27	<0.27	0.27	0.19	2.0
delta-BHD (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Dieldrin (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.0015	
Endosulfan I (1)	<0.027	<0.027	<0.027	<0.027	0.027	78	
Endosulfan II (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endosulfane sulfate (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endrin (1)	<0.053	<0.053	<0.053	<0.053	0.053	1.7	2.0
Endrin aldehyde (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endrin ketone (1)	<0.053	<0.053	<0.053	<0.053	0.053		
gamma-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
gamma-Chlordane (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Heptachlor (1)	<0.027	<0.027	<0.027	<0.027	0.027	0.0018	0.4
Heptachlor epoxide (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Methoxychlor (1)	<0.27	<0.27	<0.27	<0.27	0.27	27	40
Toxaphene (1)	<2.7	<2.7	<2.7	<2.7	2.7	0.013	3.0
Azinphos-methyl	<2.0	<2.0	<2.0	<2.0	2		
Bulstar (Sulfprofos)	<1.0	<1.0	<1.0	<1.0	1		
Chloropyrifos	<1.0	<1.0	<1.0	<1.0	1	6.200	
Coumaphos	<2.0	<2.0	<2.0	<2.0	2		
Demeton-O & S	<1.0	<1.0	<1.0	<1.0	1		
Diazinon	<1.0	<1.0	<1.0	<1.0	1	7.900	
Dichlorvos	<1.0	<1.0	<1.0	<1.0	1	0.230	
Disulfoton	<1.0	<1.0	<1.0	<1.0	1	0.380	
Ethoprop	<1.0	<1.0	<1.0	<1.0	1		
Fensulfothion	<1.0	<1.0	<1.0	<1.0	1		
Fenthion	<1.0	<1.0	<1.0	<1.0	1		
Malathion	<1.0	<1.0	<1.0	<1.0	1	300.000	
Merphos	<1.0	<1.0	<1.0	<1.0	1		
Methyl parathion	<1.0	<1.0	<1.0	<1.0	1	3.400	
Mevinphos	<2.0	<2.0	<2.0	<2.0	2		
Naled	<2.0	<2.0	<2.0	<2.0	2	31.000	
Phorate	<1.0	<1.0	<1.0	<1.0	1	2.300	
Ronnel	<1.0	<1.0	<1.0	<1.0	1	300.000	
Tetrachlor0vinphos	<1.0	<1.0	<1.0	<1.0	1		
Tokuthion	<1.0	<1.0	<1.0	<1.0	1		
Trichloronate	<1.0	<1.0	<1.0	<1.0	1		

Notes:
(1) - EPA Method 8081A
MCL - Maximum Contaminant Level

FIGURES



SOURCES: ESRI WORLD TOPO, 2015



N

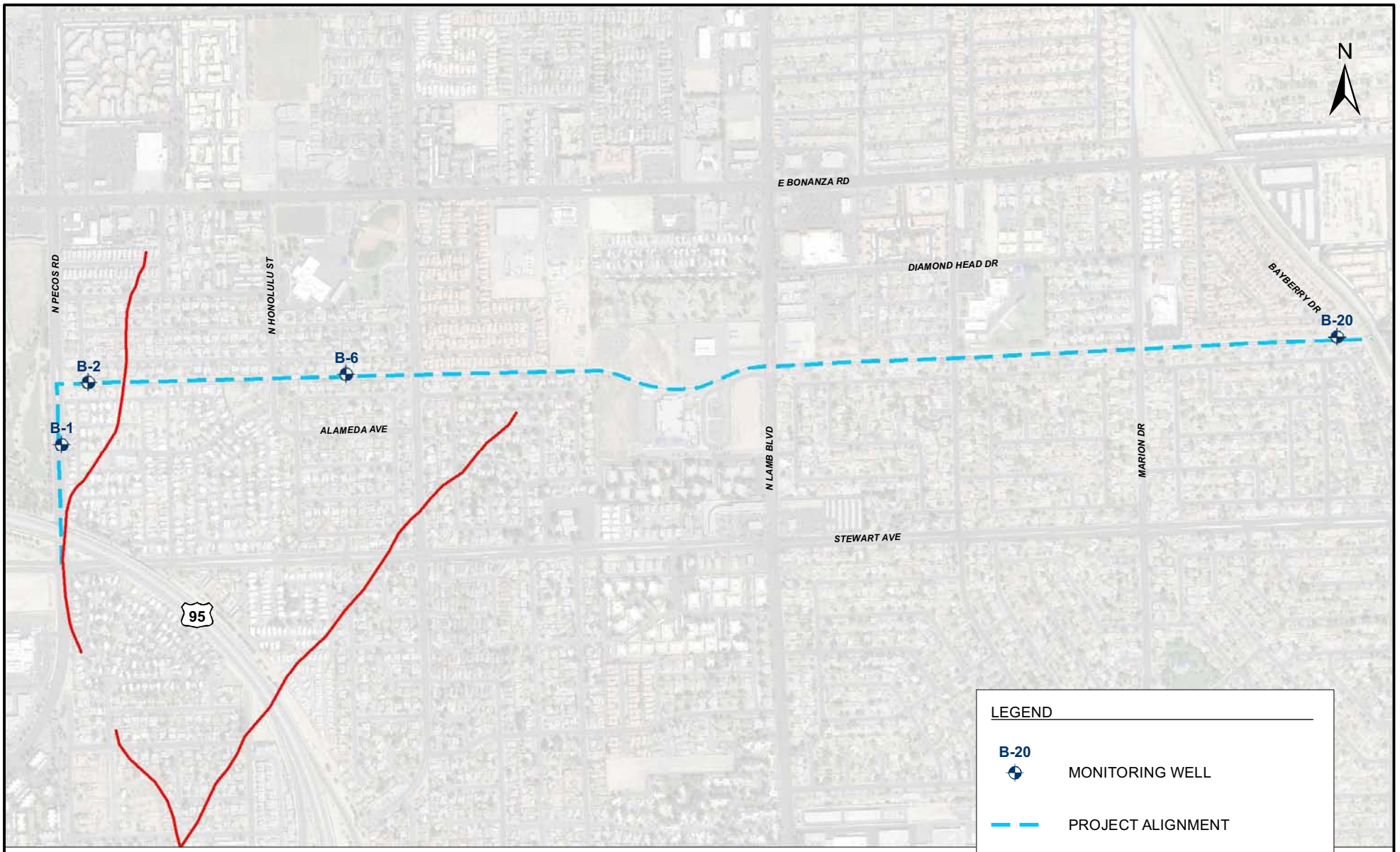
SCALE IN FEET

0 1,500 3,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710002 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710002_SL.mxd 4/14/2015 10:25:03 AM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore	MONITORING WELL LOCATIONS	FIGURE
PROJECT NO. 303710002 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2

2_303710002_BL.mxd 4/14/2015 JDL

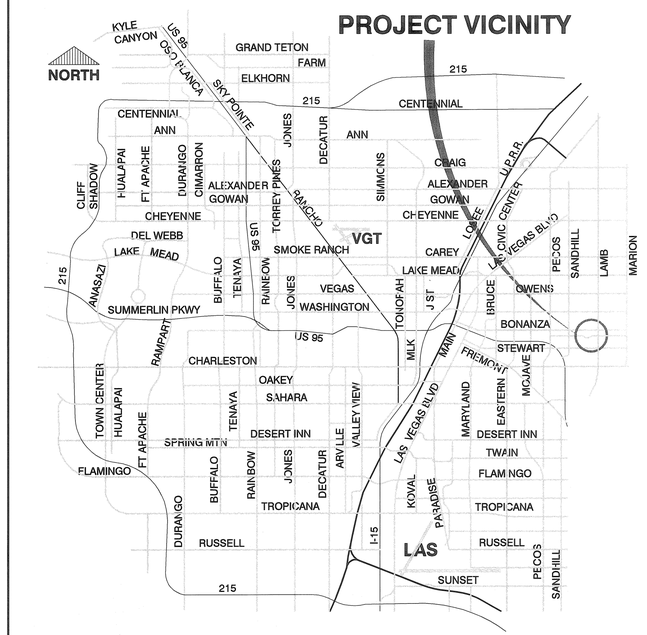
Appendix D

Record of Survey

RECORD OF SURVEY FOR

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

LOCATED IN SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.



VICINITY MAP

N.T.S.

BENCHMARK:

CITY OF LAS VEGAS BENCHMARK
RIVET & PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO.

NAVD 1988 DATUM
ELEVATION = 536.414 METERS
1759.89 FEET

SURVEYOR'S CERTIFICATE

I, ERIC CHRISTIANSON, A PROFESSIONAL LAND SURVEYOR LICENSED IN THE STATE OF NEVADA, CERTIFY THAT:

1. THIS PLAT REPRESENTS THE RESULTS OF A SURVEY CONDUCTED UNDER MY DIRECT SUPERVISION AT THE INSTANCE OF THE CITY OF LAS VEGAS
2. THE LANDS SURVEYED LIE WITHIN SECTIONS 31 AND 32 TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AND THE SURVEY WAS COMPLETED ON MARCH 20, 2015.
3. THIS PLAT COMPLIES WITH THE APPLICABLE STATE STATUTES AND ANY LOCAL ORDINANCES IN EFFECT ON THE DATE THAT THE GOVERNING BODY GAVE ITS FINAL APPROVAL.
4. THE MONUMENTS DEPICTED ON THE PLAT ARE OF THE CHARACTER SHOWN, OCCUPY THE POSITIONS INDICATED AND ARE OF SUFFICIENT NUMBER AND DURABILITY.

ERIC CHRISTIANSON
PROFESSIONAL LAND SURVEYOR
STATE OF NEVADA
NEVADA LICENSE No. 8895

PROFESSIONAL LAND SURVEYOR · STATE OF NEVADA
ERIC CHRISTIANSON
Exp. 12-31-15
No. 8895

6/11/15

NEVADA COORDINATE REFERENCE SYSTEM BASIS OF BEARING AND DATUM STATEMENT

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

TRANSVERSE MERCATOR PROJECTION

STANDARD PARALLEL & GRID ORIGIN:	36°15'00"N
CENTRAL MERIDIAN:	114°58'00"W
FALSE NORTHING:	200,000m 656,166.6667 FEET(US)
FALSE EASTING:	100,000m 328,083.3333 FEET(US)
STANDARD PARALLEL SCALE:	1.0001 (EXACT)

COUNTY RECORDER'S NOTE

ANY SUBSEQUENT CHANGES TO THIS MAP SHOULD BE EXAMINED AND MAY BE DETERMINED BY REFERENCE TO THE COUNTY RECORDER'S CUMULATIVE MAP INDEX NRS 278.5695

SHEET 1 OF 3

RECORD OF SURVEY

PORTIONS OF SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

ATKINS
2270 Corporate Circle.
Suite 200
Henderson, NV 89074-7755
Telephone: 702/263-7275
Fax: 702/263-7200

No. _____

Filed at the request of
Atkins North America, Inc.

Date _____ *Time* _____

File _____ *Page* _____

of SURVEYS
Official Records Book No.

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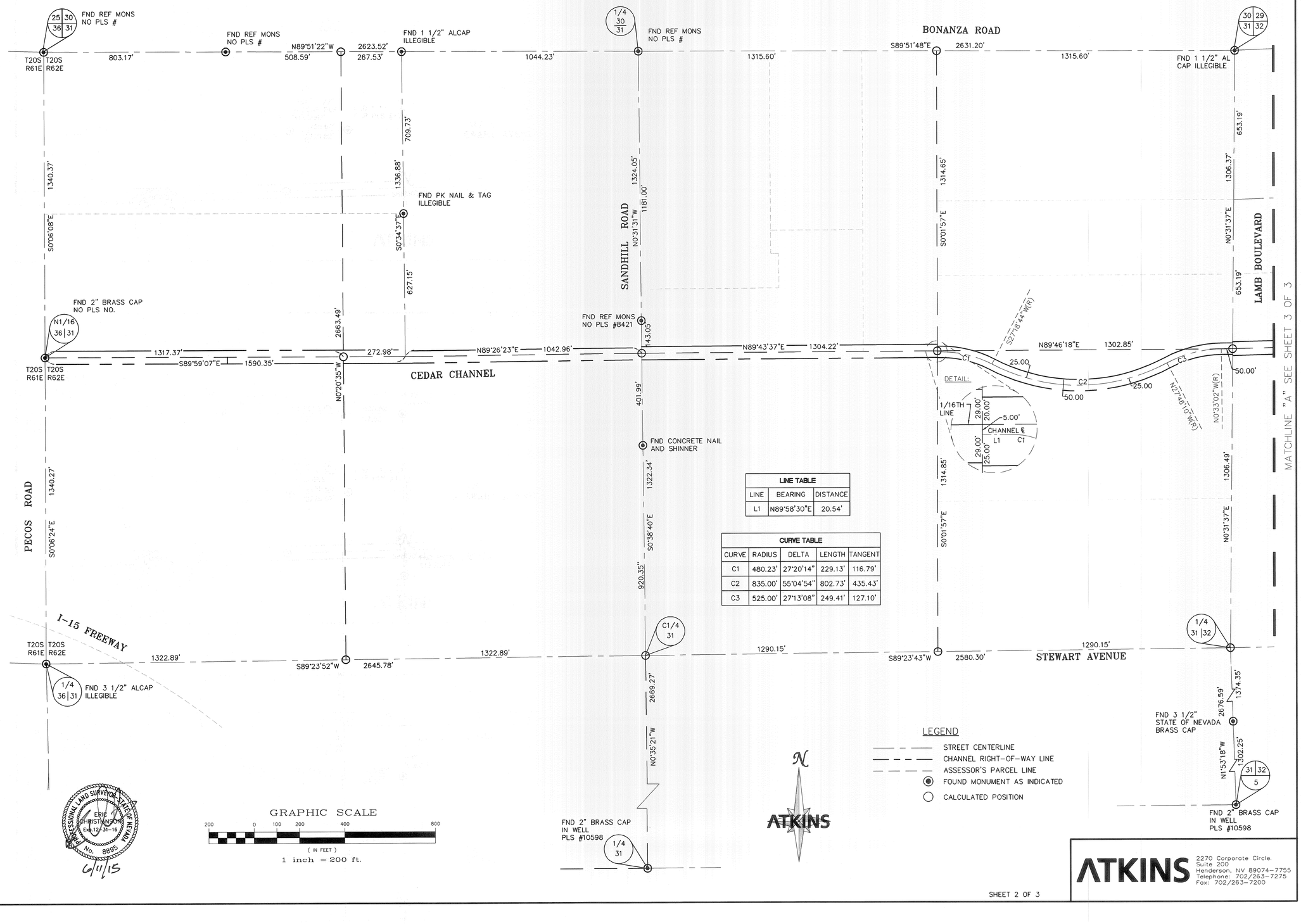
Clark County, Nevada Records
DEBBIE CONWAY, Recorder

Fee _____ *Deputy* _____

RECORD OF SURVEY FOR

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

LOCATED IN SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.



LINE TABLE		
LINE	BEARING	DISTANCE
L1	N89°58'30"E	20.54'

CURVE TABLE				
CURVE	RADIUS	DELTA	LENGTH	TANGENT
C1	480.23'	27°20'14"	229.13'	116.79'
C2	835.00'	55°04'54"	802.73'	435.43'
C3	525.00'	27°13'08"	249.41'	127.10'

LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED
- CALCULATED POSITION

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)

1 inch = 200 ft.

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTIANSON
EXP. 12-31-16
No. 8895

6/11/15

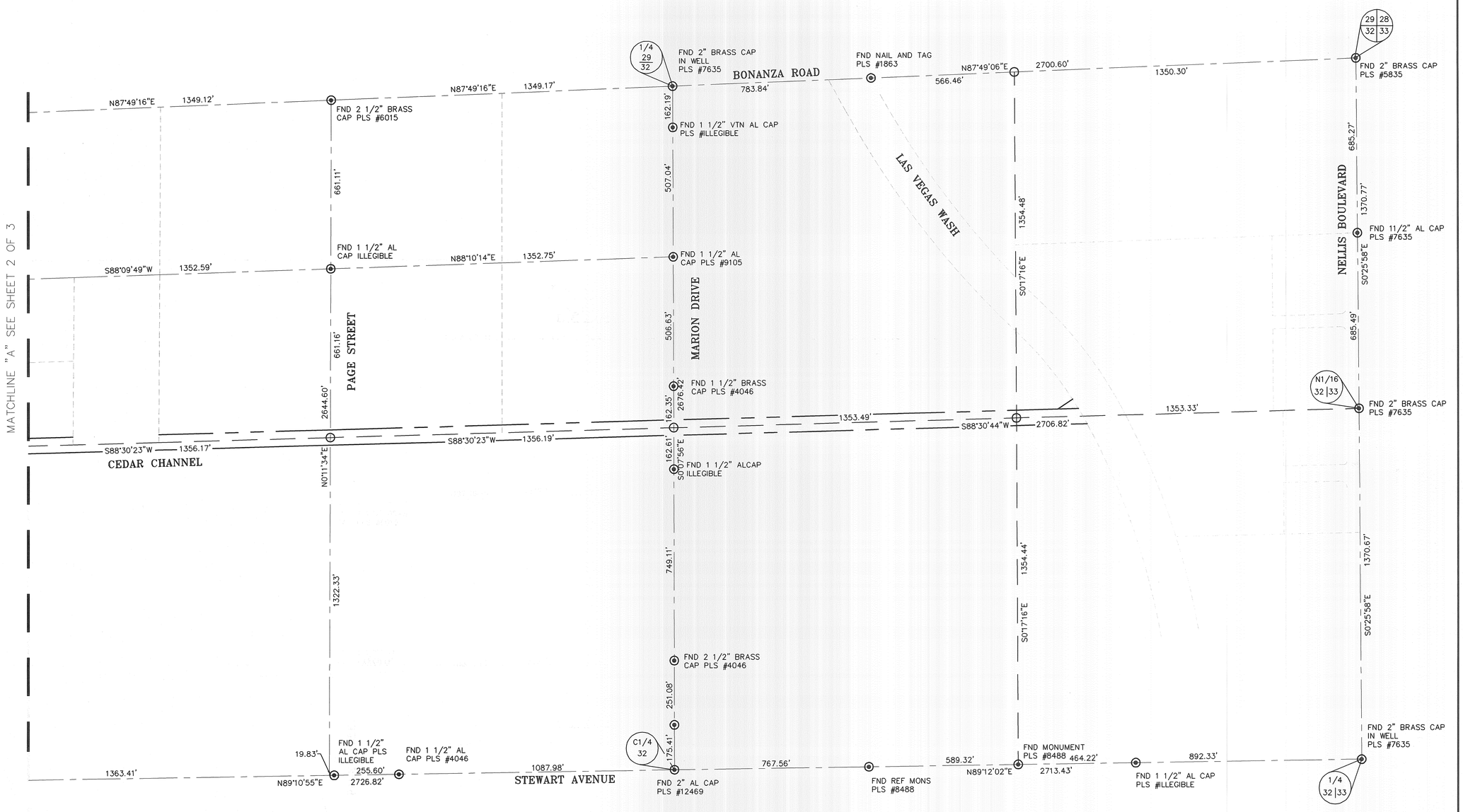
SHEET 2 OF 3

ATKINS
2270 Corporate Circle.
Suite 200
Henderson, NV 89074-7755
Telephone: 702/263-7275
Fax: 702/263-7200

RECORD OF SURVEY FOR

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

LOCATED IN SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.







GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)

1 inch = 200 ft.

LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
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SHEET 3 OF 3

ATKINS
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Appendix E

Utility Conflict Schedule

UTILITY CONFLICT SCHEDULE - MAINLINE

PROJECT: Las Vegas Wash Central Cedar Avenue Channel PREPARED BY: MM DATE: 5/31/2015

PROJECT NO.: 100039014 CHECKED BY: SB DATE: 7/17/2015

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA		SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
SD01	13+09.83	0'				UGP	1791.83	1791.50		TYPICAL DEPTH	2 -8'X4' RCB	1792.06	1786.73	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+19.86	0'				1-1/4" STREETLIGHT	1791.97	1791.80		TYPICAL DEPTH	2-8'X4' RCB	1792.02	1786.69	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+24.09	0'				2" ITS	1790.70	1790.53		TYPICAL DEPTH	2-8'X4' RCB	1792.00	1786.67	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+43.90	0'				10" HP STL GAS	1787.79	1786.96		BOMO TH*	2-8'X4' RCB	1791.93	1786.59	0.83	0.83		0.00'	YES	RELOCATE
SD01	13+46.61	0'				2" ITS	1790.18	1790.02		TYPICAL DEPTH	2-8'X4' RCB	1791.91	1786.58	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+52.19	0'				2" ITS	1790.21	1790.04		TYPICAL DEPTH	2-8'X4' RCB	1791.89	1786.56	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+58.29	0'				36" RCP SS	1786.04	1782.37		MH DIPS	2-8'X4' RCB	1791.87	1786.53	0.5	0.5		0.49'	NO	PROTECT-IN-PLACE
SD01	13+73.21		TO	14+16.42		72" RCP SD W/ CONC CAP					18'X4' RCB					0'		YES	REMOVE EX 72" RCP SD
SD01	15+38.16	0'				24" STORM DRAIN	1789.68	1787.18		MH DIPS	18'X4' RCB	1790.41	1784.24					YES	CONNECT TO SD
SD01	15+88.70	0'				2" ITS	1790.44	1790.27		TYPICAL DEPTH	18'X4' RCB	1790.16	1783.99	0.5	0.5		0.11'	NO	RELOCATE
SD01	17+74.07		TO	19+00.00		72" RCP STORM DRAIN					12'X6' RCB					0'		YES	REMOVE EX 72" RCP SD
SD01	18+49.83					UGP	1791.78	1791.45		TYPICAL DEPTH	12'X6' RCB	1789.49	1781.49	0.5	0.5		1.96'	NO	PROTECT-IN-PLACE
SD02	19+00.00		TO	27+00.00		72" RCP STORM DRAIN					12'X6' RCB					0'		YES	REMOVE EX 72" RCP SD
SD02	25+65.78	0'				1-1/4" STREETLIGHT	1793.92	1793.75		TYPICAL DEPTH	12'X6' RCB	1786.63	1778.63	0.5	0.5		7.12'	NO	PROTECT-IN-PLACE
SD03	27+00.00		TO	31+25.16		72" RCP STORM DRAIN					12'X6' RCB					0'		YES	REMOVE EX 72" RCP SD
SD04	42+05.00	33.0' LT	TO	43+16.00	33.0' LT	1-1/4" STLT					ACCESS RAMP					6.5'		NO	PROTECT-IN-PLACE
SD05	52+59.92	33.2' LT	TO	53+56.73	32.1' LT	1-1/4" STLT					ACCESS RAMP					0.95'		NO	RELCOATE
SD06	59+65.75	25.3' LT	TO	62+00.00	25.3' LT	4" UGP					36' CHANNEL					6.25'		NO	PROTECT-IN-PLACE
SD07	62+00.00	19.9' LT	TO	68+00.00	19.1' LT	4" UGP					30'/36' CHANNEL					6.0'		NO	PROTECT-IN-PLACE
SD08	68+00.00	19.1' LT	TO	75+00.00	20.5' LT	4" UGP					30' CHANNEL					6.0'		NO	PROTECT-IN-PLACE
SD09	75+00.00	20.5' LT	TO	76+26.35	19.7' LT	4" UGP					30' CHANNEL					6.7'		NO	PROTECT-IN-PLACE
SD09	79+53.28	26.9' LT	TO	80+50.39	27.4' LT	4" UGP					ACCESS RAMP					3.9'		NO	PROTECT-IN-PLACE
SD11	92+58.11	33.2' LT	TO	93+60.03	29.5' LT	4" UGP					ACCESS RAMP					3.7'		NO	PROTECT-IN-PLACE
SD14	118+77.65	0'				6" & 8" PVC SEWER					25' CHANNEL		1744.46						RELOCATE SEWER

* - USED DEPTH FROM BOMO TEST HOLES THAT WERE IN THE VICINITY OF THE PROPOSED IMPROVEMENTS.

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - LATERALS

PROJECT: Las Vegas Wash Central Cedar Channel PREPARED BY: MM DATE: 5/31/2015

PROJECT NO.: 100039014 CHECKED BY: SB DATE: 6/18/2015

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA		SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
SD01	10+04.83					18" ACP WATER	1786.07	1784.57		BOMO TH*	7'X3' RCB SD	1792.00	1787.66	1.5	1.5		1.59'	NO	RELOCATE WATERLINE DUE TO HORIZONTAL CLEARNACE FROM DI
SD01	10+07.83					2" STL GAS	1790.37	1790.20		BOMO TH*	7'X3' RCB SD	1791.98	1787.65	0.83	0.83		0.00'	YES	RELOCATE
SD01	10+48.19					STREETLIGHT CONDUIT	1793.44	1793.27		TYPICAL DEPTH	7'X3' RCB SD	1791.78	1787.45	0.5	0.5		1.49'	NO	PROTECT-IN-PLACE
SD01	10+48.19					TRAFFIC SIGNAL/ITS CONDUIT	1792.27	1792.10		TYPICAL DEPTH	7'X3' RCB SD	1791.78	1787.45	0.5	0.5		0.32'	NO	RELOCATE
SD01	10+68.80					18" PVC BOMO FM	1785.05	1783.49		PER CADD FILES	7'X3' RCB SD	1791.68	1787.34	0.5	0.5		2.29'	NO	PROTECT-IN-PLACE
SD01	10+79.52					8" VCP SS	1787.53	1786.81		MH DIPS	7'X3' RCB SD	1791.62	1787.29	0.5	0.5		0.00'	YES	RELOCATE
SD01	10+80.65					24" RCP SD	1790.80	1788.30		MH DIPS	7'X3' RCB SD	1791.62	1787.28						CONNECT TO RCB SD
SD01	10+04.82					18" ACP WATER	1785.45	1783.95		BOMO TH*	7'X3' RCB SD	1791.67	1787.67	1.5	1.5		2.22'	NO	RELOCATE WATERLINE DUE TO HORIZONTAL CLEARNACE FROM DI
SD01	10+07.82					2" STL GAS	1789.65	1789.48		BOMO TH*	7'X3' RCB SD	1791.65	1787.65	0.83	0.83		0.00'	YES	RELOCATE
SD01	10+48.20					STREETLIGHT CONDUIT	1792.82	1792.65		TYPICAL DEPTH	7'X3' RCB SD	1791.45	1787.45	0.5	0.5		1.20'	NO	PROTECT-IN-PLACE
SD01	10+48.20					TRAFFIC SIGNAL CONDUIT	1791.65	1791.48		TYPICAL DEPTH	7'X3' RCB SD	1791.45	1787.45	0.5	0.5		0.03'	YES	RELOCATE
SD01	10+68.78					18" PVC BOMO FM	1784.97	1783.40		PER CADD FILES	7'X3' RCB SD	1791.35	1787.35	0.5	0.5		2.38'	NO	PROTECT-IN-PLACE
SD01	10+79.63					8" VCP SS	1787.17	1786.49		MH DIPS	7'X3' RCB SD	1791.29	1787.29	0.5	0.5		0.12'	YES	RELOCATE
SD01	10+04.83					18" ACP WATER	1785.19	1783.69		BOMO TH*	5X3' RCB SD	1791.73	1787.39	1.5	1.5		2.20'	NO	RELOCATE WATERLINE DUE TO HORIZONTAL CLEARNACE FROM DI
SD01	10+07.83					2" STL GAS	1789.39	1789.22		BOMO TH*	5X3' RCB SD	1791.71	1787.38	0.83	0.83		0.00'	YES	RELOCATE
SD01	10+48.24					STREETLIGHT CONDUIT	1792.34	1792.17		TYPICAL DEPTH	5X3' RCB SD	1791.51	1787.18	0.5	0.5		0.66'	NO	PROTECT-IN-PLACE
SD01	10+48.24					TRAFFIC SIGNAL CONDUIT	1791.17	1791.00		TYPICAL DEPTH	5X3' RCB SD	1791.51	1787.18	0.5	0.5		0.00'	YES	RELOCATE
SD01	10+68.81					18" PVC BOMO FM	1784.90	1783.33		PER CADD FILES	5X3' RCB SD	1791.41	1787.07	0.5	0.5		2.17'	NO	PROTECT-IN-PLACE
SD01	10+79.75					8" VCP SS	1786.85	1786.19		MH DIPS	5X3' RCB SD	1791.35	1787.02	0.5	0.5		0.17'	YES	RELOCATE

* - USED DEPTH FROM BOMO TEST HOLES THAT WERE IN THE VICINITY OF THE PROPOSED IMPROVEMENTS.

Appendix F

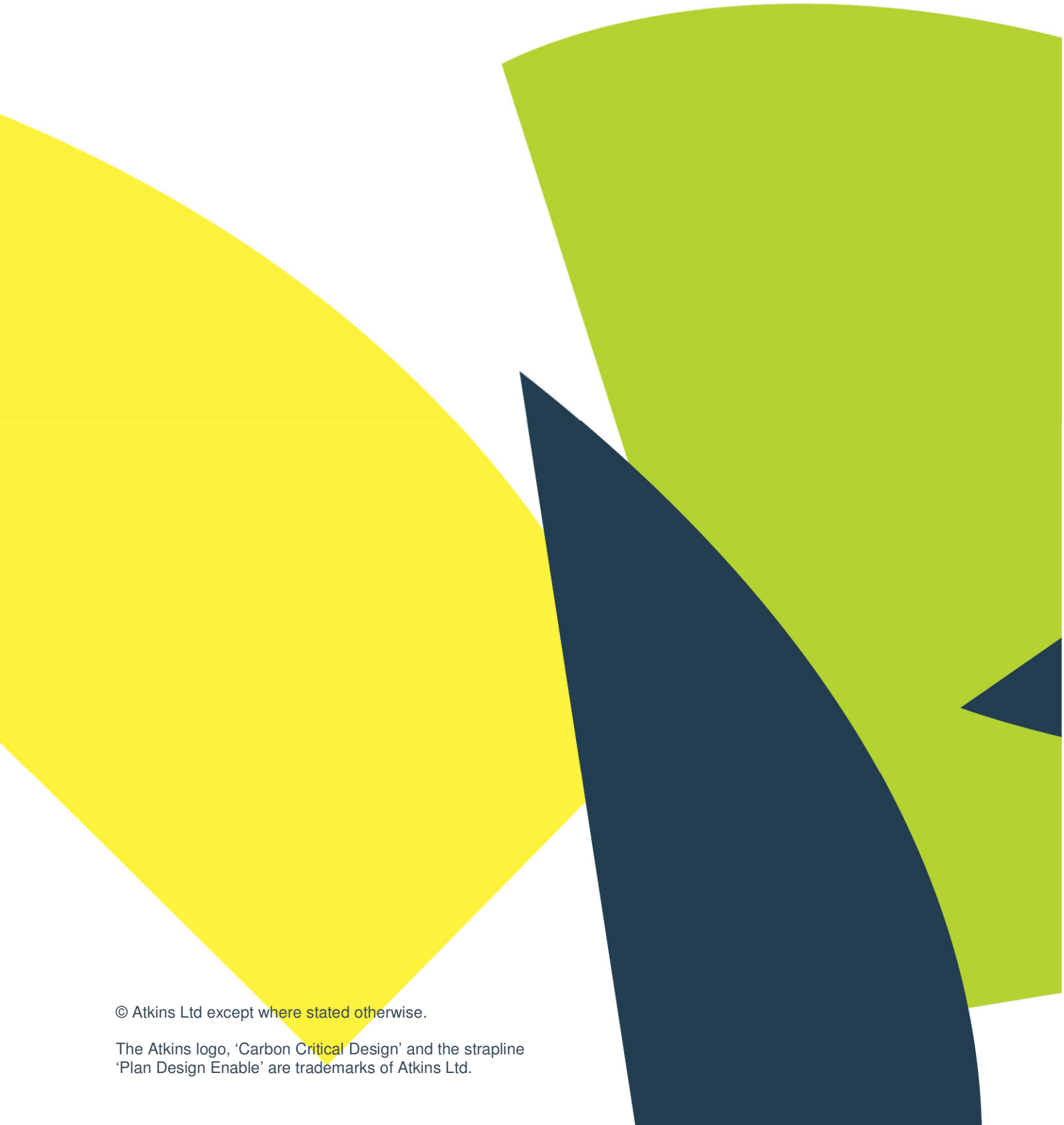
Cost Estimate

Freeway Channel
Washington, MLK to Rancho Drive
Preliminary Cost Estimate - Final Submittal

			CCRFCD		TOTAL			
#	ITEM	DESCRIPTION	QUANTITY	COST	QUANTITY	UNIT	UNIT COST	TOTAL COST
	200.01	MOBILIZATION & DEMOBILIZATION	1	$700,000.00	1	LS	$700,000.00	$700,000.00
	202.01	REMOVAL OF ASPHALT PAVEMENT	20490	$117,817.50	20,490	SY	$5.75	$117,817.50
	202.02	REMOVE EXISTING SIDEWALK	1650	$4,950.00	1,650	SF	$3.00	$4,950.00
	202.03	REMOVE EXISTING CURB AND GUTTER	788	$5,516.00	788	LF	$7.00	$5,516.00
	202.04	REMOVE EXISTING MEDIAN ISLAND	1819	$7,276.00	1,819	SF	$4.00	$7,276.00
	202.05	REMOVE EXISTING RCP STORM DRAIN	2168	$43,360.00	2,168	LF	$20.00	$43,360.00
	202.06	REMOVE EXISTING MANHOLE	7	$7,000.00	7	EA	$1,000.00	$7,000.00
	202.07	REMOVE EXISTING DROP INLET	4	$6,000.00	4	EA	$1,500.00	$6,000.00
	202.08	REMOVE EXISTING SANITARY SEWER	271	$2,710.00	271	LF	$10.00	$2,710.00
	202.09	REMOVE EXISTING CHANNEL	276256	$1,657,536.00	276,256	SF	$6.00	$1,657,536.00
	212.01	REMOVE AND REPLACE EXISTING LANDSCAPING	1	$75,000.00	1	LS	$75,000.00	$75,000.00
	270.01	DEWATERING	1	$200,000.00	1	LS	$200,000.00	$200,000.00
	302.01	TYPE II AGGREGATE BASE	3660	$91,500.00	3,660	CY	$25.00	$91,500.00
	402.01	2-INCH PLANTMIX BITUMINOUS SURFACE	10810	$108,100.00	10,810	SY	$10.00	$108,100.00
	402.02	9-INCH PLANTMIX BITUMINOUS SURFACE	7920	$435,600.00	7,920	SY	$55.00	$435,600.00
	413.01	1-INCH UTACS BONDED WITH A PMM, S3 GRADATION	7920	$55,440.00	7,920	SY	$7.00	$55,440.00
	502.01	22-FOOT WIDE REINFORCED CONCRETE CHANNEL	1054	$1,212,100.00	1,054	LF	$1,150.00	$1,212,100.00
	502.02	25-FOOT WIDE REINFORCED CONCRETE CHANNEL	1225	$1,010,625.00	1,225	LF	$825.00	$1,010,625.00
	502.03	30-FOOT WIDE REINFORCED CONCRETE CHANNEL	1214	$1,092,600.00	1,214	LF	$900.00	$1,092,600.00
	502.04	31-FOOT WIDE REINFORCED CONCRETE CHANNEL	2780	$2,641,000.00	2,780	LF	$950.00	$2,641,000.00
	502.05	36-FOOT WIDE REINFORCED CONCRETE CHANNEL	1264	$1,282,960.00	1,264	LF	$1,015.00	$1,282,960.00
	502.06	CHANNEL ACCESS RAMP	610	$137,250.00	610	LF	$225.00	$137,250.00
	502.07	JUNCTION STRUCTURE	1	$50,000.00	1	LS	$50,000.00	$50,000.00
	502.08	5-FT X 3-FT REINFORCED CONCRETE BOX	151	$37,750.00	151	LF	$250.00	$37,750.00
	502.09	7-FT X3-FT REINFORCED CONCRETE BOX	172	$62,780.00	172	LF	$365.00	$62,780.00
	502.10	8-FT X 4-FT REINFORCED CONCRETE BOX	253	$107,525.00	253	LF	$425.00	$107,525.00
	502.11	12-FT X6-FT REINFORCED CONCRETE BOX	1496	$1,458,600.00	1,496	LF	$975.00	$1,458,600.00
	502.12	18-FT X4-FT REINFORCED CONCRETE BOX	332	$410,020.00	332	LF	$1,235.00	$410,020.00
	502.13	TRANSITION STRUCTURE #1	10	$4,250.00	10	LF	$425.00	$4,250.00
	502.14	TRANSITION STRUCTURE #2	30	$37,050.00	30	LF	$1,235.00	$37,050.00
	502.15	TEMPORARY RETAINING WALL	21470	$644,100.00	21,470	SF	$30.00	$644,100.00
	603.01	18-INCH REINFORCED CONCRETE PIPE (CLASS III)	24	$4,560.00	24	LF	$190.00	$4,560.00
	603.02	24-INCH REINFORCED CONCRETE PIPE (CLASS III)	11	$2,200.00	11	LF	$200.00	$2,200.00
	609.01	36-INCH ACCESS MANHOLE W/ STEPS	1	$3,000.00	1	EA	$3,000.00	$3,000.00
	609.02	48-INCH ACCESS MANHOLE W/ STEPS	3	$10,500.00	3	EA	$3,500.00	$10,500.00
	609.03	20-FOOT TYPE "C" MODIFIED DROP INLET	5	$100,000.00	5	EA	$20,000.00	$100,000.00
	609.04	CULVERT HEADWALL	1	$4,000.00	1	EA	$4,000.00	$4,000.00
	613.01	L TYPE CURB AND GUTTER	312	$7,800.00	312	LF	$25.00	$7,800.00
	613.02	A TYPE CURB	476	$7,140.00	476	LF	$15.00	$7,140.00
	613.03	CONCRETE SIDEWALK	1650	$8,250.00	1,650	SF	$5.00	$8,250.00
	613.04	TACK-ON MEDIAN	1819	$14,552.00	1,819	SF	$8.00	$14,552.00
	622.01	CONSTRUCTION SURVEYING	1	$75,000.00	1	LS	$75,000.00	$75,000.00
	623.01	REMOVE AND REPLACE TRAIL LIGHT	2	$6,000.00	2	EA	$3,000.00	$6,000.00
	624.01	TRAFFIC CONTROL AND MAINTENANCE	1	$150,000.00	1	LS	$150,000.00	$150,000.00
	629.01	REMOVE AND 18-INCH WATERLINE	1	$80,000.00	1	LS	$80,000.00	$80,000.00
	630.01	8-INCH PVC SDR 35 SANITARY SEWER PIPE	370	$64,750.00	370	LF	$175.00	$64,750.00
	630.02	48-INCH SANITARY SEWER MANHOLE	3	$36,000.00	3	EA	$12,000.00	$36,000.00
	637.01	DUST CONTROL	1	$150,000.00	1	LS	$150,000.00	$150,000.00
	637.02	NPDES DISCHARGE PERMIT	1	$50,000.00	1	LS	$50,000.00	$50,000.00
		TOTAL		**$14,480,167.50**				**$14,480,167.50**
		Contingencies (15%)		$2,172,025.13				$2,172,025.13
		GRAND TOTAL		**$16,652,192.63**			**TOTAL PROJECT**	**$16,652,192.63**

Electronic Data CD

Atkins North America, Inc.
2270 Corporate Circle, Suite 200
Henderson NV 89074-7755
702.263.7275



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Meeting Minutes

Project:	Las Vegas Wash Central, Cedar Avenue Channel		
Subject:	Meeting Minutes: Progress Meeting #13		
Date & Time:	Wednesday, April 15, 2015	**Hansen No.**	49866
Meeting Place:	CLV, PW Granite Room	**Minutes By:**	Manogya Khanal

Present:

Rosa Cortez, CLV
Peter Jackson, CLV
Rick Schroder, CLV
Tim Parks, CLV
Fred Solis, CLV
Randy Mrowicki, CLV
Todd Myers, CCRFCD
Harshal Desai, Atkins
Brian Rowley, Atkins
Steve Bellino, Atkins
Manogya Khanal, Atkins

SUMMARY OF ACTION ITEMS:

Item	Description & Action	Responsible
1	Provide Atkins with the ultimate flow in the 36" RCP sewer at Pecos/Stewart intersection	CLV (Tim)(closed)
2	Perform a hydraulic analysis of 36" RCP splitting into two 18" RCP sewer at Pecos/Stewart intersection	Atkins(closed)
3	Email Rosa with parcel numbers of the four parcels where it is necessary to acquire ROW/easements.	Atkins(closed)
4	Provide Atkins ROW/easement information on the four parcels	CLV (Rosa)
5	Provide a rough estimate of the cost differences between the with sewer relocation and without sewer relocation options.	Atkins(closed)
6.	Provide pros and cons of storm drain design options at Stewart/Pecos in the meeting minutes	Atkins(closed)

SUMMARY OF DISCUSSION:

The purpose of the meeting was to discuss project progress and design considerations related to the 30% submittal for the Cedar Avenue Channel project. A summary of key discussion points is below:

Storm Drain Design Options (Upstream Collection System)
Atkins presented preliminary layout of the upstream collection system, and discussed the design constraints. Two design options were discussed, and are listed below:

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

Option 1: Without Sewer Relocation
This design is constricted by the existing 36" RCP SS. The sewer line is not very deep, therefore, limits the storm drain to be very shallow. This design consists of an 18'X4' RCB that transitions into a dual 8'X4' RCB at the Pecos/Stewart intersection. This is transition is needed because there is not enough room to cross the 36" RCP sewer using a mega box (18' x 4' RCB) with a thicker slab. This above section of the stormdrain system will be constructed in the empty parcel (139-36-604-001) located at northwest corner of the Stewart/Pecos intersection. This parcel is owned by City of Las Vegas.

After crossing the sewer, the dual 8'X4' RCB transitions into an 18'X4' RCB and collect flow from Pecos. It will then transition into a 12'X6' RCB downstream (see attached Storm Drain Option 1 Plan and Profile). The pros and cons of this option are listed below:

Pros

- Smaller facility sizes
- Does not require sewer relocation
- Cheaper than option 2 by approximately $1.7 million

Cons

- Very flat slopes because of crossing the sewer and also constrained by the existing invert at Cedar Channel
- The box is very shallow at the Pecos/Stewart intersection. Only a foot of cover is available at the Pecos/Stewart intersection with dual 8'X4' RCBs
- Preliminary model done by Atkins shows that collecting 500 cfs on Stewart Ave will result in pressurized flow in the SD with less than a 0.5' freeboard at the Pecos/Stewart intersection.
- The placement of the precast mega RCB boxes under US-95 might not be possible and would require cast-in place RCBs
- Approximately 300-350 cfs will bypass on Stewart east of Pecos

Option 2: With Sewer Relocation
This option requires relocation of approximately 1,300 LF of the existing 36" RCP SS. It starts with a 19' X4' RCB in the empty parcel described above and transitions to a 21'X4' RCB to collect the flow from Pecos. It will transition to 12'X7' RCB after it turns east to discharge into Cedar Channel (see attached Storm Drain Option 2 Plan and Profile). The pros and cons are listed below:

Pros

- About 2 feet of cover is obtained at Stewart/Pecos intersection
- No longer constrained to use dual 8'X4' RCBs at Stewart/Pecos intersection. Transitions can be avoided by using a single box with thicker top and bottom slab 21'X4' RCB can be continued into a 12'X7' RCB at the turn into the Cedar Channel.
- It collects more flow than the option described above. About 600 cfs is collected on Stewart. Approximately 200-250 cfs is bypassed on Stewart east of Pecos

Cons

- Larger facility size
- Requires relocation of sewer
- Very flat slopes because of crossing the sewer and also constrained by the existing invert at Cedar Channel
- The placement of the precast mega RCB boxes under US-95 might not be possible and would require cast-in place RCBs
- More expensive than Option 1 by approximately $1.7 million

Additional discussions

- Another possibility, as discussed in the meeting, could be to split the 36" RCP SS at Pecos/Stewart intersection into two 18" RCP SS to gain cover at the Stewart/Pecos intersection. The City (Tim Parks) provided Atkins with the ultimate flow in the 36" RCP SS (9.75 MGD), and Atkins did normal depth calculations to check if splitting into two 18" RCP SS is a viable option. Normal depth calculations indicated that the two 18" RCP SS cannot handle a flow of 9.75 MGD (approx. 15 cfs) using 0.6d/D, and therefore, eliminated the option.
- It was discussed that the 10" STL HP gas line will have to be relocated with both the options.
- Additional variations to the above options were also discussed regarding the storm drain system as it makes its turn out of Pecos and into the Cedar Channel. There were two variations. The first variation was to eliminate the structure that transitions the 21'x4' RCB to a 12'x7' RCB and install a mega box to the existing open channel. This system will collect the flow from both existing storm drains (60 inch and 66 inch) at the turn and eliminate the need for dual systems. The second variation is similar to the above-mentioned variation except it involves extending the open channel all the way to Pecos instead of using RCBs. The existing landscape trail corridor would be reduced with this variation.

Cedar Ave Channel

Channel Access Ramp Configuration

Atkins presented preliminary layout of some channel access ramp configuration (see attached Access Ramp Exhibit 1 and 2) . A few of the key design considerations are listed below:

- The City will look into whether the trail can be reduced for the channel access ramps. All of the access ramps will reduce the cross section of the trail with access ramp at Sandhill reducing the most to a 5' access. The reduction will last approximately 110'.
- The City is going to look into the school property between Sandhill and Lamb for the possibility of constructing an access ramp to the channel and getting an easement.
- Confirmed that continuous drivability is not required. Emergency access was also discussed and the City of Las Vegas and Clark County Regional Flood Control noted that if access is discontinued due to the channel access ramp the access road could be accessed from the next road crossing downstream of the ramp. Access is still provided it just isn't continuous.
- Discussed eliminating access ramp downstream of Sandhill if ramp can be constructed between Sandhill and Lamb at the school property.

Limited Channel ROW (between Sandhill and Lamb)
Atkins mentioned that the ROW constricts from 60 feet to 50 feet between Sandhill and Lamb at the curvilinear section of the channel. Atkins presented an option of having a 4 feet cantilever into the channel in order to obtain 10 feet trail with a spot reduction to 8' for trail lighting in this section. Obtaining an easement from the property on the north side of the channel was also discussed. The property currently has a plan for development of the property but the City will look into this.

Marion Bridge Options/ Downstream Channel Width

It was discussed that the City had directed the consultant for the Las Vegas Wash improvements to maintain 25 feet bottom width for Cedar Channel while designing it confluence with Las Vegas Wash. If this bottom width is maintained downstream of Marion Bridge, then it is not required to replace the bridge to accommodate the ultimate flow (which includes the flow from Bonanza System). Atkins recommended that

the design should progress based on not replacing and deepening the Marion Bridge and maintaining 25 feet bottom width downstream. It was also recommended that the preliminary design report (PDR) will include a detail discussion on this and will also include hydraulic calculations and preliminary layout of an option with a 22 feet bottom width and replacement/deepening of Marion Bridge.

The City and CCRFCD agreed with this approach considering Atkins is only taking this design to 70% level and in future if a 25 foot channel cannot be accommodated downstream near the confluence of Las Vegas Wash then the design can be reverted back to the 22 foot channel option with a replacement of Marion Bridge.

Future Submittals and Progress Meeting Schedule: Atkins will submit the preliminary design report and 30% submittal in four-five weeks after the City selects the design option associated with the upstream collection system. CLV will schedule future, recurring progress meetings for the third Wednesday of each month at 10:30 AM. The next progress meeting will be held on May 20th.

--- End of Meeting Minutes ---

NORTH

STEWART AVENUE

US-9 SOUTHBOUND

US-9 NORTHBOUND

PECOS ROAD

CEDAR CHANNEL

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

18+00

19+00

20+00

21+00

22+00

23+00

24+00

25+00

26+00

27+00

28+00

29+00

30+00

31+00

18'X4' RCB

2 - 8'X4' RCB

8'X4' RCB

12'X6' RCB

18"PVC FM (BOMO)

72"RCP SD W/ CONC. CAP

GRAPHIC SCALE

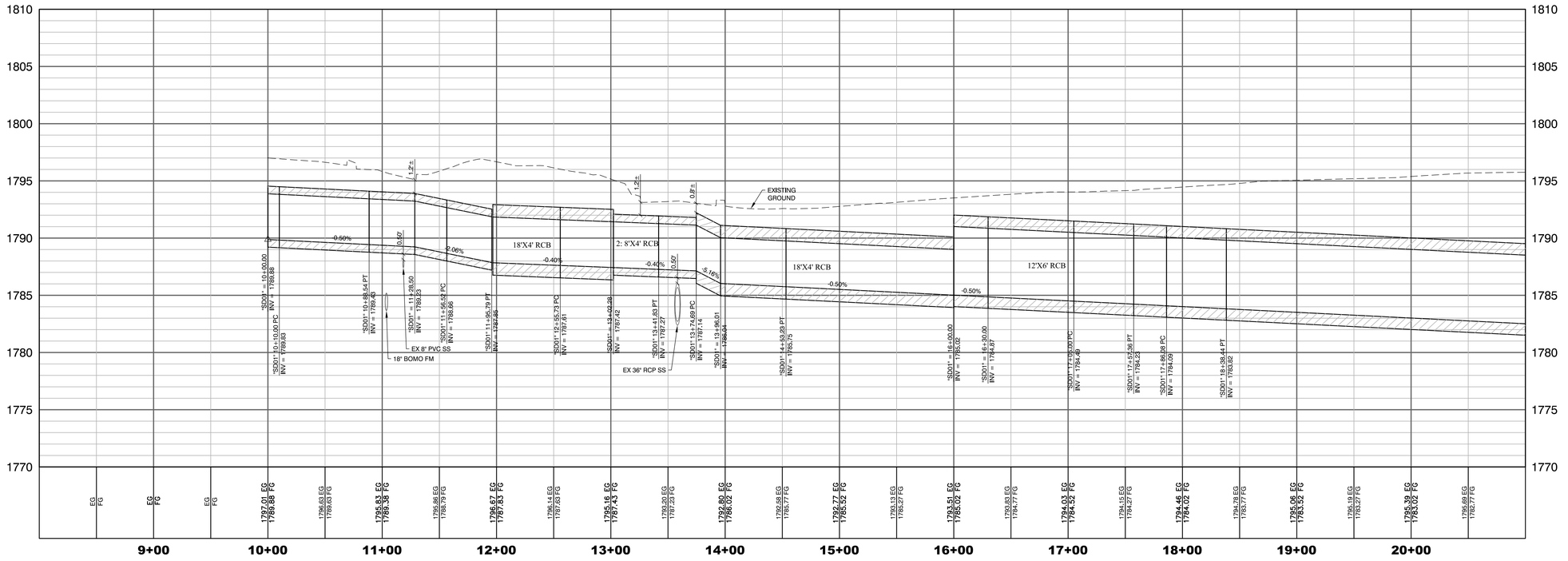
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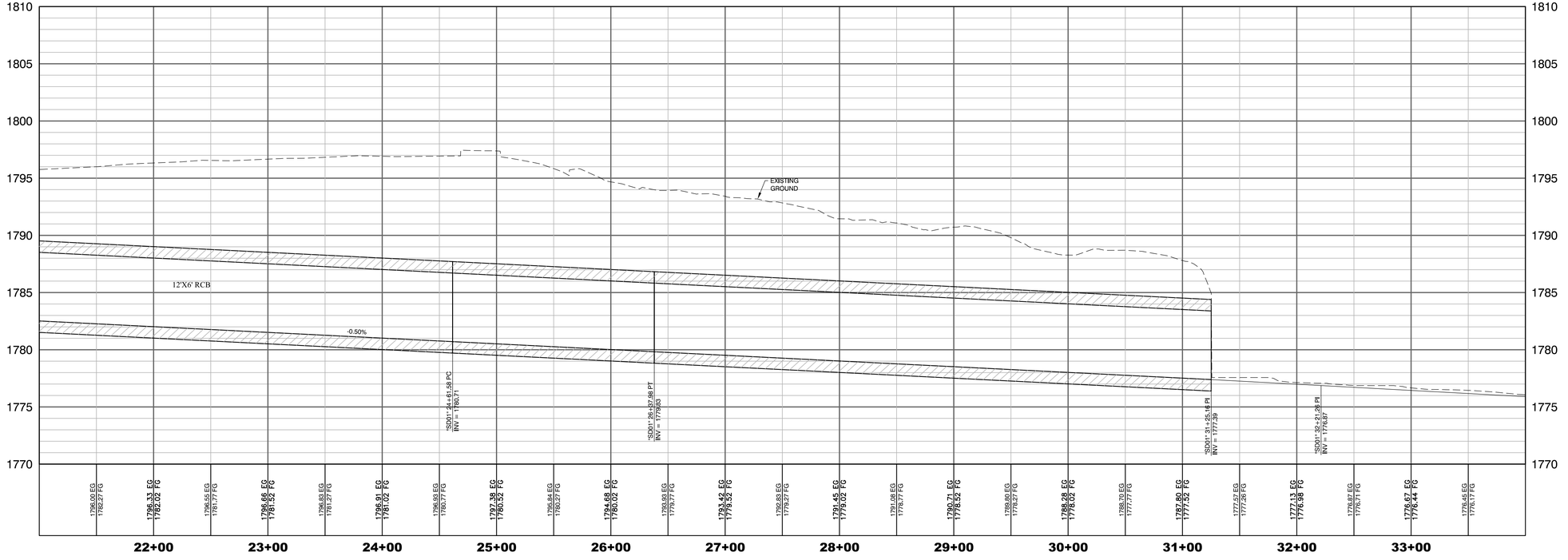
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STORM DRAIN OPTION 1

APRIL 15, 2015

ATKINS





GRAPHIC SCALE

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(IN FEET)

STORM DRAIN OPTION 1 PROFILE

APRIL 15, 2015

ATKINS

NORTH

STEWART AVENUE

US-9 SOUTHBOUND

US-9 NORTHBOUND

PECOS ROAD

CEDAR CHANNEL

19'X4' RCB

21'X4' RCB

12'X7' RCB

10+00 11+00 12+00 13+00 14+00 15+00 16+00 17+00 18+00 19+00 20+00 21+00 22+00 23+00 24+00 25+00 26+00 27+00 28+00 29+00 30+00 31+00 31+25

18"PVC FM (BOMO)

63"x43" HE RCP SD

39"RCP SD

48"RCP SD

18"RCP SD

24"RCP SD

30"RCP SD

36" RCP SS

42"RCP SD

72"RCP SD

72" RCP SS W/ CONC. CAP

10' STL HP G

1-1/4" STLT

2" ITS

1-3.5" PVC TEL

8"ACP W

12"ACP W

16"ACP W

1-1/2" STLT

12' SD

GRAPHIC SCALE

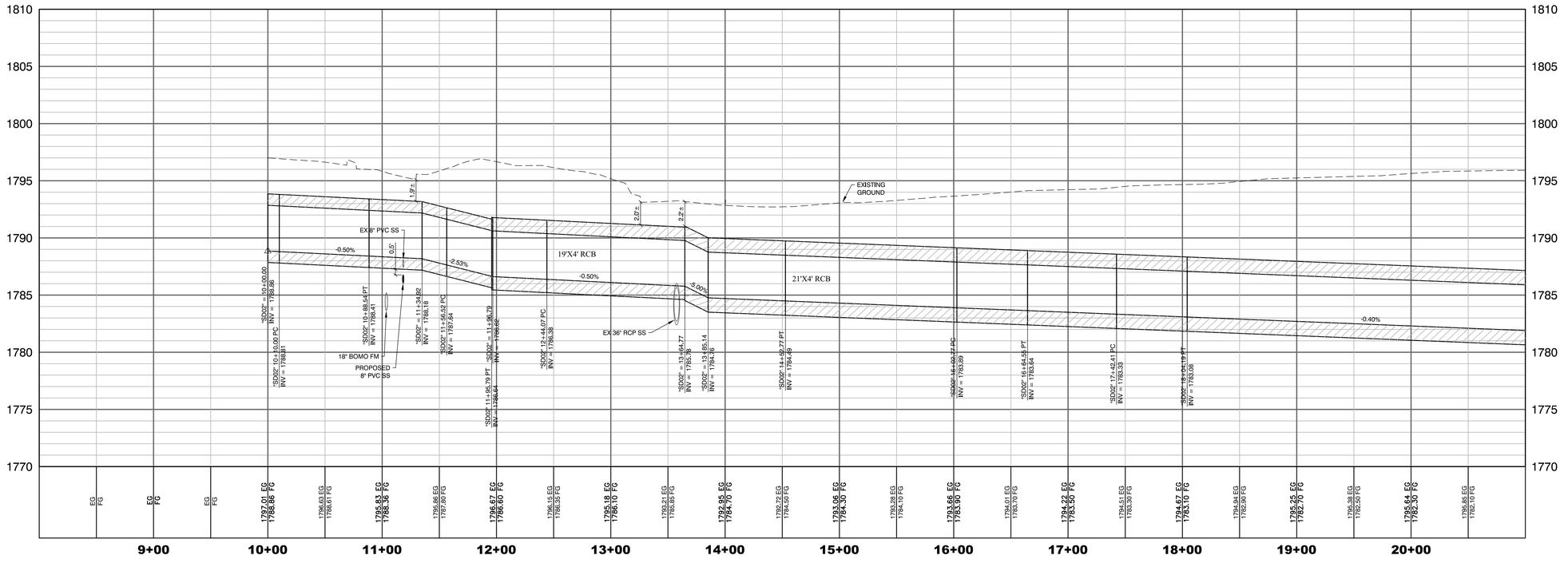
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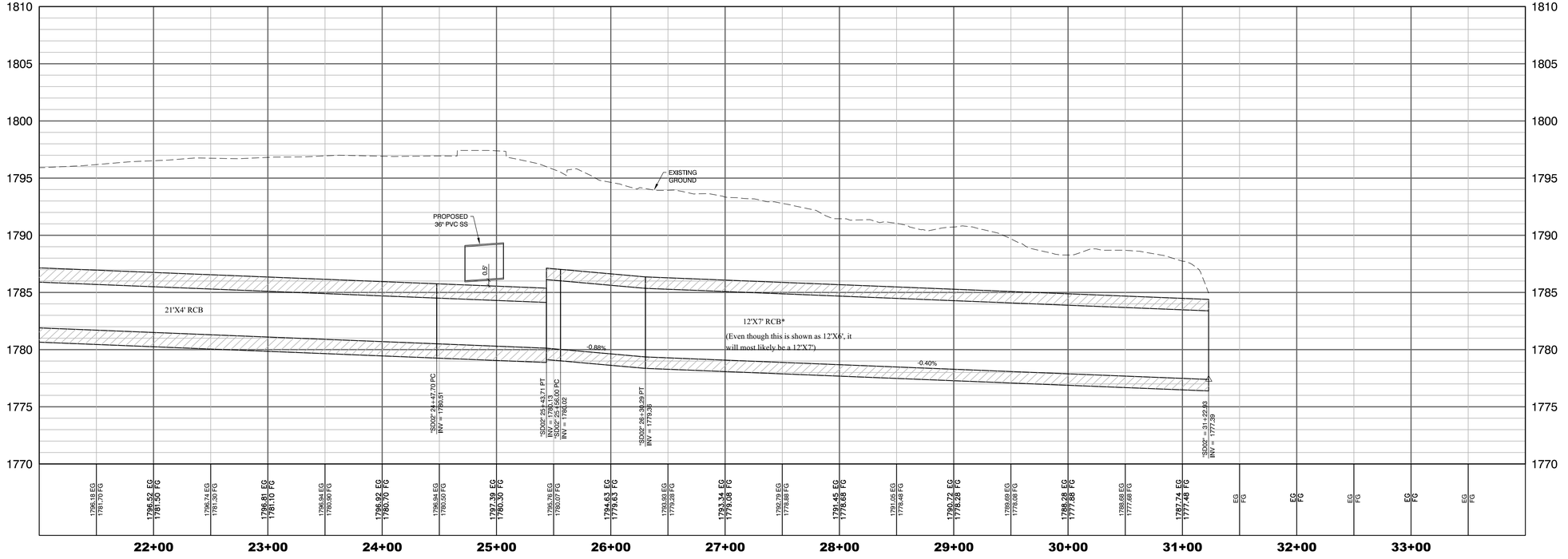
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STORM DRAIN OPTION 2

APRIL 15, 2015

ATKINS





GRAPHIC SCALE

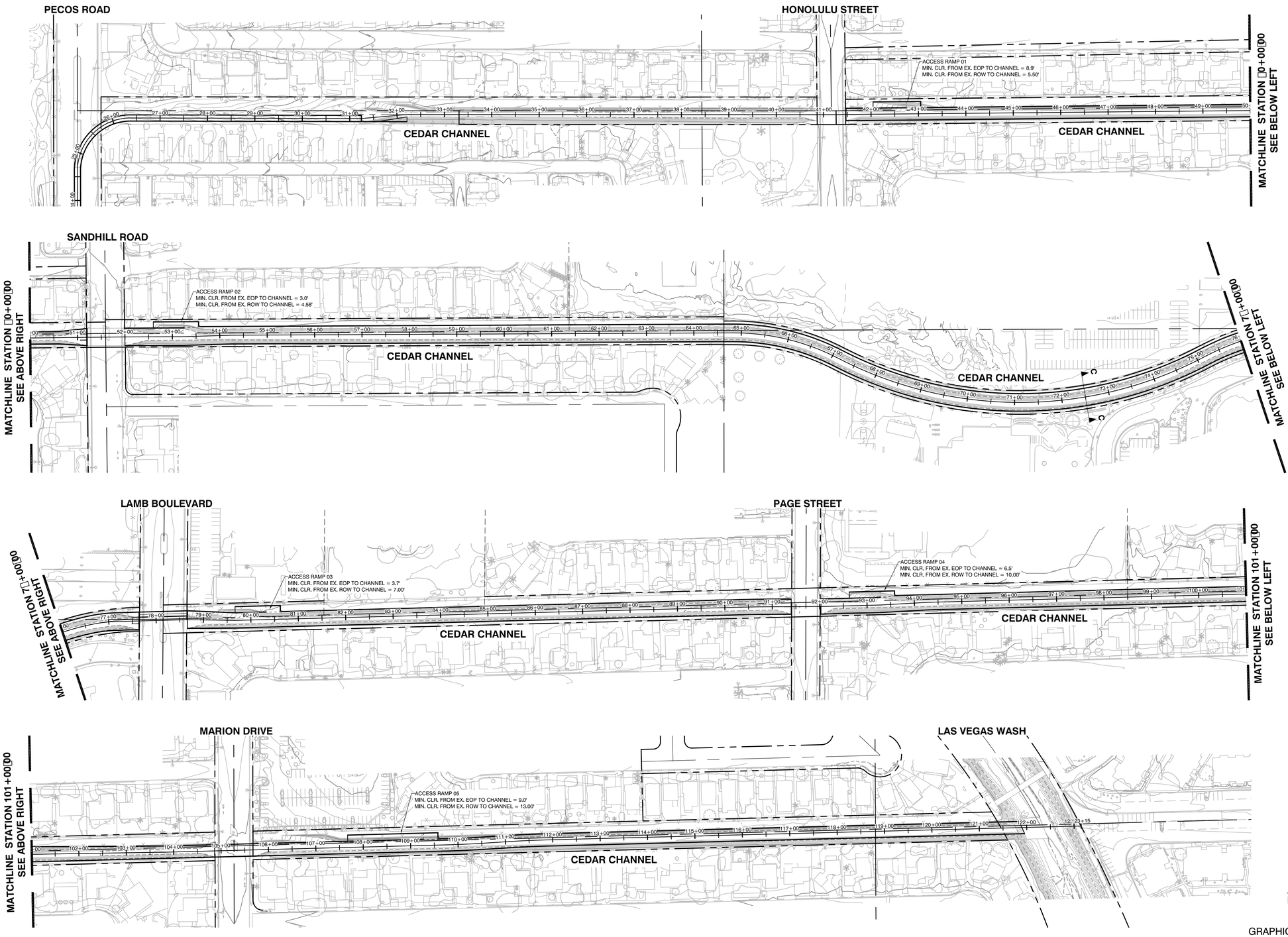
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(IN FEET)

STORM DRAIN OPTION 2 PROFILE

APRIL 15, 2015

ATKINS



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# 49866

DATE: 04/10/2015

SUBMITTAL STAGE:
30% - PRELIMINARY

BID#

DESIGNED BY: SMB

DRAWN BY: MM

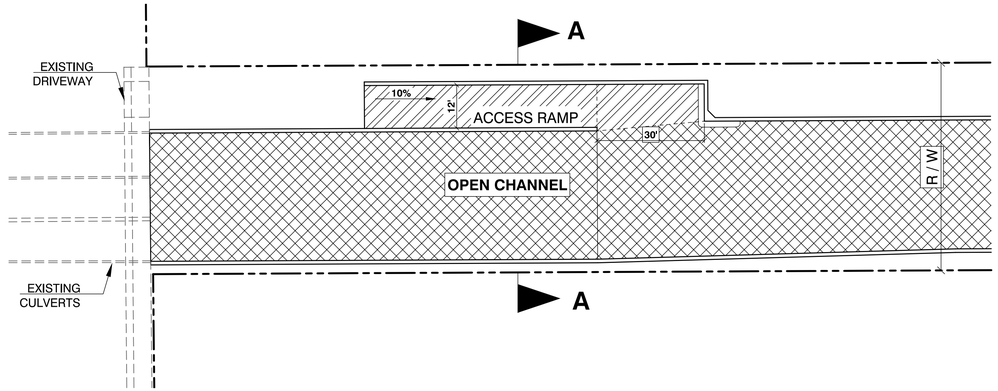
CHECKED BY:

TITLE
LAS VEGAS WASH
CENTRAL CEDAR AVENUE

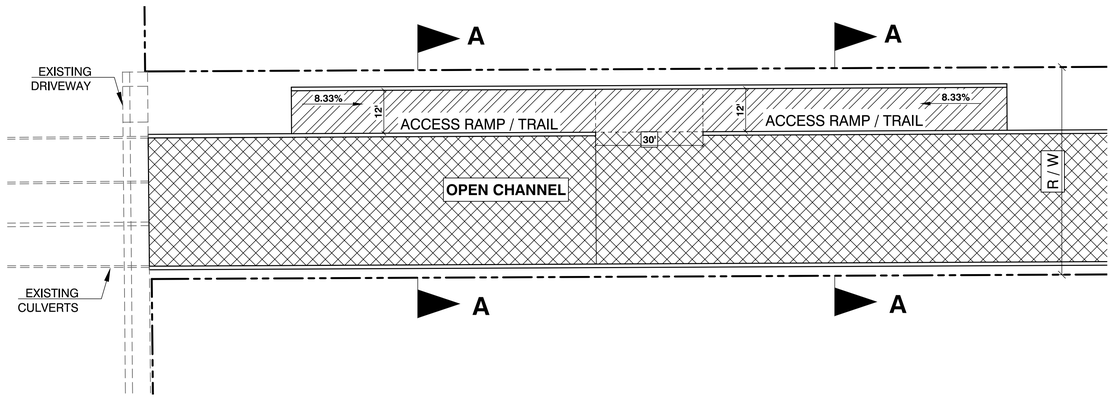
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ACCESS RAMP EXHIBIT 01

SHEET
AR-01
1 OF **2**
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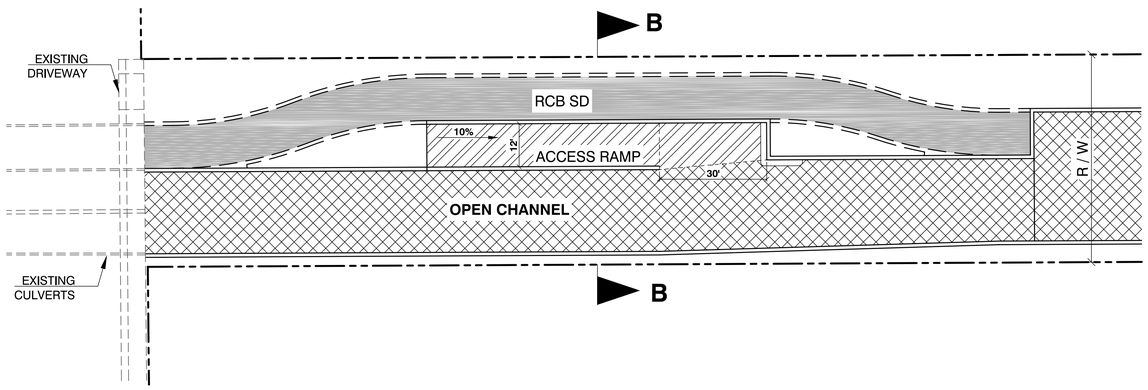
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OPTION 1



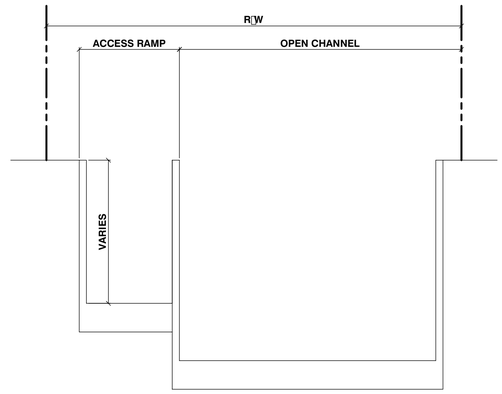
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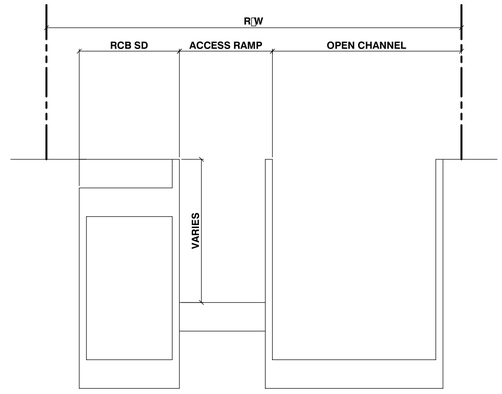
OPTION 3

LEGEND

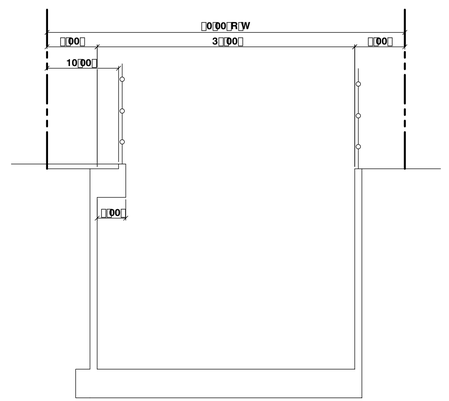
- CHANNEL ACCESS RAMP
- OPEN CHANNEL
- RCB STORM DRAIN



SECTION A-A



SECTION B-B



SECTION C-C

NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2370 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# 49866

DATE: 04/10/2015

BID# XX.XXXXX

DESIGNED BY: SMB

DRAWN BY: MM

CHECKED BY: XXX

SUBMITTAL STAGE:
30% - PRELIMINARY

TITLE
LAS VEGAS WASH
CENTRAL CEDAR AVENUE
ACCESS RAMP
E□HIBIT 02

SHEET
AR-2
2 OF 2

DRAWING NO.
XXX-XXXX

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Meeting Minutes

Project:	Las Vegas Wash Central, Cedar Avenue Channel		
Subject:	Meeting Minutes: Progress Meeting #14		
Date & Time:	Thursday, July 16, 2015	**Hansen No.**	49866
Meeting Place:	CLV, PW Gravel Room	**Minutes By:**	Manogya Khanal

Present:

Rosa Cortez, CLV
Peter Jackson, CLV
Rick Schroder, CLV
Alan Riekki, CLV
Todd Myers, CCRFCD
Harshal Desai, Atkins
Brian Rowley, Atkins
Manogya Khanal, Atkins

SUMMARY OF ACTION ITEMS:

Item	Description & Action	Responsible
1	Verify if the area south of Cedar Channel between Pecos and Honolulu drains north into the channel	Atkins
2	Verify if any bypass from west of Eastern at Cedar Avenue flows into subbasin CA06-C, and eventually into the channel	Atkins
3	Run various iterations of HEC-RAS model with different flows to determine the maximum flow that Cedar Avenue Channel can handle	Atkins
4	Perform an analysis to determine if using a 5-foot tall box at Pecos/Stewart intersection instead of a 4-foot box will provide any hydraulic or design benefits	Atkins
5	Confirm if the “Top of bank” shown in the 30% Design Plans matches the existing condition	Atkins
6.	Evaluate the collection capacity and condition of existing drop inlets at the Cedar Avenue Channel cross streets	Atkins

SUMMARY OF DISCUSSION:

The purpose of the meeting was to discuss comments from the City and/or CCRFCD on the Preliminary Design Report (PDR) and the 30% Design Plans that were submitted by Atkins on June 22, 2015. The City stated that they completed their review of the 30% Design and PDR and overall the information was well organized and thoroughly presented. The City will be providing Atkins with written comments within a few days. CCRFCD is also in the process of reviewing the PDR and plans and will provide their comments when ready. Some of the major comments from the City were discussed in the meeting as summarized below. Refer to the written comments from the project for more details and information.

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

- **Hydrology.** The City wants Atkins to verify hydrology at two locations:
    - Between Pecos and Honolulu: In the 2008 MPU HEC-1 model, the area south of Cedar Avenue Channel between Pecos and Honolulu drains south toward Stewart Avenue. However, the City stated that there is a high point on Honolulu Street that may direct flow back towards the channel from the south. Atkins will verify if the flows in this area drain to the channel.
    - Eastern/Cedar Intersection: The City requested that Atkins review the area draining to the intersection of Eastern and Cedar to determine if there is any additional flow that enters the existing storm drain system or eventually flows through the golf course to the Cedar Avenue Channel. Atkins said they will review this area but is not likely to have any impact on channel flows since the existing storm drain facility is flowing at capacity and any remaining surface flow will likely be cut off at the golf course.
- **Flood Walls.** In the PDR, Atkins proposed a 1-foot tall flood wall along the north side of the channel for a length of 1,500 feet upstream of Lamb Blvd to achieve at least a foot of freeboard. The City asked if having taller flood walls on both sides of the channel would be a feasible design alternative that would allow the existing trapezoidal channel geometry to remain in place. Atkins stated that this alternative proposed by the City has already been modeled and was discarded because it results in a water surface elevation higher than the existing condition and especially higher flood depths at the bridge crossings.
- **18 x 4 RCB.** Atkins proposed a shallow 18 x 4 RCB at the Pecos/Stewart intersection because of an existing sewer conflict and minimal cover. The City mentioned the difficulties of maintaining a 4-foot tall box and expressed that they prefer 5-foot tall boxes. The City mentioned options of re-profiling the road to gain more cover or raising the top of box up to the asphalt without re-profiling the road. CCRFCD expressed concern with this alternative. Atkins will look into this alternative to determine if it is even feasible or if it provides any benefits to the project in terms of hydraulic performance or maintainability. Atkins also stated that if the box increases that may increase channel flow and have an adverse on the downstream channel design.
- **Access Ramps**. In the PDR, the current design shows an 8-feet wide trail from Sandhill going east to a point where the right-of-way constricts from 60-feet to 50-feet. This portion of the trail will not be driveable. The City asked about the possibility of providing driveable access by having a steel plate or something similar to cover the access ramp. Atkins will review this concept as well as the option to have a cantilevered section of the trail over the channel. The access ramp location will continue to be investigated during the 70% design.
- **Future Regional Facility in Marion Dr.** In the PDR, Atkins assumed that the future regional system in Marion Dr will need to be a dual box (each box approximately 10-feet wide) in order to have a reasonable support for the structural stability of the trail span over the box. This will have to be taken into consideration when the future Bonanza system is designed.
- **Constructability**. Atkins stated that they wrote up several of the constructability concerns in the PDR. Atkins asked if the City would be interested in performing a constructability review at this point, but the City stated that they only do full reviews at a later phase of the project. Atkins will do some internal reviews of constructability issues during the 70% design phase.
- **Drop Inlets**. The City asked Atkins to review the drop inlet condition and collection capacity on the cross streets along the Cedar Avenue channel to ensure they collect surface flows as shown in the hydrologic analysis.

- **Other Coordination Items:**

    - **NDOT Coordination**. The City stated that no detailed coordination with NDOT is needed yet on the project. Atkins should just check that NDOT stationing is accounted for on the plans. Further coordination will continue as the design continues. Atkins agreed.

    - **Model Stationing**. The City requested that the stationing on the plans for the channel and storm drain match up with the stationing used in the hydraulic models (HEC-RAS and WSPG) if possible. Atkins agreed.

    - **Walk Through**. The walk through for the project will occur at the 70% submittal milestone.

    - **Schedule**. The 70% design submittal is scheduled for October.

    - **Traffic**. Rick will provide Rosa with a written summary of comments which will then be provided to Atkins. Rick also provided Atkins with the walking routes of the schools that should be accounted for as the design and construction phase continue.

--- End of Meeting Minutes ---

SIGN-IN SHEET

Las Vegas Wash Central – Cedar Avenue Channel

Progress Meeting #14, July 16, 2015, 4:00 PM

City of Las Vegas, PW Gravel Room

Las Vegas Wash Central – Cedar Avenue Channel

Name	Affiliation	Phone Number	Email Address	Initials	Attendance
Rosa Cortez	CLV	702-229-6264	rcortez@lasvegasnevada.gov	RC	☑
Oh-Sang Kwon	CLV	702-229-1815	okwon@lasvegasnevada.gov		☐
Tim Parks	CLV	702-229-2178	tparks@lasvegasnevada.gov		☐
Alan Riekki	CLV	702-229-6217	ariekki@lasvegasnevada.gov	AR.	☑
Nancy Almanzan	CLV	702-229-6343	nalmanzan@lasvegasnevada.gov		☐
Jeremy Leavitt	CLV	702-229-6278	jeleavitt@LasVegasNevada.gov		☐
Greg McDermott	CLV	702-229-2143	gmcdermott@lasvegasnevada.gov		☐
Tom Hayes	CLV	702-229-6735	thayes@lasvegasnevada.gov		☐
Mike Janssen	CLV	702-229-4866	mjanssen@lasvegasnevada.gov		☐
Bart Anderson	CLV	702-229-2198	banderson@lasvegasnevada.gov		☐
Rick Schroder	CLV	702-229-2452	rschroder@lasvegasnevada.gov	RSA	☑
Fred Solis	CLV	702-229-5407	fsolis@lasvegasnevada.gov		☐
Todd Myers	CCRFCD	702-685-0000	tmyers@regionalflood.org	TM	☑
Matt Baird	Atkins	702-990-7432	matt.baird@atkinsglobal.com		☐
Harshal Desai	Atkins	702-551-0349	harshal.desai@atkinsglobal.com		☐
Brian Rowley	Atkins	702-551-0320	brian.rowley@atkinsglobal.com	BR	☑
Steve Bellino	Atkins	702-551-0304	steve.bellino@atkinsglobal.com		☐
Nanoaya Amnal	Atkins			NA	
Peter Jackson	CLV				

ATKINS

Meeting Minutes

Project:	Las Vegas Wash Central, Cedar Avenue Channel		
Subject:	Meeting Minutes: Progress Meeting #17		
Date & Time:	Tuesday, August 2, 2016	**Hansen No.**	49866
Meeting Place:	CLV, Boulder Room	**Minutes By:**	Manogya Khanal

Present:

Anita Marquez, CLV
Peter Jackson, CLV
Tim Parks, CLV
Harshal Desai, Atkins
Steve Roberts, Atkins
Manogya Khanal, Atkins

SUMMARY OF ACTION ITEMS:

Item	Description & Action	Responsible
1	Provide Atkins with the plans for the 21" SS at Pecos/Stewart intersection	CLV (pending)
2	Confirm the inlet of the 60"RCP and 66" RCP	Atkins (pending)
3	Confirm the required minimum trail width	CLV, Anita (pending)
4	Provide Atkins decision regarding Access Ramp	CLV, Anita (pending)
5.	Check if access easement is available at three parcels: (1) School Board of Trustees parcel between Sandhill and Lamb, (2) Las Vegas VOA Elderly Housing between Lamb and Page, and (3) School Board of Trustees between Page and Marion	CLV (pending)
5	Provide the City with the copy of the presentation	Atkins (completed)

SUMMARY OF DISCUSSION:

The purpose of the meeting was to go over the decisions that have been made since the 30% submittal and discuss the comments received from constructability review for the Cedar Avenue Channel Project. A summary of key discussion points is below:

- **Stewart/Pecos Intersection.** Atkins reconfirmed that the 70% design submittal will proceed using a 5-feet tall RCBs instead of 4-feet tall RCBs for easy maintenance access. It was also confirmed that the existing 8-inch SS will be upsized with the BOMO project. Atkins also went over the flow range that was determined using various modelling approaches (HEC1/WSPG/Flowmaster and XPSWMM).

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

- **Sandhill Rd Crossing**. Atkins looked at the possibility of replacing the Sandhill Crossing with a megabox to eliminate one of the piers and improve hydraulic performance. The change resulted in minimal hydraulic benefit. Atkins said they have looked at options to lower the channel invert and raise the road profile and there are no viable options. The crossing will remain as is in the 70% Design Plans. The City agreed.

- **Lamb Blvd Megabox**. Atkins evaluated the option of removing and replacing the existing 2: 12' x 6' RCB crossing at Lamb Blvd with a bigger megabox of 2: 15' x 6'. The hydraulic model shows that this would provide additional conveyance capacity at the crossing and lower the water surface profile by a little less than a foot. There are pros and cons associated with replacing the crossing with bigger megaboxes, as outlined in the PowerPoint slides (see attached). The primary benefit is better hydraulic performance and the major disadvantage is the cost and the requirement to relocate the existing 36" waterline. Atkins asked which option they should use for the 70% Design Plans. The City directed Atkins to proceed with 2: 15' x 6' for the 70% Design Submittals.

- **Access Ramps.** In 30% Design Plans, the trail width at channel access ramp at Sandhill is only 4.58 feet. Atkins proposed several options that would retain a wider trail:

    - Remove ramp at Sandhill and access Sandhill from Lamb. Replacing the Lamb culverts from 5' tall boxes to 6' tall boxes allows for the maintenance equipment to pass through. This provides extra 12' to the trail at Sandhill.
    - Place ramp on the south side of the channel in the parcel owned by School Board of Trustees. The city will check to see if access easement can be obtained.
    - Instead of access ramp, place removable handrails that allows for maintenance equipment to be lowered into the channel
    - Place heavy steel grates that can be used as trail over the access ramp. However, the grates are expensive, heavy and require extra effort to be removed each time the channel needs to be accessed.

  Atkins also suggested moving the access ramps at Lamb and Page at different locations will help with constructability of the channel. The City will check if access easement can be obtained on the parcel owned by Las Vegas VOA Elderly Housing to place the Lamb access ramp, and on the parcel owned by School Board of Trustees for the Page access ramps.

  The City will provide Atkins with directions on what options to proceed with in the 70% Design Plans.

- **Constructability Review**. Atkins went over the comments received from Shawn Meagher on Constructability Review

    - Atkins stated that the storm drain design at Pecos/Stewart intersection represents the optimum system. Connecting three drop inlets on each side and having only one lateral across Stewart Avenue would reduce the conveyance capacity of the system, and add to the bypass going east. The city agreed.

      The storm drain system is placed at the drainage easement to avoid affecting traffic in the major intersection. The intersection is also the low point, therefore, leaving no room for cover over the storm drain. The curve from Stewart Avenue is not tangent to Pecos as that is the minimum radius required for precast boxes.

      The storm drain system will remain as is in the 70% Design Plans. The City agreed.

    - One of the comments was to combine the proposed RCB with the existing 60" RCP and 66" RCP as the storm drain turns east on Cedar Avenue. According to the survey

information that is available on the invert elevations of the 60" RCP and 66" RCP, combining the three is not a feasible option. Atkins will confirm the inlet elevations, and will look at the feasibility.

- Atkins acknowledged that downstream of Marion Bridge is hard to build as channel gets very deep. However, such a drop is necessary to account for the flow coming in from the Bonanza system. The drop can be avoided if the Bonanza system is kept separate.

Atkins will include constructability comments and response in the 70% Design Submittal.

- **Moving Channel North.** Atkins suggested that moving the channel north by 2 or 3 feet will reduce the cost of stabilizing temporary construction slopes. However, this will impact the maintenance access ramps and trail widths. Moving the ramps to different locations as mentioned above will allow for the channel to be shifted north while still maintaining the trail widths.
- **Other Coordination Items:**
  - **Constructability Specifications.** Constructability Specifications will not be submitted with the 70% Design Plans.

--- End of Meeting Minutes ---

SIGN-IN SHEET

Las Vegas Wash Central – Cedar Avenue Channel

Progress Meeting #17, August 2, 2016 09:30 A.M.

City of Las Vegas

Las Vegas Wash Central – Cedar Avenue Channel

Name	Affiliation	Phone Number	Email Address	Initials	Attendance
Anita Marquez	CLV	702-229-6264	amarquez@LasVegasNevada.gov		☑
Jeremy Leavitt	CLV	702-229-6264	jeleavitt@LasVegasNevada.gov		☐
Oh-Sang Kwon	CLV	702-229-1815	okwon@lasvegasnevada.gov		☐
Peter Jackson	CLV	702-229-5266	pjackson@lasvegasnevada.gov		☑
Tim Parks	CLV	702-229-2178	tparks@lasvegasnevada.gov		☐
Alan Riekki	CLV	702-229-6217	ariekki@lasvegasnevada.gov		☐
Nancy Almanzan	CLV	702-229-6343	nalmanzan@lasvegasnevada.gov		☐
Greg McDermott	CLV	702-229-2143	gmcdermott@lasvegasnevada.gov		☐
Tom Hayes	CLV	702-229-6735	thayes@lasvegasnevada.gov		☐
Mike Janssen	CLV	702-229-4866	mjanssen@lasvegasnevada.gov		☐
Bart Anderson	CLV	702-229-2198	banderson@lasvegasnevada.gov		☐
Rick Schroder	CLV	702-229-2452	rschroder@lasvegasnevada.gov		☐
Fred Solis	CLV	702-229-5407	fsolis@lasvegasnevada.gov		☐
Michael Kinney	CLV	702-229-6938	mkinney@lasvegasnevada.gov		☐
Todd Myers	CCRFCD	702-685-0000	tmyers@regionalflood.org		☐
Matt Baird	Atkins	702-990-7432	matt.baird@atkinsglobal.com		☐
Harshal Desai	Atkins	702-551-0349	harshal.desai@atkinsglobal.com		☑
Steve Roberts	Atkins	702-551-0301	Stephen.Roberts2@atkinsglobal.com	SCR	☑
Manogya Khanal	Atkins	702-605-9063	Manogya.khananl@atkinsglobal.com	MK.	☑
					☐
					☐

ATKINS

City of Las Vegas, DSC

Progress Meeting #17

Tuesday, August 2, 2016

Boulder Conference Room

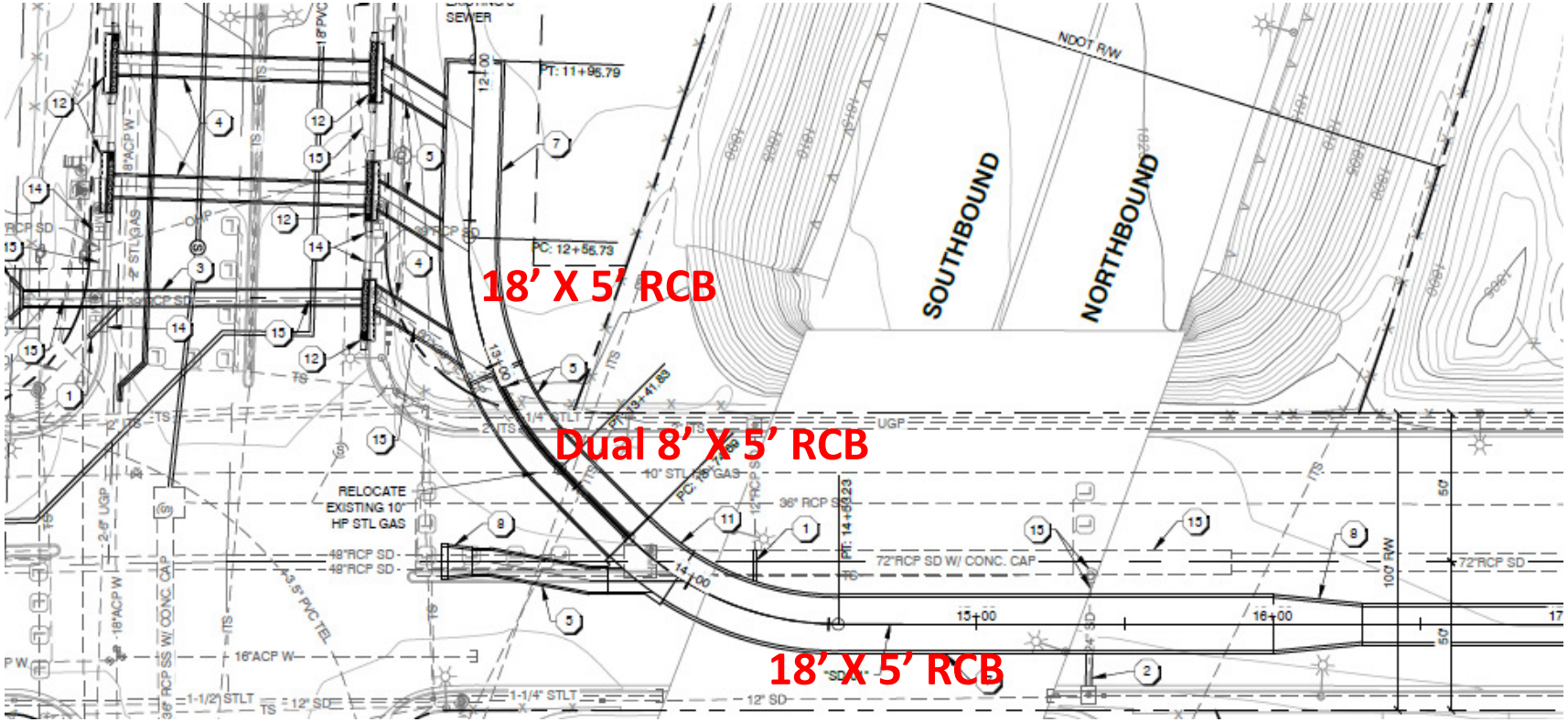
CEDAR AVENUE STORM DRAIN AND CHANNEL



Decisions after 30% Submittal

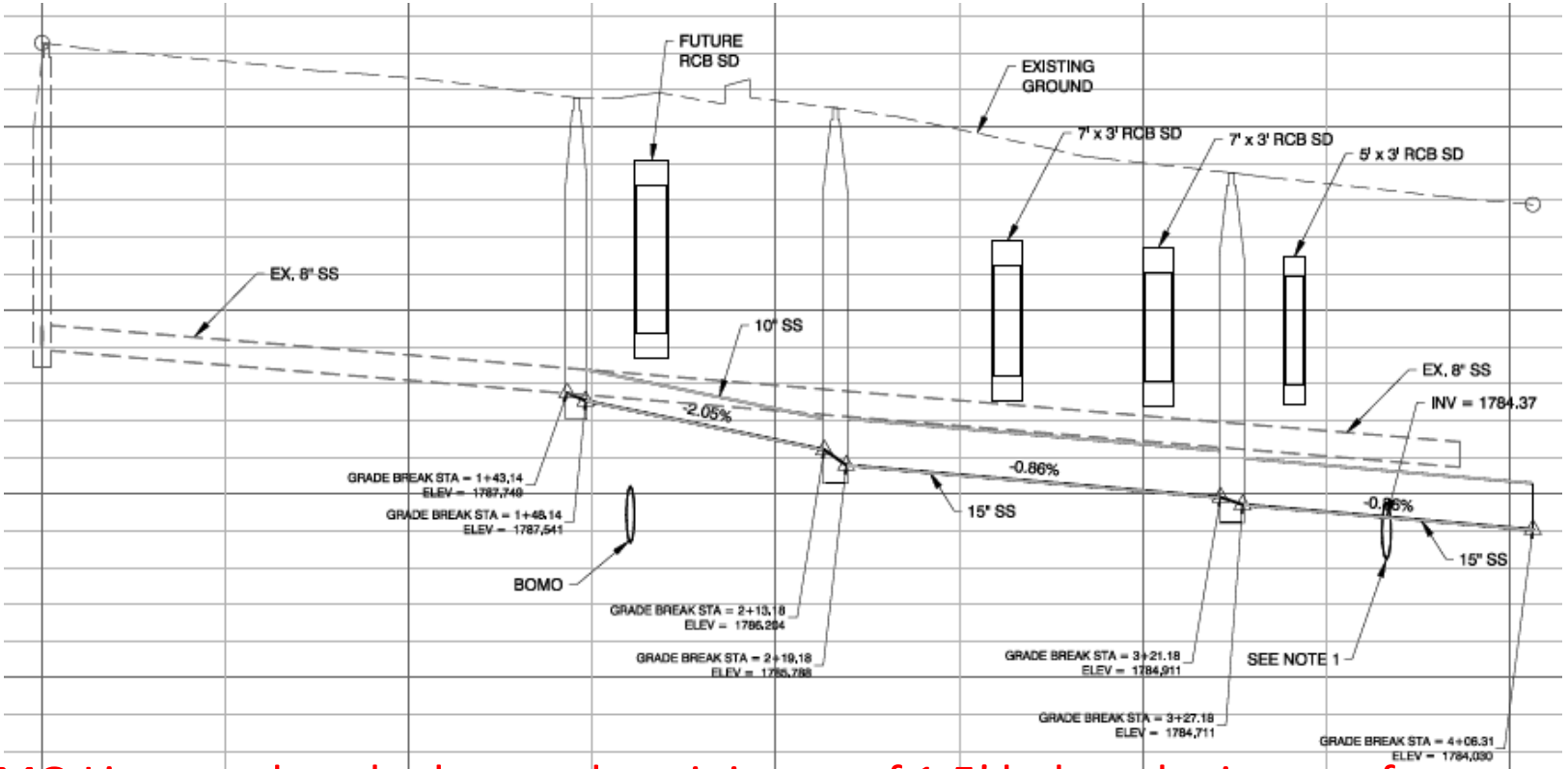
- Collection and Bypass at Pecos/Stewart Intersection
  - 5-foot tall boxes
  - Upsize sewer with BOMO project
  - Design Flow vs Maximum Flow

5’ Tall Boxes



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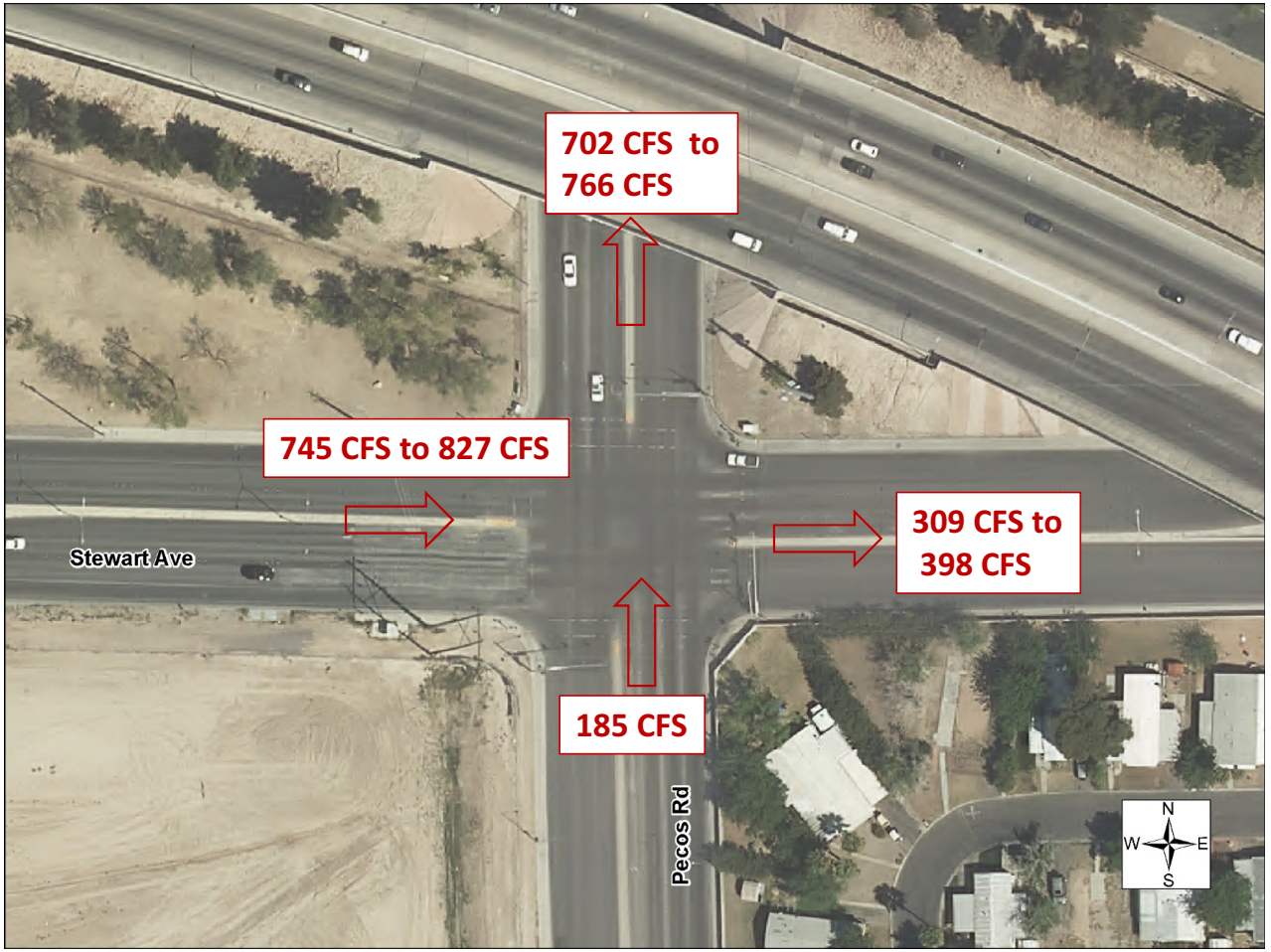
Upgrade Sanitary Sewer with BOMO



BOMO Line needs to be lowered a minimum of 1.5’ below the invert of proposed 15” SS

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Collection and Bypass Range at Pecos/Stewart Intersection

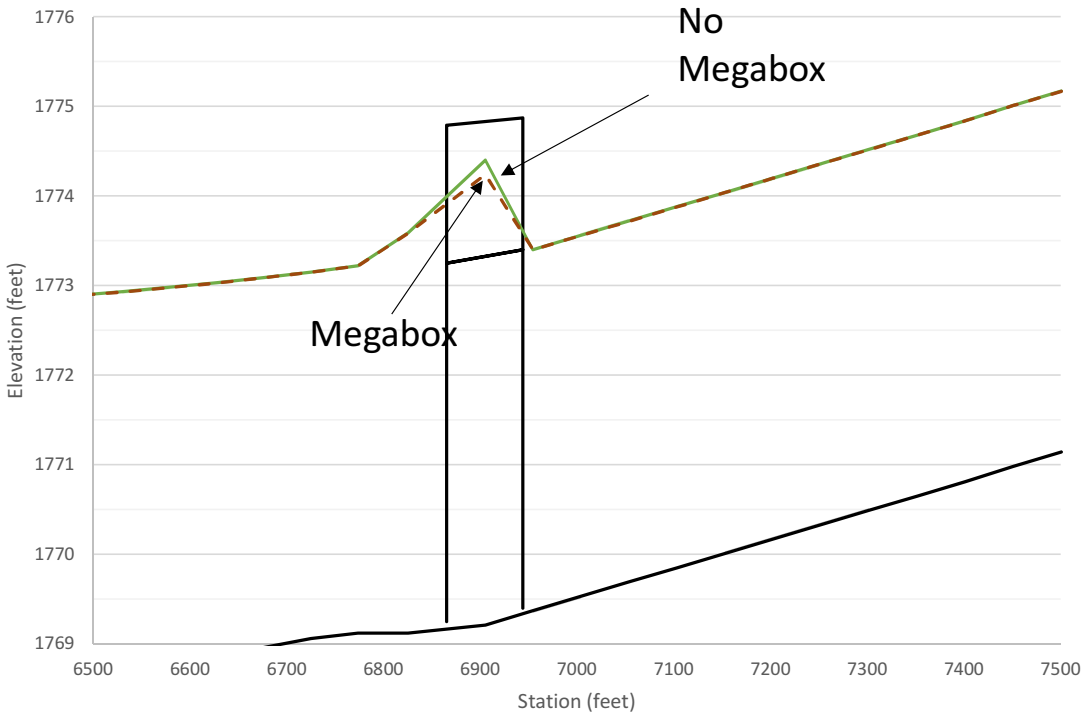


ATKINS

Decisions after 30% Submittal

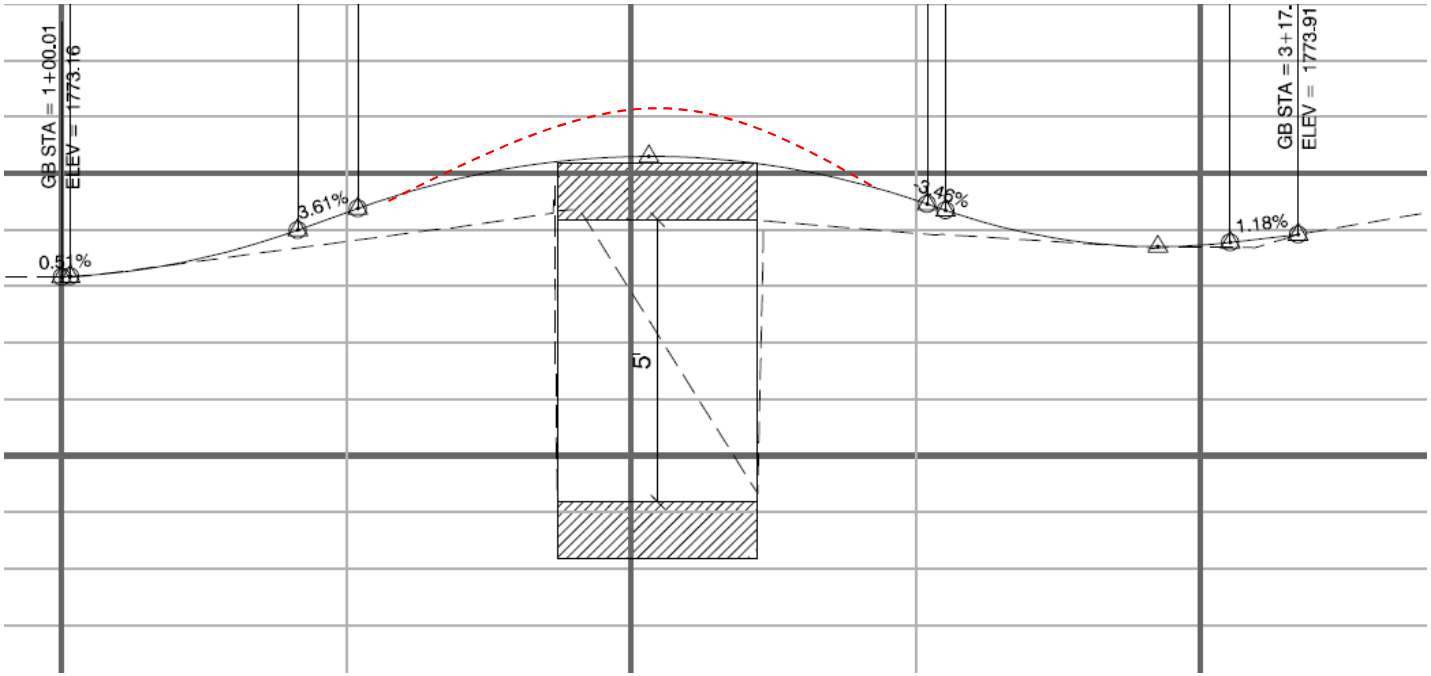
- Channel
  - Sandhill Crossing
    - Megabox
    - 5-foot tall box
  - Lamb Crossing – Replace with dual 15’ by 6’
  - Access Ramp options
  - Downstream of Marion

Replacing Sandhill with a megabox does not help hydraulically

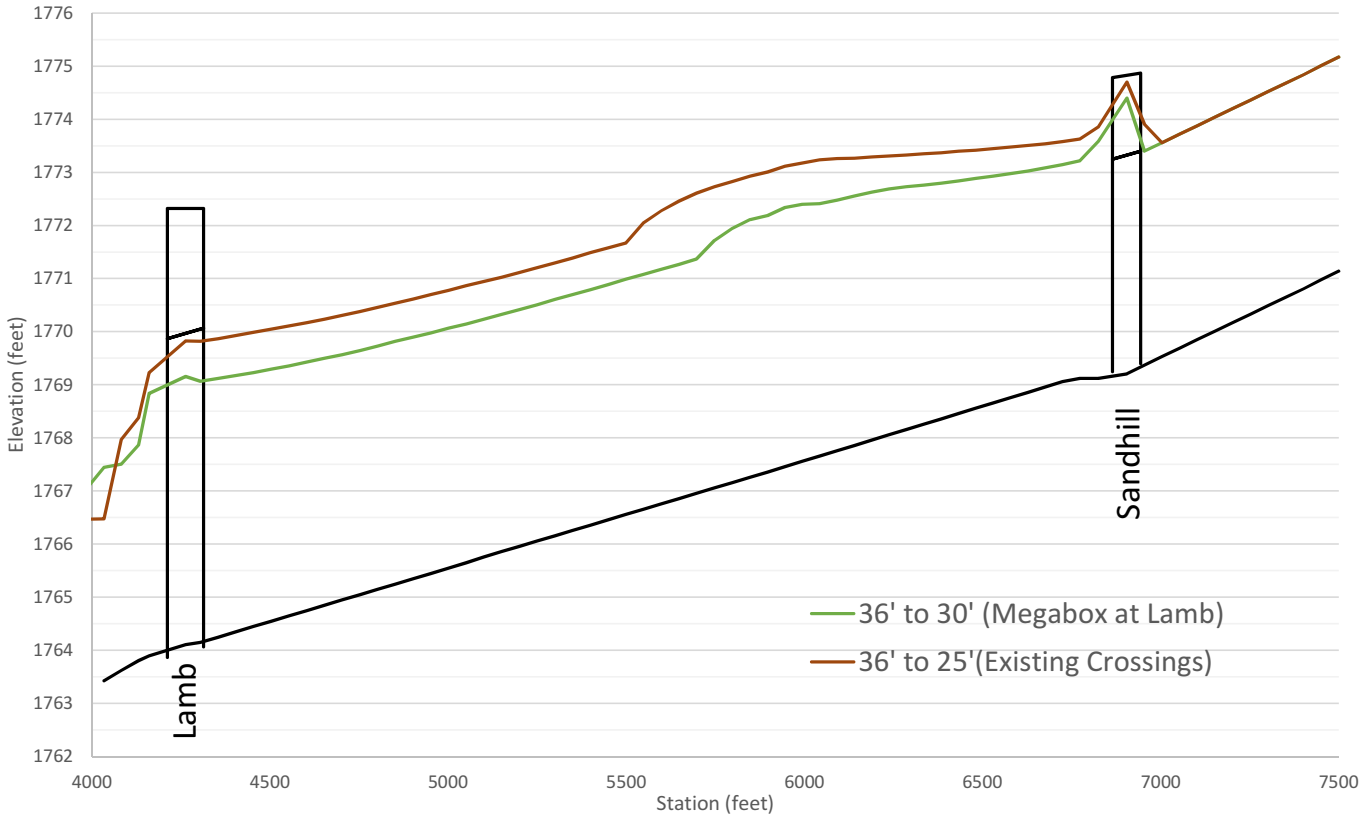


Re-profiling Sandhill Road is not feasible

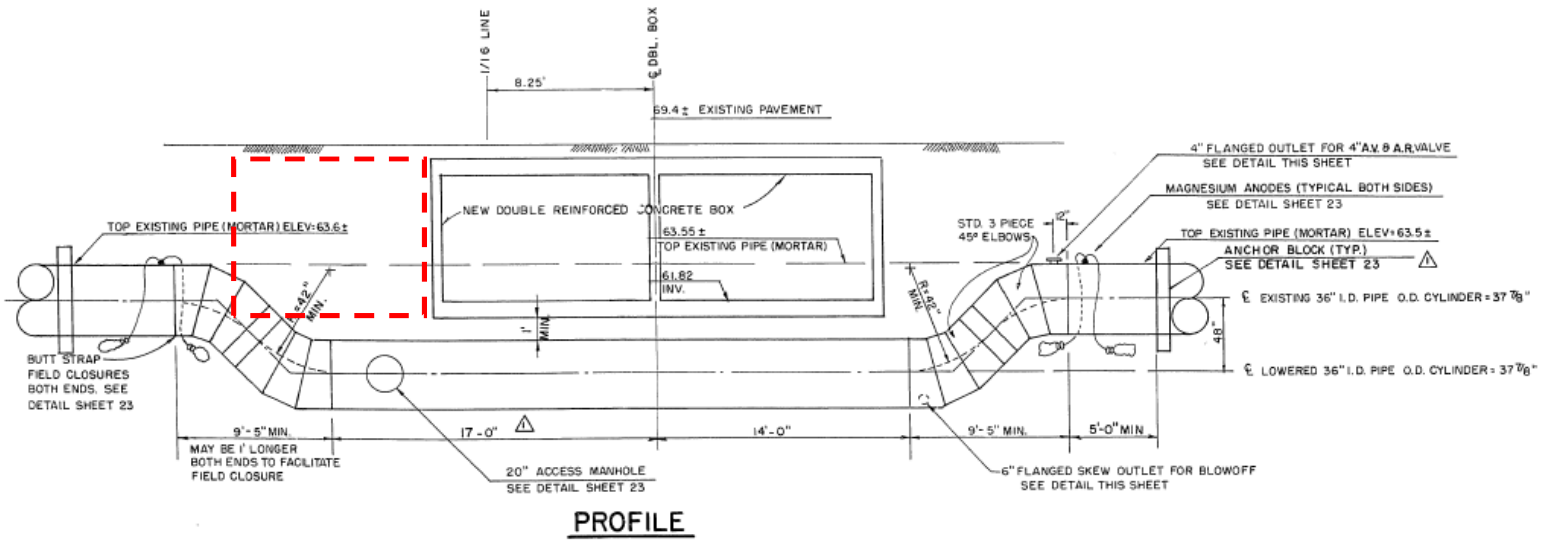
Speed Limit < 15 mph



Replace Lamb Crossing with Megabox (dual 15’ X 6’)



Waterline Relocation at Lamb Blvd



PROFILE

Dual 15’ by 16’ at Lamb

Pros

- WSE about a foot below the bridge low chord at Lamb
- Works better hydraulically
- CCRFCD freeboard criteria is met with the 1-foot tall floodwall

Cons

- Relocation of water line
- Costs to replace the crossing ($415K + waterline relocation costs)
- Trail width narrower

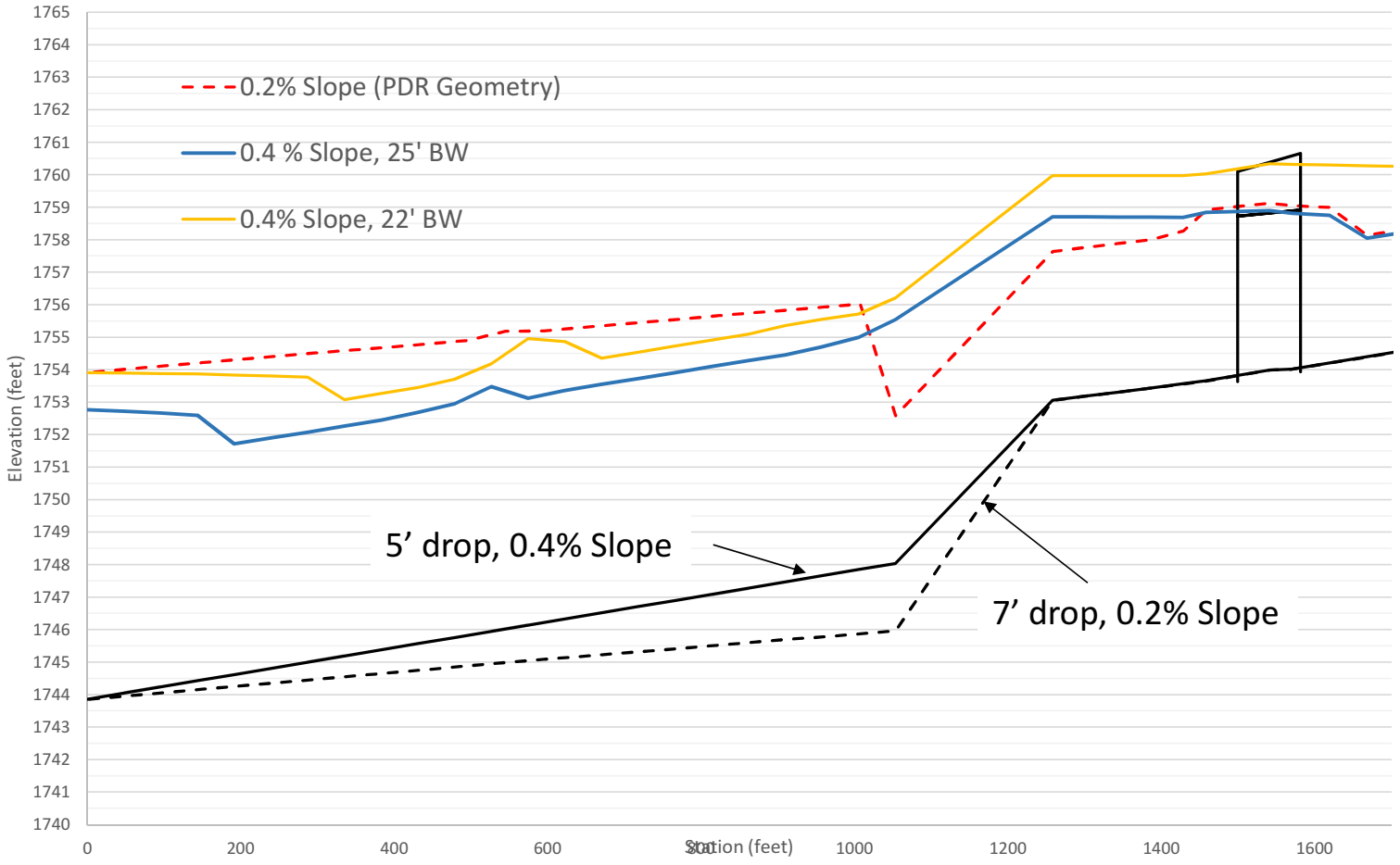
Decision Pending

Access Ramp

Trail width at channel access ramp at Sandhill is only 4.58 feet

- Maintain 8-foot trail
- Removable grate on top of the access ramp

Downstream of Marion Bridge



Other Decisions

- Section 8 Screening will not occur before 70% design submittal
- VCPs at the bridge crossings along Cedar Avenue channel will not be replaced
- Use manning's n of 0.015 in the model to account for debris and other factors
- Existing Channel with floodwall doesnot have enough capacity

Constructability Review

Stewart/Pecos Intersection:

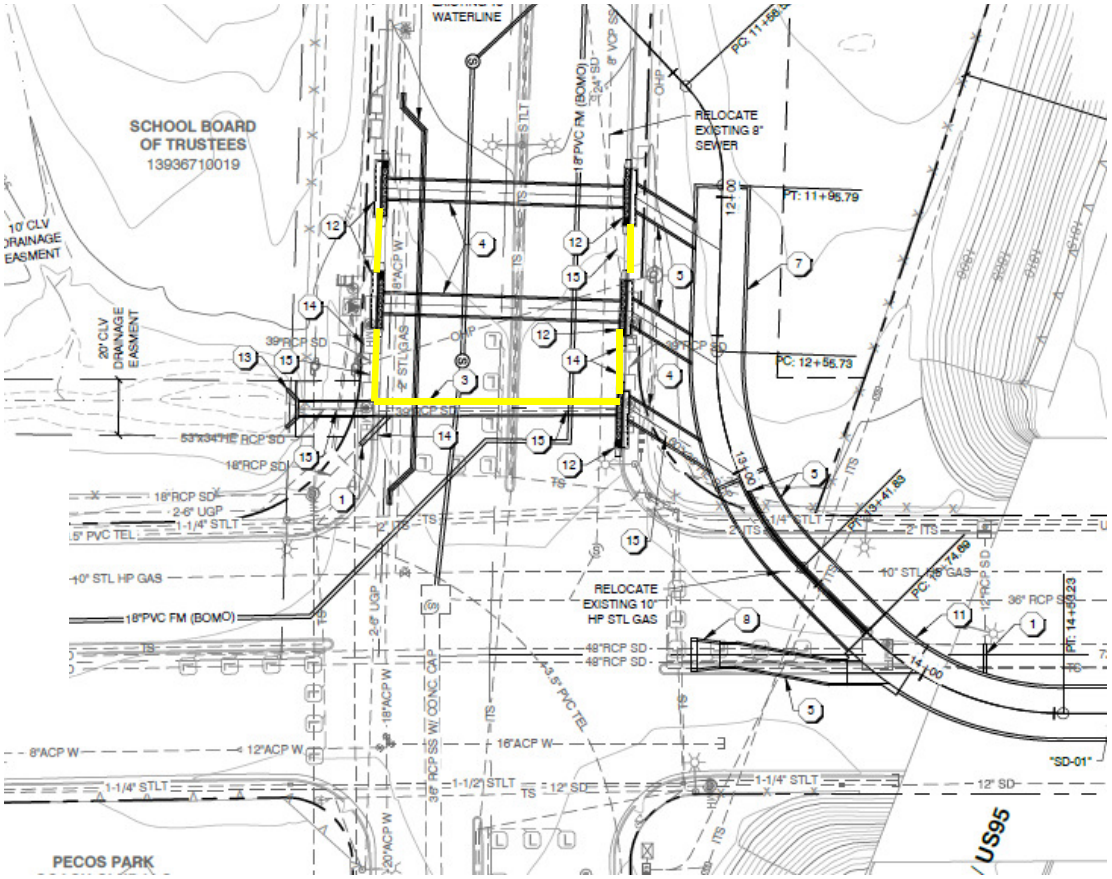
- Connect 3 DIs on each side of the road
- Move the mainline SD to the centerline of Stewart Avenue
- Make the curve from Stewart Avenue tangent to Pecos so that reverse curve is eliminated
- Put the laterals in one area so that there is only one trench and work zone

Comment:

Connect 3 Dis on each side of the road

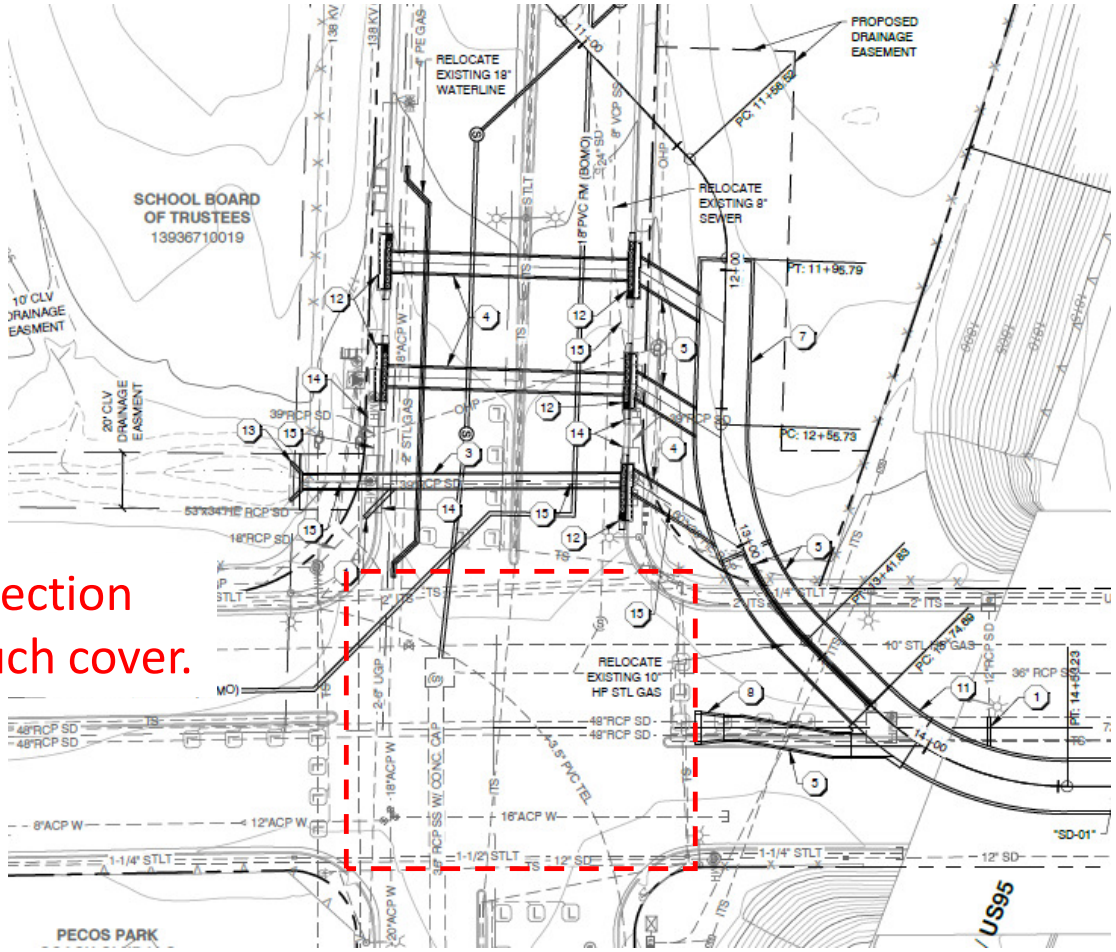
Put the laterals in one area so that there is only one trench and work zone

Current configuration allows maximum flow collection



Comment:

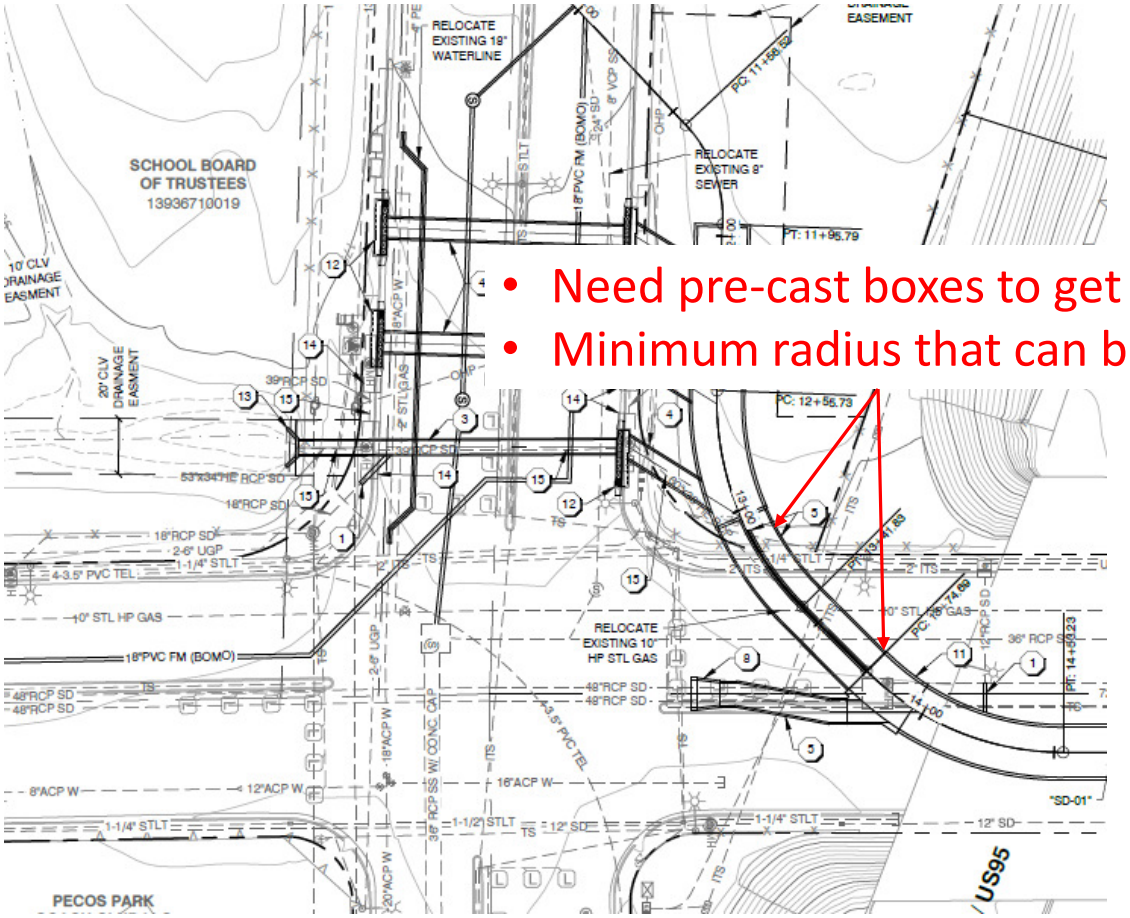
Move the mainline SD to the centerline of Stewart Avenue



- Avoid major intersection
- Low point. Not much cover.

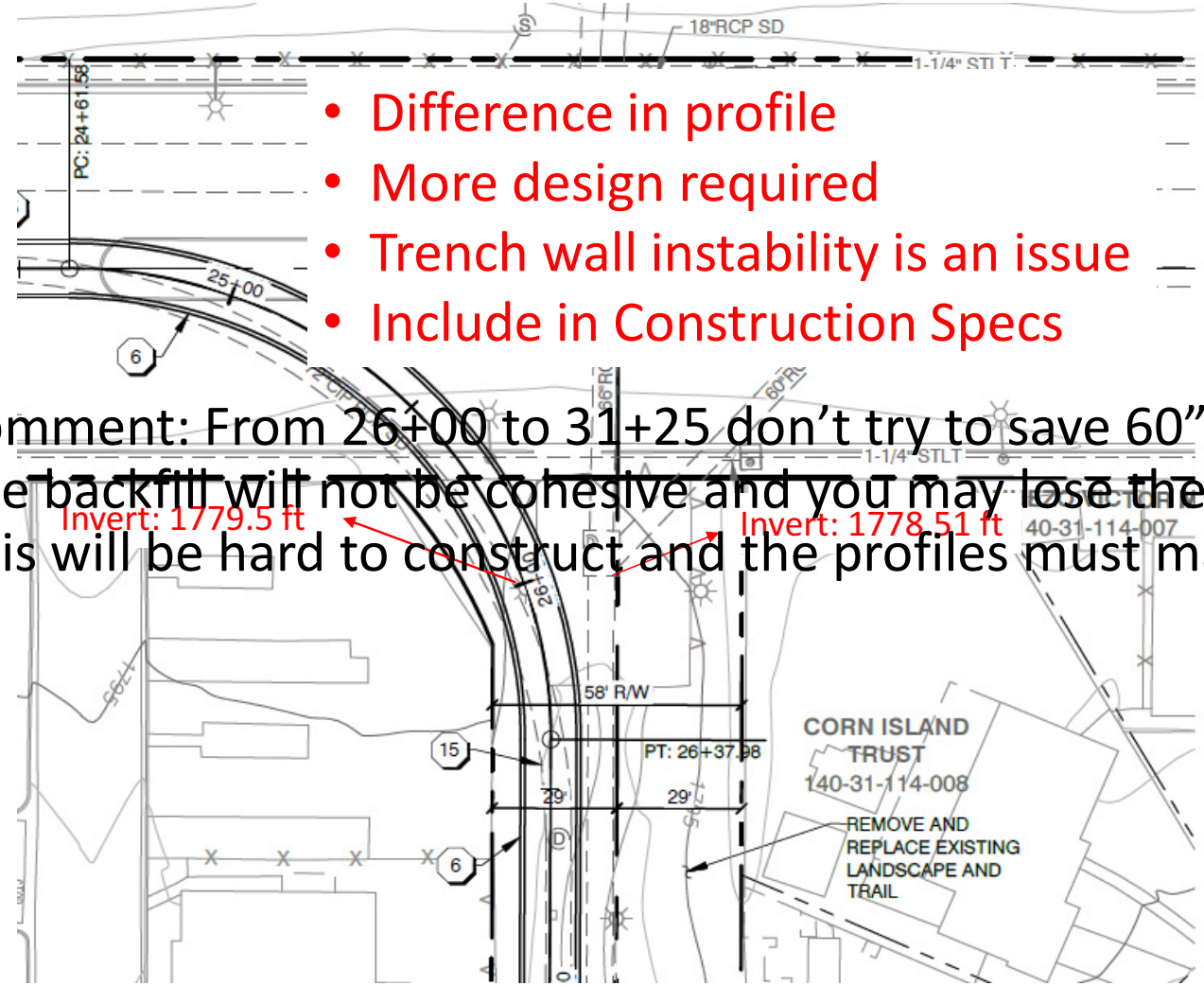
Comment:

Make the curve from Stewart Avenue tangent to Pecos so that reverse curve is eliminated



- Need pre-cast boxes to get over the sewer
- Minimum radius that can be fabricated

Constructability Review



- Difference in profile
- More design required
- Trench wall instability is an issue
- Include in Construction Specs

Comment: From 26+00 to 31+25 don't try to save 60" RCP. The backfill will not be cohesive and you may lose the RCP. This will be hard to construct and the profiles must match.

Constructability Review

Comment:

Starting 108+00 the channel goes too deep. Widen the channel or put a box under the maintenance road or find some other way to make the channel wider so the depth will not have to be so deep next to the private property. This is extremely deep next to existing right-of-way line and the possibility of damaging private property is very high.

Constructability Review

Response:

Drop is needed for the channel to work hydraulically.

Drop can be avoided if the flow coming in from Bonanza is eliminated.

Constructability Review

Comment:

The right-of-way is very narrow along this [channel] corridor and will not allow for vehicles to drive past each other if you construct the entire section. Consider designing a section that will allow a construction joint along the south side so you can build that side of the project and then drive a concrete truck along it

Constructability Review

Response

Possibilities will be dealt with in the construction specs

Construction Specifications will not be submitted with 70% Design Submittals

Atkins' Constructability Review

Move Channel 2-foot to 3-foot towards the North

Pros

- Reduces the cost of stabilizing temporary construction slopes

Cons

- Impacts maintenance access ramps
- Transitions will have hydraulic impact

Access Ramp Options

- Reduce ramp width from 12’ to 10’
- Relocate ramp to areas where land is available for purchase
- Cover ramp with grate
- Eliminate ramp and place in removable handrails
  - Allows to lower equipment with mobile cranes

City of Las Vegas, DSC

Progress Meeting #16

Wednesday, November 18, 2015

PW Granite Room

CEDAR AVENUE STORM DRAIN AND CHANNEL



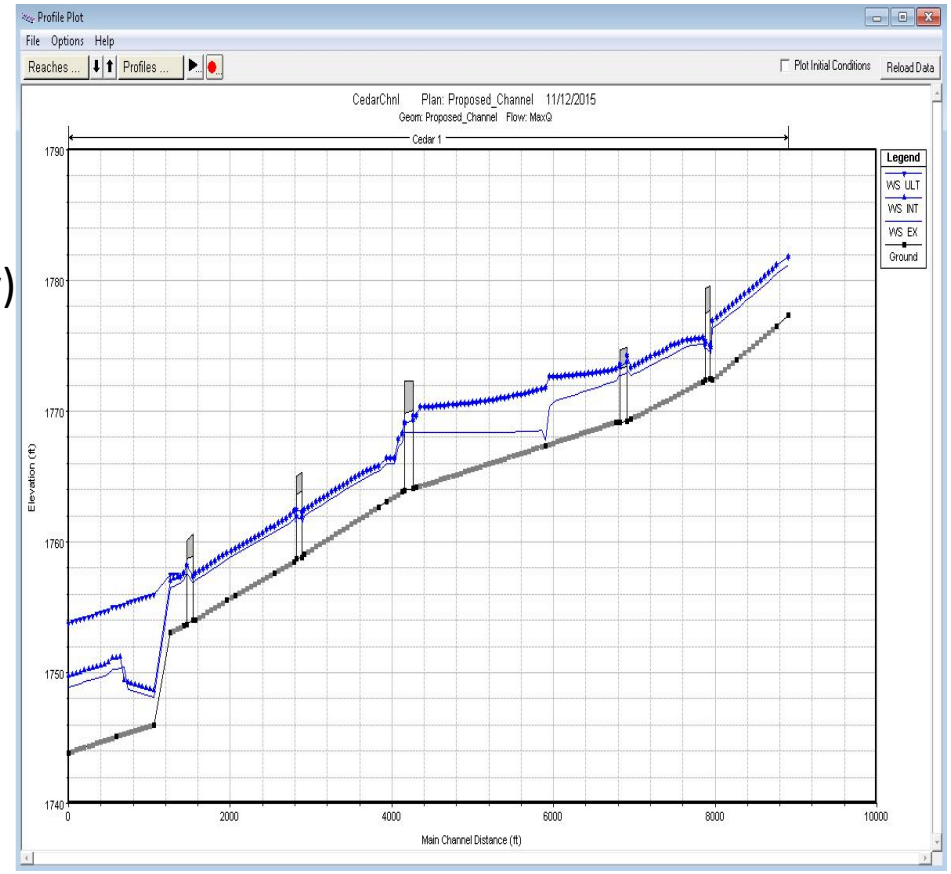
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Design Progress Overview

- Stewart/Pecos Flow Collection
- Maximum Flow in the Channel
- Megaboxes at Sandhill and Lamb Crossings

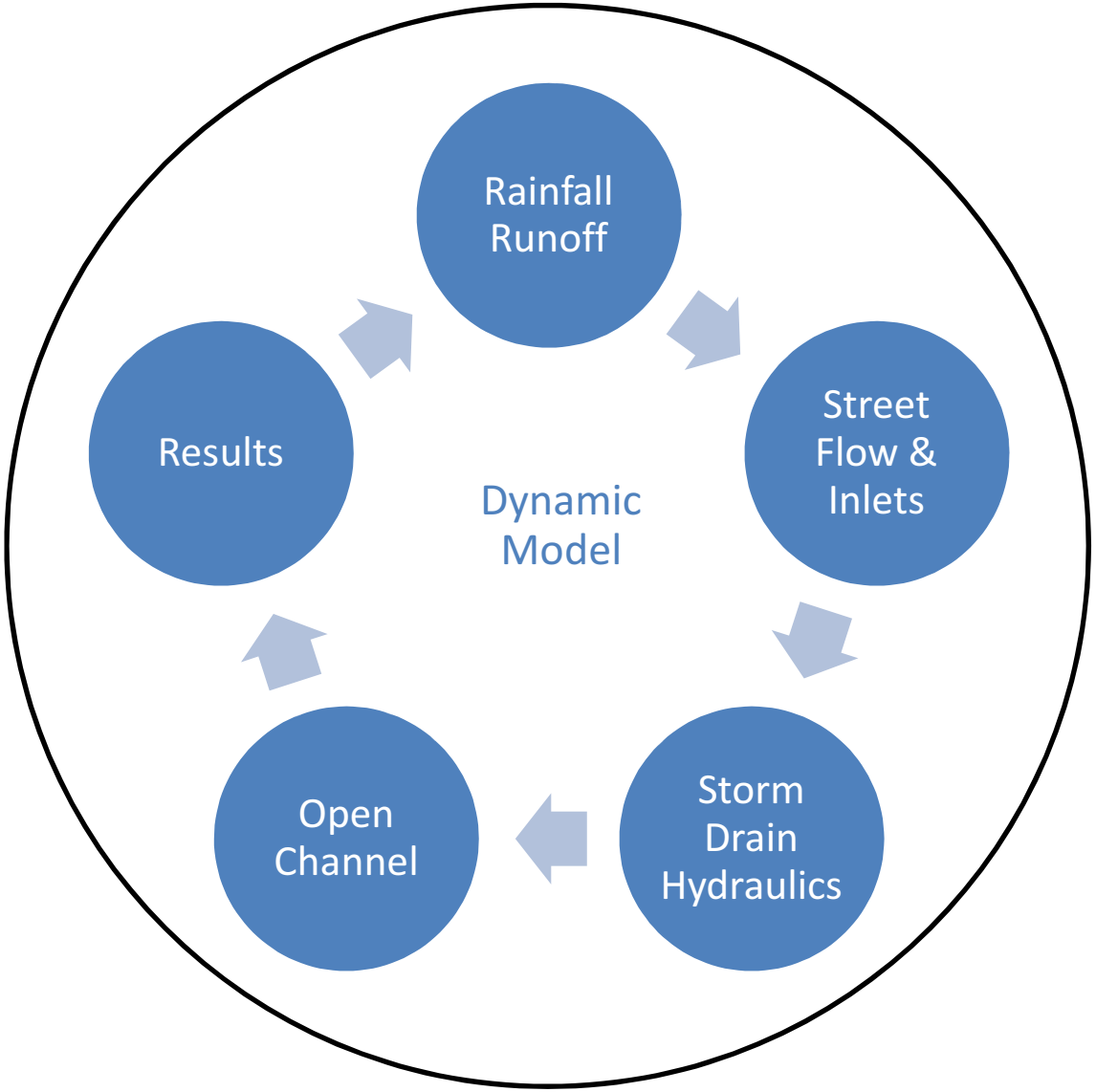
PDR Methodology

- Rainfall-runoff modeling (hydrology)
  HEC-1
- Street flow and drop inlet calcs
  Flowmaster
- Storm drain sizing/ analysis
  WSPG
- Open channel analysis
  HEC-RAS

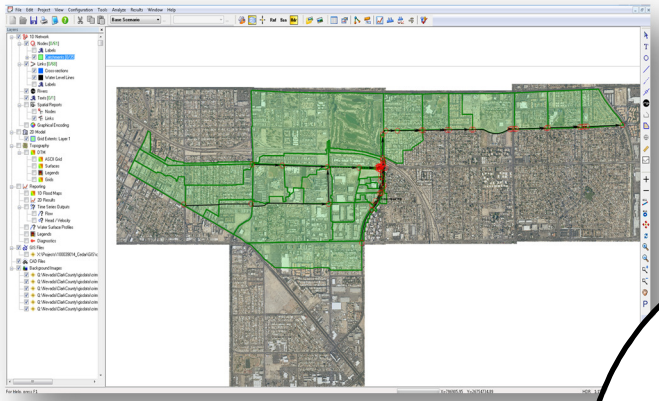


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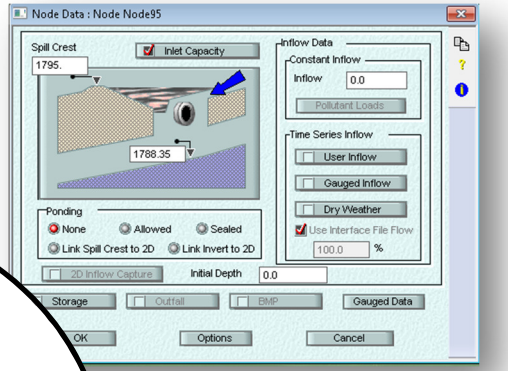
Linked, Dynamic Modeling Approach



Linked, Dynamic Modeling Approach

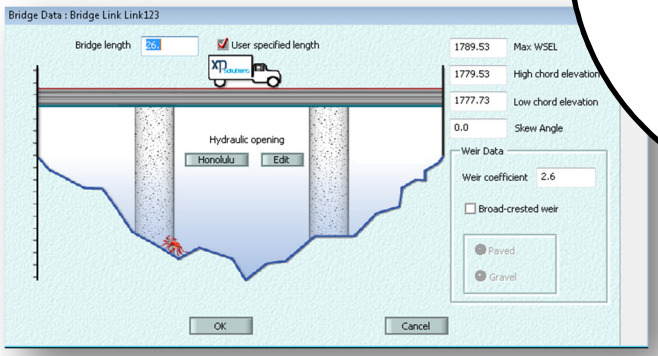


Hydrology

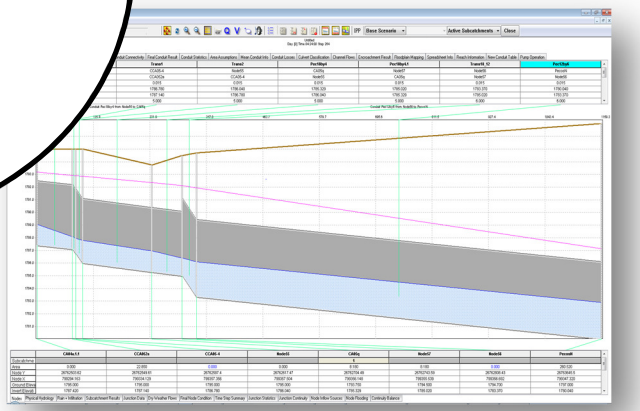


Drop Inlet Calculations

Dynamic Model

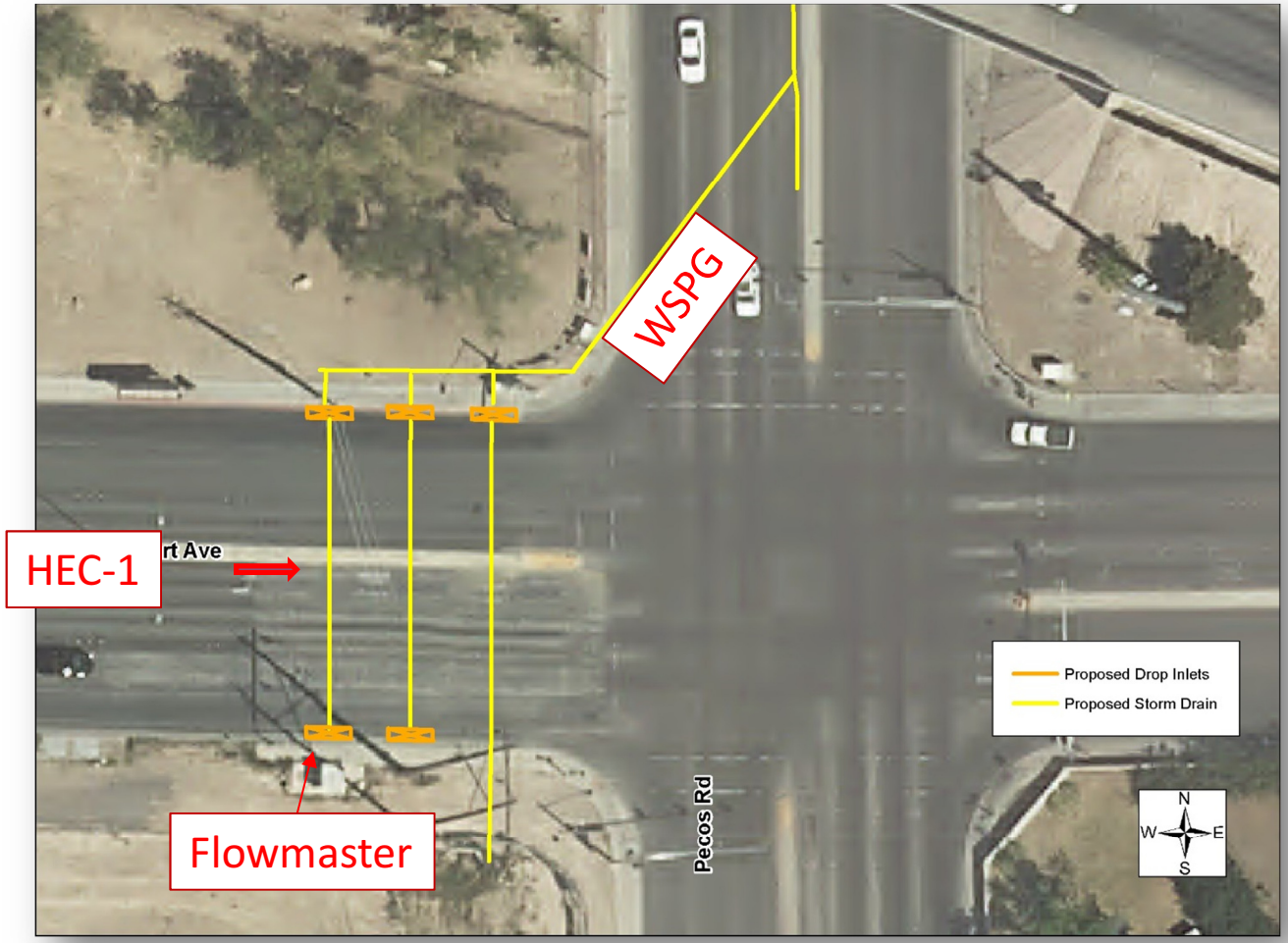


Open Channel Hydraulics



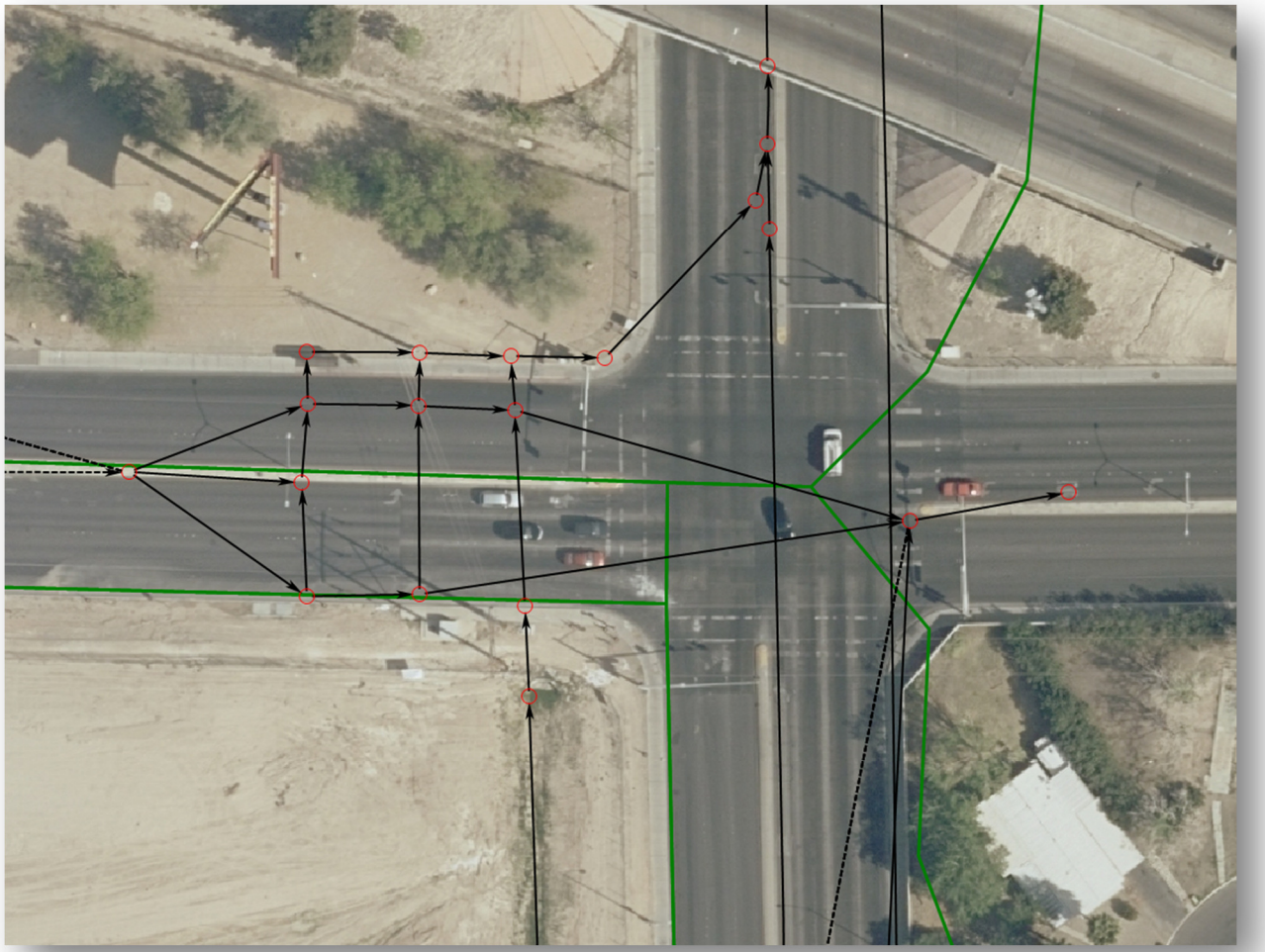
SD Hydraulics

Stewart/Pecos Collection System (30% Design)



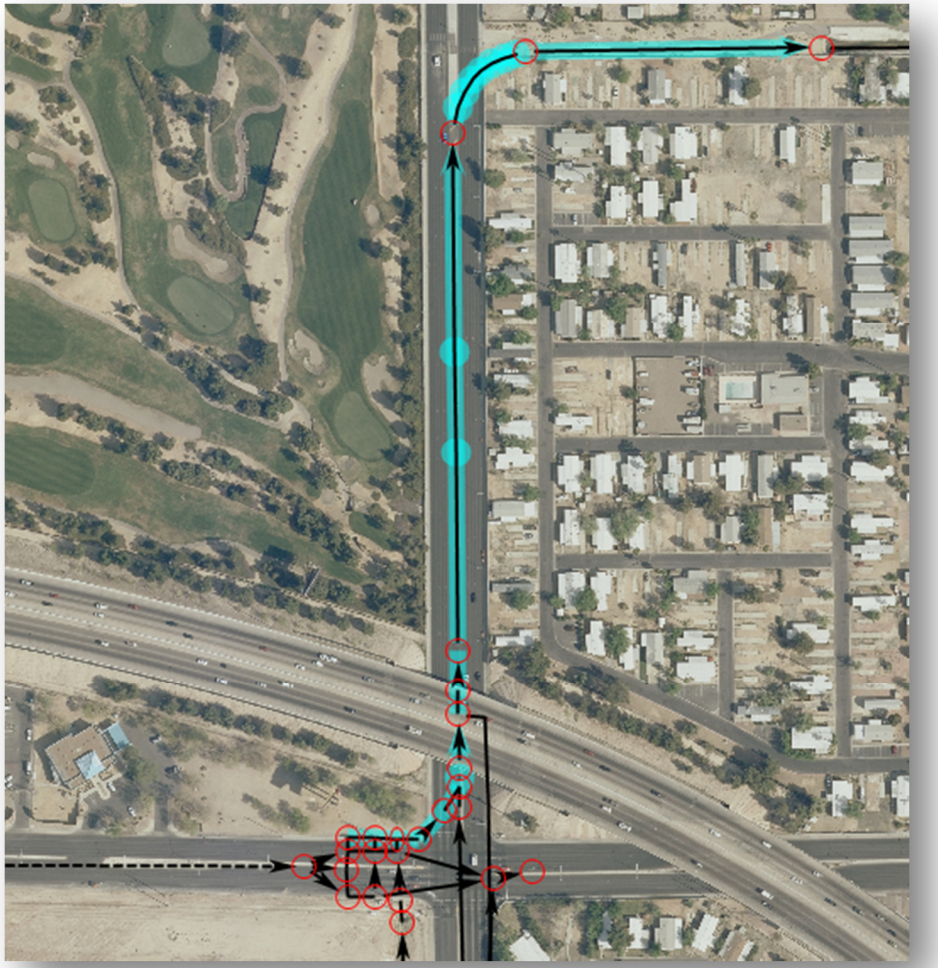
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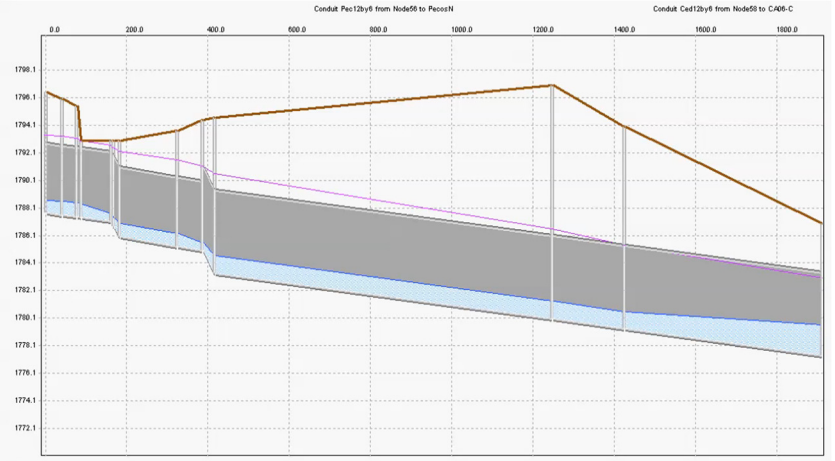
Stewart/Pecos Collection System
XPSWMM Schematic



xpswmm Animations

Storm Drain

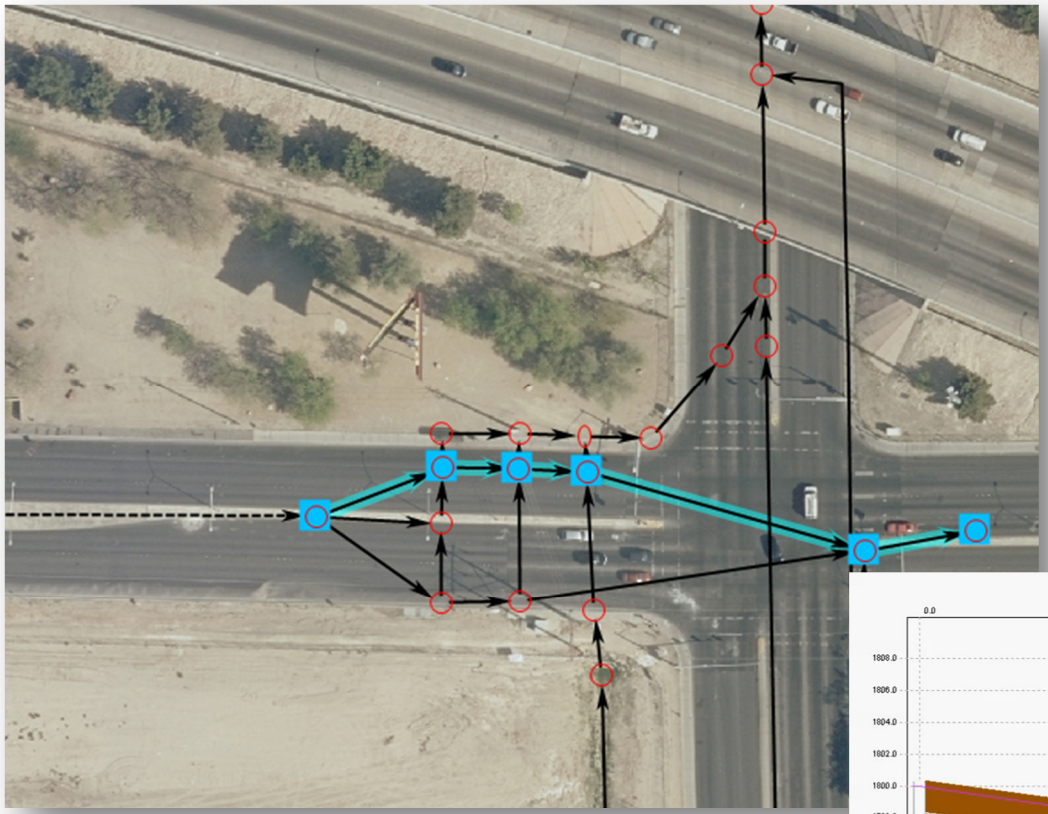


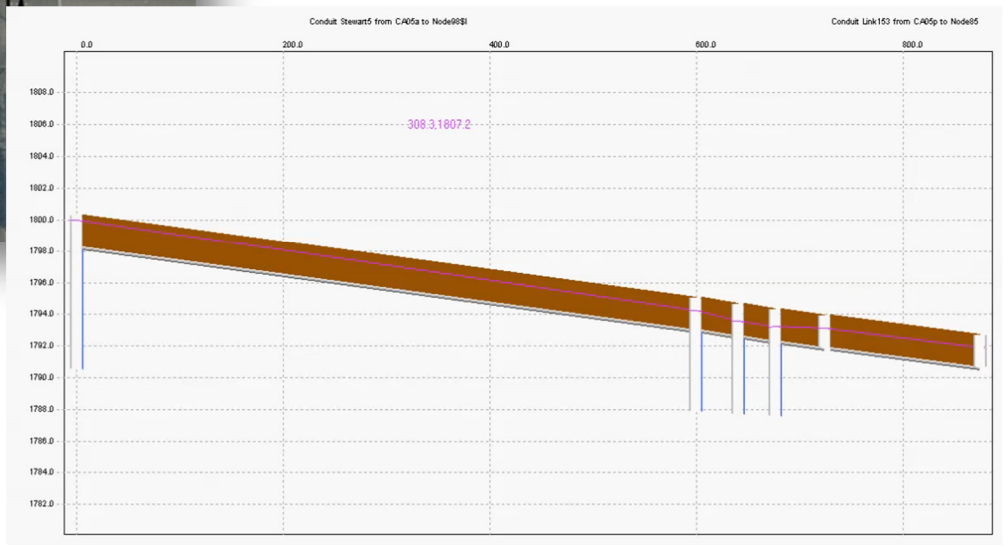


ATKINS

xpswmm Animations

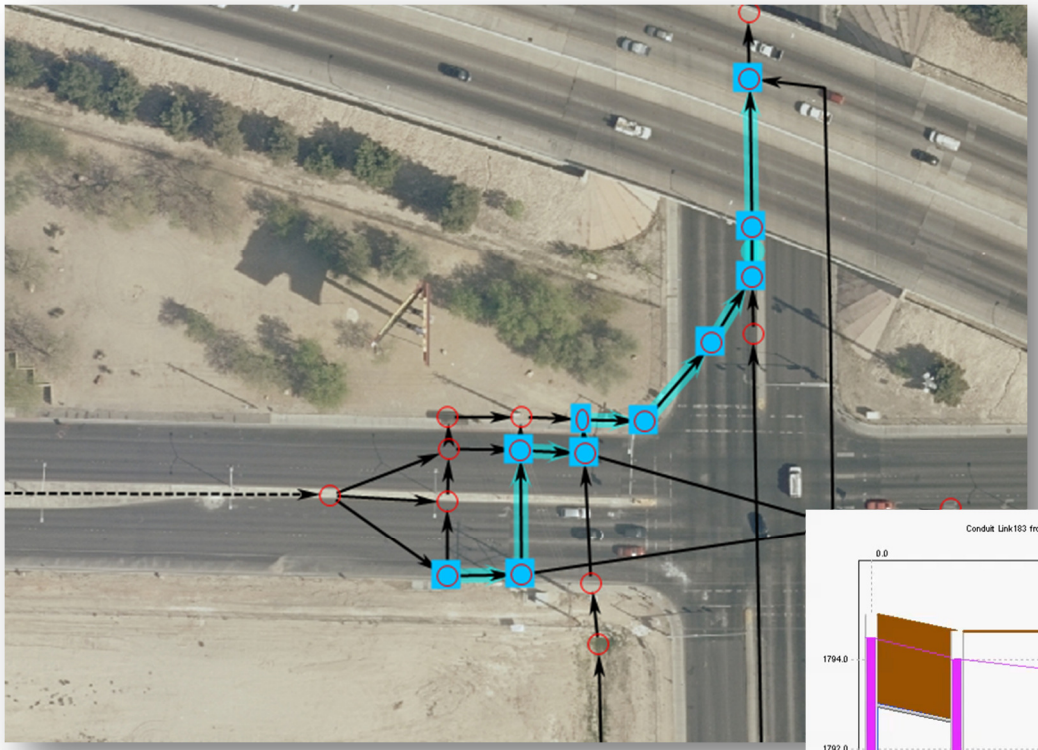
Street

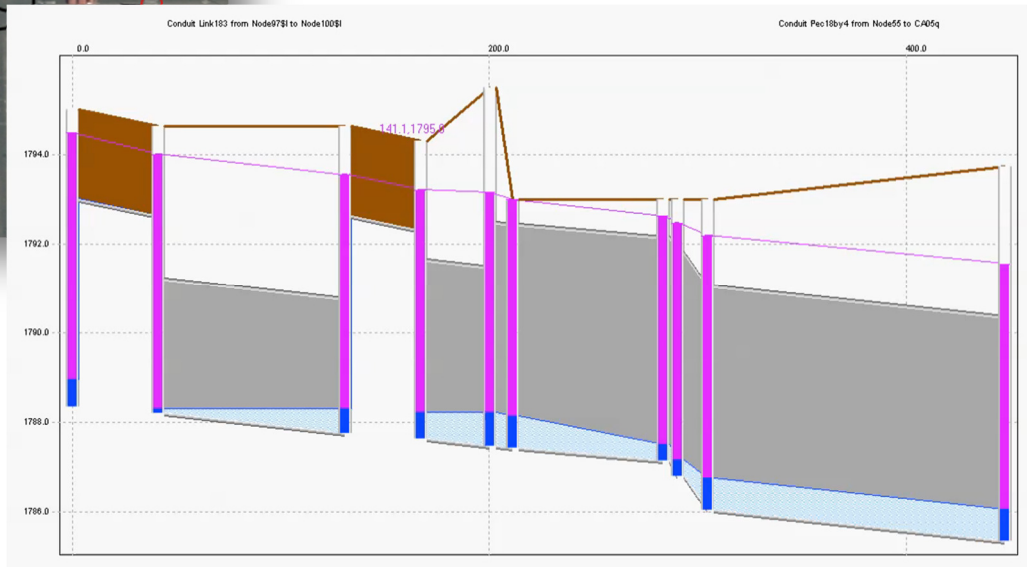




xpswmm Animations

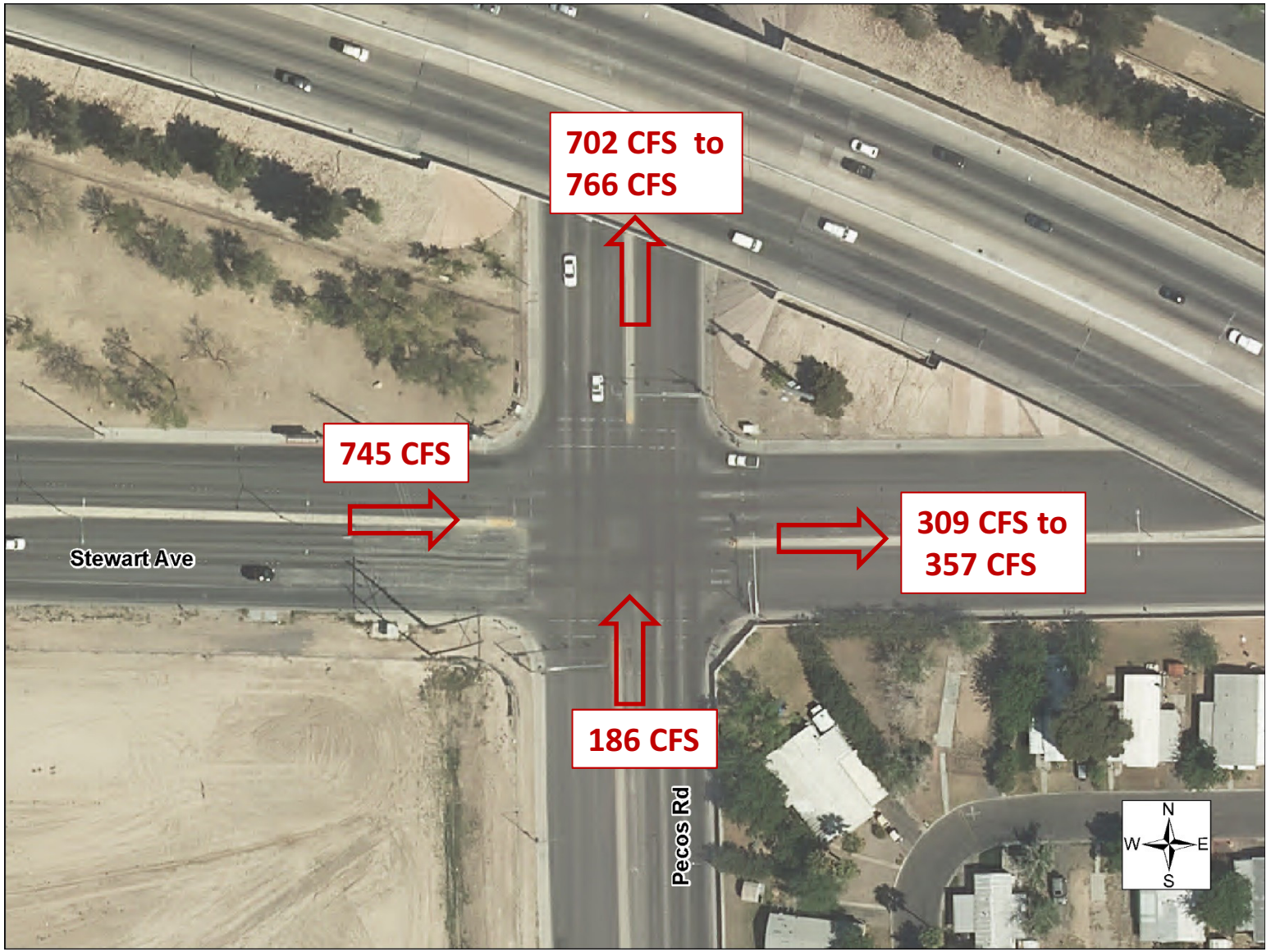
Combined Surface and Sub-Surface





Collection and Bypass at Pecos/Stewart Intersection

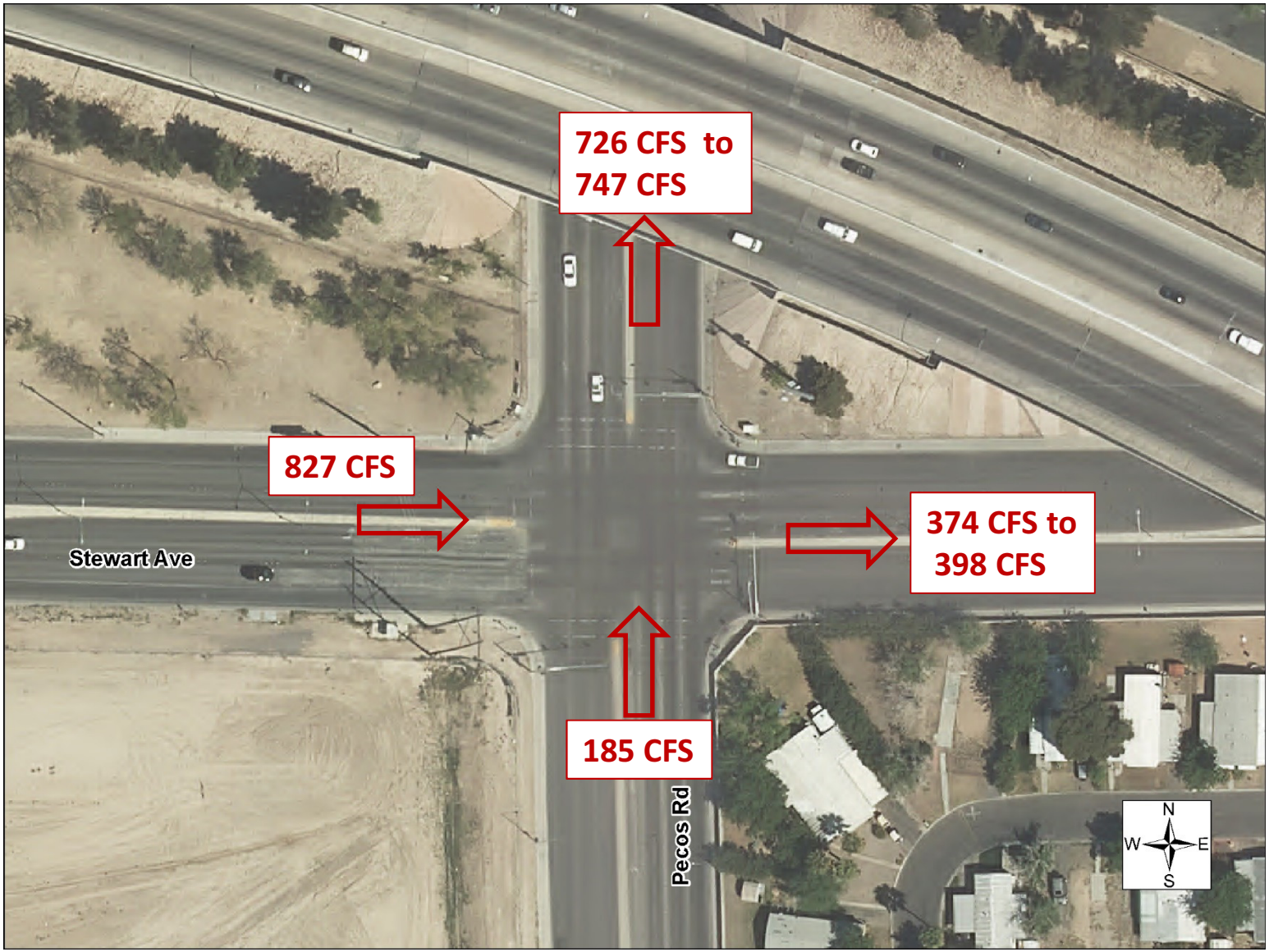
Design Flow (50% clogging, 1ft below grade)
vs Maximum Flow (no clogging, surcharging up to street)



(HEC-1, WSPG, Flowmaster)

Collection and Bypass at Pecos/Stewart Intersection

Design Flow (50% clogging, 1ft below grade)
vs Maximum Flow (no clogging, surcharging up to street)



(XPSWMM approach)

Subbasin Flows Comparision from HEC-1 and XPSWMM

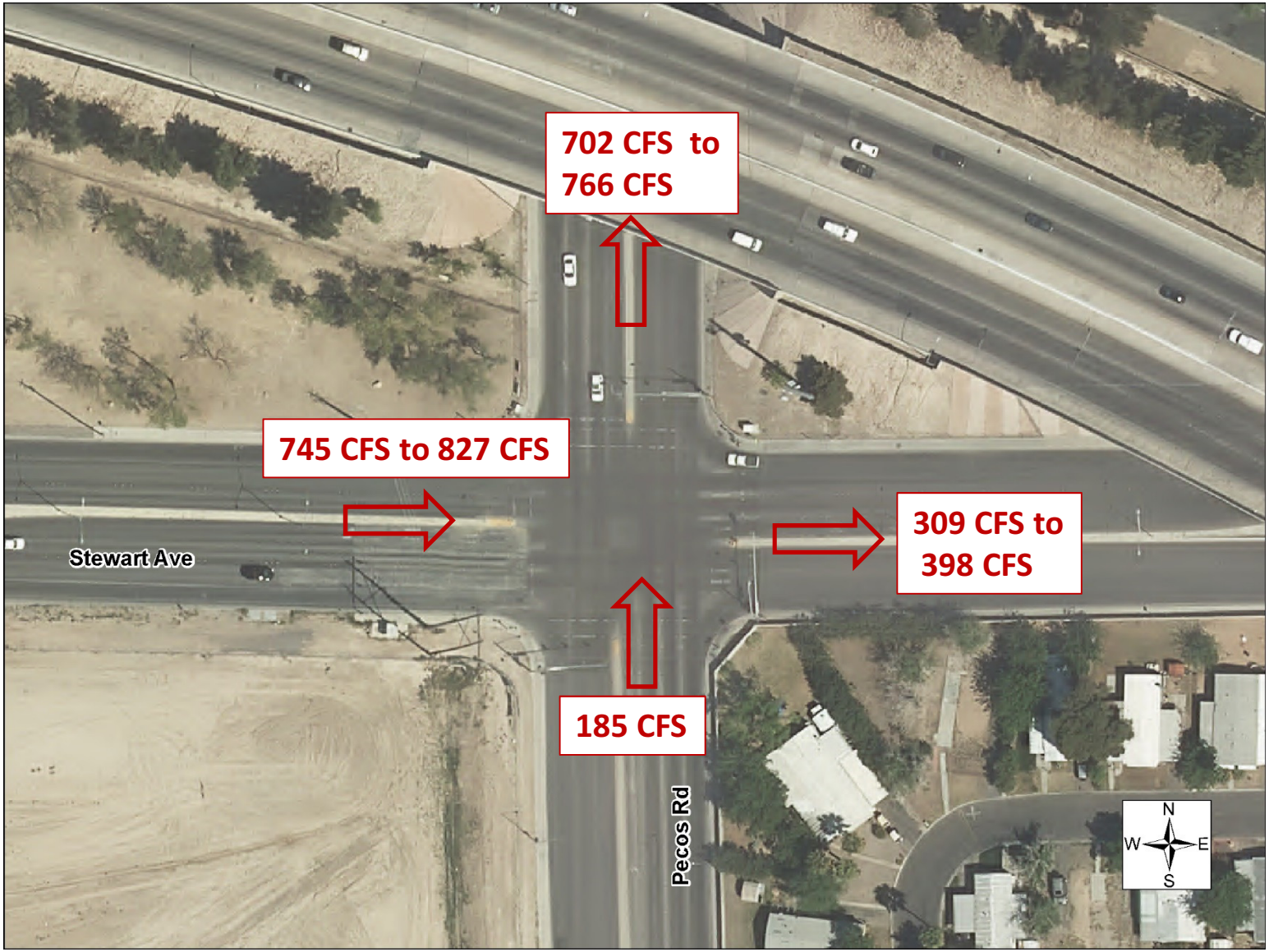
Subbasins draining to Pecos Road from Stewart Avenue

HEC-1		XPSWMM		
Subbasin	Flow (cfs)	Subbasin	Flow (cfs)	Flow Difference (cfs)
CA03a	107	CA03a	110	3
CA03b	86	CA03b	88	2
CA03c	25	CA03c	25	0
CA04a	44	CA04a	46	2
CA04b	71	CA04b	75	4
CA04c	41	CA04c	44	3
CA04d	72	CA04d	76	4
CA04e	194	CA04e	197	3
CA04f	61	CA04f	66	5
CA04g	81	CA04g	83	2
CA05a	47	CA05a	49	2
CA05b	66	CA05b	68	2

ATKINS

Collection and Bypass Range at Pecos/Stewart Intersection

Combined Modeling Approaches

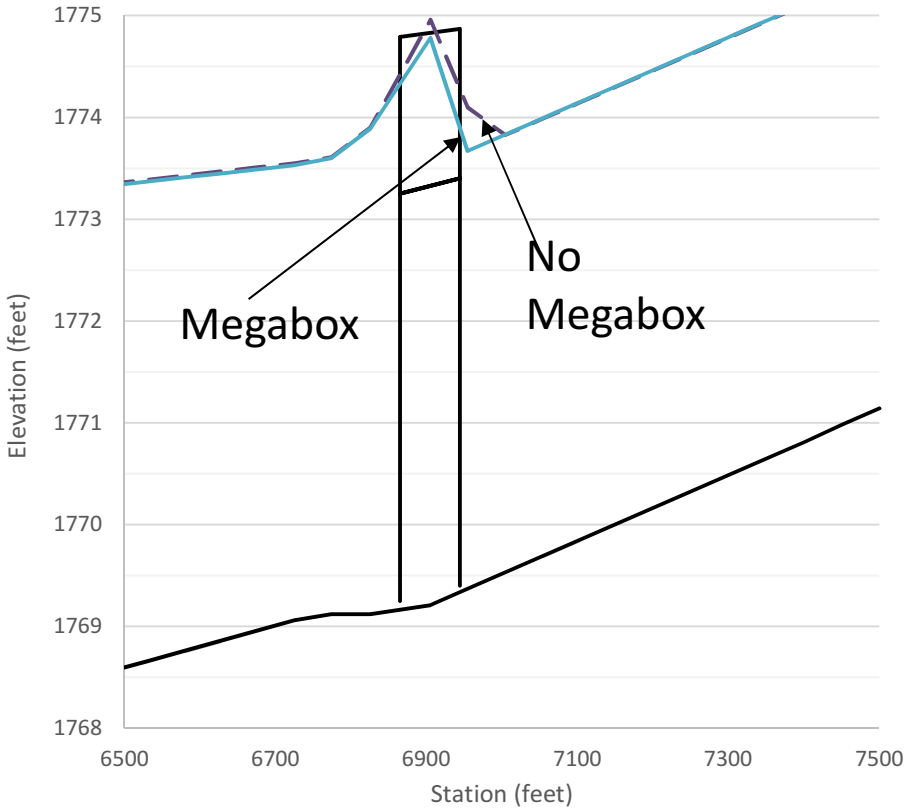


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Megabox at Sandhill

- Replace Sandhill Crossing with a Megabox

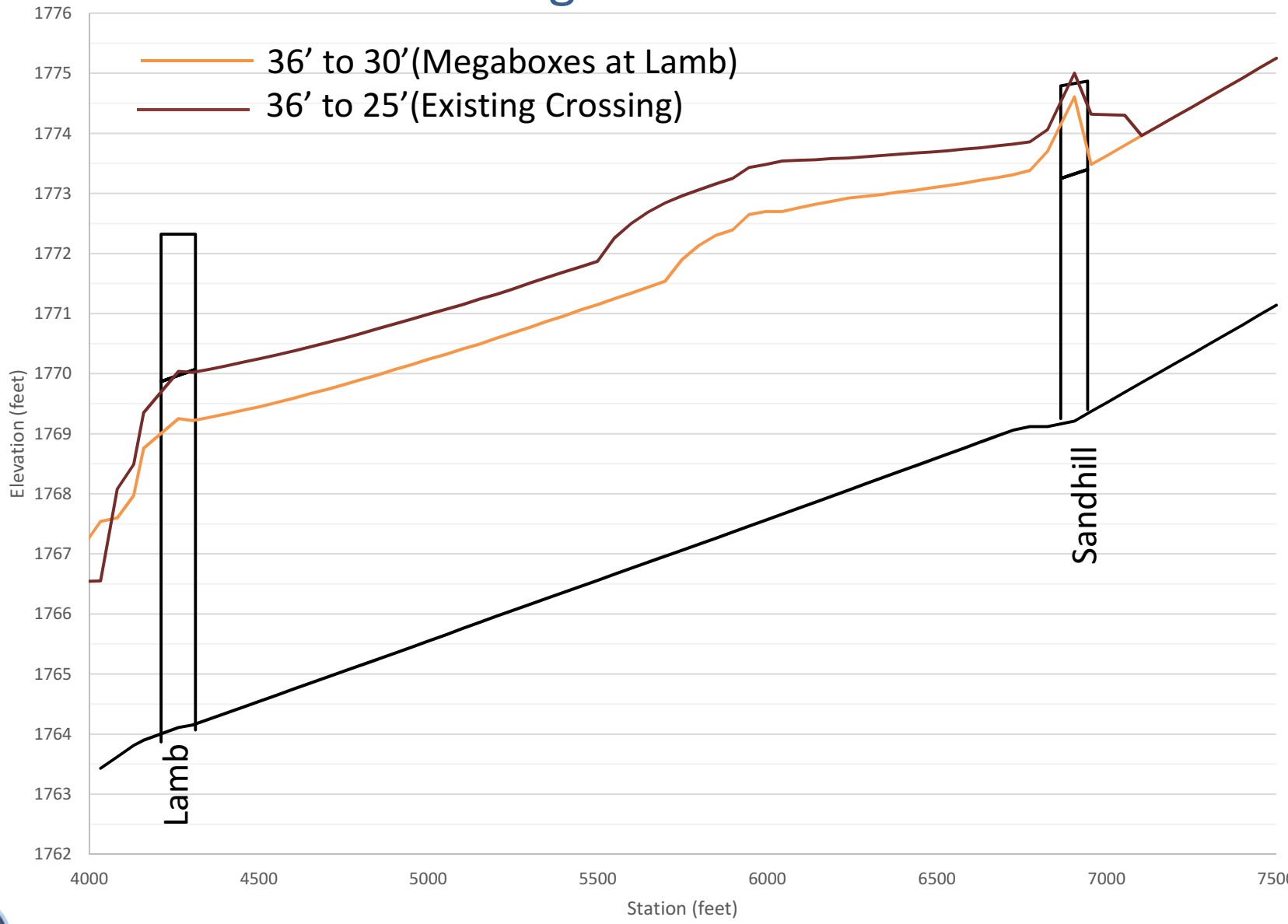
  Minimal benefit hydraulically



Cedar Channel – Between Sandhill and Lamb

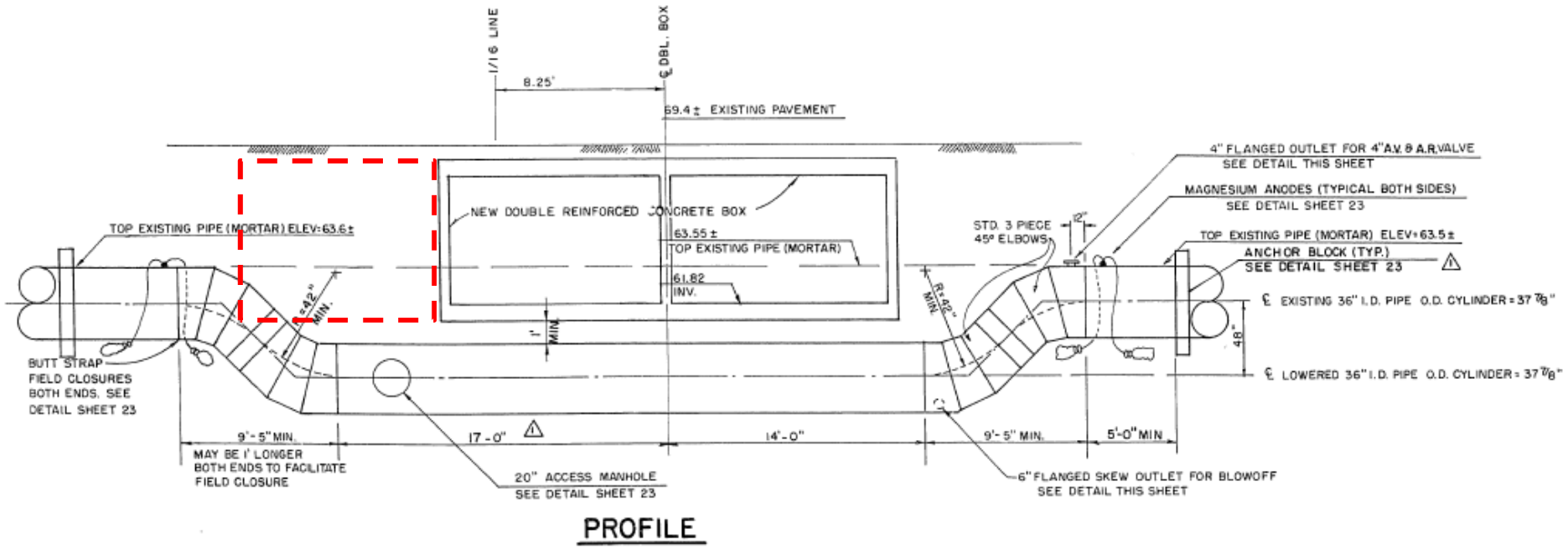
- Replace Lamb Crossing with a Megabox (dual 15’ by 6’ boxes)

Design Flow Scenario



ATKINS

Waterline Relocation at Lamb Blvd



Dual 15’ by 16’ at Lamb

Pros

- Overtopping does not occur at Sandhill
- WSE below the bridge low chord at Lamb
- Works better hydraulically

Cons

- Relocation of water line
- Costs to replace the crossing ($415K + waterline relocation costs)
- Trail width narrower

Meeting Minutes

Project:	Las Vegas Wash Central, Cedar Avenue Channel		
Subject:	Meeting Minutes: Progress Meeting #15		
Date & Time:	Wednesday, August 19, 2015	**Hansen No.**	49866
Meeting Place:	CLV, PW Granite Room	**Minutes By:**	Manogya Khanal

Present:

Rosa Cortez, CLV
Peter Jackson, CLV
Jeremy Leavitt, CLV
Oh-Sang Kwon, CLV
Rick Schroder, CLV
Michael Kinney, CLV
Allen Pavelka, CLV
Todd Myers, CCRFCD
Harshal Desai, Atkins
Brian Rowley, Atkins
Steve Bellino, Atkins
Manogya Khanal, Atkins

SUMMARY OF ACTION ITEMS:

Item	Description & Action	Responsible
1	Provide the City with pothole plans	Atkins
2	Provide the City with an exhibit that shows the lowered sewer line at the Pecos Rd/Stewart Ave intersection so the City can coordinate with BOMO project to lower their proposed profile	Atkins/CLV
3	Call Tim Sutko and USACE to do some coordination on the environmental requirements that will be required on this project	Atkins
4	Get a constructability review performed prior to 70% submittal. Coordinate on funding source.	CLV/CCRFCD

SUMMARY OF DISCUSSION:

The purpose of the meeting was to discuss project progress and design considerations related to the 30% comments and 70% submittal for the Cedar Avenue Channel Project. A summary of key discussion points is below:

- **Hydrology.** As discussed during Progress Meeting # 14, Atkins verified hydrology at two locations:
    - South of Cedar Avenue Channel, between Pecos Rd and Honolulu: Based on a comment and subsequent site visit, Atkins added a subbasin south of the channel that drains to the channel. This subbasin contributes 58 cfs to the channel.
    - Eastern Ave/Cedar Ave Intersection: Atkins reviewed the area draining to the intersection of Eastern Ave and Cedar Ave and determined that this subbasin area will

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

not impact the channel flows since the existing storm drain facilities that connect to the channel (60" RCP through Desert Pines golf course and 60" RCP in Pecos Road that combine into single 72" RCP that connects to the channel) are flowing at capacity and any remaining surface flow will not reach the channel. The City agreed. No changes will be made to the hydrology in this area.

- **Maximum Capacity of Storm Drain System**: Atkins analyzed the proposed storm drain to determine the maximum flow that could enter the system, since the drop inlets may be able to collect more during a large storm event. An additional 40-45 cfs can be collected and conveyed in the system in a fully surcharged condition. The surcharged flows would overtop the inlets on Stewart Ave (west of Pecos Rd) and continue to the east as bypass flow. Atkins will model this maximum flow scenario when running the hydraulic analysis of the channel to understand any impacts.

- **Channel Optimization and Floodwalls.** During Progress Meeting #14, the City asked if the existing trapezoidal channel geometry can be saved if floodwalls are used to meet the freeboard criteria. Atkins performed hydraulic analysis and concluded that this is not a feasible for the following reasons: (1) this will result in a water surface elevation in the proposed condition higher than the existing condition today, (2) at each of the channel crossings you will have more flooding/overtopping onto the road and constructing a high floodwall at the crossings will result in significant backwater and may not be feasible, and (3) floodwalls would be considered "levees" retaining water near adjacent residences (instead of just short floodwalls to help provide additional freeboard like currently proposed).

  Atkins will look at various ways to optimize the channel design such as:

  - Reducing the channel width where possible, especially between Sandhill Road and Lamb Boulevard.
  - Making more gradual transitions between Sandhill Road and Lamb Boulevard
  - Avoiding transitions and contractions on bends or near culverts (e.g., upstream of Lamb Blvd)
  - Replacing the crossings at Sandhill Road and/or Lamb Boulevard with mega boxes to avoid or reduce pier walls and improve conveyance

- **Sewer Replacement.** The City commented on the 30% Design Plans that the 8-inch sewer line at the Pecos Rd/Stewart Ave intersection needs to be upgraded to a 15-inch sewer and likely realigned. Atkins reviewed this proposed sewer alignment and size and determined it can be done but the relocated, larger sewer will be in conflict with the proposed BOMO line. The City said they would like to go forward with this design change and lower the BOMO line in order to accommodate the future sewer. Atkins will provide the City with the proposed sewer profile, and the City will coordinate with the BOMO project to make sure the profile is lowered accordingly.

- **5-foot tall RCBs.** During Progress Meeting #14, the City commented on the dual 8' x 4' RCBs proposed at Stewart Ave/Pecos Rd intersection and said they prefer 5-foot tall boxes for maintenance purposes. Atkins reviewed two options to accommodate the 5-foot tall box: re-profiling the road or raising the top of box up to the asphalt (essentially having no cover and paving over the box). Re-profiling the road would provide an extra 10 inches of cover and would require the entire intersection to be re-profiled. Raising the box would require a thicker slab that is adequate for driving over. The City directed Atkins to proceed with the option to use a 5-foot tall box with no cover and not to re-profile the road. CCRFCD agreed.

- **Re-profiling Sandhill Rd**. Atkins looked at replacing 4-foot tall RCB at Sandhill with 5-foot tall RCB to avoid overtopping of the crossing. Atkins stated that re-profiling of Sandhill Road is not feasible because the vertical curve would be significant and constrained by design speeds less

than 15 MPH. Sandhill Road crossing is constrained in both direction (can't lower the invert or raise the culvert) and width. CCRFCD suggested possibly using a mega box to eliminate one of the pier walls. Atkins will review. CCRFCD and the City agreed that re-profiling Sandhill Road is not a feasible or desirable alternative.

- **Constructability**. Atkins and CCRFCD suggested performing a constructability review before the 70% submittal. The City agreed. The City will look into options on how to get that review done and when. CCRFCD also said they will check if funding is available.

- **Other Coordination Items:**

    - **Section 8 Screening**. Atkins stated that the Section 8 Environmental Screening will not occur before the 70% design submittal. That can be done in the future prior to funding the project at the 90% milestone in a later phase. Atkins will do a little coordination now with Tim Sutko and USACE to understand what will be required.

    - **Schedule**. The 70% design submittal will occur later in November instead of October because of the constructability review. Atkins said they would like to wait before going too far with the 70% design plans in case there are significant comments from the constructability review. The City agreed.

    - **VCPs**. Atkins said they will not be replacing the VCPs at bridge crossings along the Cedar Avenue channel because no improvements are proposed to the crossings as part of this project. The City agreed.

    - **Manning's n Roughness.** One of the City comments stated to include a manning's roughness coefficient of 0.013 for the channel. Atkins said they will continue to use 0.015 in the model to account for debris and other factors. The City agreed.

    - **Management.** Jeremy Leavitt stated that Rosa Cortez is changing roles at the City and will no longer be the active project manager on the job. Jeremy will take over as the project manager for the time being.

--- End of Meeting Minutes ---

SIGN-IN SHEET

Las Vegas Wash Central – Cedar Avenue Channel

Progress Meeting #15, August 19, 2015 10:00 A.M.

City of Las Vegas, PW Granite Room

Las Vegas Wash Central – Cedar Avenue Channel

Name	Affiliation	Phone Number	Email Address	Initials	Attendance
Rosa Cortez	CLV	702-229-6264	rcortez@lasvegasnevada.gov		☒
Oh-Sang Kwon	CLV	702-229-1815	okwon@lasvegasnevada.gov		☑
Peter Jackson	CLV	702-229-5266	pjackson@lasvegasnevada.gov		☑
Tim Parks	CLV	702-229-2178	tparks@lasvegasnevada.gov		☐
Alan Riekki	CLV	702-229-6217	ariekki@lasvegasnevada.gov		☐
Nancy Almanzan	CLV	702-229-6343	nalmanzan@lasvegasnevada.gov		☐
Jeremy Leavitt	CLV	702-229-6278	jeleavitt@LasVegasNevada.gov	JPL	☑
Greg McDermott	CLV	702-229-2143	gmcdermott@lasvegasnevada.gov		☐
Tom Hayes	CLV	702-229-6735	thayes@lasvegasnevada.gov		☐
Mike Janssen	CLV	702-229-4866	mjanssen@lasvegasnevada.gov		☐
Bart Anderson	CLV	702-229-2198	banderson@lasvegasnevada.gov		☐
Rick Schroder	CLV	702-229-2452	rschroder@lasvegasnevada.gov		☑
Fred Solis	CLV	702-229-5407	fsolis@lasvegasnevada.gov		☐
Todd Myers	CCRFCD	702-685-0000	tmyers@regionalflood.org		☑
Matt Baird	Atkins	702-990-7432	matt.baird@atkinsglobal.com		☐
Harshal Desai	Atkins	702-551-0349	harshal.desai@atkinsglobal.com		☑
Brian Rowley	Atkins	702-551-0320	brian.rowley@atkinsglobal.com		☑
Steve Bellino	Atkins	702-551-0304	steve.bellino@atkinsglobal.com	SMB	☑
Manogya Khanal	Atkins	702-605-9063	Manogya.khananl@atkinsglobal.com	MK	☑
MICHAEL KINNEY	CLV	229-6938	MKINNEY@LASVEGAS...		☑

ATKINS

Meeting Minutes

Project:	Las Vegas Wash Central, Cedar Avenue Channel		
Subject:	Meeting Minutes: Progress Meeting #16		
Date & Time:	Wednesday, November 18, 2015	**Hansen No.**	49866
Meeting Place:	CLV, PW Granite Room	**Minutes By:**	Brian Rowley

Present:

Peter Jackson, CLV
Jeremy Leavitt, CLV
Rick Schroder, CLV
Randy Mrowicki, CLV

Harshal Desai, Atkins
Brian Rowley, Atkins

SUMMARY OF ACTION ITEMS:

Item	Description & Action	Responsible
1	Send information and meeting minutes to CCRFCD (Todd) regarding the option to use a megabox at Lamb Blvd crossing	Atkins (pending)
2	Provide Shawn Meagher with plans and Preliminary Design Report so he can put together a proposal for constructability review	Atkins (complete)
3	Finalize agreement and start Shawn Meagher on constructability review	CLV, Jeremy (pending)
4	Schedule future progress meeting in January	CLV, Jeremy/Rosa (pending)

SUMMARY OF DISCUSSION:

The purpose of the meeting was to discuss project progress and design considerations related to the 30% comments and 70% submittal for the Cedar Avenue Channel Project. A summary of key discussion points is below:

- **H&H Analysis at Stewart/Pecos Intersection.** Atkins developed an xpswmm model of the watershed and the proposed storm drain and collection facilities at Stewart Ave and Pecos Rd. The intent of the model was to analyze the complex flow interaction between the street flow, inlets, laterals, storm drain flow, and bypass flow. The xpswmm model was compared with the HEC-1/WSPG models previously developed for the 30% submittal. The model results were shared at the meeting using PowerPoint (slides are attached to these meeting notes). The model worked well as intended and resulted in the following conclusions:
    - The rainfall-runoff (SCS method) results (peak flows) at each subbasin were very similar in xpswmm and HEC-1.

NOTE TO RECIPIENTS:

These meeting notes record Atkins understanding of the meeting and intended actions arising there from. Your agreement that the notes form a true record of the discussion will be assumed unless adverse comments are received in writing within five days of receipt.

- The routing of flows in HEC-1 occurs using kinematic wave routing, whereas the xpswmm model uses dynamic wave routing on an actual street section that is input into the model. This results in less attenuation and slightly higher flows in xpswmm.

- The different modeling approaches showed a maximum flow of around 766 cfs can be collected and conveyed north in the proposed storm drain to the Cedar Avenue channel. The maximum flow assumes surcharged pipes and no clogging on the inlets. Atkins will use this maximum flow to ensure no adverse impacts along the channel downstream.

- Atkins said that this addresses one of Todd Myers' comments at a previous meeting about determining how much flow could potentially enter the system if there is no clogging at the inlets. The modeling showed the storm drain is already pressurized to a foot below grade in the design flow scenario, so any additional flow collection at unclogged inlets or surcharging will not result in a significantly higher flows in the storm drain going north. Using these model results, Atkins will finalize modeling results and the design of the drop inlets, laterals, and storm drain facilities in the Draft Final Design Report.

- **Sandhill Rd Megabox**. Atkins looked at the possibility of replacing the Sandhill Crossing with a megabox to eliminate on of the piers and improve hydraulic performance. The change resulted in minimal hydraulic benefit. Atkins said they have looked at options to lower the channel invert and raise the road profile and there are no viable options. The crossing will remain as is in the 70% Design Plans. The City Agreed.

- **Lamb Blvd Megabox**. Atkins evaluated the option of removing and replacing the existing 2: 12' x 6' RCB crossing at Lamb Blvd with a bigger megabox of 2: 15' x 6'. The hydraulic model shows that this would provide additional conveyance capacity at the crossing and lower the water surface profile by a little less than a foot. There are pros and cons associated with replacing the crossing with bigger megaboxes, as outlined in the PowerPoint slides (see attached). The primary benefit is better hydraulic performance and the major disadvantage is the cost and the requirement to relocate the existing 36" waterline. Atkins asked which option they should use for the 70% Design Plans. The City said to send this information to CCRFCD (Todd) and get his input before making a final decision.

- **Other Coordination Items:**

  - **Constructability Review:** Jeremy said that he asked Shawn Meagher to put together a proposal to do a constructability review. Atkins will send Shawn the plans and preliminary design report that includes a list of constructability issues and considerations. The City will coordinate with Shawn to get that review underway. At this point, Atkins will wait to make substantial progress on the plans until the review occurs.

  - **Drainage Criteria Exceptions**: During the discussion of H&H analysis and channel hydraulics etc., Peter requested that Atkins include a table or summary of design criteria that is not being met in the Draft Final Design Report. Atkins agreed.

  - **Phase 1 Potholing Complete**. Atkins completed Phase 1 of the potholing effort and is incorporating the data into the design plans.

  - **Schedule**. The City stated that constructability review will be the priority and no progress meeting will be scheduled in December. We will meet again in January. The City will send out the meeting invite for the next meeting.

--- End of Meeting Minutes ---

City of Las Vegas, DSC

Progress Meeting #16

Wednesday, November 18,2015

PW Granite Room

CEDAR AVENUE STORM DRAIN AND CHANNEL



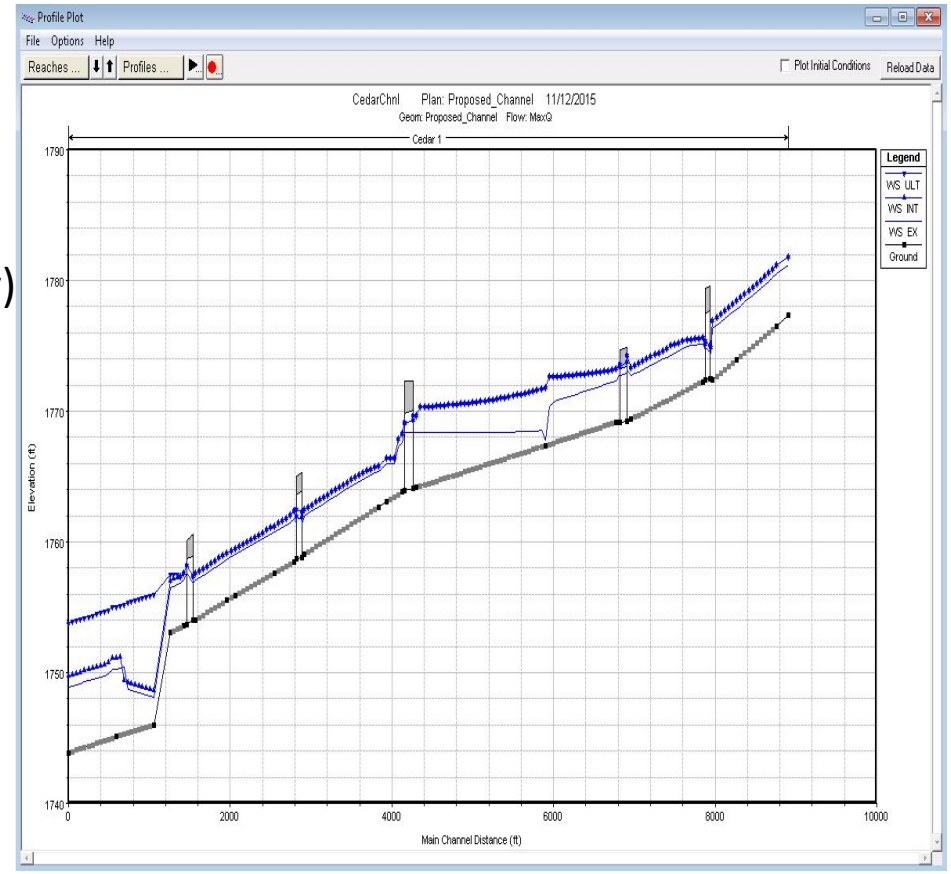
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Design Progress Overview

- Stewart/Pecos Flow Collection
- Maximum Flow in the Channel
- Megaboxes at Sandhill and Lamb Crossings

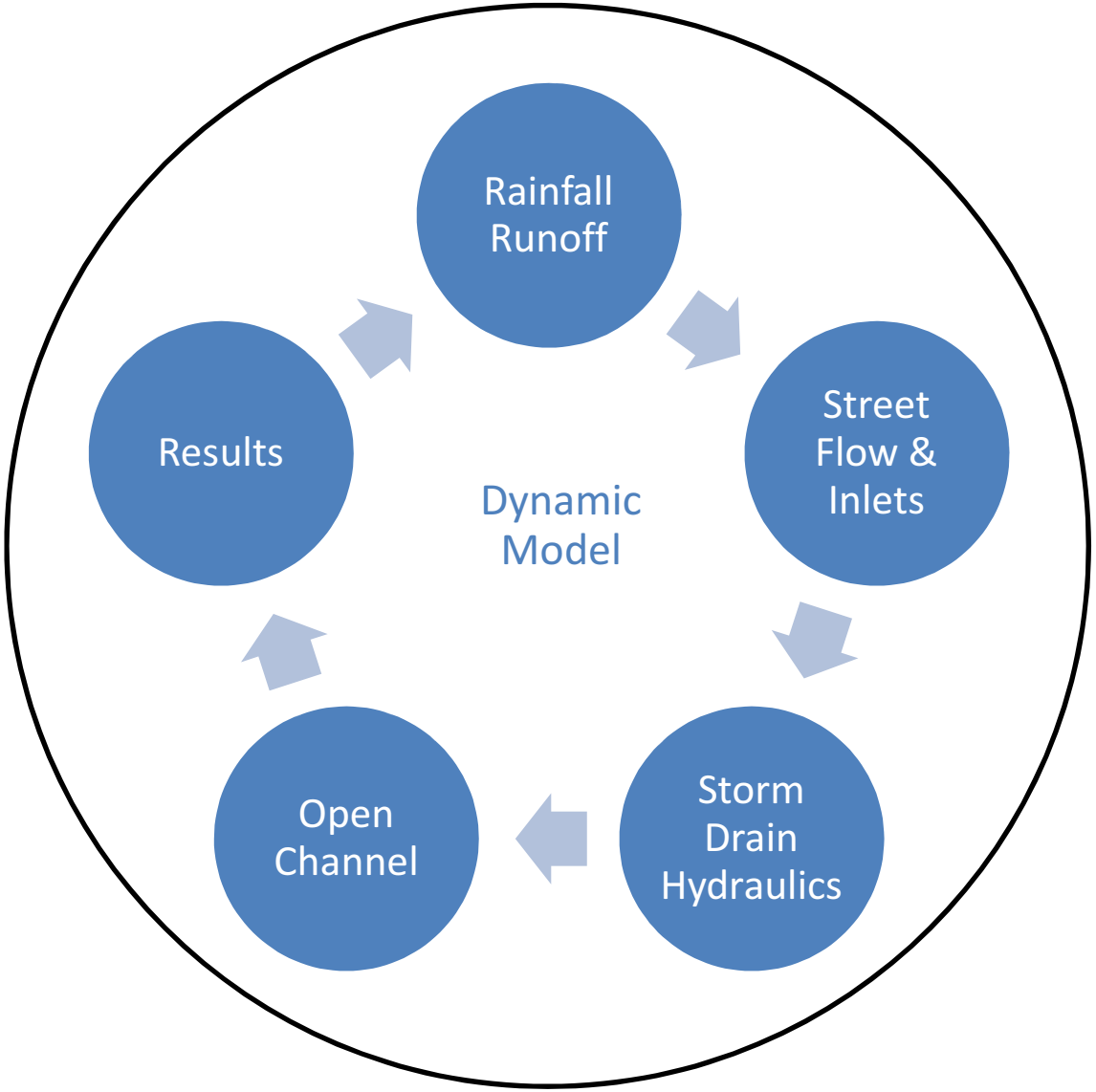
PDR Methodology

- Rainfall-runoff modeling (hydrology)
  HEC-1
- Street flow and drop inlet calcs
  Flowmaster
- Storm drain sizing/ analysis
  WSPG
- Open channel analysis
  HEC-RAS

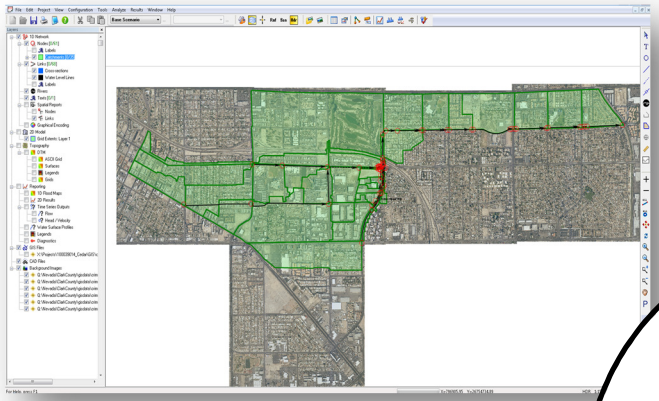


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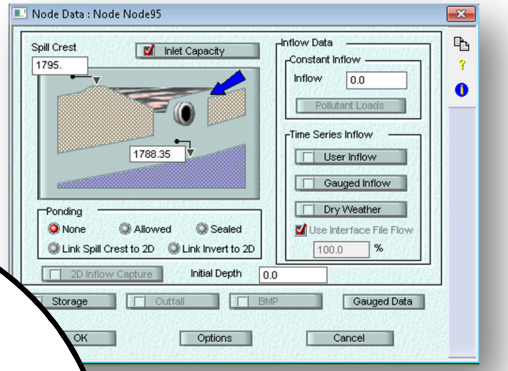
Linked, Dynamic Modeling Approach



Linked, Dynamic Modeling Approach

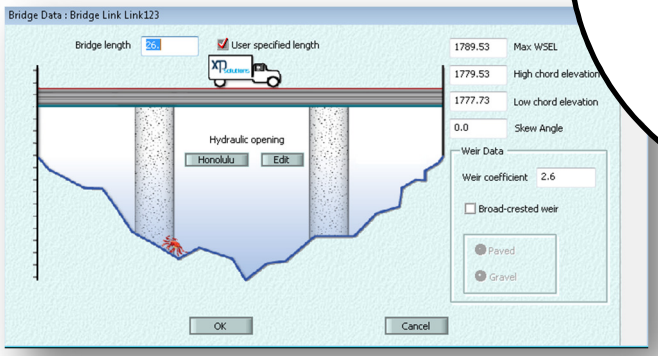


Hydrology

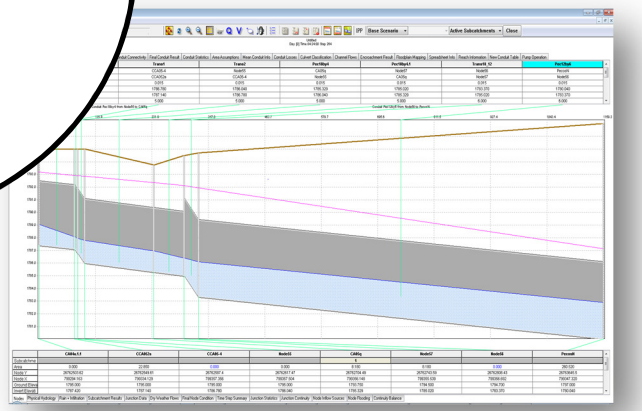


Drop Inlet Calculations

Dynamic Model

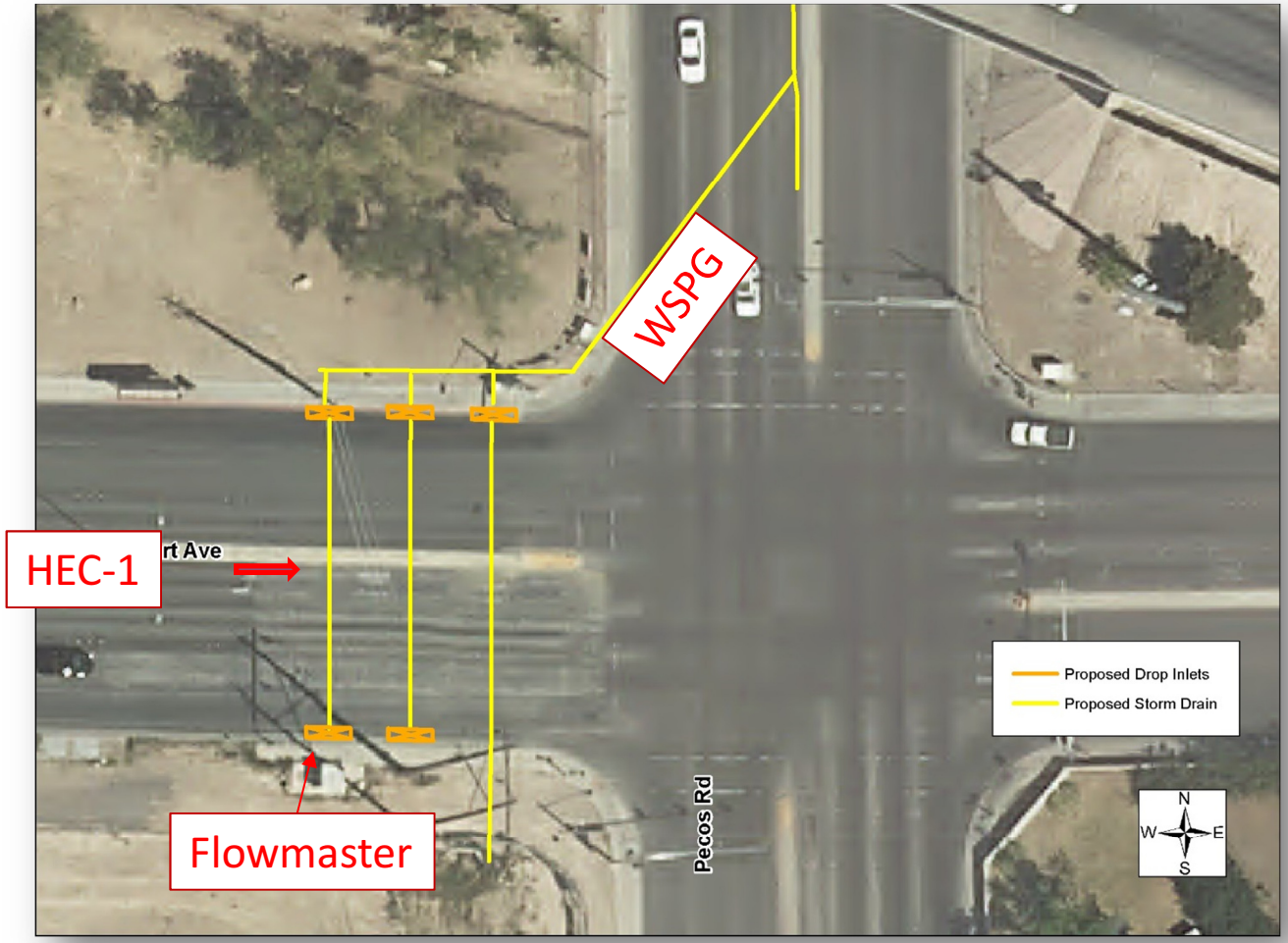


Open Channel Hydraulics



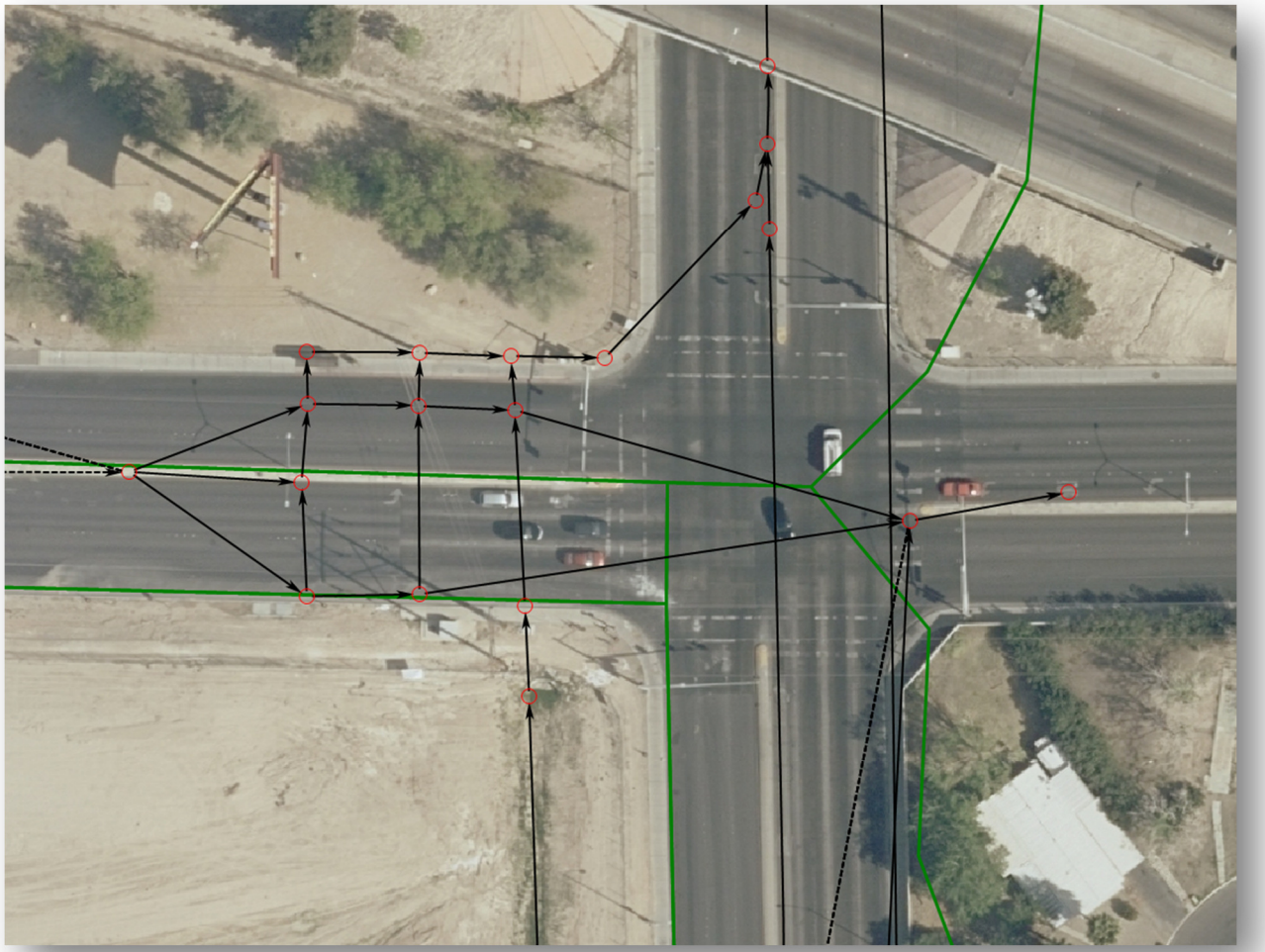
SD Hydraulics

Stewart/Pecos Collection System (30% Design)



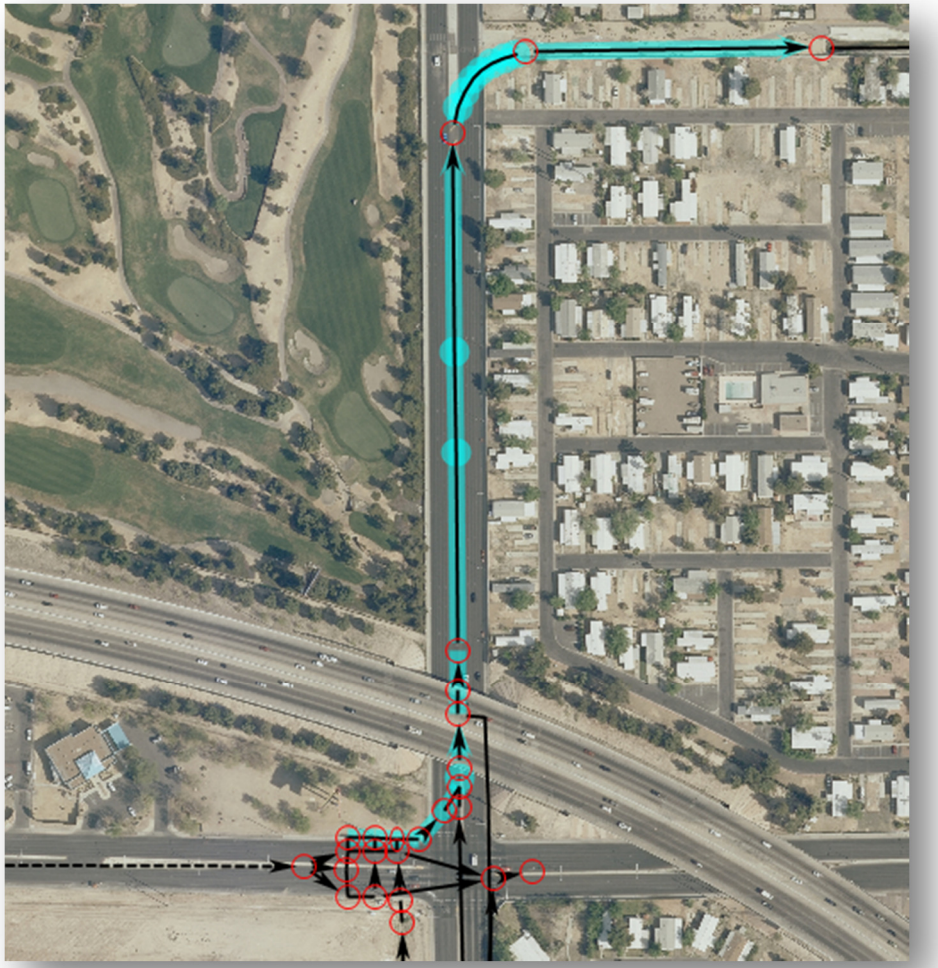
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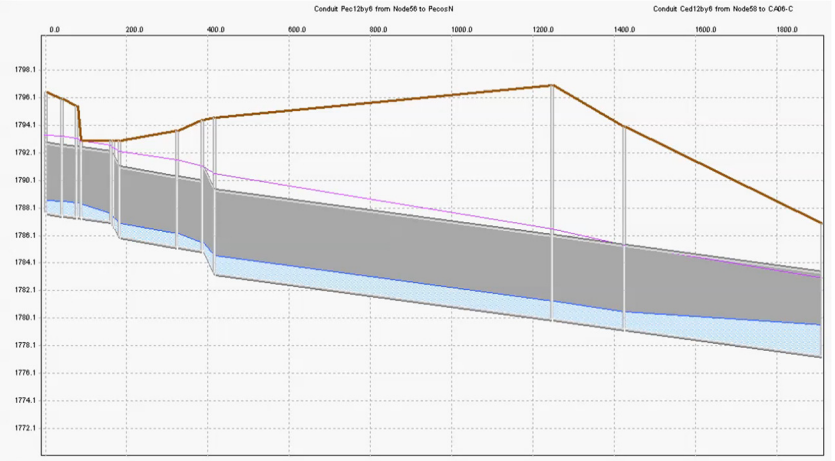
Stewart/Pecos Collection System
XPSWMM Schematic



xpswmm Animations

Storm Drain

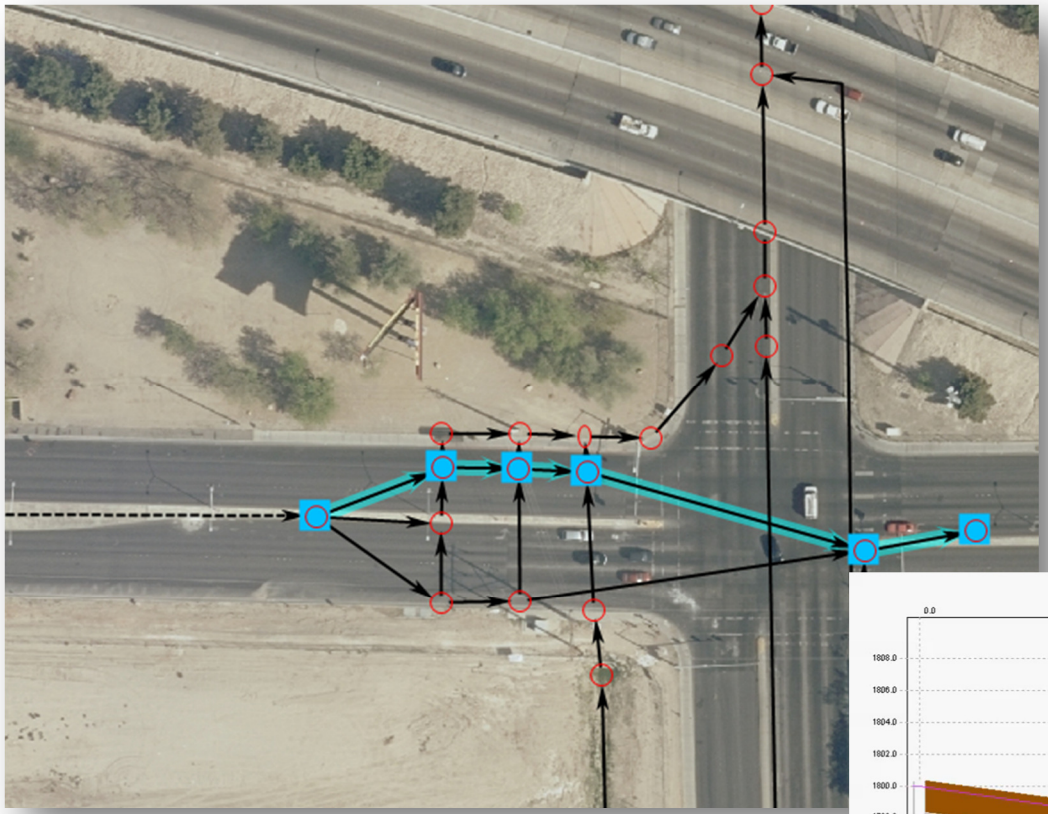


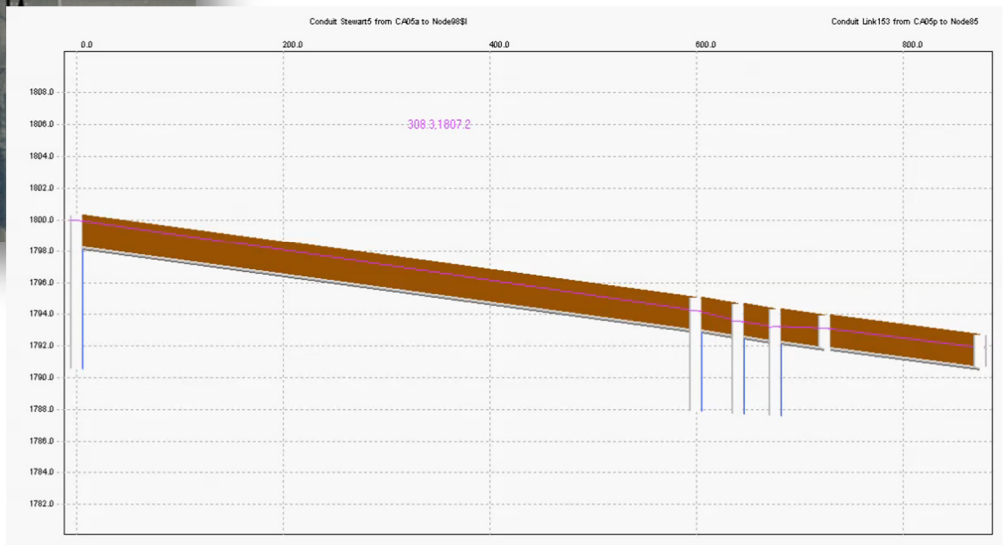


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xpswmm Animations

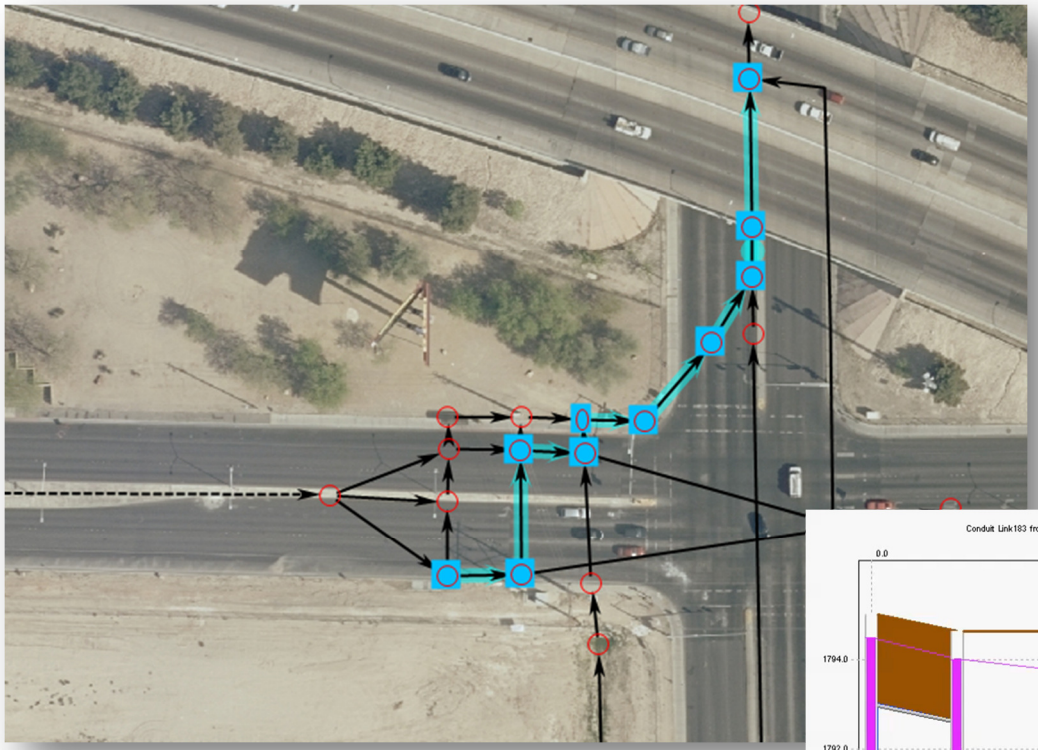
Street

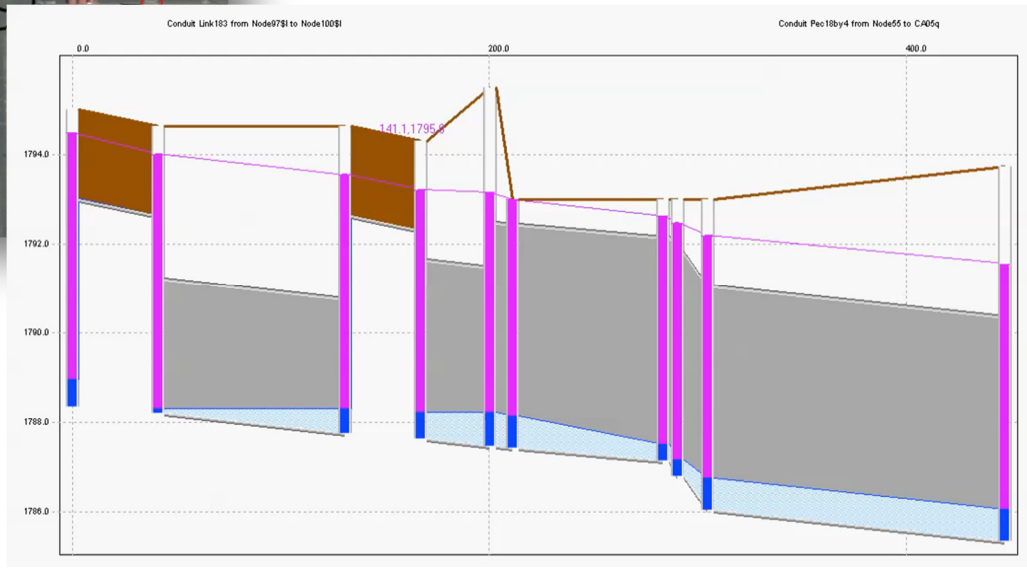




xpswmm Animations

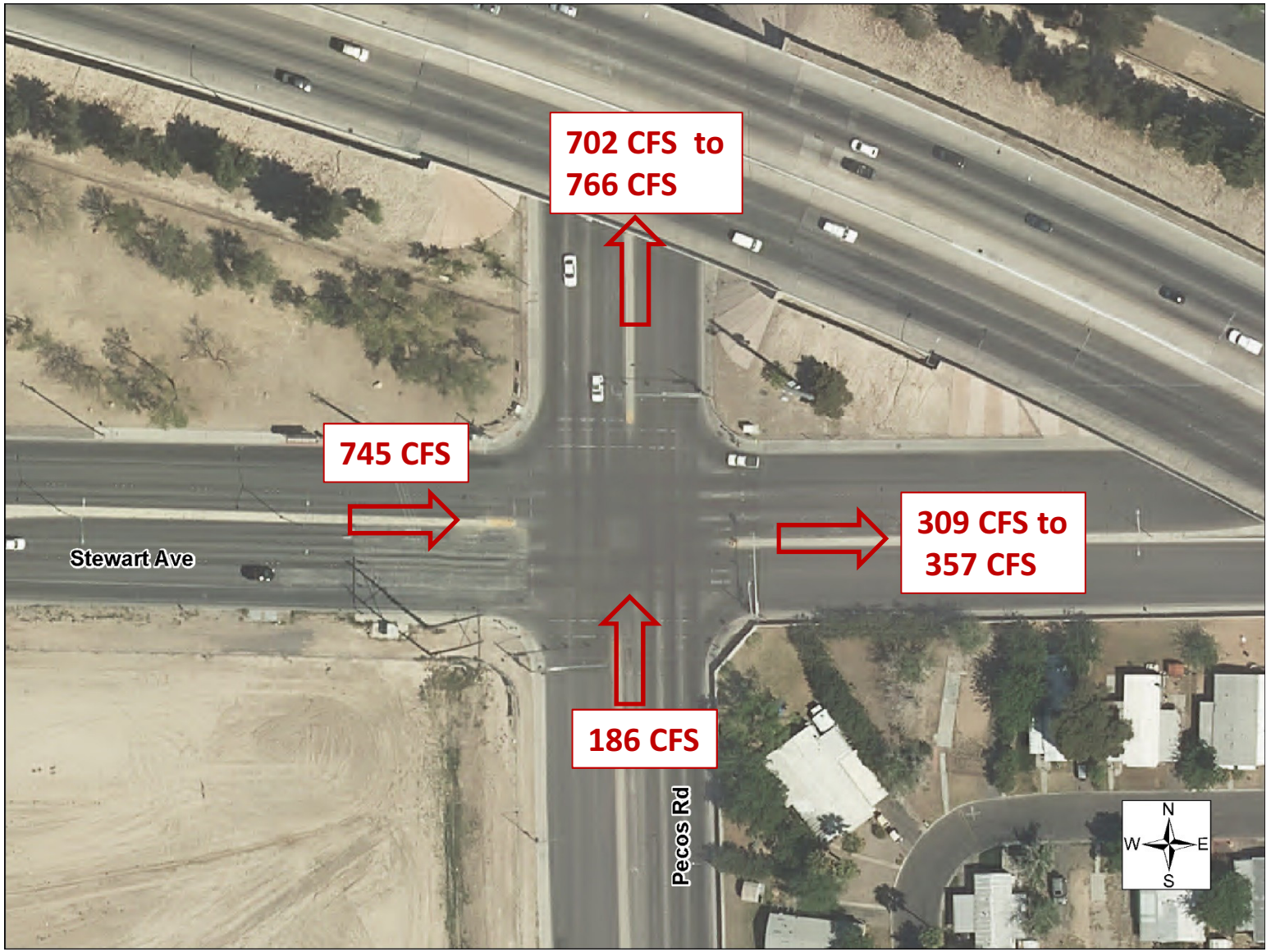
Combined Surface and Sub-Surface





Collection and Bypass at Pecos/Stewart Intersection

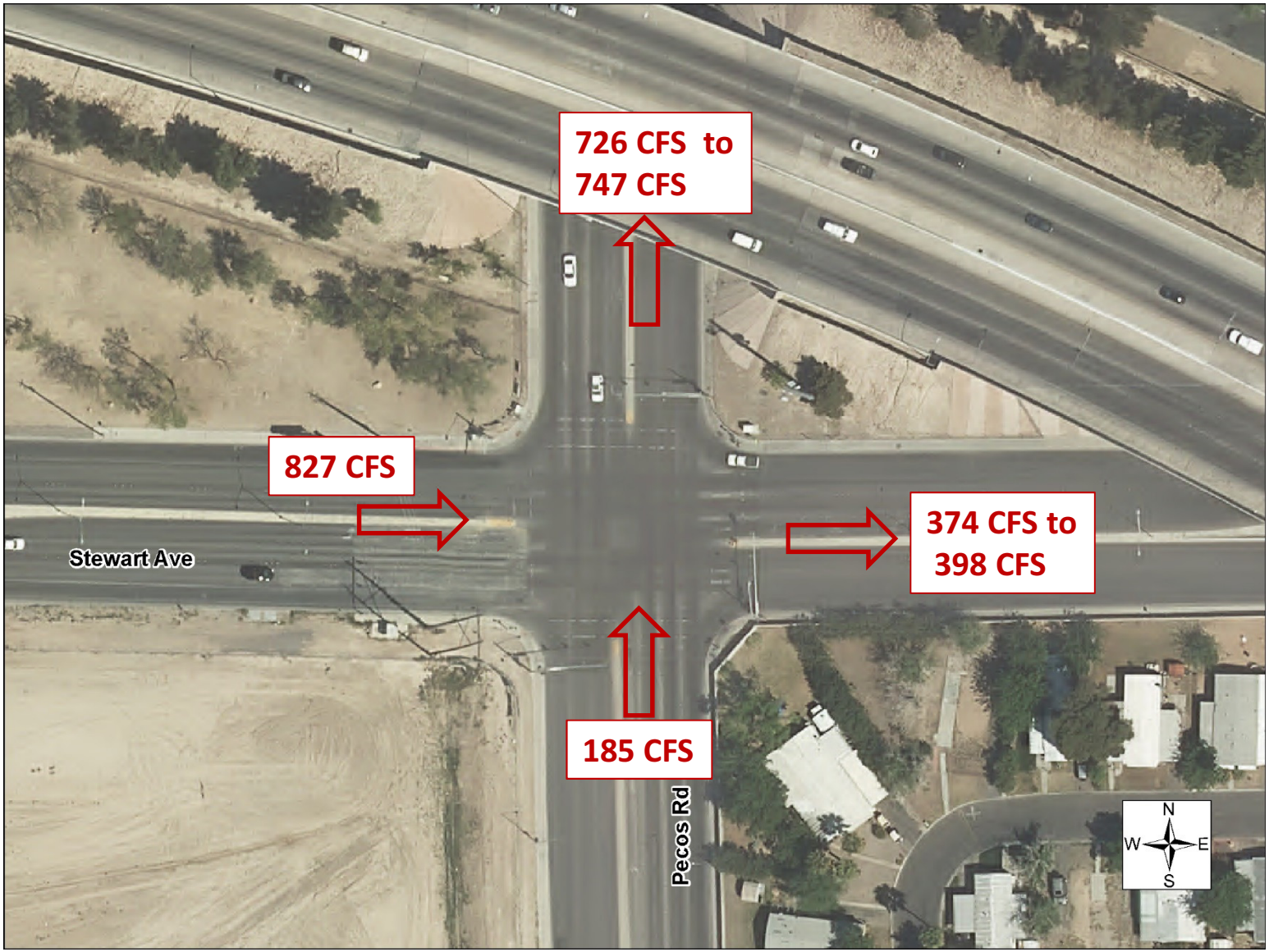
Design Flow (50% clogging, 1ft below grade)
vs Maximum Flow (no clogging, surcharging up to street)



(HEC-1, WSPG, Flowmaster)

Collection and Bypass at Pecos/Stewart Intersection

Design Flow (50% clogging, 1ft below grade)
vs Maximum Flow (no clogging, surcharging up to street)



(XPSWMM approach)

Subbasin Flows Comparision from HEC-1 and XPSWMM

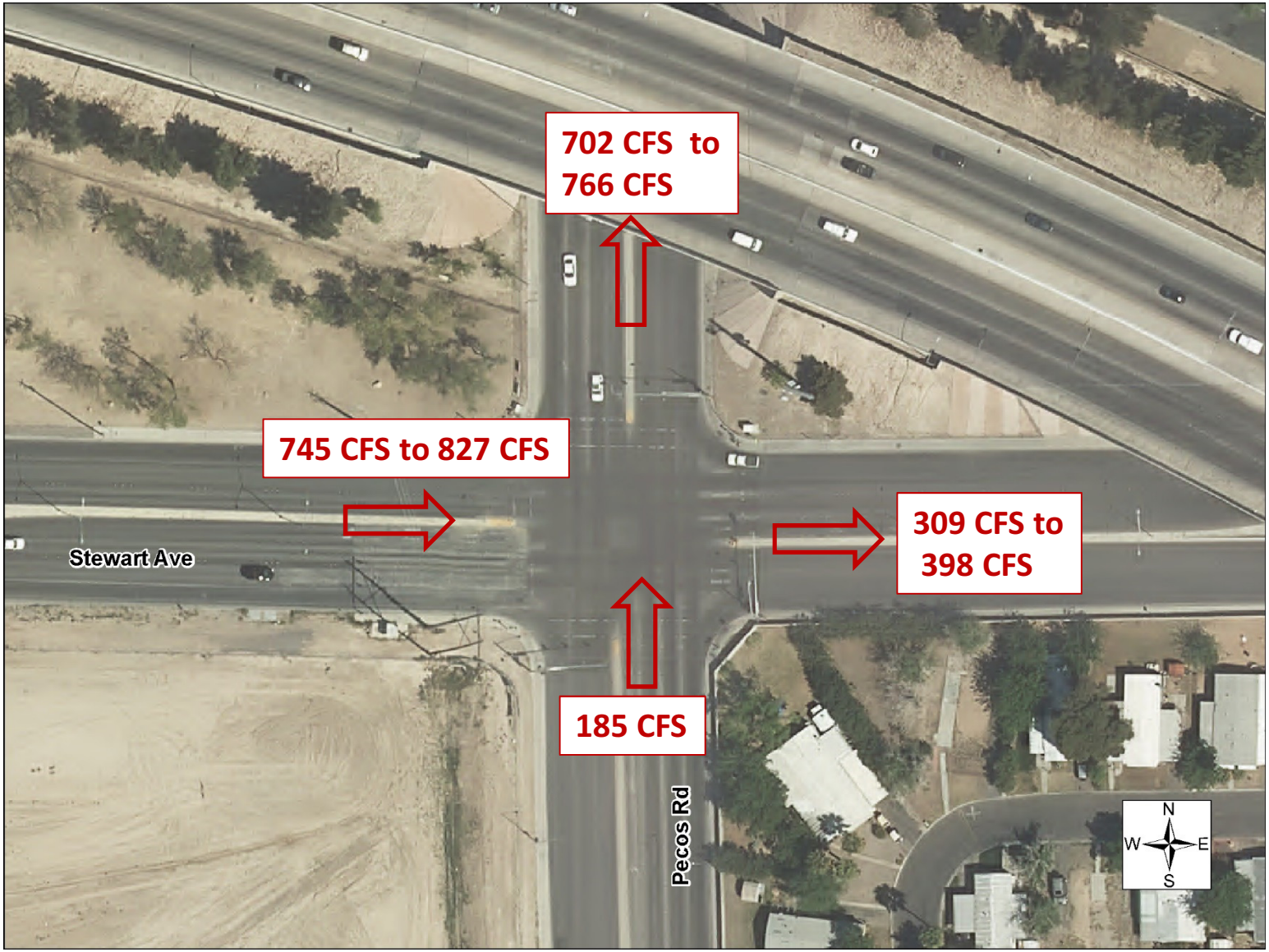
Subbasins draining to Pecos Road from Stewart Avenue

HEC-1		XPSWMM		
Subbasin	Flow (cfs)	Subbasin	Flow (cfs)	Flow Difference (cfs)
CA03a	107	CA03a	110	3
CA03b	86	CA03b	88	2
CA03c	25	CA03c	25	0
CA04a	44	CA04a	46	2
CA04b	71	CA04b	75	4
CA04c	41	CA04c	44	3
CA04d	72	CA04d	76	4
CA04e	194	CA04e	197	3
CA04f	61	CA04f	66	5
CA04g	81	CA04g	83	2
CA05a	47	CA05a	49	2
CA05b	66	CA05b	68	2

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Collection and Bypass Range at Pecos/Stewart Intersection

Combined Modeling Approaches

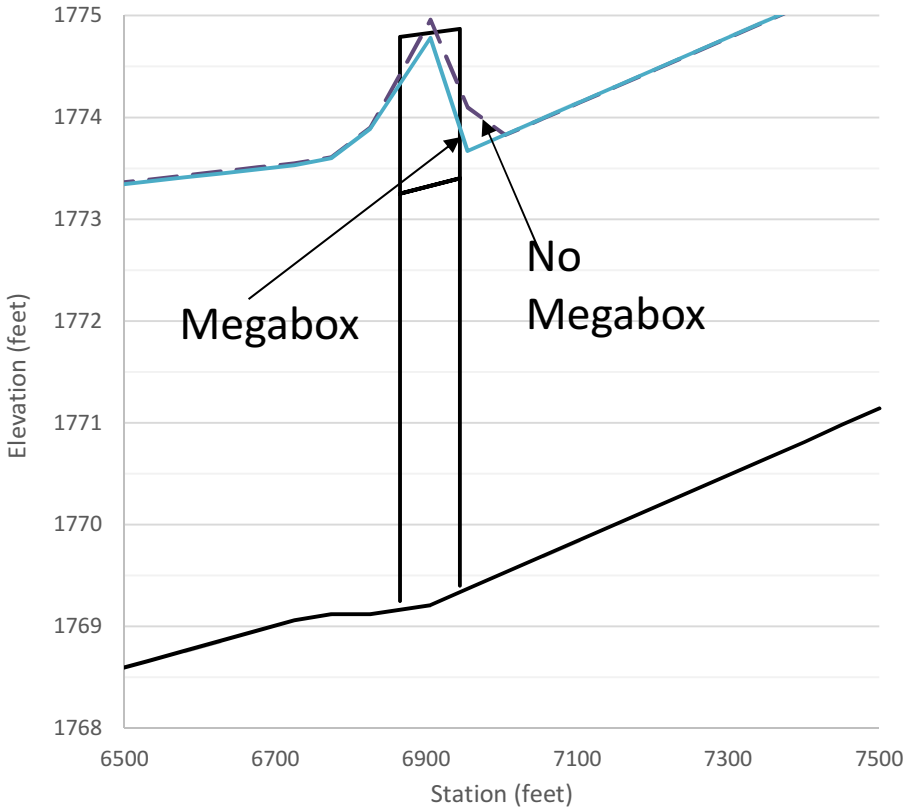


ATKINS

Megabox at Sandhill

- Replace Sandhill Crossing with a Megabox

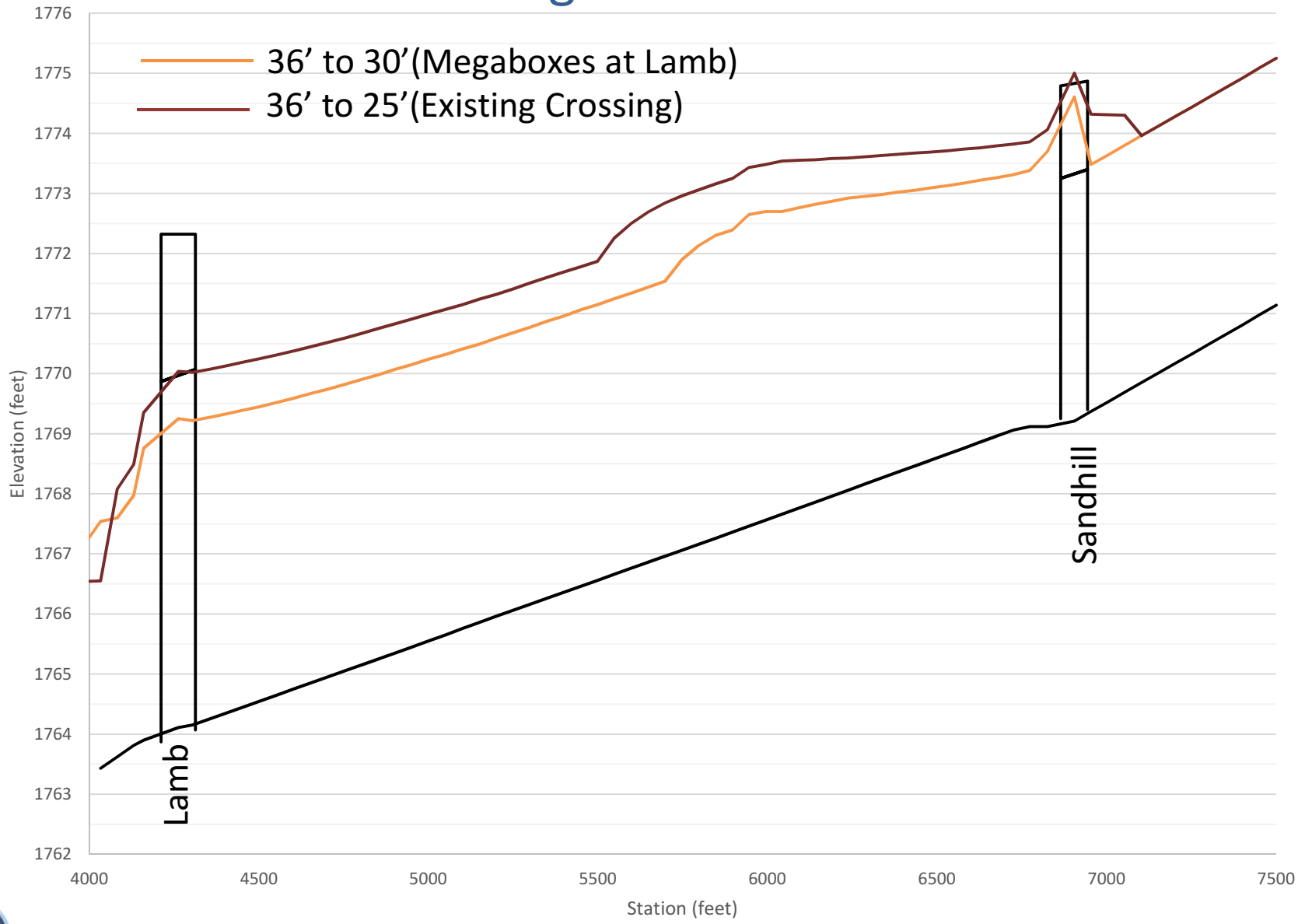
  Minimal benefit hydraulically



Cedar Channel – Between Sandhill and Lamb

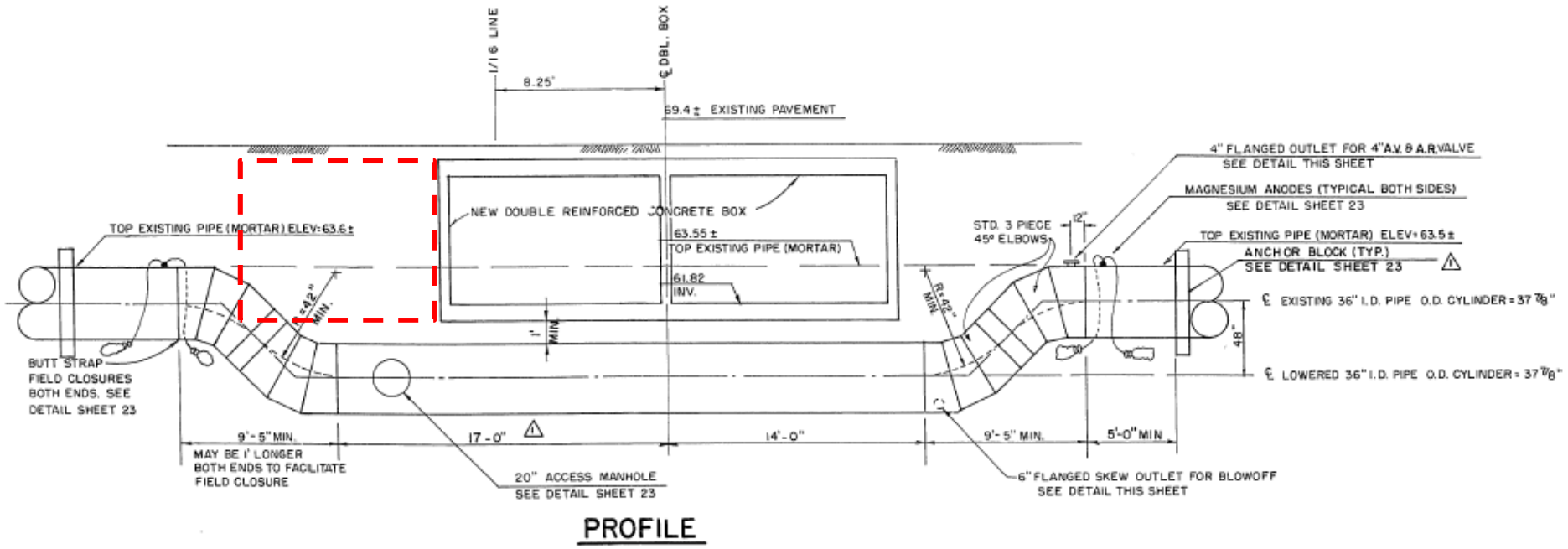
- Replace Lamb Crossing with a Megabox (dual 15’ by 6’ boxes)

Design Flow Scenario



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Waterline Relocation at Lamb Blvd



PROFILE

ATKINS

Dual 15’ by 16’ at Lamb

Pros

- Overtopping does not occur at Sandhill
- WSE below the bridge low chord at Lamb
- Works better hydraulically

Cons

- Relocation of water line
- Costs to replace the crossing ($415K + waterline relocation costs)
- Trail width narrower

Khanal, Manogya

From: Anita Marquez <amarquez@LasVegasNevada.GOV>
Sent: Tuesday, August 23, 2016 11:12 AM
To: Desai, Harshal
Cc: Khanal, Manogya
Subject: RE: Cedar Avenue Channel- Meeting Minutes

This message has been archived.

Min Trail width is 8 ft.

O&M should get back to us by beginning of next week.

I'll check in with Matthew Meyer on the ramp review today.

-Anita

From: Desai, Harshal [mailto:Harshal.Desai@atkinsglobal.com]
Sent: Tuesday, August 23, 2016 11:08 AM
To: Anita Marquez; Khanal, Manogya
Subject: RE: Cedar Avenue Channel- Meeting Minutes

Hi Anita,

Any updates on this. Couple of things we need before we can make progress on 70%:

1) Minimum width of the trail.

2) Decision regarding ramps.

If needed, we can participate in a meeting with O&M to facilitate decision making. Thanks,

Harshal B. Desai, PE, CFM
Vice President - Business Development

West Region

ATKINS

2270 Corporate Circle, Suite 200, Henderson, Nevada 89074 I Tel: 702.263.7275 Ext. 4513047 I Cell: 702.408.7808 I Direct: 702.551.0303

Email: harshal.desai@atkinsglobal.com <mailto:harshal.desai@atkinsglobal.com> I Web: www.atkinsglobal.com/no

Attachments:

image001.jpg	(6 KB)
image002.jpg	(3 KB)

Appendix A

Comment matrix

- Appendix A-1: 30% Design Comment Matrix
- Appendix A-2: Constructability Response Comment Matrix

Appendix A-1

30% Design Comment Matrix

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
CLV, Peter Jackson, Flood Control				
1	General	Field reconnaissance of the sub-basins by Flood Control Staff has identified possible changes to the sub-basin areas impacting the Cedar Avenue System. The overall HEC-1 analysis needs to be reevaluated to verify if additional drainage areas impacting the Cedar Avenue System from the south and west are warranted. It appears that there is a high point on Eastern, north of Cedar Ave. that could add surface flow to the overall system. Additionally the storm drain in Cedar Ave also collects flow within Eastern Ave. north of US-95. The current watershed boundary routes all flow west of Eastern, north to Bonanza. It appears that there is also additional flow impacting the sub-basins from the existing mobile home park southwest of concentration point CCA08 at Honolulu. Please investigate and reflect any necessary changes in flows based upon the revised sub-basin areas. Review and revise the Study Boundary and Exhibits accordingly.	Addressed in **Progress Meeting #15** (08-19-2015) Eastern/Cedar: Subbasin will not impact the channel Q as SD that connect to the channel are at max capacity and surface flow will not reach channel. City agreed. South of Cedar (between Pecos and Honolulu): Added a subbasin based on site visit. Subbasin contricutes 58 cfs to the channel.	Peter Jackson (CLV/FC) July 16, 2015
2	General	Flood Control notes that this project will require a Master Plan Change (MPC) for the proposed MPU facilities per CCRFCD requirements. The MPC will be prepared and submitted by the City of Las Vegas. The updated PDR by Atkins will serve as the technical foundation to support the MPC. The MPC will need to be approved prior to the 90% submittal.	Noted	Peter Jackson (CLV/FC) July 16, 2015
3	General	The Draft PDR has been reviewed and comments to the report are marked-up on the report for comment. Review, consider the impact, and incorporate these comments into the next PDR submittal.	Noted	Peter Jackson (CLV/FC) July 16, 2015
4	General	Review the system flow parameters to determine the potential max flow rate that the system can handle with the future extension of the system westward in Stewart Avenue.	The dual 8' by 5' dictates the maximum flow that the SD can take.The max Q at that location is 537 cfs.	Peter Jackson (CLV/FC) July 16, 2015
5	General	Portions of the proposed channel include an above grade Floodwall. Providing additional Floodwalls could reduce the impact of the total reconstruction. This needs to be considered as a possible value engineering option.	Addressed in **Progress Meeting #15** (08-19-2015) Perfomed hydraulic analysis and concluded that it is not feasible.	Peter Jackson (CLV/FC) July 16, 2015
6	General	The reduced 8-foot access width from Sandhill east to the School site is problematic. Usable maintenance access shall be maintained. Consider extending the Floodwall system to allow for the wider 10-foot access.	Addressed in **Progress Meeting #17** (08-22-2016) City agreed the minimum trail width should be 8' . 70% design maintains an 8' or wider trail everywhere.	Peter Jackson (CLV/FC) July 16, 2015
7	General	Consider alternate access ramp design that will maintain the 10-foot access width. Review the access ramp design to provide a grated lid over the ramp structure to allow for through maintenance access. The lid structure would be similar to the grated access structures and would be constructed over the ramp and then could be removed in sections to provide channel access.	**Progress Meeting#17**: As mentioned in Response#6, City agrees the minimum trail width is 8 feet. At Sandhill access ramp is replaced by access gate to maintain the 8' trail.	Peter Jackson (CLV/FC) July 16, 2015
8	General	The PDR indicates that the CCRFCD Manual requirements for Freeboard are not fully met. The rational for not meeting the manual requirements needs to be discussed. Is there a justification for not raising the channel walls to meet criteria?	Replacing Lamb Crossings with dual 15' x 6' RCBs meets the freeboard criteria everywhere except for the downstream faces of Sandhill and Marion.	Peter Jackson (CLV/FC) July 16, 2015
9	General	Revise the minimum acceptable height of the RCB's to 5-foot. Consider reducing the cover into the base section to provide the 5-foot minimum height. As an alternative to the shallow cover over the dual 8'x4' RCB's, consider the cost to reprofile part of Stewart and Pecos to allow for the 5-foot RCB height and roadway cover. This could offer a value engineering opportunity for a better system.	Completed. See 70% Design Plans. However, Stewart/Pecos cannot be reprofiled. There is essentially no cover over the box at Stewart and Pecos. Thick slab will need to be used for drivability. Hydraulically, the flow that the SD can take doesn't change much,	Peter Jackson (CLV/FC) July 16, 2015
10	General	Provide an updated hydraulic analysis with the next submittal that incorporates the final revised HEC-1 flow data. The WSPG, HEC-RAS and the HEC-1 data need to match the proposed mainline system parameters. Flood Control recommends that the plans and the WSPG & HEC-RAS Stationing match. The lateral and inlet analysis needs to match the more detailed analysis for the drop inlet collection system.	Completed. See 70% design Plans XPSWMM model was was run to check the results obtained from HEC-1, WSPG and HEC-RAS. Results from the XPSWMM model were discussed in **Progress Meeting #16**	Peter Jackson (CLV/FC) July 16, 2015

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
11	General	Provide a detailed analysis of the drop inlet collection system that includes the existing inlets. Identify where the existing inlets need to be upgraded and/or replaced to collect the flow into the channel at the street crossings. Provide additional inlets as necessary where the inlet spacing along the roadway alignment exceeds 600-feet.	Completed. Inlets analyzed using FlowMaster and Inlet Control Nomographs. Additional inlets not provided as Storm Drain and channel are at the maximum capacity	Peter Jackson (CLV/FC) July 16, 2015
12	General	Review the overflow impacts at the existing street crossings to verify that the new channel sections and elevations do not negatively impact the adjacent homes.	Noted	Peter Jackson (CLV/FC) July 16, 2015
13	General	Provide Flood Control with a copy of CCRFCD's acceptance of the Environmental Screening for this project.	Environmental Screening will not be provided at this phase	Peter Jackson (CLV/FC) July 16, 2015
14	General	Dewatering of this project is expected and the potential for groundwater contamination levels exceeding the NDEP discharge limits has been identified that could require compliance measures per the Nevada Division of Environmental Protection. Coordinate the design requirements and plan specifications with the City's Environmental Officer, Sherri McMahon @ 229-2338.	Noted	Peter Jackson (CLV/FC) July 16, 2015
15	General	Constructability review of this project will be provided by the City of Las Vegas after the 70% submittal.	Completed. See Draft Final Design Report for Constructability Review Comments	Peter Jackson (CLV/FC) July 16, 2015
16	General	Provide pothole data with the next submittal. The pothole information should identify the bottom limits of conduit bank crossings and show the limits of concrete encasement where applicable. Review the RCB location to reduce utility relocations, maximize the hydraulic efficiencies and the relocation costs to determine the recommended course of action and system impacts.	Completed.	Peter Jackson (CLV/FC) July 16, 2015
17	General	Provide the HGL and Q100 on all Profiles.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
18	General	Show the RCB angle points and/or curved segments by station location and angle/degree change. Include the radius information and discuss how the curved sections are to be completed using curved forms or multiple angled segments. This needs to be explained within the Specifications. This information is needed to allow for the use of precast RCB's as well as cast in place construction.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
19	General	Provide details for the RCB construction. System design needs to accommodate the construction option of pre-cast or cast-in-place improvements. Verify that the Specifications and schedule accommodate the construction methods.	Construction specifications will not be completed at this phase.	Peter Jackson (CLV/FC) July 16, 2015
20	General	Provide details for the proposed inlet types. Limit the length of the drop inlets to maximum 20-foot increments. Provide a minimum spacing of twenty feet between inlets.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
21	General	Provide Access Manholes along the RCB at 400-foot spacing. Adjust spacing to include Manholes near the junction structures for maintenance consideration. Consider using Manhole openings that are cast with the RCB's to reduce costs.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
22	General	Provide updated inlet calculations as necessary based upon the final system design with the next submittal.	Completed. See Draft Final Design Report	Peter Jackson (CLV/FC) July 16, 2015
23	General	Provide the lateral and inlet design information to include water and/or sewer relocations with the next submittal. Provide the clearance between storm drain and the water & sewer lines. Provide encasement requirements and details.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
24	General	The existing and proposed utility crossings of the storm drain must be shown on the storm drain plan and profiles sheets and on the lateral profiles. Indicate the type of material of water and sewer lines. ACP will require special consideration and handling and must be addressed in the specifications.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
25	General	Clearly identify the required utility relocations and which relocations are incidental to and part of the storm drain work.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
26	General	Provide separate plan and profiles for relocated sewer and/or water lines with the next submittal.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
27	General	Provide detail sheets showing typical details needed for the construction, connection and any special transition structure details. Structural details, if required, must be submitted by the 90% submittal.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
28	General	Add a note for all storm drain drop inlets that references the newly adopted USDCCA Drawing No. 421 (Stormwater Quality Management Stamp and Sign Detail). Include the USDCCA Drawing No. 421 (Stormwater Quality Management Stamp and Sign Detail) note to the concrete collar detail for the NDOT Type 2B inlets.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
29	General	Continue to coordinate the downstream Cedar Channel Improvements with the Las Vegas Wash segment being prepared by Stanley Consultants.	Noted	Peter Jackson (CLV/FC) July 16, 2015
30	General	Provide an updated detailed cost estimate with the next submittal for review. The cost estimate must be refined prior to the 90% submittal and request for construction funding to assure that the requested and allocated storm drain funds are sufficient for construction.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
31	General	The Final Design report needs to include an electronic copy of the entire report with the input and output files for both the hydraulics and hydrology.	Noted	Peter Jackson (CLV/FC) July 16, 2015
32	General	Address following questions regarding the 30% Plan review: a. Include the saw cut and paving limits in next submittal. b. Include removal and reconstruction of curb, gutter, sidewalk, median islands, stripping, etc on the plan. c. Clearly show the limits of the storm drain facility being removed. d. Clearly label the utilities that will require relocation. e. Identify existing and proposed lateral locations. f. Show all existing drop inlets and label their size and type. g. Identify any broken inlets requiring reconstruction. h. See plans for additional comments.	Completed. See 70% design Plans	Peter Jackson (CLV/FC) July 16, 2015
33	SU01	Markups: a. Include saw cut and paving limits in the next submittal b. Include removal on the plan	Completed. See 70% design Plans	CLV/FC July 16, 2015
34	SD01	Markups: a. Include manholes on the plan and profile b. Consider using 5' tall RCBs instead of 4' tall RCBs c. Consider reprofiling part of the street d. Include all other utilities information on the profile e. Show the 18" lateral on the profile. f. Are the existing Inlets large enough?	a. Completed. See 70% design Plans b. See Response # 9 c. See Response # 9 d. Completed. See 70% design Plans e. Completed. See 70% design Plans f. Inlets are replace. See 70% design Plans	CLV/FC July 16, 2015
35	SD02	Markups: a. Include manholes on the profile b. Label existing inlets. c. Are the existing inlets adequate?	a. Completed. See 70% design Plans b. Completed. See 70% design Plans c. See response # 11	CLV/FC July 16, 2015
36	SD04	Markups: a. Consider grated lid access along channel (typical) b. Are existing inlets adequate (typical) c. Check is there is any flow enters the channel from south of Honolulu	a. Grate lid access not considered b. C. No flow enters from south of Honululu	CLV/FC July 16, 2015
37	SD05	Check the overflow path	Water will flow east along the trail and eventually into the channel	CLV/FC July 16, 2015
38	SD08	Extend the floodwall height to meet manual freeboard	Not necessary to extend floodwall height. Freeboard is met	CLV/FC July 16, 2015
39	SD11	Check the overflow path	Water will flow east along the trail and eventually into the channel	CLV/FC July 16, 2015
40	SD12	Markups: a. Are existing inlets adequate b. Check overflow path	Addressed in DFDR	CLV/FC July 16, 2015
41	SD14	Continue to coordinate flows and design with LV Wash design (Stanley Consultants)	Noted	CLV/FC July 16, 2015
42	TY01	Recommend floodwall to be extended to meet manual freeboard requirements	Noted	CLV/FC July 16, 2015
Comments on PDR, CLV Flood Control				
43	General	Zipcode for CLV Department of Public Works is 89106	Corrected	CLV/FC July 16, 2015
44	General	Rename figures 13 and 14 as Right-of-Way Plan 1 and Right-of-Way Plan 2	Corrected	CLV/FC July 16, 2015

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
45	PDR- Page 1	Markups: a. Figure F-26 and Table F-26 should be Figure F-32 and Table F-32. b. Add statement: Figures from 2013 MPU and analysis from 2008 MPU c. Add statement:Master Plan Change is being prepared by CLV	a. Completed b. Completed c. Completed	CLV/FC July 16, 2015
46	PDR- Page 5	Markups: a. Should watershed description be rephrased? Watershed 1 from Pecos/Maryland/Bonanza Charleston. Wastershed 2 from Pecos/Bonanza/LV Wash/ Cedar Channel. See Figure 6. Yes to include entire channel. b.Maryland Pkwy is ultimate condition boundary. c. Figure 3: Shift yellow line slightly lower and to the right to show existing channel and existing SD	Completed	CLV/FC July 16, 2015
47	PDR- Page 6	Markups: a. Add a statement about existing drop inlets on west of Pecos b. Spell out Street Type for consistency c. Rephrase: "There is an existing low point with under sized drop inlets further downstream on Stewart, west of Marion Drive, where flow will pond up during storm d. Check the size of RCP that brings flow from Desert Pines Golf Course area e. Add space between 36" sewer.	Completed	CLV/FC July 16, 2015
48	PDR- Page 7	Markups: a. Add: "Just west of Pecos" in Section 1.4.2 b. Check the size of storm drain form Desert Pines Golf Course. Plans are labelled as 60" RCP. c. Add "CLV" d. Mention BOMO system is being designed by HDR e. Mention CCPW/CLV in the Las Vegas Wash project f. Mention Las Vegas Wash designed by CH2MHill/Stanley Consultants	Completed	CLV/FC July 16, 2015
49	PDR- Page 9	Markups: a. Change "2008 MPU" and "2013 MPU". b. Should we list the 2013 LVVFC MPU to indicate that the figures/tables where referenced? c. Use " instead of inch for consistency d. Add period at the end of the sentence e. Spell out street type for consistency f. Add email 4/28 that included the meeting notes of 4/15 to the CD	A. Completed b. This is mentioned in Page 5 c. Completed d. Completed e. Completed e. Email is provided in Data CD	CLV/FC July 16, 2015
50	PDR- Page 10	Mention future Maryland Parkway Facility	Completed	CLV/FC July 16, 2015
51	PDR- Page 11	How will MPU flow be impacted with new soil data? Already reflected in 2008	Analysis presented in DFDR	CLV/FC July 16, 2015
52	PDR- Page 12	Verify that summary reflects HEC-1 in Appendix	Completed	CLV/FC July 16, 2015
53	PDR- Page 13	Markups (Table 1): a. 702 CFS is not necessisarily at Pecos/Stewart intersection b. Add note for including Bonanza MPU Flow c. Which flow did LV Wash project reference?	Addressed in DFDR	CLV/FC July 16, 2015
54	PDR- Page 13	Markups: a. Assuming 20' Dis, plans show 5 proposed DIs at Stewart/Pecos: about 90 cfs per DI. Is That correct? b. How does 357 cfs bypass affect the design of Cedar Channel? Does it help? Less cfs in Cedar Channel. c. Add "at Marion Drive"	a. Plans show 5 proposed 15' Dis. Drop Inlet Calculations can be found in DFDR. B. Even with 357 cfs bypassing on Stewart, the flow reaching Cedar Channel is more than in the existing condition c. Fixed	CLV/FC July 16, 2015
55	PDR- Page 19	Spell out the street type for consistency	ok	CLV/FC July 16, 2015
56	PDR- Page 23	Include 0.013 for Manning's roughness	Model with 0.013 for manning's roughness is included in the appendix	CLV/FC July 16, 2015

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
57	PDR- Page 25	Markups: a. Spell out the street type for consistency b. Where is freeboard not met? Extend wall height to meet freeboard. c. Do we need to upgrade existing inlets to collect flow into channel?	a. Fixed b. Freeboard is met after replacing Lamb Crossing with dual 15' x 6's c. Existing inlets are upgraded on Pecos/Stewart	CLV/FC July 16, 2015
58	PDR- Page 26	Markups: a. Include the size of proposed regional facility CNST 0000 b. Figure 11: Show the red dash line in legend	a. Completed b. Completed	CLV/FC July 16, 2015
59	PDR- Page 27	Markups: a. Sandhill Road to Channel Bend: 8' trail is too narrow for maintenance access road. b. Channel Bend to Lamb Bouleward: What is the trail width? c. 4.58' paved trail width is too narrow at Sandhill Road d.	a. AfterProgress Meeting £17, it was agreed that 8' trail is acceptable. The City directed that 8' is the minimum required trail width. B. 8' c. Access ramp at Sandhill is eliminated from the design therefore resulting in a wider trail width	CLV/FC July 16, 2015
60	PDR- Page 28	Markups: a. Location of utility relocation will be crucial b. Make "Section 4.3" bold	a. Noted b. Fixed	CLV/FC July 16, 2015
61	PDR- Page 29	Markups: a. Make "Section 4.3" bold b. Change "Las Vegas Wash CMAR" to "Las Vegas Wash Project"	a. Noted b. Fixed	CLV/FC July 16, 2015
62	PDR- Photo Log	Markups: a. Photo 1: Change caption to "Looking west at the upstream end of the channel at the (2) 72-inch RCPs" b. Photo 1: Add the approximate distance from Pecos to the caption c. Photo 2: Include nearest crossing in the caption d.Photo 16 and 17: Place photoes 16 and 17 before Marion Crossing photos to have them in order of crossings e. Add photos of drop inlets at Pecos/Cedar Channel.	a. Fixed b.Added c. Included d. Fixed e. Added	CLV/FC July 16, 2015
63	PDR- General	Recommend that HEC-RAS station and plans match. If not, provide exhibit with conversion	Completed.	CLV/FC July 16, 2015
CLV, Keith Letus, Sewer				
64	General and SU01	The existing 8" SS in Stewart Ave is PVC, not VCP.	Completed. See 70% design Plans	Keith Letus (CLV/Sewer) July 16, 2015
65	General and SU02	The existing SS in Pecos Road north of the SSMHs at the Cedar Channel alignment is 21" VCP, not 36" RCP.	Completed. See 70% design Plans	Keith Letus (CLV/Sewer) July 16, 2015
66	General and SD01	When relocating the existing 8" SS in Stewart Ave, the new sewer must have the following capacity requirements: 1. Underneath the future SD crossing ,the new sewer must be 10" diameter at min 1.99% or 12" diameter at 0.76%. This pipe must be able to convey 1.0 mgd at d/D=0.5. (For future reference, 1.0 mgd is the approximate peak flow in this pipe under current conditions as monitored in 2011, and is the expected peak flow upon ultimate build-out of the CLV detention facility (estimated 0.5 mgd peak) and the vacant land on Spectrum Blvd (estimated 0.5 mgd peak) 2. At a SSMH that can accommodate a connection from a future (not yet under design) sewer from Universal Laundry from the west on the south side of the Stewart Ave, the new sewer must be 15" diameter at min 0.86% or 18" diameter at min 0.33%. This pipe must be able to convey 2.6 mgd at d/D-0.6. (For future reference, 2.6 mgd is the approximate peak flow expected from the following sources: A. 0.5 mgd peak from CLV detention facility build-out (estimated) B. 0.5 mgd peak from vacant land on Spectrum Blvd (estimated) C. 1.6 mgd peak from Universal Laundry. Universal Laundry has indicated that they intend to "double" in size. Their current peak wastewater flow is estimated at 0.8 mgd based on monitoring in 2008	HDR proceeding with the design. 70% Design Plans show the latest information obtained from HDR (as of October 27, 2016)	Keith Letus (CLV/Sewer) July 16, 2015
67	General and SD01	For the new sewer design in Stewart Ave always match elevations a pipe crowns when changing from smaller to larger pipe diameters. Consider building the sewer on the southside of Stewart Ave to align with existing SS junction box at Stewart/Pecos. Alternatively connect to the sewer and Pecos Rd., via two MHs with 45° bends.	HDR proceeding with the design. 70% Design Plans show the latest information obtained from HDR (as of October 27, 2016)	Keith Letus (CLV/Sewer) July 16, 2015

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
68	General and SD01	When crossing SD over SS with less than 2 feet of cover add concrete cap over SS as per DCSWCS SD – 21	Noted	Keith Letus (CLV/Sewer) July 16, 2015
69	General and SD05	Remove and replace VCP SS with C-900 PVC SS.	As discussed in **Progress Meeting 15**, Atkins will not be replacing VCPs at bridge crossings	Keith Letus (CLV/Sewer) July 16, 2015
70	General and SD09	Add concrete cap over SS per DCSWCS SD-21. If there is no room for the concrete cap, remove and replace VCP SS with C-900 PVC SS.	Noted	Keith Letus (CLV/Sewer) July 16, 2015
71	General and SD11	Remove and replace VCP SS with C-900 PVC SS.	As discussed in **Progress Meeting 15**, Atkins will not be replacing VCPs at bridge crossings	Keith Letus (CLV/Sewer) July 16, 2015
72	General and SD12	Provide verification of steel casing around 10" VCP SS.	As discussed in **Progress Meeting 15**, Atkins will not be replacing VCPs at bridge crossings	Keith Letus (CLV/Sewer) July 16, 2015
CLV, Rick Schroder, Traffic				
73	General	Need traffic sheet and specs for next review	Completed. See 70% Design Plans	Rick Schroder (CLV/Traffic) July 16, 2015
74	General	Per the meeting minutes, Rick provided maps showing walking routes of the schools in the project area and said those should be accounted for as the design and construction phase continues	Noted	Rick Schroder (CLV/Traffic) July 16, 2015
CCRFCD, Todd Myers				
1	General	Please use information presented in the PDR to prepare a Master Plan Change (MPC) for the proposed improvements to the Channel. The MPC is to be presented to the District's advisory committes and Board for approval adoption.	Noted	Todd Myers (CCRFCD) August 8, 2015
2	General	Complete a facility-specific environmental analysis (Section 8) in accordance with Chapter 8 of District's *Supplemental Programmatic Environmental Impact Statement, Clark County Regional Flood Control District, 2002 Master Plan Update Setember 2004* Submit analysis to District for review prior to funding request for construction.	As discussed in Progress Meeting 15, Section 8 screening will not occur before 70% submittal. Atkins will coordinate little with Tim Sutko and USACE to understand what's needed.	Todd Myers (CCRFCD) August 8, 2015
3	General	Identify all right-of-way (ROW) and easement acquisition requirements for this project. All ROW/easements must be acquired prior to City's request for construction funding.	Noted	Todd Myers (CCRFCD) August 8, 2015
4	General	There are numerous construtability challenges involved with this project including: construction of 18' x 4' RC B under US95 bridge, constructing (shoring) 12' x 6' RCB adjacent to screen walls in Cedar Avenue alignment, construction (shoring) of open channel adjacent existing screen walls and properties with swimming pools, ground water, construction of junction at Marion and deep channel section downstream of Marion; all within a narrow corridor. **District recommends that a constructability review be initiated during this preliminary phase of design.**	Yes	Todd Myers (CCRFCD) August 8, 2015
5	General	Please provide pothole information for any major utilities within the proposed storm drain alignment with the 70% submittal.	Completed. See 70% Design Plans	Todd Myers (CCRFCD) August 8, 2015
6	Report	Section 2.8 of the report indicates a combined flow rate of over 500cfs concentrating at a low point in Stewart Avenue, west of Marion. Atkins recommends additional reviewof the area for consideration of an MPU facility. District concurs. This should be investigated prior to finalizing design of the downstream Las Vegas Wash-Stewart to Bonanza project.	Noted	Todd Myers (CCRFCD) August 8, 2015
7	Report	Section 3.32 of report indicates that freeboard criteria is met upstream of Sandhill Road crossing. According to HEC-RAS and profile, only 0.62-ft of freeboard is provided.	Freeboard is met everywhere except at the faces om Sandhill Bridge and Marion Bridge. Replacing Lamb Crossing with dual 15' by 6's helped with freeboard	Todd Myers (CCRFCD) August 8, 2015
8	Hydrology/ Hydraulics	Report incidated that 315-cfs will bypass the system and continue east on Stewart. The open channel is designed based on the bypass flow. In reality, this bypass can' be regulated based on drop inlet and lateral capacities, especially once the storm drain is extended to the west in Stewart Avenue. Provided a sensitivity analysis of the open channel based on the maximum capacity of RCB.	The storm drain is already pressurized to a foot below the grade in the design flow scenario so any additional flow collection will not result in significantly higher flows (see Meeting notes from Progress Meeting #16)	Todd Myers (CCRFCD) August 8, 2015
9	Hydrology/ Hydraulics	Sandhill Crossing: Plan and Profile sheet SD05, and the HEC-RAS analyisis indicate that freeboard and bridge crossing criteria is not met at this location. Investigate the cost/benefit of replacing this crossing with a more hydraulically efficient facility.	Atkins modeled a scenario where the box at Sandhill is replaced by a megabox. Did not result in any hydraulic benefit. City agreed the crossing will remain in place (Progress Meeting #16)	Todd Myers (CCRFCD) August 8, 2015

NO.	SHEET/ DRAWING NO.	REVIEW COMMENTS	DESIGNER RESPONSE / ACTION	REVIEWER NAME & DATE
10	Hydrology/ Hydraulics	The HEC-RAS models the 36-ft. to the 30-ft top width channel transition between channel stations 6081.06 and 6129.77. Plan and profile sheets show this transition between stations 6413.39 and 6463.35. Revise HEC-RAS and/or plans accordingly.	Completed	Todd Myers (CCRFCD) August 8, 2015
11	Hydrology/ Hydraulics	Lamb Boulevard: There are several things happening from Stations 75+00 to 78+00. The channel is coming out of radius section, the channel is transitioning from 30-ft to 25-ft top width, and there is a culvert crossing that doesn't meet bridge flow criteria. Consider modeling the transition section further upstream to see if the flow will normalize prior to the culvert crossing. In addition try a single cell "mega box" (24' x 6') at crossing and determine estimated cost/benefit of replacing this crossing.	Culverts at Lam were replaced by dual 15' x 6'. This avoids the channel from transitioning just upstream of the crossing	Todd Myers (CCRFCD) August 8, 2015
12	Geotechnical Report	Provide Appendicies A - *Exploratory Boring Logs and B-Laboratory Testing* of Geotechnical Report.	Provided in the Data CD	Todd Myers (CCRFCD) August 8, 2015
13	Plans	Provide the following information with 70% submittal: a. Draft Special Provisions; b. Removal Plan; c. Utilities; d. Signage and Striping; e. Draft Structural Drawings; f. Lateral Profiles; g. First round pothole information.	Completed. See 70% Design Plans	Todd Myers (CCRFCD) August 8, 2015
14	Sheet SD01:	(1) Dual pre-cast RCB is difficult to construct on a radius. Limit the dual RCB to straight reaches where possible. (2) Call-out the US95 bridge low chord elevation on plan and/or profile. Construction of the 18' x 4' RCB section may require contractor to ramp trench to invert and install with fork lift. (3) Show additional utility crossings on profile and provide pothole information for major crossings with the 70%. Typical all.	1. Dual precast is required at the curve because it has a thiner slab that is required to o over the sewer. 2. Noted 3. Completed. See 70% Design Plans	Todd Myers (CCRFCD) August 8, 2015
15	Sheet SD02:	Provide RCB manholes at minimum 400-ft intervals and show estimated paving limits with 70% submittal. Typical all.	Completed. See 70% Design Plans	Todd Myers (CCRFCD) August 8, 2015
16	Sheet SD03	It appears the existing 60" RCP storm drain will remain in place. Coordinate with geotechnical engineer to verify that the existing trench backfill is non-flowable and can be supported, during construction of the RCB.	Noted	Todd Myers (CCRFCD) August 8, 2015
17	Sheet SD04	See comment No.9 above. The Sandhill crossing is not meeting freeboard or bridge flow criteria. Its acknowledged that its highly unlikely that bridge flow criteria will be met for this crossing. Investigate the cost/benefit of replacing the crossing with a more hydraulically efficient facility.	See Response #9	Todd Myers (CCRFCD) August 8, 2015
18	Sheet SD06 and SD07	See Comment No.10	See Response #10	Todd Myers (CCRFCD) August 8, 2015
19	Sheet SD09	See Comment No. 11	See Response #11	Todd Myers (CCRFCD) August 8, 2015
20	Plans	See additional red-line comments on attached check prints.	Noted	Todd Myers (CCRFCD) August 8, 2015

Appendix A-2

Constructability Review Comment Matrix

Project: Cedar Channel
***Submittal:* 30% Constructability Check**

***Date:* July 1, 2016**
Review of:

Designer: Atkins
***Reviewer:* CA Group Team**

Disposition:
A = Agree / Comply
B = Will Evaluate
C = No Action

Item #	Sheet	Comment	Reviewer	Response	Disposition / Resolution
1	SD01	Consider connecting the three Dis on each side of the road so that there will only be a single lateral	SM	The configuration of the drop inlets will not be revised. The current configuration allows for maximum flow to be captured. Connecting the three drop inlets in either side or having one confluence point will result in a big confluence.	
2	SD01	Move the mainline channel to the centerline of Stewart Avenue		The alignment of the mainline storm drain will remain the same as 30% designs. Centerline of Stewart Avenue is the low point. Moving the storm drain to the centerline will reduce cover and will adversely affect traffic through the intersection.	
3	SD01	Stay out of the drainage easement property so that you can maintain a better distance away from the freeway. NDOT is going to develop the freeway and may need that ROW.	SM	The City advised Atkins to stay within the drainage easement	
4	SD01	Make the curve from Stewart Avenue tangent to Pecos so you don't have the reverse curve with the boxes thus eliminating a another bevel box situation	SM	The radius at which the mainline storm drain is exiting Stewart Avenue and going north on Pecos Road is the minimum radius for pre-cast boxes. Pre-cast boxes are needed to get over the existing 36" sewer	
5	SD01	Put all the laterals in one area so that there'll only be one trench and one work zone	SM	See Response #1.	
6	SD01	Straighten out the 8 x 4 connection point so there won't be two hinge points	SM	The 8' x 4' connection point cannot be straightened out because it needs to connect to the junction structure past the precast boxes.	
7	SD02	From 26+00 to 31+25 don't try to save the 60" rcp. The backfill will not be cohesive and you may lose the rcp. This will be hard to construct and the profiles must match.	SM	The 60" RCP and the proposed RCB cannot be combined until they reach the existing channel because of difference in profiles. Shoring will be required for installation of RCB in this segment.	
8	SD02	Starting at 22+00 make the rcb curve into the middle of the alignment since it is so deep.	SM	The alignment will stay the same as 30% design. The proposed RCB must be on as alignment south of the 66" RCP.	
9	SD05	Add another cell under Sandhill to lower the hydraulic grade line.	SM	Adding another cell under Sandhill is not feasible. Sandhill Road cannot be reprofiled, and thus any box taller than the existing 4' box cannot be used. Replacing existing Sandhill boxes with mega boxes does not improve bridge hydraulics.	
10	SD07	Starting at 62+00 whiten or deep in the channel to avoid constructing the floodwalls.	SM	The channel will not be widened or deepened. The depth of the channel is constrained by the downstream invert. The channel is already at minimal slope. If the channel is widened, it would have to constrict at the road crossings. This constriction of the channel will have negative effects hydraulically.	

11	SDO9	Add another cell under lamb Boulevard. We realize the 36 inch waterline will have to be lowered. The hydraulic grade line is too high at this point	SM	70% design incorporates replacing Lamb crossing with dual 15’ x 6’ RCBs. This lowers the HGL. 36” waterline will need to be replaced.	
12	SD13	Starting at 108 +00 the channel goes too deep. Widen the channel or put a box under the maintenance Road or find some other way to make the channel wider so the depth will not have to be so deep next to the private property. This is extremely deep next to existing right of way line and the possibility of damaging private property is very high.	SM	It is necessary to drop the channel to combine the flow (1785 cfs) coming in from the future Bonanza system work hydraulically. The only way the drop in the channel can be avoided is if the Bonanza system is kept separate.	
13	General	The right-of-way is very narrow along this corridor and will not allow for two vehicles to drive past each other if you construct the entire section. Consider designing a section that will allow a construction joint along the south side so you can build that side of the project and then drive a concrete truck along it.		Agreed. This will be incorporated during 90% design.	
14	General	The special provisions must thoroughly transfer the risk of damage to the private properly to the contractor. The contractor must design their shoring system to accommodate for this risk and bid the risk thus eliminating the risk to the city.		Agreed.	
15	General	The concrete delivery method to the channel must be practical or the time duration of the project must account for this.		Agreed	
16	General	If a practical concrete delivery method cannot be developed the timeframe for this project will be extremely long and the contractor will be at a heavy risk situation. Can we divert the upstream flows to another direction to alleviate damage during construction?		This will be incorporated during 90% design.	
17					

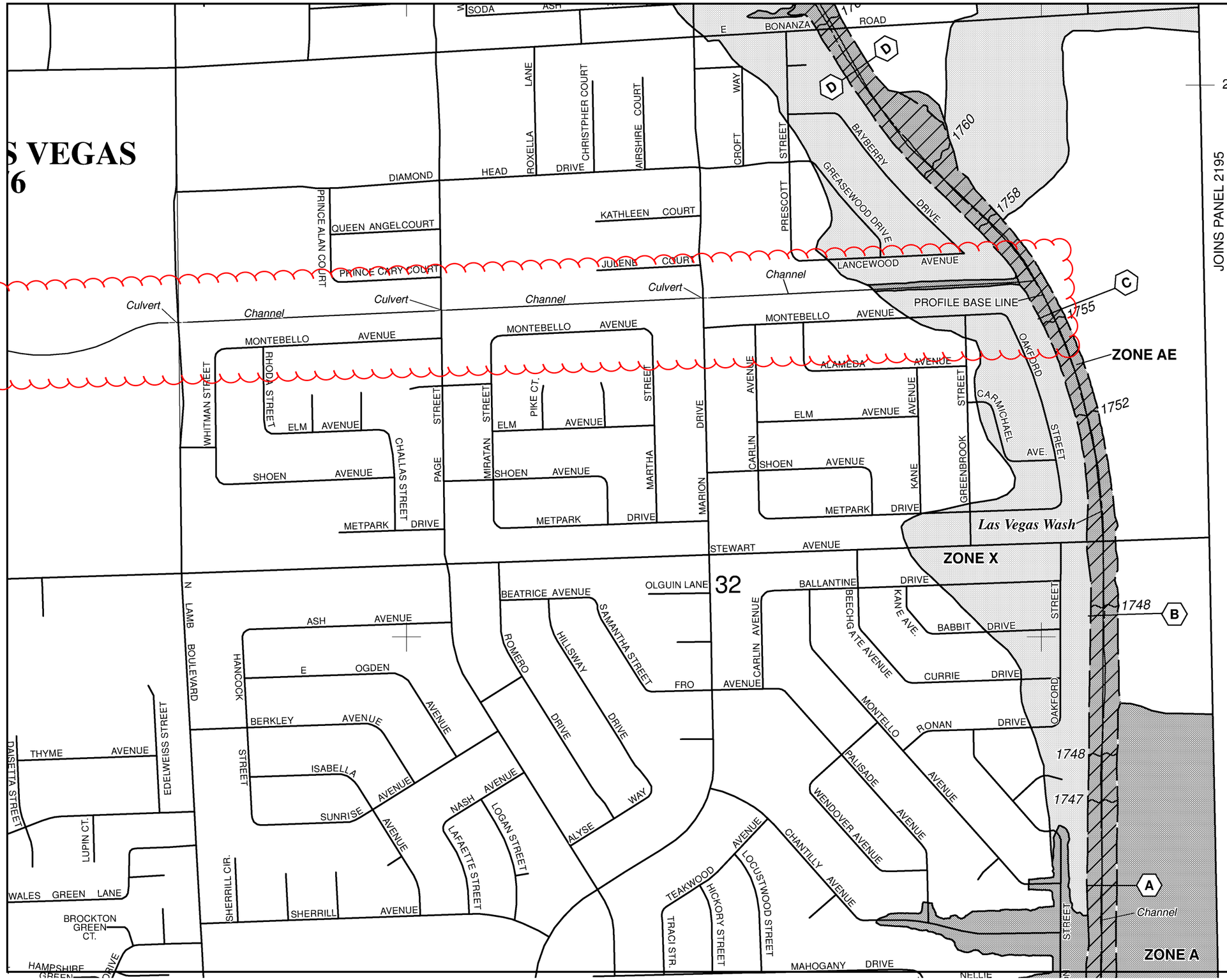
Appendix B

Hydrologic Analysis

- Appendix B-1: FEMA FIRMette
- Appendix B-2: Existing Condition Photo Library
- Appendix B-3: HEC-1 Model
- Appendix B-4: CCRFD Design Manual Tables
- Appendix B-5: Hydrologic Parameters
- Appendix B-6: Land Use Map and Soils Map

Appendix B-1

FEMA FIRMette



NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2187F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA

AND INCORPORATED AREAS

PANEL 2187 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2187	F
LAS VEGAS, CITY OF	325276	2187	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2187F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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CITY OF LAS VEGAS
325276

MAP SCALE 1" = 500'
250 0 500 1000 FEET METE

JOINS PANEL 2186

E BONANZA ROAD
TRIEST
N HONOLULU STREET
SANDHILL ROAD
POSSE AVENUE
BED STREET
RIVER
BUFFALO BILL AVENUE
HUDSON BAY AVENUE
LIGHTHOUSE AVENUE
BUFFALO
N
Channel
Culvert
MONTEBELLO AVENUE
ALAMEDA AVENUE
GAVIOTA AVENUE
CENTURA AVENUE
COSTA MESA AVENUE
ANCHOR STREET
GALVESTON STREET
LEHMAN STREET
CENTURY
BANDERA DRIVE
BOLSA DRIVE
ORION AVENUE
TYBO AVENUE
STEWART AVENUE
31
PELHAM COURT
SACRAMENTO DRIVE
SAGUARO LANE
TRABUCO DRIVE
E OGDEN AVENUE
AVENUE
LA BREA COURT
VALLEJO
MIDAS STREET
KATHY JO WAY
DRIVE
SUZY CT.
SACRAMENTO
DEL NORTE CIRCLE
COLUSA CIRCLE
PARK STREET
PARK COURT
HAMPSHIRE GREEN CT.
DRIVE
RONALD LANE
PRINCE LANE
CHELSEANN STREET
DAISETTA STREET
THYME AVENUE
LUPIN CT.
SUNRISE AVENUE
WALES GREEN LANE
BROCKTON GREEN CT.
EDELWEISS STREET
N LAMB BOULEVARD
0m N
N HONOLULU STREE

DIAMOND HEAD DRIVE
ROXELLA LANE
CHRISTPHER COURT
PRINCE ALAN COURT
QUEEN ANGEL COURT
PRINCE CARY COURT
KA
JU
MONTEBELLO AVENUE
WHITMAN STREET
RHODA STREET
ELM AVENUE
SHOEN AVENUE
METPARK DRIVE
CHALLAS STREET
PAGE STREET
MIRATAN STREET
PIKE CT.
ASH AVENUE
E OGDEN AVENUE
HANCOCK AVENUE
BERKLEY AVENUE
ISABELLA AVENUE
SUNRISE AVENUE
NASH AVENUE
LOGAN STREET
LAFAETTE STREET
SHERRILL CIR.
SHERRILL AVENUE
BEATRICE AVENUE
ROMERO DRIVE
HILLSWAY
ALYSE

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2187F

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY, NEVADA
AND INCORPORATED AREAS

PANEL 2187 OF 4090
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2187	F
LAS VEGAS, CITY OF	325276	2187	F

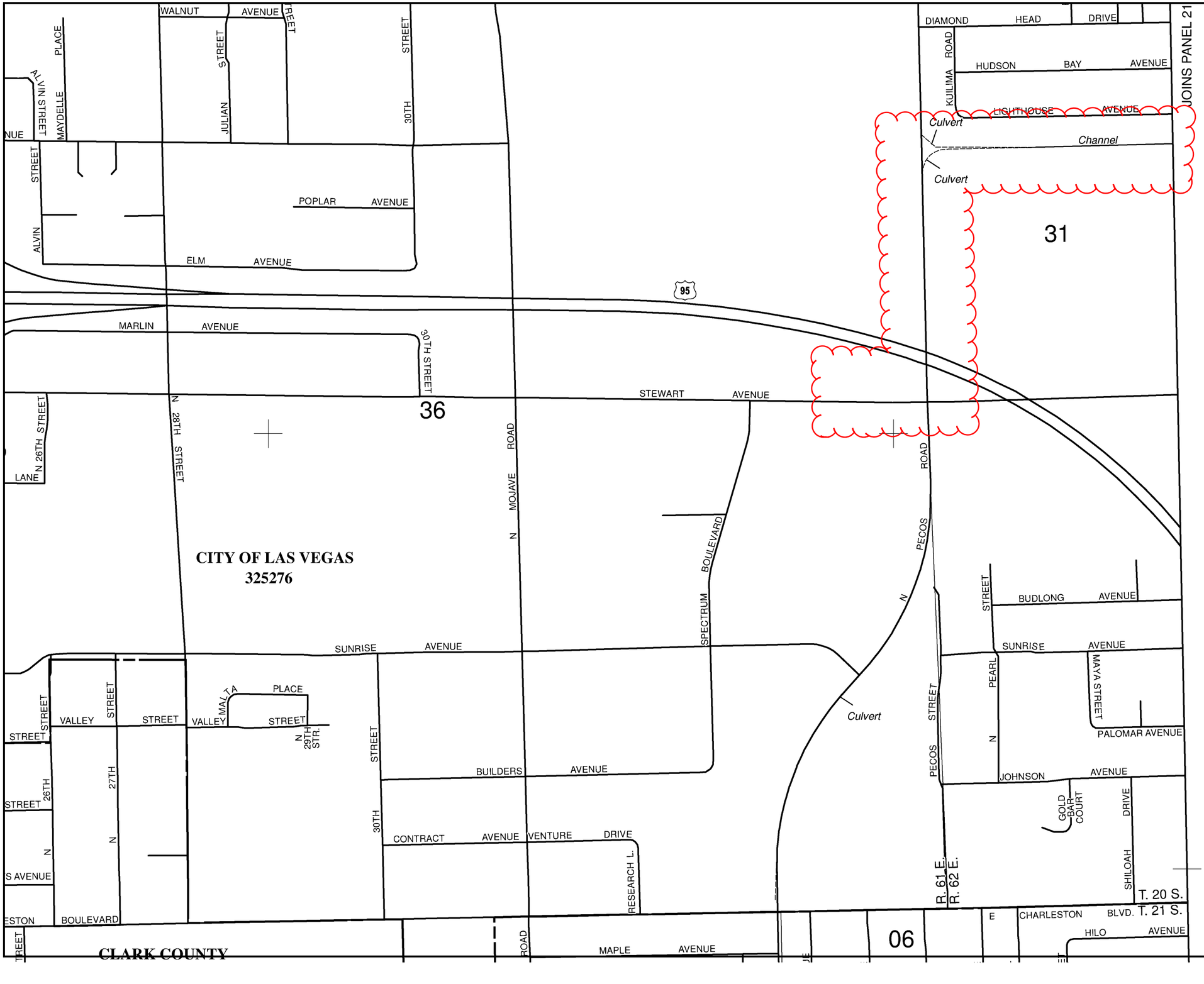
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2187F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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MAP SCALE 1" = 500'

250 0 500 1000 FEET METE

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2186F

FIRM

FLOOD INSURANCE RATE MAP

CLARK COUNTY, NEVADA AND INCORPORATED AREAS

PANEL 2186 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2186	F
LAS VEGAS, CITY OF	325276	2186	F
NORTH LAS VEGAS, CITY OF	320007	2186	F

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
32003C2186F

MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

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Appendix B-2

Existing Condition Photo Library



Photo 1: Looking west at the upstream end of the channel at the two (2) 72-inch RCP's (Apprrox 100 LF East of Pecos)



Photo 2: Looking east at the trail along the Cedar Channel near Pecos Road



Photo 3: Looking east at the Cedar channel upstream of Honolulu Street crossing



Photo 4: Looking east at the upstream face of Honolulu Street crossing



Photo 5: Looking west at the downstream face of Honolulu Street crossing



Photo 6: Looking east at the Cedar channel downstream of Honolulu Street crossing



Photo 7: Looking east at the Cedar channel upstream of Sandhill Road crossing



Photo 8: Looking east at the upstream face of Sandhill Road crossing



Photo 9: Looking west at the downstream face of Sandhill Road crossing



Photo 10: Looking east at the Cedar channel downstream of Sandhill Road crossing



Photo 11: Looking east at the Cedar channel upstream of Lamb Boulevard crossing



Photo 12: Looking east at the upstream face of Lamb Boulevard crossing



Photo 13: Looking west at the downstream face of Lamb Boulevard crossing



Photo 14: Looking east at the upstream face of Page Street crossing



Photo 15: Looking west at the downstream face of Page Street crossing



Photo 16: Looking east at the upstream face of Marion Street crossing



Photo 17: Looking west at the downstream face of Marion Street crossing



Photo 18: Looking north at drop inlets on Stewart Ave, west of Pecos Rd



Photo 19:Looking east at drop inlets on south side of Stewart Ave, west of Pecos Rd



Photo 20:Looking east at channel access ramp east of Honolulu St



Photo 21: Drop Inlet on west side of Pecos Road at Pecos and Cedar Avenue Channel intersection



Photo 22: Drop Inlet on est side of Pecos Road at Pecos and Cedar Avenue Channel intersection

Appendix B-3

HEC- 1 Model

Ultimate Condition HEC-1 Model

```
1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
 *              JUN   1998               *                    *    HYDROLOGIC ENGINEERING CENTER      *
 *            VERSION 4.1                *                    *          609 SECOND STREET            *
 *                                       *                    *       DAVIS, CALIFORNIA 95616         *
 *  RUN DATE   03NOV15  TIME  14:38:06   *                    *           (916) 756-1104              *
 *                                       *                    *                                       *
 *****************************************                    *****************************************

                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                  HEC-1 INPUT                                                  PAGE  1

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                         *DIAGRAM
 *** FREE ***
              1          ID    LAS VEGAS WASH CENTRAL-CEDAR AVENUE
              2          ID
              3          ID    INPUT FILE = CEDAR_ULT.DAT
              4          ID    INPUT FILE DATE =  APRIL 2014
              5          ID    DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
              6          ID    STORM DISTRIBUTION = SDN #3
              7          ID    MODELED BY ATKINS (MANOGYA KHANAL)
              8          ID    CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
              9          ID    NO STORM CENTERING
             10          ID    REFERENCED HYDROLOGIC MODELS:
             11          ID    2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
             12          ID    MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
             13          ID    CENTRAL NEIGHBORHOOD STUDY
             14          ID
             15          ID
             16          ID    JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
             17          ID
             18          ID                        AREA       DARF
             19          ID                        SQ. MI.
             20          ID                        0-0.5     0.990
             21          ID                        0.5-1      0.975
             22          ID                        1-2       0.950
             23          ID                        2-3        0.925
             24          ID                        3-4        0.915
             25          ID                        4-5        0.908
             26          ID                        5-6        0.903
             27          ID
             28          IT       5       0       0     300
             29          IO       5       0       0
             30          IN       5       0       0
             31          JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908   0.903    0.57
                         *
             32          KK   CA03a
             33          BA   0.095
             34          PB    2.77
             35          PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
             36          PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
             37          PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
             38          PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
             39          PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
             40          PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
             41          PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
             42          PC   0.998   0.999   1.000
             43          LS       0    87.8
             44          UD   0.234
                         *
1                                                  HEC-1 INPUT                                                  PAGE  2

          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

             45          KK   CA03c
             46          BA   0.022
             47          PB    2.77
```

```
 48          LS       0    87.9
 49          UD   0.238
             *

 50          KK  CCA03c
 51          KM  COMBINE CA03a AND CA03c
 52          KM  EASTERN AND STEWART
 53          HC       2
             *

 54          KK   CA03b
 55          BA   0.079
 56          PB    2.77
 57          LS       0    87.9
 58          UD   0.257
             *

 59          KK   CCA03
 60          KM  COMBINE CCA03c AND CA03b
 61          KM  EASTERN AND STEWART
 62          HC       2
             *

 63          KK  RCCA03
 64          KM  ROUTE CCA03 TO CCA04b
 65          KM  STEWART
 66          RD    1240 0.01371   0.016       0    TRAP       0      50
             *

 67          KK   CA04b
 68          BA   0.060
 69          PB    2.77
 70          LS       0    88.1
 71          UD   0.203
             *

 72          KK  CCA04b
 73          KM  COMBINE RCCA03, CA04a AND CA04b
 74          KM  STEWART AT 28th STREET
 75          HC       2
             *

 76          KK RCCA04b
 77          KM  ROUTE CCA04b TO CCA04
 78          KM  STEWART
 79          RD    1780 0.00955   0.016       0    TRAP       0      50
             *
1                                        HEC-1 INPUT                                                PAGE  3

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 80          KK   CA04a
 81          BA   0.039
 82          PB    2.77
 83          LS       0    87.5
 84          UD   0.224
             *

 85          KK   CA04c
 86          BA   0.031
 87          PB    2.77
 88          LS       0    90.7
 89          UD   0.199
             *

 90          KK CCA04-1
 91          KM  COMBINE RCCA04b, CA04a AND CA04c
 92          KM  STEWART AT MOJAVE
 93          HC       3
             *

 94          KK   CA04g
 95          BA   0.052
 96          PB    2.77
 97          LS       0    92.4
 98          UD   0.156
             *

 99          KK  RCA04g
100          KM  ROUTE CA04g TO CCA04d
101          KM  SUNRISE
102          RD    3500   0.014   0.016       0    TRAP       0      50
             *

103          KK   CA04d
104          BA   0.052
105          PB    2.77
106          LS       0    91.2
107          UD   0.191
             *

108          KK  CCA04d
109          KM  COMBINE RCA04g AND CA04d
110          KM  SUNRISE AND EASTERN
```

```
          111          HC       2
                       *

          112          KK  RCA04d
          113          KM  ROUTE CA04c TO CCA04d
          114          KM  SUNRISE
          115          RD    3050 0.01148   0.016       0    TRAP       0      50
                       *
1                                        HEC-1 INPUT                                                PAGE  4

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          116          KK   CA04e
          117          BA   0.190
          118          PB    2.77
          119          LS       0    90.0
          120          UD   0.349
                       *

          121          KK  CCA04e
          122          KM  COMBINE RCBN03 AND BN08
          123          KM  SUNRISE AND MOJAVE
          124          HC       2
                       *

          125          KK RCCA04e
          126          KM  ROUTE CCA04e TO CCA04f
          127          KM  MOJAVE
          128          RD    1360 0.00368   0.016       0    TRAP       0      50
                       *

          129          KK   CA04f
          130          BA   0.046
          131          PB    2.77
          132          LS       0    91.6
          133          UD   0.209
                       *

          134          KK  CCA04f
          135          KM  COMBINE RCCA04d AND CA04e
          136          KM  MOJAVE AT STEWART
          137          HC       2
                       *

          138          KK   CCA04
          139          KM  COMBINE CCA04 AND CCA04e
          140          KM  STEWART AT MOJAVE
          141          HC       2
                       *

          142          KK  RCCA04
          143          KM  ROUTE CCA04 TO CCA05
          144          KM  STEWART
          145          RD    2130 0.00892   0.016       0    TRAP       0      50
                       *

          146          KK   CA05a
          147          BA   0.036
          148          PB    2.77
          149          LS       0    91.0
          150          UD   0.215
                       *
1                                        HEC-1 INPUT                                                PAGE  5

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          151          KK   CA05b
          152          BA   0.050
          153          PB    2.77
          154          LS       0    91.9
          155          UD   0.232
                       *

          156          KK CCA05-1
          157          KM  COMBINE RCCA04, CA05a AND CA05b
          158          KM  STEWART AT PECOS
          159          HC       3
          160          KO       1
                       *

          161          KK  DCCA05
          162          KM  DIVERT BYPASS FLOW ON STEWART THAT CONTINUES EAST ON STEWART
          163          KM  REMAINING FLOW IS THE FLOW COLLECTED IN INLETS
          164          DT  DSTEWQ
          165          DI       0     200     400     430     600     745     900
          166          DQ       0       0       0       0     170     315     470
                       *

          167          KK   CA05c
          168          BA   0.023
          169          PB    2.77
          170          LS       0    91.9
          171          UD   0.146
```

```
                *
  172           KK  RCA05c
  173           KM  ROUTE CA05c TO CCA05e
  174           KM  SUNRISE
  175           RD     750 0.00933   0.016       0    TRAP       0      50
                *
  176           KK   CA05d
  177           BA   0.043
  178           PB    2.77
  179           LS       0    91.5
  180           UD   0.202
                *
  181           KK   CA05e
  182           BA   0.003
  183           PB    2.77
  184           LS       0    92.0
  185           UD   0.104
                *
1                                       HEC-1 INPUT                                                 PAGE  6

 LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  186           KK  CCA05e
  187           KM  COMBINE RCA05d AND CA05c
  188           KM  SUNRISE AT PECOS
  189           HC       3
                *
  190           KKDTCCA05e
  191           KM  DIVERT FLOW INTO THE STREET.
  192           KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
  193           KM  AT PECOS NORTH OF SUNRISE
  194           DT  DTA05e
  195           DI       0    49.5      99
  196           DQ       0    26.5      53
                *
  197           KK   CA05f
  198           BA   0.009
  199           PB    2.77
  200           LS       0    92.0
  201           UD   0.123
                *
  202           KK DTCAO5f
  203           KM  DIVERT FLOW INTO THE STREET.
  204           KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
  205           KM  AT PECOS NORTH OF SUNRISE
  206           DT  DTA05f
  207           DI       0     3.5       7
  208           DQ       0    1.75     3.5
                *
  209           KK  CCA05f
  210           KM  COMBINE RCA05e AND CA05f
  211           HC       2
                *
  212           KK RCCA05f
  213           KM  ROUTE CCA05f TO CCA05f
  214           KM  PECOS
  215           RD     820 0.00732   0.013       0    CIRC       3       0
                *
  216           KK   CA05h
  217           BA   0.003
  218           PB    2.77
  219           LS       0    92.0
  220           UD   0.101
                *
1                                       HEC-1 INPUT                                                 PAGE  7

 LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


  221           KK   CA05i
  222           BA   0.004
  223           PB    2.77
  224           LS       0    92.0
  225           UD   0.093
                *
  226           KK   CA05k
  227           BA   0.010
  228           PB    2.77
  229           LS       0    91.9
  230           UD   0.105
                *
  231           KK  CCA05k
  232           KM  COMBINE RCCA05f, CA05h, CA05i AND CA05k
```

```
 233          KM  UNDEVELOPED PARCEL AT STEWART AND PECOS
 234          HC       4
              *

 235          KK   CA05g
 236          BA   0.007
 237          PB    2.77
 238          LS       0    92.0
 239          UD   0.101
              *

 240          KK   CA05j
 241          BA   0.005
 242          PB    2.77
 243          LS       0    92.0
 244          UD   0.083
              *

 245          KK   CA05p
 246          BA   0.006
 247          PB    2.77
 248          LS       0    91.1
 249          UD   0.183
              *

 250          KK  CCA05p
 251          KM  COMBINE CA05g, CA05j AND CA05p
 252          KM  ON PECOS SOUTH OF STEWART
 253          HC       3
              *

 254          KK  DRA05e
 255          KM  RETURN FLOW FROM DIVERTED
 256          KM  FLOW ON THE STREET
 257          DR  DTA05e
              *
1                                   HEC-1 INPUT                                        PAGE  8

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 258          KK  DRA05f
 259          KM  RETURN FLOW FROM DIVERTED
 260          KM  FLOW ON THE STREET
 261          DR  DTA05f
              *

 262          KK CCA05-3
 263          KM  COMBINE DRA05f, DRA05e AND CCA05p
 264          KM  ON PECOS SOUTH OF STEWART
 265          HC       3
              *

 266          KKDTCCA053
 267          KM  DIVERT FLOW INTO THE STREET.
 268          KM  REMIANING WILL FLOW INTO THE DROPINTET
 269          KM  AT PECOS SOUTH OF STEWART, WEST
 270          DT DTA05-3
 271          DI       0    43.5      87
 272          DQ       0      40      80
              *

 273          KK CCA05-2
 274          KM  COMBINE CCA05-1 AND CCA05p
 275          KM  ON PECOS SOUTH OF STEWART
 276          HC       2
              *

 277          KKCCA05-2a
 278          KM  COMBINE CCA05-2 AND CCA05-1
 279          KM  ON STEWART AND PECOS
 280          HC       2
              *

 281          KK    CHAR
 282          BA  0.0365
 283          QI     0.0     0.0     0.0     0.0     0.0     0.3     0.8     1.3     1.8     1.5
 284          QI     1.3     0.8     0.5     0.5     0.5     0.8     1.0     1.3     2.3     2.8
 285          QI     3.1     2.8     2.6     2.1     1.8     1.8     2.3     3.6     3.9     3.6
 286          QI     3.6     3.6     3.6     3.6     3.6     4.6    11.3    18.0    27.0    36.0
 287          QI    42.2    43.0    39.4    33.7    27.3    17.8    14.2    11.3     9.3     8.2
 288          QI     8.5     9.3     9.8    10.0     9.8     9.0     7.7     6.4     4.9     3.9
 289          QI     3.1     2.3     1.8     1.3     1.3     1.0     1.0     0.8     0.5     0.5
 290          QI     0.3     0.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
 291          QI     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 292          KK   RCHAR
 293          KM  ROUTE CHAR TO CH70-C
 294          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 295          RD    4600  0.0098   0.016       0    TRAP       0      50
              *
1                                   HEC-1 INPUT                                        PAGE  9

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 296          KK  CH70-C
 297          BA   0.137
 298          PB    2.77
 299          LS       0    92.7
 300          UD   0.305
              *

 301          KK   CCHAR
 302          KM  COMBINE CHAR AND CH70-C
 303          HC       2
              *

 304          KK  RCCHAR
 305          KM  ROUTE CCHAR TO CCA05-2
 306          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 307          KM  LINING = RCP
 308          RD    1250  0.0096   0.013       0    CIRC     5.5       0
              *

 309          KK   CA05m
 310          BA   0.005
 311          PB    2.77
 312          LS       0    91.5
 313          UD   0.134
              *

 314          KK  CCA05n
 315          KM  COMBINE CHAR AND CA05m
 316          KM  ON PECOS AND SUNRISE
 317          HC       2
              *

 318          KK RCCA05m
 319          KM  ROUTE CCA05n TO CCA05-2
 320          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 321          KM  LINING = RCP
 322          RD    1580 0.00633   0.013       0    CIRC     5.5       0
              *

 323          KK CCA05-4
 324          KM  COMBINE CCA05n AND CA05m
 325          KM  ON PECOS AND SUNRISE
 326          HC       2
              *

 327          KK   CA05n
 328          BA   0.004
 329          PB    2.77
 330          LS       0    91.4
 331          UD   0.106
              *
```



```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 332          KK   CA05q
 333          BA   0.013
 334          PB    2.77
 335          LS       0    82.5
 336          UD   0.215
              *

 337          KK  CCA05q
 338          KM  COMBINED FLOW IN EXISTING STORM DRAIN
 339          KM  STEWART AND PECOS
 340          HC       2
              *

 341          KK   CCA05
 342          KM  TOTAL FLOW ON SURFACE AND SYSTEM
 343          KM  STEWART AND PECOS
 344          HC       2
              *

 345          KK  RCCA05
 346          KM  ROUTE CCA05 TO CCA08
 347          KM  PROPOSED FACILITY IN PECOS ROAD
 348          KM  LINING = RCB
 349          RD    1310   0.005   0.013       0    TRAP      14       0
              *

 350          KK  CA06-C
 351          BA   0.407
 352          PB    2.77
 353          LS       0    82.5
 354          UD   0.465
              *

 355          KK  CH59-C
 356          BA   0.213
 357          PB    2.77
 358          LS       0    94.4
```

```
 359          UD   0.371
              *

 360          KK DCH58-C
 361          KM  FLOW SPLIT TO CH58-C
 362          KM  SPLIT TO FLAMINGO WASH SYSTEM
 363          KM  DEVELOPED FROM CWH MODEL
 364          KM  CAPACITY = 144 CFS (100 YR STORM DRAIN CAPACITY)
 365          DT   DFLAM
 366          DI       0     144    1000
 367          DQ       0       0     856
              *
1                                      HEC-1 INPUT                                                PAGE 11

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 368          KK  RDCH58
 369          KM  ROUTE DCH58-C TO CCH58-C
 370          KM  LAS VEGAS BLVD STORM DRAIN
 371          RD    5900    0.01   0.013       0    CIRC       4       0
              *

 372          KK  CH58-C
 373          BA   0.128
 374          PB    2.77
 375          LS       0    93.4
 376          UD   0.312
              *

 377          KK CCH58-C
 378          KM  COMBINE DCH58-C AND CH58-C
 379          KM  US 95
 380          HC       2
              *

 381          KKDDCH59-C
 382          KM  FLOW SPLIT TO BN03-C
 383          KM  DIVERT Q EXCEEDING LAS VEGAS BLVD DRAIN CAPACITY:  48" PIPE, 167 CFS
 384          KM  DBN00 IN CWH
 385          DT   DBN03
 386          DI       0     167    1000
 387          DQ       0       0     833
              *

 388          KK  DDCH59
 389          KM  DIVERT FLOW OUT OF PECOS/BONANZA SYSTEM
 390          DT  DBN03a
 391          DI       0     167    1000
 392          DQ       0     167    1000
              *

 393          KK  BN06-C
 394          BA   0.340
 395          PB    2.77
 396          LS       0    89.1
 397          UD   0.201
              *

 398          KK  BN03-C
 399          BA   0.539
 400          PB    2.77
 401          LS       0    87.3
 402          UD   0.344
              *
1                                      HEC-1 INPUT                                                PAGE 12

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 403          KK   DBN03
 404          KM  RETREIVE DBN03
 405          DR   DBN03
              *

 406          KK  RDBN03
 407          KM  ROUTE DBN03 TO CBN03
 408          KM  BONANZA
 409          RD    5900  0.0264   0.016       0    TRAP       0      50
              *

 410          KK   CBN03
 411          KM  COMBINE BN06-C, BN03-C, AND RDBN03
 412          KM  BONANZA AND EASTERN
 413          HC       3
              *

 414          KK  RCBN03
 415          KM  ROUTE CBN03 TO CBN08
 416          KM  FACILITY = LAS VEGAS WASH - BONANZA
 417          KM  FACILITY # = LVBZ 0211,0224
 418          KM  LINING = RCB
 419          RD    2980  0.0072   0.015       0    TRAP       8       0
              *
```

```
 420          KK    BN08
 421          BA   0.210
 422          PB    2.77
 423          LS       0    91.8
 424          UD   0.378
              *

 425          KK   CBN08
 426          KM  COMBINE RCBN03 AND BN08
 427          KM  BONANZA AND MOJAVE
 428          HC       2
              *

 429          KK  RCBN08
 430          KM  ROUTE CBN08 TO CBN09
 431          KM  FACILITY = LAS VEGAS WASH - BONANZA
 432          KM  FACILITY # = LVBZ 0167, 0188
 433          KM  LINING = RCB
 434          RD    2330   0.007   0.015       0    TRAP       9       0
              *

 435          KK    BN09
 436          BA   0.233
 437          PB    2.77
 438          LS       0    83.9
 439          UD   0.411
              *
1                                        HEC-1 INPUT                                          PAGE 13

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 440          KK   CBN09
 441          KM  COMBINE RCBN08 AND BN09
 442          KM  BONANZA AND PECOS
 443          HC       2
              *

 444          KK   DBN09
 445          KM  FLOW SPLIT TO PECOS
 446          KM  DIVERT Q EXCEEDING 60" PIPE, 202 CFS
 447          DT  DBN09a
 448          DI       0     202    1000    2000
 449          DQ       0       0     798    1798
              *

 450          KK  CCBN09
 451          KM  COMBINE DDCH59 AND DBN09
 452          KM  SHOULD BE THE SAME AS CBN09
 453          KM  DDCH59 HAS ZERO FLOW
 454          KM  BONANZA AND PECOS
 455          HC       2
 456          KO       1
              *

 457          KK CCA06-1
 458          KM  BONANZA FLOW AND CA06-C
 459          HC       2
              *

 460          KK   CCA06
 461          KM  CEDAR AND PECOS
 462          HC       2
              *

 463          KK  RCCA06
 464          KM  ROUTE CCA05 TO CCA08
 465          KM  FACILITY = CEDAR AVENUE CHANNEL
 466          KM  FACILITY # = CACH 0127,0129,0146,0148
 467          KM  LINING = CONCRETE
 468          RD    1545  0.0026   0.015       0    TRAP      10     1.5
              *

 469          KK    CA08
 470          BA   0.073
 471          PB    2.77
 472          LS       0    85.4
 473          UD   0.258
              *

 474          KK   CA08a
 475          BA  0.0478
 476          PB    2.77
 477          LS       0    89.1
 478          UD   0.215
              *
1                                        HEC-1 INPUT                                          PAGE 14

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 479          KK   CCA08
 480          KM  CEDAR AND HONOLULU
 481          HC       3
              *
```

```
482          KK  RCCA08
483          KM  ROUTE CCA08 TO CCA09
484          KM  FACILITY = CEDAR AVENUE CHANNEL
485          KM  FACILITY # = CACH 0079,0081
486          KM  LINING = CONCRETE
487          RD    1050  0.0026   0.015       0    TRAP      10     1.5
             *

488          KK    CA09
489          BA   0.048
490          PB    2.77
491          LS       0    89.6
492          UD   0.225
             *

493          KK   CCA09
494          KM  CEDAR AND SANDHILL
495          HC       2
             *

496          KK  RCCA09
497          KM  ROUTE CCA09 TO CCA10
498          KM  FACILITY = CEDAR AVENUE CHANNEL
499          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
500          KM  LINING = CONCRETE
501          RD     935   0.002   0.015       0    TRAP      12     1.5
             *

502          KK    CA10
503          BA   0.032
504          PB    2.77
505          LS       0    93.0
506          UD   0.221
             *

507          KK   CCA10
508          KM  CEDAR AVE CHANNEL
509          HC       2
             *

510          KK  RCCA10
511          KM  ROUTE CCA10 TO CCA11
512          KM  FACILITY = CEDAR AVENUE CHANNEL
513          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
514          KM  LINING = CONCRETE
515          RD    1730   0.002   0.015       0    TRAP      12     1.5
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

516          KK    CA11
517          BA   0.092
518          PB    2.77
519          LS       0    90.2
520          UD   0.288
             *

521          KK   CCA11
522          KM  CEDAR AND LAMB
523          HC       2
             *

524          KK  RCCA11
525          KM  ROUTE CCA11 TO CCA12
526          KM  FACILITY = CEDAR AVENUE CHANNEL
527          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
528          KM  LINING = CONCRETE
529          RD    1340  0.0038   0.015       0    TRAP      10     1.5
             *

530          KK    CA12
531          BA   0.062
532          PB    2.77
533          LS       0    94.1
534          UD   0.245
             *

535          KK   CCA12
536          KM  CEDAR AND PAGE
537          HC       2
             *

538          KK  RCCA12
539          KM  ROUTE CCA12 TO CCA13
540          KM  FACILITY = CEDAR AVENUE CHANNEL
541          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
542          KM  LINING = CONCRETE
543          RD    1365  0.0037   0.015       0    TRAP      10     1.5
             *

544          KK   CA13a
545          BA   0.065
```

```
 546          PB    2.77
 547          LS       0    95.9
 548          UD   0.247
              *

 549          KK  CCA13a
 550          KM  CEDAR AND MARION
 551          HC       2
              *
1                                      HEC-1 INPUT                                          PAGE 16

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 552          KK  BN10-C
 553          BA   0.257
 554          PB    2.77
 555          LS       0    88.8
 556          UD   0.406
              *

 557          KK  DBN09a
 558          KM  RETREIVE DBN09a
 559          DR  DBN09a
              *

 560          KK CBN10-C
 561          KM  COMBINE DBN09a AND BN10-C
 562          KM  BONANZA AND SANDHILL
 563          HC       2
              *

 564          KKRCBN10-C
 565          KM  ROUTE CBN10-C TO CBN12-C
 566          KM  FACILITY = LAS VEGAS WASH - BONANZA
 567          KM  FACILITY # = LVBZ 0064
 568          KM  LINING = RCB
 569          RD    2630   0.004   0.015       0    TRAP      24       0
              *

 570          KK  BN12-C
 571          BA   0.323
 572          PB    2.77
 573          LS       0    87.4
 574          UD   0.397
              *

 575          KK CBN12-C
 576          KM  COMBINE RCBN10-C AND BN12-C
 577          KM  BONANZA AND LAMB
 578          HC       2
              *

 579          KKRCBN12-C
 580          KM  ROUTE CBN12-C TO CBN15-C
 581          KM  FACILITY = LAS VEGAS WASH - BONANZA
 582          KM  FACILITY # = LVBZ 0000
 583          KM  LINING = RCB
 584          RD    2740   0.004   0.015       0    TRAP      24       0
              *

 585          KK  BN15-C
 586          BA   0.283
 587          PB    2.77
 588          LS       0    87.0
 589          UD   0.414
              *
1                                      HEC-1 INPUT                                          PAGE 17

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 590          KK CBN15-C
 591          KM  COMBINE  RCBN12-C AND BN15-C
 592          KM  LAS VEGAS WASH AND BONANZA
 593          HC       2
 594          KO       1
              *

 595          KKRCBN15-C
 596          KM  ROUTE CCBN15-C TO CCA13a
 597          KM  TO CEDAR CHANNEL FROM MARION DRIVE
 598          KM  LINING = RCB
 599          RD    1371  0.0073   0.015       0    TRAP      20       0
              *

 600          KK   CCA13
 601          KM  CEDAR CHANNEL AT MARION DRIVE
 602          KM  COMBINES FLOWS FROM CEDAR CHANNEL AND BONANZA
 603          HC       2
              *

 604          KK  RCCA13
 605          KM  ROUTE CCA13 TO CCA14
 606          KM  FACILITY = CEDAR AVENUE CHANNEL
```

```
            607           KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
            608           KM  LINING = CONCRETE
            609           RD    1680   0.002   0.015       0    TRAP      14     1.5
                          *

            610           KK    CA14
            611           BA   0.055
            612           PB    2.77
            613           LS       0    97.7
            614           UD   0.233
                          *

            615           KK   CCA14
            616           KM  CEDAR CHANNEL AT WASH
            617           HC       2
                          *

            618           KK DRDTA05
            619           KM  RETURN FLOW FROM DIVERTED
            620           KM  FLOW ON THE STREET FROM PECOS
            621           DR DTA05-3
                          *

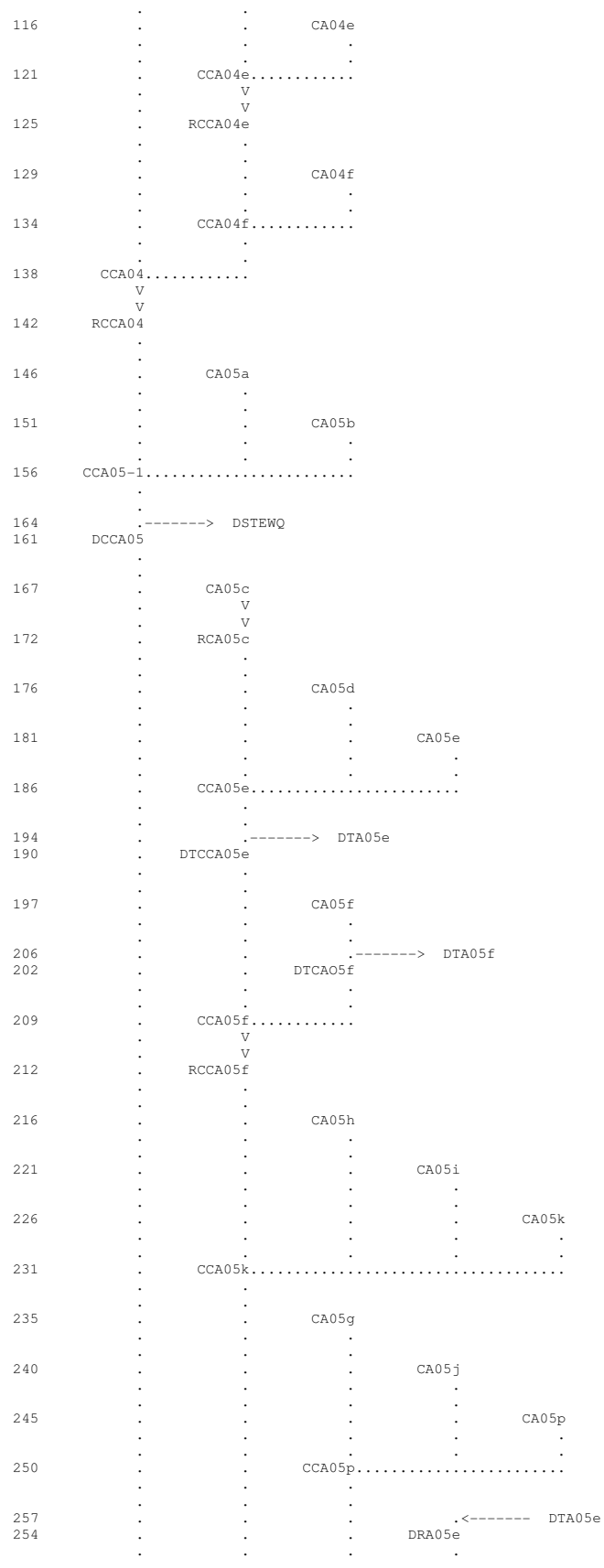
            622           KK DRDSTEW
            623           KM  RETURN FLOW FROM DIVERTED
            624           KM  FLOW ON THE STREET FROM STEWART
            625           DR  DSTEWQ
                          *
1                                                HEC-1 INPUT                                                PAGE 18

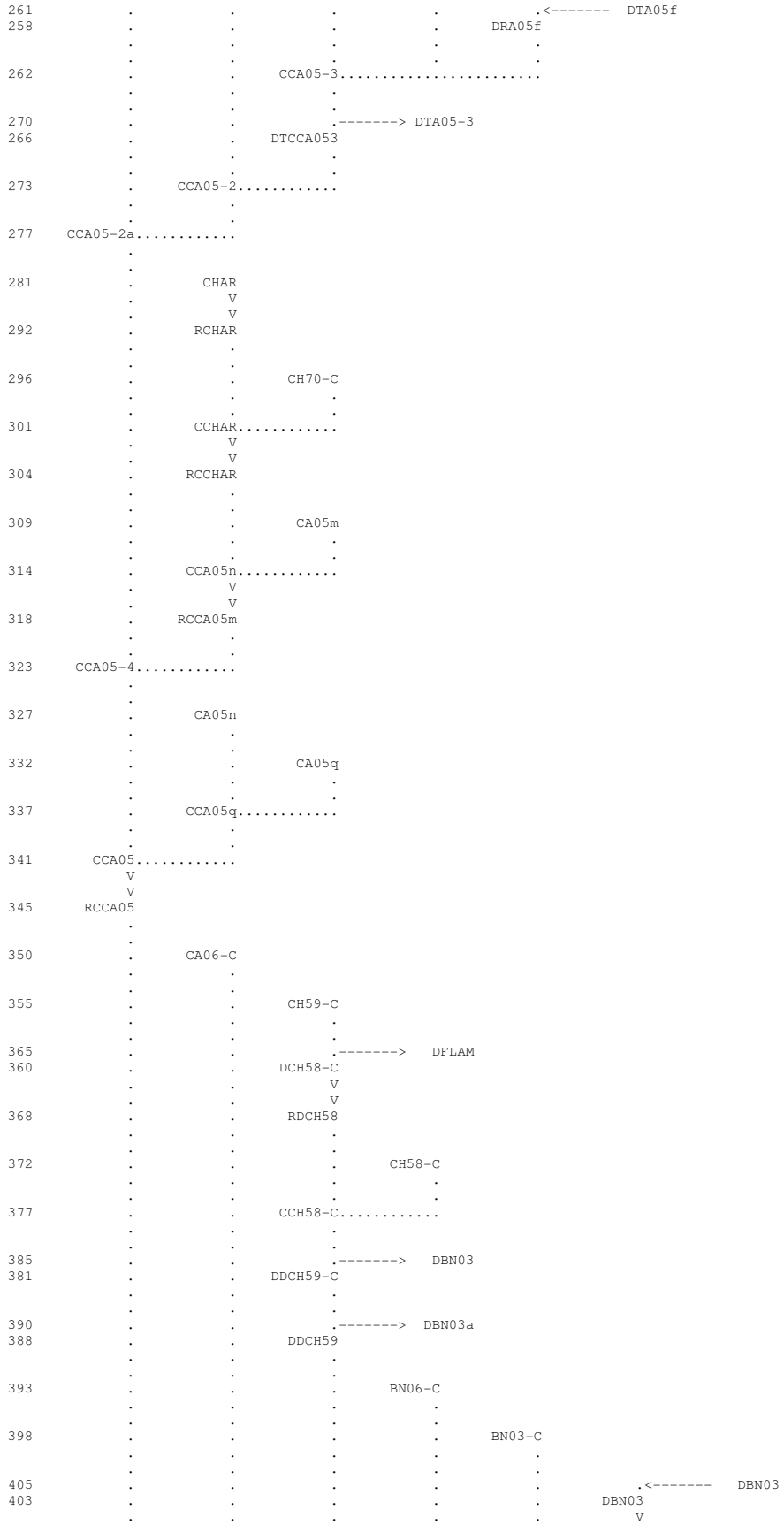
           LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

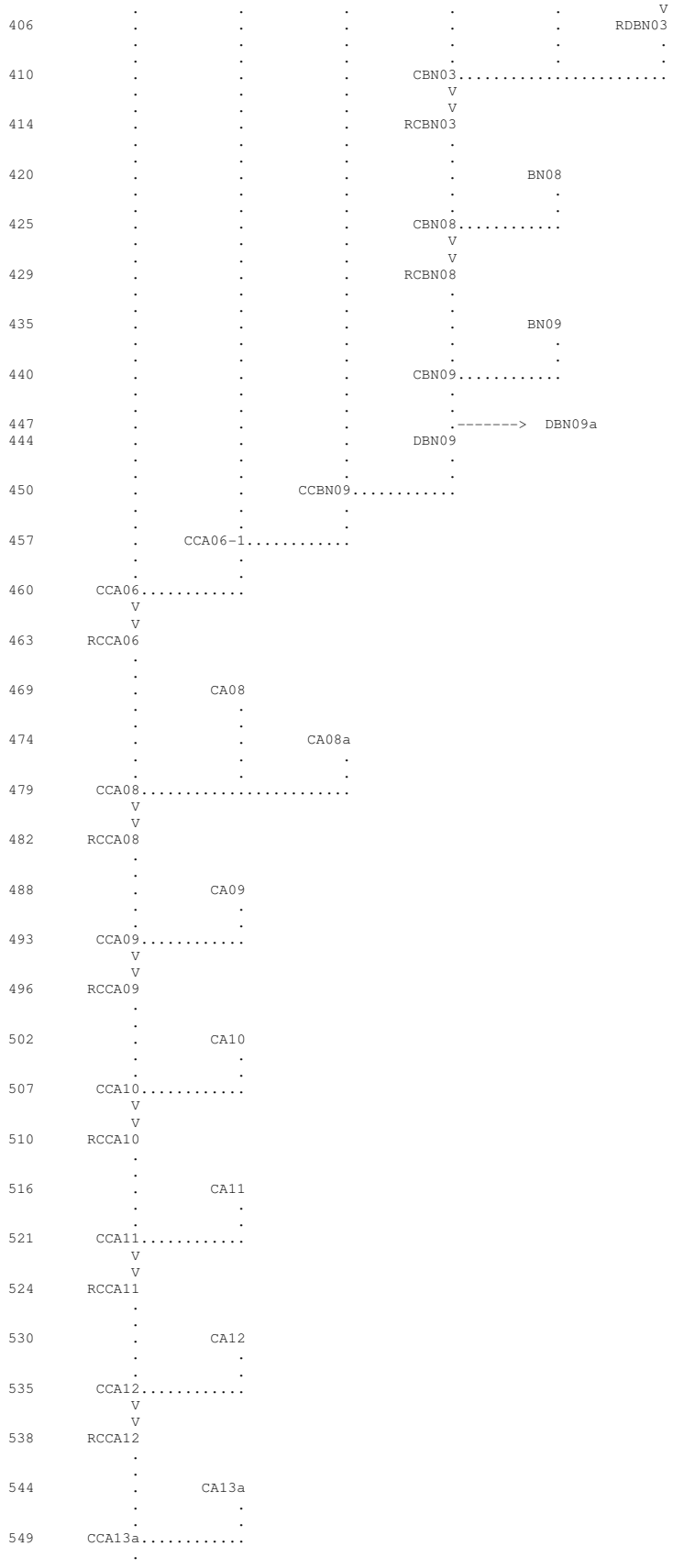

            626           KK CSTEWBY
            627           KM  BYPASS FLOW ON STEWART
            628           HC       2
                          *
            629           ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

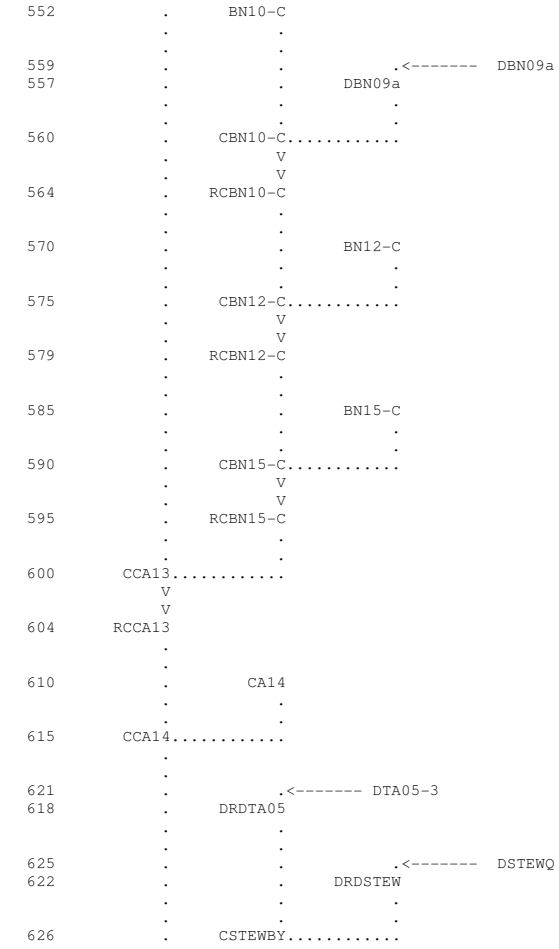
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     32       CA03a
                  .
                  .
     45           .       CA03c
                  .           .
                  .           .
     50      CCA03c............
                  .
                  .
     54           .       CA03b
                  .           .
                  .           .
     59       CCA03............
                  V
                  V
     63      RCCA03
                  .
                  .
     67           .       CA04b
                  .           .
                  .           .
     72      CCA04b............
                  V
                  V
     76     RCCA04b
                  .
                  .
     80           .       CA04a
                  .           .
                  .           .
     85           .           .       CA04c
                  .           .           .
                  .           .           .
     90     CCA04-1.......................
                  .
                  .
     94           .       CA04g
                  .           V
                  .           V
     99           .      RCA04g
                  .           .
                  .           .
    103           .           .       CA04d
                  .           .           .
                  .           .           .
    108           .      CCA04d............
                  .           V
                  .           V
    112           .      RCA04d
                  .           .
```


CA04e
CCA04e
RCCA04e
CA04f
CCA04f
CCA04
RCCA04
CA05a
CA05b
CCA05-1
DSTEWQ
DCCA05
CA05c
RCA05c
CA05d
CA05e
CCA05e
DTA05e
DTCCA05e
CA05f
DTA05f
DTCAO5f
CCA05f
RCCA05f
CA05h
CA05i
CA05k
CCA05k
CA05g
CA05j
CA05p
CCA05p
DTA05e
DRA05e


261
258
262
270
266
273
277
281
292
296
301
304
309
314
318
323
327
332
337
341
345
350
355
365
360
368
372
377
385
381
390
388
393
398
405
403
DTA05f
DRA05f
CCA05-3
DTA05-3
DTCCA053
CCA05-2
CCA05-2a
CHAR
RCHAR
CH70-C
CCHAR
RCCHAR
CA05m
CCA05n
RCCA05m
CCA05-4
CA05n
CA05q
CCA05q
CCA05
RCCA05
CA06-C
CH59-C
DFLAM
DCH58-C
RDCH58
CH58-C
CCH58-C
DBN03
DDCH59-C
DBN03a
DDCH59
BN06-C
BN03-C
DBN03
DBN03


406 RDBN03
410 CBN03
414 RCBN03
420 BN08
425 CBN08
429 RCBN08
435 BN09
440 CBN09
447 DBN09a
444 DBN09
450 CCBN09
457 CCA06-1
460 CCA06
463 RCCA06
469 CA08
474 CA08a
479 CCA08
482 RCCA08
488 CA09
493 CCA09
496 RCCA09
502 CA10
507 CCA10
510 RCCA10
516 CA11
521 CCA11
524 RCCA11
530 CA12
535 CCA12
538 RCCA12
544 CA13a
549 CCA13a



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   03NOV15  TIME  14:38:06   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

LAS VEGAS WASH CENTRAL-CEDAR AVENUE

INPUT FILE = CEDAR_ULT.DAT
INPUT FILE DATE = APRIL 2014
DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY ATKINS (MANOGYA KHANAL)
CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
NO STORM CENTERING
REFERENCED HYDROLOGIC MODELS:
2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
CENTRAL NEIGHBORHOOD STUDY

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA SQ. MI.	DARF
0-0.5	0.990
0.5-1	0.975
1-2	0.950
2-3	0.925
3-4	0.915
4-5	0.908
5-6	0.903

```
 29 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN           5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME         0000  STARTING TIME
                        NQ          300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2    0  ENDING DATE
                    NDTIME         0055  ENDING TIME
                     ICENT           19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.92 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                     NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                    .99       .98       .95       .93       .92       .91       .90       .57


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
156 KK     *   CCA05-1  *
           *            *
           **************

160 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           1  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

159 HC          HYDROGRAPH COMBINATION
                     ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***
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****

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .99

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	22.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	19.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	16.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	14.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	1.	1		0640	81	9.	1		1255	156	0.	1		1910	231	0.
1		0030	7	2.	1		0645	82	7.	1		1300	157	0.	1		1915	232	0.
1		0035	8	4.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	5.	1		0655	84	4.	1		1310	159	0.	1		1925	234	0.
1		0045	10	6.	1		0700	85	3.	1		1315	160	0.	1		1930	235	0.
1		0050	11	6.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	6.	1		0710	87	2.	1		1325	162	0.	1		1940	237	0.
1		0100	13	6.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	7.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	7.	1		0725	90	1.	1		1340	165	0.	1		1955	240	0.
1		0115	16	8.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	8.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	9.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	11.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	13.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	16.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	20.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	23.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	26.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	28.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	30.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	31.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	32.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	34.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	36.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.

1	0230	31	39.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	41.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	45.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	50.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	54.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	56.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	55.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	57.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	65.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	80.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	109.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	166.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	275.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	435.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	598.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	709.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	751.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	726.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	654.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	560.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	463.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	376.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	305.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	251.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	212.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	189.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	178.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	175.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	179.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	185.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	189.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	188.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	180.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	166.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	147.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	125.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	105.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	87.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	71.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	58.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	48.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	40.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	34.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	29.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	25.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 751.	3.83		139.	35.	34.	34.
		(INCHES)	1.715	1.722	1.722	1.722
		(AC-FT)	69.	69.	69.	69.

CUMULATIVE AREA = .75 SQ MI

****

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .98

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0615	76	22.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	19.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	16.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	1.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	2.	*	1		0645	82	7.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	3.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	5.	*	1		0655	84	4.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	6.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	6.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	5.	*	1		0710	87	2.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	5.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	6.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	6.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	7.	*	1		0730	91	1.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	7.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	8.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	10.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	13.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	16.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	19.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	22.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	25.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	27.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	28.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.

1	0210	27	29.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	30.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	32.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	35.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	38.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	40.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	43.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	48.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	53.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	54.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	54.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	56.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	63.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	78.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	108.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	165.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	268.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	419.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	582.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	701.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	745.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	717.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	644.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	551.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	456.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	371.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	301.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	247.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	208.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	185.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	174.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	172.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	176.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	182.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	186.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	184.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	176.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	162.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	144.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	123.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	103.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	85.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	70.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	58.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	48.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	40.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	34.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	29.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	25.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 745.	3.83	136.	34.	33.	33.
		(INCHES) 1.683	1.690	1.690	1.690
		(AC-FT) 68.	68.	68.	68.

CUMULATIVE AREA = .75 SQ MI

****

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .95

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	21.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	19.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	16.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	2.	*	1		0645	82	7.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	3.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	4.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	5.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	5.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	5.	*	1		0710	87	2.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	5.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	5.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	5.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	6.	*	1		0730	91	1.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	7.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	7.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	9.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	12.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	15.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	18.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.

1	0150	23	21.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	23.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	25.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	26.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	27.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	29.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	30.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	33.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	36.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	38.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	41.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	45.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	50.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	51.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	51.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	53.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	59.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	74.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	104.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	163.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	267.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	412.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	557.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	665.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	714.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	697.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	628.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	534.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	440.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	359.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	292.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	241.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	204.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	181.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	170.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	167.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	169.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	176.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	180.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	179.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	172.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	158.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	140.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	120.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	100.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	83.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	68.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	56.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	46.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	39.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	33.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	28.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	24.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 714.	3.83	132.	33.	32.	32.
		(INCHES) 1.627	1.633	1.633	1.633
		(AC-FT) 65.	65.	65.	65.

CUMULATIVE AREA = .75 SQ MI

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .93

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	21.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	18.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	15.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	7.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	3.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	4.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	4.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	4.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	4.	*	1		0710	87	2.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	4.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	4.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	5.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	5.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	6.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	7.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.

1	0130	19	8.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	11.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	14.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	16.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	19.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	21.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	23.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	24.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	25.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	27.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	29.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	31.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	33.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	36.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	38.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	43.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	46.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	48.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	49.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	50.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	57.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	71.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	97.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	147.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	241.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	383.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	534.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	642.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	685.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	665.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	601.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	516.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	429.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	350.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	285.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	234.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	198.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	174.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	163.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	161.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	165.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	170.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	174.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	172.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	165.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	152.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	136.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	117.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	98.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	81.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	66.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	55.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	45.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	38.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	32.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	28.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	24.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 685.	3.83	126.	32.	30.	30.
		(INCHES) 1.558	1.564	1.564	1.564
		(AC-FT) 62.	63.	63.	63.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .92

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	21.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	18.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	15.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	7.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	4.	1		0655	84	4.	1		1310	159	0.	1		1925	234	0.
1		0045	10	4.	1		0700	85	3.	1		1315	160	0.	1		1930	235	0.
1		0050	11	4.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	4.	1		0710	87	2.	1		1325	162	0.	1		1940	237	0.
1		0100	13	4.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	4.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.

1	0110	15	4.	*	1	0725	90	1.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	5.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	6.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	6.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	8.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	11.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	13.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	16.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	18.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	20.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	22.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	23.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	25.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	26.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	28.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	30.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	33.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	35.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	37.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	41.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	45.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	47.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	48.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	49.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	56.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	69.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	95.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	145.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	236.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	374.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	524.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	635.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	682.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	661.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	595.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	510.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	424.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	346.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	281.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	231.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	195.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	173.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	161.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	159.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	162.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	168.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	172.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	170.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	163.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	150.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	134.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	115.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	97.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	80.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	66.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	54.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	45.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	38.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	32.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	27.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	24.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 682.	3.83	124.	31.	30.	30.
		(INCHES) 1.537	1.543	1.543	1.543
		(AC-FT) 62.	62.	62.	62.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .91

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW
1 0000	1	0.	*	1 0615	76	20.	*	1 1230	151	0.	*	1 1845	226	0.
1 0005	2	0.	*	1 0620	77	18.	*	1 1235	152	0.	*	1 1850	227	0.
1 0010	3	0.	*	1 0625	78	15.	*	1 1240	153	0.	*	1 1855	228	0.
1 0015	4	0.	*	1 0630	79	13.	*	1 1245	154	0.	*	1 1900	229	0.
1 0020	5	0.	*	1 0635	80	11.	*	1 1250	155	0.	*	1 1905	230	0.
1 0025	6	0.	*	1 0640	81	8.	*	1 1255	156	0.	*	1 1910	231	0.
1 0030	7	1.	*	1 0645	82	7.	*	1 1300	157	0.	*	1 1915	232	0.
1 0035	8	2.	*	1 0650	83	5.	*	1 1305	158	0.	*	1 1920	233	0.
1 0040	9	4.	*	1 0655	84	4.	*	1 1310	159	0.	*	1 1925	234	0.
1 0045	10	4.	*	1 0700	85	3.	*	1 1315	160	0.	*	1 1930	235	0.

1	0050	11	4.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	4.	*	1	0710	87	2.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	3.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	4.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	4.	*	1	0725	90	1.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	5.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	5.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	6.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	8.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	10.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	13.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	15.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	18.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	20.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	21.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	23.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	24.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	26.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	28.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	30.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	32.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	34.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	36.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	41.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	45.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	47.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	47.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	48.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	55.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	68.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	94.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	145.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	235.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	369.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	515.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	627.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	676.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	659.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	592.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	506.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	419.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	341.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	278.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	229.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	193.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	171.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	159.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	157.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	160.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	166.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	170.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	169.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	162.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	149.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	133.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	115.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	96.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	79.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	65.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	54.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	44.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	37.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	32.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	27.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	23.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
	(CFS)				
+ 676.	3.83	123.	31.	30.	30.
	(INCHES)	1.522	1.527	1.527	1.527
	(AC-FT)	61.	61.	61.	61.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .90

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	20.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	18.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	15.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	8.	*	1		1255	156	0.	*	1		1910	231	0.

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0030	7	1.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.
1		0035	8	2.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	3.	1		0655	84	4.	1		1310	159	0.	1		1925	234	0.
1		0045	10	4.	1		0700	85	3.	1		1315	160	0.	1		1930	235	0.
1		0050	11	4.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	4.	1		0710	87	2.	1		1325	162	0.	1		1940	237	0.
1		0100	13	3.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	3.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	4.	1		0725	90	1.	1		1340	165	0.	1		1955	240	0.
1		0115	16	5.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	5.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	6.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	7.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	10.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	13.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	15.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	17.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	19.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	21.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	22.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	24.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	25.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	27.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	29.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	31.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	33.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	36.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	40.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	44.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	46.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	46.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	48.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	54.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	68.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	94.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	145.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	237.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	368.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	510.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	622.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	674.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	657.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	589.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	504.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	417.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	339.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	276.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	227.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	192.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	170.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	159.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	156.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	159.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	165.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	169.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	168.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	161.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	149.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	133.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	114.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	96.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	79.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	65.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	54.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	44.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	37.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	32.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	27.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	23.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)				
		(CFS)			
674.	3.83	122.	31.	30.	30.
		(INCHES) 1.514	1.519	1.519	1.519
		(AC-FT) 61.	61.	61.	61.

CUMULATIVE AREA = .75 SQ MI

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .57

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	12.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	11.	1		1235	152	0.	1		1850	227	0.

1	0010	3	0.	*	1	0625	78	9.	*	1	1240	153	0.	*	1	1855	228	0.
1	0015	4	0.	*	1	0630	79	8.	*	1	1245	154	0.	*	1	1900	229	0.
1	0020	5	0.	*	1	0635	80	7.	*	1	1250	155	0.	*	1	1905	230	0.
1	0025	6	0.	*	1	0640	81	5.	*	1	1255	156	0.	*	1	1910	231	0.
1	0030	7	0.	*	1	0645	82	4.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	0.	*	1	0650	83	3.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	2.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	0.	*	1	0705	86	1.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	0.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	0.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	0.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	0.	*	1	0725	90	1.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	0.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	0.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	0.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	1.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	1.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	2.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	2.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	3.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	3.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	3.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	3.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	3.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	4.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	5.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	6.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	7.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	8.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	9.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	10.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	12.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	14.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	14.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	15.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	17.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	22.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	32.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	51.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	82.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	133.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	203.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	269.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	310.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	323.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	309.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	276.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	234.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	193.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	158.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	130.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	111.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	97.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	89.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	86.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	86.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	90.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	93.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	92.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	89.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	84.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	76.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	68.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	58.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	48.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	40.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	33.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	28.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	24.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	20.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	17.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	15.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 323.	3.92	59.	15.	14.	14.
		(INCHES) .734	.735	.735	.735
		(AC-FT) 29.	29.	29.	29.

CUMULATIVE AREA = .75 SQ MI

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450 KK * CCBN09 *

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 456 KO          OUTPUT CONTROL VARIABLES
                       IPRNT           1  PRINT CONTROL
                       IPLOT           0  PLOT CONTROL
                       QSCAL          0.  HYDROGRAPH PLOT SCALE

 455 HC          HYDROGRAPH COMBINATION
                       ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .99

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	30.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	24.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	19.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	14.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	10.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	7.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	5.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	7.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	11.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	13.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	12.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	10.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	8.	1		0720	89	0.	1		1335	164	0.	1		1950	239	0.
1		0110	15	6.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	5.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	6.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	9.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	13.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	19.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	28.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	38.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	46.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	50.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	50.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	45.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	39.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	35.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	39.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	51.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	66.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	77.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	80.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	81.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	83.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	87.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	87.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	86.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	96.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	137.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	202.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	202.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	202.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	202.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	202.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	202.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	202.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	202.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	202.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	202.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	202.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	202.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	202.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	202.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	202.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	202.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	202.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	202.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	202.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	202.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	202.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	202.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	202.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	202.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	202.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	170.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	137.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	110.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	89.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	72.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	60.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	52.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.

1	0600	73	46.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	41.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	35.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.33	102.	26.	25.	25.
		(INCHES) .573	.575	.575	.575
		(AC-FT) 51.	51.	51.	51.

CUMULATIVE AREA = 1.66 SQ MI

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HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .98

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	29.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	24.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	10.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	7.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	3.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	6.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	10.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	12.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	11.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	9.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	7.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	5.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	5.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	6.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	8.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	12.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	18.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	27.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	36.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	44.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	48.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	48.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	43.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	37.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	34.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	37.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	49.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	64.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	74.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	78.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	78.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	80.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	84.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	84.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	83.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	93.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	132.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	202.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.
1		0420	53	202.	*	1		1035	128	0.	*	1		1650	203	0.	*	1		2305	278	0.
1		0425	54	202.	*	1		1040	129	0.	*	1		1655	204	0.	*	1		2310	279	0.
1		0430	55	202.	*	1		1045	130	0.	*	1		1700	205	0.	*	1		2315	280	0.
1		0435	56	202.	*	1		1050	131	0.	*	1		1705	206	0.	*	1		2320	281	0.
1		0440	57	202.	*	1		1055	132	0.	*	1		1710	207	0.	*	1		2325	282	0.
1		0445	58	202.	*	1		1100	133	0.	*	1		1715	208	0.	*	1		2330	283	0.
1		0450	59	202.	*	1		1105	134	0.	*	1		1720	209	0.	*	1		2335	284	0.
1		0455	60	202.	*	1		1110	135	0.	*	1		1725	210	0.	*	1		2340	285	0.
1		0500	61	202.	*	1		1115	136	0.	*	1		1730	211	0.	*	1		2345	286	0.
1		0505	62	202.	*	1		1120	137	0.	*	1		1735	212	0.	*	1		2350	287	0.
1		0510	63	202.	*	1		1125	138	0.	*	1		1740	213	0.	*	1		2355	288	0.
1		0515	64	202.	*	1		1130	139	0.	*	1		1745	214	0.	*	2		0000	289	0.
1		0520	65	202.	*	1		1135	140	0.	*	1		1750	215	0.	*	2		0005	290	0.
1		0525	66	167.	*	1		1140	141	0.	*	1		1755	216	0.	*	2		0010	291	0.
1		0530	67	134.	*	1		1145	142	0.	*	1		1800	217	0.	*	2		0015	292	0.
1		0535	68	108.	*	1		1150	143	0.	*	1		1805	218	0.	*	2		0020	293	0.

1	0540	69	88.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.	
1	0545	70	71.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.	
1	0550	71	59.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.	
1	0555	72	51.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.	
1	0600	73	45.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.	
1	0605	74	40.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.	
1	0610	75	35.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.	
				*					*					*					

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.33	101.	25.	25.	25.
		(INCHES) .567	.569	.569	.569
		(AC-FT) 50.	51.	51.	51.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .95

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	29.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	23.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	10.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	7.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	5.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	9.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	10.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	10.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	8.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	6.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	5.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	4.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	5.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	8.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	11.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	16.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	24.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	33.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	41.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	45.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	44.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	40.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	35.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	32.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	35.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	46.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	60.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	70.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	73.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	74.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	76.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	79.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	79.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	79.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	88.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	125.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	202.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.
1		0420	53	202.	*	1		1035	128	0.	*	1		1650	203	0.	*	1		2305	278	0.
1		0425	54	202.	*	1		1040	129	0.	*	1		1655	204	0.	*	1		2310	279	0.
1		0430	55	202.	*	1		1045	130	0.	*	1		1700	205	0.	*	1		2315	280	0.
1		0435	56	202.	*	1		1050	131	0.	*	1		1705	206	0.	*	1		2320	281	0.
1		0440	57	202.	*	1		1055	132	0.	*	1		1710	207	0.	*	1		2325	282	0.
1		0445	58	202.	*	1		1100	133	0.	*	1		1715	208	0.	*	1		2330	283	0.
1		0450	59	202.	*	1		1105	134	0.	*	1		1720	209	0.	*	1		2335	284	0.
1		0455	60	202.	*	1		1110	135	0.	*	1		1725	210	0.	*	1		2340	285	0.
1		0500	61	202.	*	1		1115	136	0.	*	1		1730	211	0.	*	1		2345	286	0.
1		0505	62	202.	*	1		1120	137	0.	*	1		1735	212	0.	*	1		2350	287	0.
1		0510	63	202.	*	1		1125	138	0.	*	1		1740	213	0.	*	1		2355	288	0.
1		0515	64	202.	*	1		1130	139	0.	*	1		1745	214	0.	*	2		0000	289	0.

1	0520	65	198.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	162.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	130.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	105.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	85.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	69.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	57.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	49.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	44.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	39.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	34.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.33	100.	25.	24.	24.
		(INCHES) .558	.560	.560	.560
		(AC-FT) 49.	50.	50.	50.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .93

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0615	76	28.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	23.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	9.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	7.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	7.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	9.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	9.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	7.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	5.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	4.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	4.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	5.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	7.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	10.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	14.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	22.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	30.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	37.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	41.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	41.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	37.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	32.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	29.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	32.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	42.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	56.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	65.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	69.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	69.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	71.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	75.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	75.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	74.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	83.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	118.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	202.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.
1		0420	53	202.	*	1		1035	128	0.	*	1		1650	203	0.	*	1		2305	278	0.
1		0425	54	202.	*	1		1040	129	0.	*	1		1655	204	0.	*	1		2310	279	0.
1		0430	55	202.	*	1		1045	130	0.	*	1		1700	205	0.	*	1		2315	280	0.
1		0435	56	202.	*	1		1050	131	0.	*	1		1705	206	0.	*	1		2320	281	0.
1		0440	57	202.	*	1		1055	132	0.	*	1		1710	207	0.	*	1		2325	282	0.
1		0445	58	202.	*	1		1100	133	0.	*	1		1715	208	0.	*	1		2330	283	0.
1		0450	59	202.	*	1		1105	134	0.	*	1		1720	209	0.	*	1		2335	284	0.
1		0455	60	202.	*	1		1110	135	0.	*	1		1725	210	0.	*	1		2340	285	0.

1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	192.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	157.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	126.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	102.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	83.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	67.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	55.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	48.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	42.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	37.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	33.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	98.	25.	24.	24.
		(INCHES) .549	.550	.550	.550
		(AC-FT) 49.	49.	49.	49.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .92

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	27.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	9.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	6.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	7.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	8.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	8.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	7.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	5.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	4.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	4.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	4.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	6.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	9.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	14.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	21.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	29.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	36.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	40.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	40.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	36.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	31.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	28.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	31.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	41.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	54.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	64.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	67.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	67.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	70.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	73.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	73.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	73.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	81.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	115.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	197.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.
1		0420	53	202.	*	1		1035	128	0.	*	1		1650	203	0.	*	1		2305	278	0.
1		0425	54	202.	*	1		1040	129	0.	*	1		1655	204	0.	*	1		2310	279	0.
1		0430	55	202.	*	1		1045	130	0.	*	1		1700	205	0.	*	1		2315	280	0.
1		0435	56	202.	*	1		1050	131	0.	*	1		1705	206	0.	*	1		2320	281	0.

1	0440	57	202.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	202.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	202.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	202.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	190.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	155.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	125.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	101.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	82.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	66.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	54.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	47.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	42.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	37.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	32.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	97.	24.	24.	24.
		(INCHES) .544	.546	.546	.546
		(AC-FT) 48.	48.	48.	48.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .91

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	27.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	9.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	6.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	6.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	8.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	8.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	6.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	5.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	4.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	3.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	4.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	6.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	9.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	13.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	20.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	28.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	35.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	39.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	39.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	35.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	30.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	28.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	31.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	40.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	53.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	62.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	66.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	66.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	68.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	72.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	72.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	71.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	79.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	113.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	194.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.

1	0420	53	202.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	202.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	202.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	202.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	202.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	202.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	202.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	202.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	188.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	153.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	124.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	100.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	81.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	65.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	54.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	47.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	42.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	37.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	32.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	97.	24.	23.	23.
		(INCHES) .542	.543	.543	.543
		(AC-FT) 48.	48.	48.	48.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .90

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	27.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	22.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	12.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	9.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	6.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	4.	1		1300	157	0.	1		1915	232	0.
1		0035	8	2.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	4.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	6.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	8.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	7.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	6.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	5.	1		0720	89	0.	1		1335	164	0.	1		1950	239	0.
1		0110	15	4.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	3.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	4.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	6.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	9.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	13.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	20.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	28.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	34.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	38.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	38.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	35.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	30.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	27.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	30.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	40.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	52.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	62.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	65.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	65.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	67.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	71.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	71.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	70.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	78.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	111.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	191.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	202.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	202.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	202.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	202.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	202.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	202.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	202.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.

1	0400	49	202.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	202.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	202.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	202.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	202.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	202.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	202.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	202.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	202.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	202.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	202.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	202.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	187.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	152.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	123.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	99.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	80.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	65.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	54.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	46.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	41.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	36.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	32.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	97.	24.	23.	23.
		(INCHES) .540	.541	.541	.541
		(AC-FT) 48.	48.	48.	48.

CUMULATIVE AREA = 1.66 SQ MI

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HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .57

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	16.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	13.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	10.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	8.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	6.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	4.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	3.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	0.	*	1		0650	83	2.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	0.	*	1		0655	84	1.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	0.	*	1		0700	85	1.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	0.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	0.	*	1		0710	87	0.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	0.	*	1		0715	88	0.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	0.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	0.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	0.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	0.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	0.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	0.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	1.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	1.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	2.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	3.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	4.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	5.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	5.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	5.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	4.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	5.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	6.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	10.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	13.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	15.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	16.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	17.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	19.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	20.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	20.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	22.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	29.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	52.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	111.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.

1	0340	45	202.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	202.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	202.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	202.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	202.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	202.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	202.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	202.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	202.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	177.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	152.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	141.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	142.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	150.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	156.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	159.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	160.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	155.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	142.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	124.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	104.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	86.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	69.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	56.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	46.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	37.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	31.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	26.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	23.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	21.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	18.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.50	67.	17.	16.	16.
		(INCHES) .376	.376	.376	.376
		(AC-FT) 33.	33.	33.	33.

CUMULATIVE AREA = 1.66 SQ MI

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590 KK

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* *
* CBN15-C *
* *
****

594 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

593 HC HYDROGRAPH COMBINATION

ICOMP	2	NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .99

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0615	76	26.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	6.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	0.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	1.	*	1		0655	84	3.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	1.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	2.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	3.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	3.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	3.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	3.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	3.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	3.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	4.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	5.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.

1	0135	20	7.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	10.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	15.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	19.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	24.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	26.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	27.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	27.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	25.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	25.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	27.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	32.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	37.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	43.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	47.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	49.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	51.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	52.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	54.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	57.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	68.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	93.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	150.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	392.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	873.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1317.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1619.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1753.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1751.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1631.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1428.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1196.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	978.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	787.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	626.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	499.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	410.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	358.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	339.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	341.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	349.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	354.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	350.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	330.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	293.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	242.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	188.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	138.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	105.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	83.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	68.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	56.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	47.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	40.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	34.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	30.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1753.	3.83	279.	70.	67.	67.
		(INCHES) 3.009	3.012	3.012	3.012
		(AC-FT) 139.	139.	139.	139.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .98

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	25.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	8.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	6.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	0.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	0.	*	1		0655	84	3.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	1.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	2.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	2.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	3.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	3.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	3.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0115	16	3.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	3.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	3.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	4.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	6.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	10.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	14.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	18.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	22.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	25.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	26.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	25.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	24.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	24.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	26.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	30.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	36.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	41.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	45.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	48.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	50.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	51.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	52.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	55.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	66.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	91.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	147.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	374.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	838.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	1278.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	1577.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	1713.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	1716.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	1600.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	1399.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	1170.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	956.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	769.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	610.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	486.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	398.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	348.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	328.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	330.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	338.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	344.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	340.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	321.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	284.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	235.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	183.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	132.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	102.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	82.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	67.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	55.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	46.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	39.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	34.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	29.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)				
		(CFS)			
1716.	3.92	272.	68.	66.	66.
		(INCHES) 2.931	2.933	2.933	2.933
		(AC-FT) 135.	135.	135.	135.

CUMULATIVE AREA = .86 SQ MI

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HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .95

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	25.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	21.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	14.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	3.	1		1310	159	0.	1		1925	234	0.
1		0045	10	1.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	1.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.

1	0055	12	2.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	2.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	2.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	3.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	4.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	6.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	8.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	12.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	16.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	20.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	23.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	24.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	23.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	22.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	22.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	24.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	28.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	34.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	38.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	42.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	45.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	47.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	48.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	49.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	52.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	62.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	85.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	135.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	330.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	783.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1213.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1513.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1653.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1660.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1540.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1339.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1119.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	915.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	735.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	585.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	466.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	382.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	330.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	309.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	311.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	320.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	326.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	323.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	304.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	270.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	223.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	173.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	126.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	98.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	79.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	65.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	53.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	45.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	38.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	33.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	28.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1660.	3.92	259.	65.	63.	63.
		(INCHES) 2.796	2.798	2.798	2.798
		(AC-FT) 129.	129.	129.	129.

CUMULATIVE AREA = .86 SQ MI

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HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .93

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1	0000	1	0.	*	1	0615	76	24.	*	1	1230	151	0.	*	1	1845	226	0.				
1	0005	2	0.	*	1	0620	77	20.	*	1	1235	152	0.	*	1	1850	227	0.				
1	0010	3	0.	*	1	0625	78	17.	*	1	1240	153	0.	*	1	1855	228	0.				
1	0015	4	0.	*	1	0630	79	13.	*	1	1245	154	0.	*	1	1900	229	0.				
1	0020	5	0.	*	1	0635	80	11.	*	1	1250	155	0.	*	1	1905	230	0.				
1	0025	6	0.	*	1	0640	81	8.	*	1	1255	156	0.	*	1	1910	231	0.				
1	0030	7	0.	*	1	0645	82	6.	*	1	1300	157	0.	*	1	1915	232	0.				

1	0035	8	0.	*	1	0650	83	4.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	3.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	1.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	1.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	2.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	2.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	2.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	3.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	5.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	7.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	11.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	15.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	18.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	21.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	22.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	21.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	21.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	20.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	22.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	26.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	31.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	36.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	39.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	42.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	44.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	45.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	46.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	49.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	59.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	81.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	125.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	282.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	727.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1151.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1440.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1576.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1582.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1473.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1287.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1077.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	880.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	707.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	560.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	445.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	364.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	314.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	293.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	294.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	302.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	308.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	306.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	290.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	256.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	212.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	165.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	123.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	95.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	77.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	63.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	52.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	43.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	37.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	32.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	28.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
	(CFS)				
+ 1582.	3.92	247.	62.	59.	59.
	(INCHES)	2.659	2.660	2.660	2.660
	(AC-FT)	122.	122.	122.	122.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .92

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	24.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	20.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.

1	0015	4	0.	*	1	0630	79	13.	*	1	1245	154	0.	*	1	1900	229	0.
1	0020	5	0.	*	1	0635	80	10.	*	1	1250	155	0.	*	1	1905	230	0.
1	0025	6	0.	*	1	0640	81	8.	*	1	1255	156	0.	*	1	1910	231	0.
1	0030	7	0.	*	1	0645	82	6.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	0.	*	1	0650	83	4.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	3.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	1.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	1.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	1.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	2.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	2.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	3.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	5.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	7.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	10.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	14.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	17.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	20.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	21.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	21.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	20.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	20.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	22.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	25.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	30.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	35.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	38.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	41.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	43.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	44.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	45.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	48.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	57.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	79.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	121.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	261.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	703.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1118.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1402.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1539.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1551.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1446.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1264.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1059.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	865.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	694.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	550.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	437.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	356.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	306.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	285.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	286.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	295.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	301.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	299.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	284.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	252.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	207.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	161.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	120.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	94.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	76.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	62.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	51.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	43.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	36.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	31.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	27.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1551.	3.92		241.	60.	58.	58.
		(INCHES)	2.599	2.600	2.600	2.600
		(AC-FT)	120.	120.	120.	120.

CUMULATIVE AREA = .86 SQ MI

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HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .91

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW

1	0000	1	0.	*	1	0615	76	23.	*	1	1230	151	0.	*	1	1845	226	0.
1	0005	2	0.	*	1	0620	77	20.	*	1	1235	152	0.	*	1	1850	227	0.
1	0010	3	0.	*	1	0625	78	16.	*	1	1240	153	0.	*	1	1855	228	0.
1	0015	4	0.	*	1	0630	79	13.	*	1	1245	154	0.	*	1	1900	229	0.
1	0020	5	0.	*	1	0635	80	10.	*	1	1250	155	0.	*	1	1905	230	0.
1	0025	6	0.	*	1	0640	81	8.	*	1	1255	156	0.	*	1	1910	231	0.
1	0030	7	0.	*	1	0645	82	6.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	0.	*	1	0650	83	4.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	3.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	1.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	1.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	1.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	1.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	2.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	3.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	4.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	7.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	10.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	13.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	17.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	19.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	20.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	20.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	19.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	19.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	21.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	25.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	30.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	34.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	38.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	40.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	42.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	43.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	44.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	47.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	56.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	78.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	120.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	268.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	690.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1103.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1390.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1529.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1541.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1436.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1252.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1047.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	855.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	686.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	543.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	430.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	349.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	299.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	278.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	280.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	290.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	296.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	294.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	278.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	246.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	204.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	159.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	120.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	93.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	75.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	62.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	51.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	42.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	36.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	31.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	27.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1541.	3.92	238.	60.	57.	57.
		(INCHES) 2.569	2.570	2.570	2.570
		(AC-FT) 118.	118.	118.	118.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .90

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	23.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	20.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	16.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	10.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	4.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	3.	1		1310	159	0.	1		1925	234	0.
1		0045	10	0.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	1.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	1.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	1.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	1.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	1.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	1.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	2.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	2.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	3.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	4.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	6.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	10.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	13.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	17.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	19.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	20.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	20.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	19.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	19.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	21.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	24.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	29.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	33.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	37.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	39.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	41.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	42.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	44.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	47.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	55.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	76.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	117.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	260.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	680.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	1087.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	1368.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	1503.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	1516.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	1416.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	1238.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	1037.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	847.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	680.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	538.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	426.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	347.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	298.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	277.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	278.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	286.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	292.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	290.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	275.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	244.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	201.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	156.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	117.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	93.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	75.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	61.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	50.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	42.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	36.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	31.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	27.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)					
		(CFS)				
1516.	3.92		235.	59.	57.	57.
		(INCHES)	2.535	2.537	2.537	2.537
		(AC-FT)	117.	117.	117.	117.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .57

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	14.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	12.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	10.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	8.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	7.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	5.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	4.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	0.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	0.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	0.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	0.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	0.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	0.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	0.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	0.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	0.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	0.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	0.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	0.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	0.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	0.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	0.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	0.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	0.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	1.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	1.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	1.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	2.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	3.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	4.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	5.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	6.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	7.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	9.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	10.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	11.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	12.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	15.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	22.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	35.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	60.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	106.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	226.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	435.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	557.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	589.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	550.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	483.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	406.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	332.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	263.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	202.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	153.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	121.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	106.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	100.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	100.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	101.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	102.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	102.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	99.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	93.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	85.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	75.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	64.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	54.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	45.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	37.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	30.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	25.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	21.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	18.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	16.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 589.	3.92		83.	21.	20.	20.
		(INCHES)	.893	.894	.894	.894
		(AC-FT)	41.	41.	41.	41.

CUMULATIVE AREA = .86 SQ MI

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PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .99	RATIO 2 .98	RATIO 3 .95	RATIO 4 .93	RATIO 5 .92	RATIO 6 .91	RATIO 7 .90	RATIO 8 .57
HYDROGRAPH AT												
+	CA03a	.09	1	FLOW	107.	104.	100.	96.	95.	94.	93.	43.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03c	.02	1	FLOW	25.	24.	23.	22.	22.	22.	22.	10.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03c	.12	1	FLOW	131.	128.	123.	119.	117.	115.	115.	53.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03b	.08	1	FLOW	86.	84.	81.	77.	76.	75.	75.	35.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03	.20	1	FLOW	217.	212.	204.	196.	193.	191.	189.	88.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO												
+	RCCA03	.20	1	FLOW	211.	205.	199.	191.	188.	185.	183.	86.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04b	.06	1	FLOW	71.	69.	66.	64.	63.	62.	62.	29.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT												
+	CCA04b	.26	1	FLOW	278.	272.	262.	251.	248.	245.	242.	112.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCCA04b	.26	1	FLOW	271.	270.	256.	248.	249.	243.	238.	113.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	CA04a	.04	1	FLOW	44.	43.	41.	40.	39.	38.	38.	18.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA04c	.03	1	FLOW	41.	40.	39.	38.	37.	37.	36.	18.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA04-1	.33	1	FLOW	345.	342.	326.	315.	315.	308.	303.	143.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04g	.05	1	FLOW	81.	79.	77.	74.	73.	73.	72.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO												
+	RCA04g	.05	1	FLOW	79.	77.	75.	71.	70.	69.	69.	38.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04d	.05	1	FLOW	72.	70.	68.	66.	65.	64.	64.	33.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA04d	.10	1	FLOW	140.	137.	133.	129.	127.	125.	123.	65.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCA04d	.10	1	FLOW	142.	139.	135.	129.	128.	126.	125.	64.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA04e	.19	1	FLOW	194.	190.	184.	177.	174.	172.	171.	85.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
2 COMBINED AT												
+	CCA04e	.29	1	FLOW	333.	326.	315.	304.	299.	296.	294.	148.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO												
+	RCCA04e	.29	1	FLOW	321.	319.	306.	294.	293.	293.	291.	147.
				TIME	3.92	3.83	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT												
+	CA04f	.05	1	FLOW	61.	60.	58.	56.	55.	55.	54.	29.

				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT													
+	CCA04f	.34	1	FLOW	363.	360.	344.	331.	329.	330.	328.	163.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CCA04	.67	1	FLOW	683.	675.	648.	623.	620.	617.	611.	292.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCCA04	.67	1	FLOW	669.	664.	637.	609.	607.	602.	601.	292.
				TIME	3.83	3.83	3.92	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT													
+	CA05a	.04	1	FLOW	47.	46.	44.	43.	42.	42.	41.	21.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	CA05b	.05	1	FLOW	66.	65.	62.	60.	60.	59.	59.	31.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT													
+	CCA05-1	.75	1	FLOW	751.	745.	714.	685.	682.	676.	674.	323.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
DIVERSION TO													
+	DSTEWQ	.75	1	FLOW	321.	315.	284.	255.	252.	246.	244.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
HYDROGRAPH AT													
+	DCCA05	.75	1	FLOW	430.	430.	430.	430.	430.	430.	430.	323.
				TIME	3.58	3.67	3.67	3.67	3.67	3.67	3.67	3.92
HYDROGRAPH AT													
+	CA05c	.02	1	FLOW	36.	35.	34.	33.	32.	32.	32.	17.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCA05c	.02	1	FLOW	34.	33.	32.	31.	30.	30.	30.	16.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05d	.04	1	FLOW	58.	57.	55.	53.	53.	52.	52.	27.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05e	.00	1	FLOW	5.	5.	5.	5.	4.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT													
+	CCA05e	.07	1	FLOW	97.	95.	92.	89.	87.	86.	86.	44.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05e	.07	1	FLOW	52.	51.	49.	47.	47.	46.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCCA05e	.07	1	FLOW	45.	44.	43.	41.	41.	40.	40.	21.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	CA05f	.01	1	FLOW	14.	14.	14.	13.	13.	13.	13.	7.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05f	.08	1	FLOW	52.	51.	49.	48.	47.	47.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCCA05f	.08	1	FLOW	50.	49.	48.	46.	45.	45.	44.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05h	.00	1	FLOW	5.	5.	5.	5.	5.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05i	.00	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05k	.01	1	FLOW	16.	16.	16.	15.	15.	15.	15.	8.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
4 COMBINED AT													

+	CCA05k	.09	1	FLOW	77.	75.	73.	70.	69.	69.	68.	36.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	CA05g	.01	1	FLOW	12.	11.	11.	11.	11.	10.	10.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05j	.00	1	FLOW	9.	9.	8.	8.	8.	8.	8.	4.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05p	.01	1	FLOW	8.	8.	8.	8.	8.	8.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA05p	.02	1	FLOW	28.	27.	26.	25.	25.	25.	25.	13.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	DRA05e	.00	1	FLOW	52.	51.	49.	47.	47.	46.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	DRA05f	.00	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA05-3	.02	1	FLOW	86.	84.	81.	79.	77.	77.	76.	40.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO												
+	DTA05-3	.02	1	FLOW	79.	77.	75.	72.	71.	71.	70.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	DTCCA053	.02	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05-2	.11	1	FLOW	84.	82.	79.	77.	75.	75.	74.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05-2a	.86	1	FLOW	514.	502.	500.	498.	497.	496.	496.	340.
				TIME	3.58	3.67	3.67	3.67	3.67	3.67	3.67	3.92
HYDROGRAPH AT												
+	CHAR	.04	1	FLOW	43.	43.	43.	43.	43.	43.	43.	43.
				TIME	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42
ROUTED TO												
+	RCHAR	.04	1	FLOW	44.	44.	44.	44.	44.	44.	44.	44.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CH70-C	.14	1	FLOW	165.	162.	156.	151.	149.	148.	147.	79.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCHAR	.17	1	FLOW	206.	203.	198.	192.	190.	189.	188.	121.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO												
+	RCCHAR	.17	1	FLOW	205.	202.	197.	192.	190.	188.	187.	120.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA05m	.00	1	FLOW	8.	8.	7.	7.	7.	7.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05n	.18	1	FLOW	210.	206.	201.	196.	194.	192.	191.	122.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO												
+	RCCA05m	.18	1	FLOW	208.	205.	199.	194.	192.	191.	190.	121.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCA05-4	1.04	1	FLOW	699.	695.	688.	681.	678.	676.	674.	450.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	CA05n	.00	1	FLOW	6.	6.	6.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05q	.01	1	FLOW	12.	11.	11.	10.	10.	10.	10.	4.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA05q	.02	1	FLOW	17.	17.	16.	16.	15.	15.	15.	6.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58

2 COMBINED AT													
+	CCA05	1.06	1	FLOW	715.	710.	702.	694.	692.	689.	687.	454.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.83
ROUTED TO													
+	RCCA05	1.06	1	FLOW	713.	708.	701.	693.	690.	688.	686.	449.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT													
+	CA06-C	.41	1	FLOW	255.	248.	237.	226.	222.	219.	217.	83.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT													
+	CH59-C	.21	1	FLOW	246.	242.	234.	227.	224.	222.	221.	124.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO													
+	DFLAM	.21	1	FLOW	102.	98.	90.	83.	80.	78.	77.	0.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	.00
HYDROGRAPH AT													
+	DCH58-C	.21	1	FLOW	144.	144.	144.	144.	144.	144.	144.	124.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.83
ROUTED TO													
+	RDCH58	.21	1	FLOW	149.	147.	147.	148.	148.	148.	148.	125.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT													
+	CH58-C	.13	1	FLOW	156.	153.	149.	144.	142.	141.	140.	77.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCH58-C	.34	1	FLOW	302.	299.	295.	292.	290.	289.	288.	194.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO													
+	DBN03	.34	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	DDCH59-C	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
DIVERSION TO													
+	DBN03a	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
HYDROGRAPH AT													
+	DDCH59	.34	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	.00	.00	.00	.00	.00	.00	.00	.00
HYDROGRAPH AT													
+	BN06-C	.34	1	FLOW	420.	411.	396.	382.	376.	371.	368.	179.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	BN03-C	.54	1	FLOW	496.	485.	466.	448.	440.	435.	431.	197.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	DBN03	.00	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
ROUTED TO													
+	RDBN03	.00	1	FLOW	139.	144.	148.	119.	121.	122.	123.	27.
				TIME	3.92	3.92	3.83	3.92	3.92	3.92	3.92	4.08
3 COMBINED AT													
+	CBN03	.88	1	FLOW	868.	862.	873.	817.	807.	798.	790.	353.
				TIME	3.67	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO													
+	RCBN03	.88	1	FLOW	861.	853.	852.	803.	794.	783.	778.	353.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT													
+	BN08	.21	1	FLOW	220.	216.	209.	202.	199.	197.	196.	103.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CBN08	1.09	1	FLOW	1082.	1069.	1061.	1005.	994.	980.	974.	453.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO													
+	RCBN08	1.09	1	FLOW	1080.	1065.	1050.	998.	987.	974.	966.	445.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT													
+	BN09	.23	1	FLOW	167.	163.	156.	149.	146.	144.	143.	59.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CBN09	1.32	1	FLOW	1247.	1228.	1206.	1147.	1133.	1118.	1109.	499.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83

DIVERSION TO												
+	DBN09a	1.32	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	DBN09	1.32	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCBN09	1.66	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCA06-1	2.07	1	FLOW	457.	450.	439.	428.	424.	421.	419.	285.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
2 COMBINED AT												
+	CCA06	3.13	1	FLOW	1138.	1128.	1110.	1092.	1085.	1080.	1077.	733.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA06	3.13	1	FLOW	1136.	1126.	1108.	1090.	1083.	1078.	1075.	731.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA08	.07	1	FLOW	71.	69.	66.	63.	62.	61.	61.	26.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT												
+	CA08a	.05	1	FLOW	58.	56.	54.	52.	52.	51.	51.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT												
+	CCA08	3.25	1	FLOW	1238.	1224.	1203.	1181.	1173.	1167.	1163.	764.
				TIME	3.75	3.75	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA08	3.25	1	FLOW	1237.	1224.	1203.	1181.	1172.	1166.	1162.	760.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA09	.05	1	FLOW	58.	57.	55.	53.	52.	52.	51.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA09	3.30	1	FLOW	1280.	1267.	1243.	1220.	1210.	1204.	1200.	775.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA09	3.30	1	FLOW	1279.	1265.	1242.	1218.	1207.	1201.	1198.	770.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA10	.03	1	FLOW	44.	43.	42.	41.	40.	40.	39.	22.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA10	3.33	1	FLOW	1310.	1296.	1272.	1247.	1236.	1229.	1226.	782.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA10	3.33	1	FLOW	1304.	1289.	1265.	1239.	1226.	1218.	1214.	775.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA11	.09	1	FLOW	103.	101.	97.	94.	92.	91.	91.	46.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCA11	3.42	1	FLOW	1397.	1380.	1353.	1324.	1310.	1301.	1297.	806.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA11	3.42	1	FLOW	1389.	1371.	1344.	1313.	1298.	1288.	1284.	804.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA12	.06	1	FLOW	86.	85.	82.	80.	79.	78.	77.	43.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA12	3.49	1	FLOW	1456.	1437.	1407.	1375.	1359.	1349.	1344.	825.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
ROUTED TO												
+	RCCA12	3.49	1	FLOW	1445.	1426.	1396.	1362.	1343.	1334.	1330.	824.
				TIME	3.83	3.83	3.83	3.83	3.83	3.92	3.92	4.00
HYDROGRAPH AT												
+	CA13a	.06	1	FLOW	95.	93.	91.	88.	87.	86.	86.	50.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA13a	3.55	1	FLOW	1518.	1498.	1466.	1430.	1410.	1401.	1395.	848.

				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT													
+	BN10-C	.26	1	FLOW	232.	227.	219.	211.	208.	205.	204.	97.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT													
+	DBN09a	.00	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CBN10-C	.26	1	FLOW	1278.	1254.	1223.	1156.	1139.	1122.	1111.	394.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCBN10-C	.26	1	FLOW	1267.	1241.	1200.	1141.	1116.	1105.	1089.	392.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT													
+	BN12-C	.32	1	FLOW	278.	272.	262.	251.	247.	244.	242.	111.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CBN12-C	.58	1	FLOW	1545.	1513.	1462.	1392.	1363.	1349.	1331.	503.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCBN12-C	.58	1	FLOW	1521.	1491.	1444.	1374.	1346.	1339.	1316.	498.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT													
+	BN15-C	.28	1	FLOW	234.	229.	220.	211.	208.	205.	203.	92.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CBN15-C	.86	1	FLOW	1753.	1716.	1660.	1582.	1551.	1541.	1516.	589.
				TIME	3.83	3.92	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO													
+	RCBN15-C	.86	1	FLOW	1750.	1715.	1658.	1580.	1549.	1538.	1513.	582.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
2 COMBINED AT													
+	CCA13	4.41	1	FLOW	3252.	3193.	3099.	2989.	2944.	2924.	2895.	1421.
				TIME	3.83	3.83	3.83	3.92	3.92	3.92	3.92	3.92
ROUTED TO													
+	RCCA13	4.41	1	FLOW	3240.	3182.	3092.	2985.	2934.	2917.	2885.	1408.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT													
+	CA14	.05	1	FLOW	85.	83.	81.	79.	78.	77.	77.	47.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CCA14	4.47	1	FLOW	3288.	3229.	3138.	3030.	2977.	2961.	2928.	1429.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT													
+	DRDTA05	.00	1	FLOW	79.	77.	75.	72.	71.	71.	70.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DRDSTEW	.00	1	FLOW	321.	315.	284.	255.	252.	246.	244.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
2 COMBINED AT													
+	CSTEWBY	.00	1	FLOW	364.	357.	325.	294.	290.	285.	283.	37.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.58

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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	INTERPOLATED TO COMPUTATION INTERVAL DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .00									
RCCA03	MANE	3.01	214.35	222.58	1.58	5.00	210.67	225.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1651E+02 EXCESS= .0000E+00 OUTFLOW= .1651E+02 BASIN STORAGE= .6123E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00									
RCCA03	MANE	3.02	207.43	223.82	1.54	5.00	205.18	225.00	1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1614E+02 EXCESS= .0000E+00 OUTFLOW= .1614E+02 BASIN STORAGE= .6428E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00									
RCCA03	MANE	3.05	202.14	222.91	1.48	5.00	198.71	225.00	1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1551E+02 EXCESS= .0000E+00 OUTFLOW= .1551E+02 BASIN STORAGE= .5685E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	3.08	193.56	222.04	1.42	5.00	190.55	225.00	1.42

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1489E+02 EXCESS= .0000E+00 OUTFLOW= .1489E+02 BASIN STORAGE= .6849E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	3.10	191.29	222.94	1.40	5.00	188.06	225.00	1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1464E+02 EXCESS= .0000E+00 OUTFLOW= .1464E+02 BASIN STORAGE= .7695E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	3.11	187.84	223.58	1.38	5.00	185.46	225.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1446E+02 EXCESS= .0000E+00 OUTFLOW= .1447E+02 BASIN STORAGE= .6824E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	3.11	185.03	224.05	1.37	5.00	183.37	225.00	1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1434E+02 EXCESS= .0000E+00 OUTFLOW= .1434E+02 BASIN STORAGE= .6084E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	3.77	86.22	222.19	.63	5.00	86.13	225.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6604E+01 EXCESS= .0000E+00 OUTFLOW= .6605E+01 BASIN STORAGE= .5828E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.65	272.99	227.61	1.58	5.00	271.38	225.00	1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2158E+02 EXCESS= .0000E+00 OUTFLOW= .2158E+02 BASIN STORAGE= .1072E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.67	271.88	224.20	1.55	5.00	270.39	225.00	1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2116E+02 EXCESS= .0000E+00 OUTFLOW= .2117E+02 BASIN STORAGE= .1322E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.71	260.73	226.28	1.49	5.00	256.48	225.00	1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2030E+02 EXCESS= .0000E+00 OUTFLOW= .2031E+02 BASIN STORAGE= .1397E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.77	249.01	224.07	1.43	5.00	248.18	225.00	1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1951E+02 EXCESS= .0000E+00 OUTFLOW= .1951E+02 BASIN STORAGE= .1361E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.78	249.56	224.75	1.41	5.00	249.10	225.00	1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1922E+02 EXCESS= .0000E+00 OUTFLOW= .1923E+02 BASIN STORAGE= .1142E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.80	245.35	225.49	1.39	5.00	243.07	225.00	1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1896E+02 EXCESS= .0000E+00 OUTFLOW= .1897E+02 BASIN STORAGE= .1033E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.81	241.94	226.01	1.38	5.00	238.21	225.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1878E+02 EXCESS= .0000E+00 OUTFLOW= .1879E+02 BASIN STORAGE= .9380E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	5.00	112.72	230.00	.63	5.00	112.72	230.00	.63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8665E+01 EXCESS= .0000E+00 OUTFLOW= .8669E+01 BASIN STORAGE= .1337E-02 PERCENT ERROR= -.1

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          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         3.75     78.66    225.00      1.95      5.00     78.66    225.00        1.95


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5415E+01 EXCESS= .0000E+00 OUTFLOW= .5422E+01 BASIN STORAGE= .1736E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         3.75     77.21    225.00      1.92      5.00     77.21    225.00        1.91


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5307E+01 EXCESS= .0000E+00 OUTFLOW= .5313E+01 BASIN STORAGE= .1720E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         3.75     74.80    225.00      1.85      5.00     74.80    225.00        1.85


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5127E+01 EXCESS= .0000E+00 OUTFLOW= .5133E+01 BASIN STORAGE= .1693E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         4.00     71.83    224.00      1.79      5.00     71.07    225.00        1.79


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4948E+01 EXCESS= .0000E+00 OUTFLOW= .4955E+01 BASIN STORAGE= .1801E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         4.00     70.84    224.00      1.76      5.00     70.11    225.00        1.76


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4876E+01 EXCESS= .0000E+00 OUTFLOW= .4884E+01 BASIN STORAGE= .1789E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         4.00     70.15    224.00      1.74      5.00     69.44    225.00        1.74


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4826E+01 EXCESS= .0000E+00 OUTFLOW= .4833E+01 BASIN STORAGE= .1780E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         4.25     69.31    225.25      1.73      5.00     69.11    225.00        1.73


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4787E+01 EXCESS= .0000E+00 OUTFLOW= .4794E+01 BASIN STORAGE= .1838E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         5.00     37.92    225.00       .90      5.00     37.92    225.00         .90


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2480E+01 EXCESS= .0000E+00 OUTFLOW= .2485E+01 BASIN STORAGE= .1892E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    142.13    230.00      1.90      5.00    142.13    230.00        1.90


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1054E+02 EXCESS= .0000E+00 OUTFLOW= .1055E+02 BASIN STORAGE= .1760E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    139.29    230.00      1.86      5.00    139.29    230.00        1.86


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1033E+02 EXCESS= .0000E+00 OUTFLOW= .1034E+02 BASIN STORAGE= .1881E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    134.72    230.00      1.80      5.00    134.72    230.00        1.80


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9974E+01 EXCESS= .0000E+00 OUTFLOW= .9979E+01 BASIN STORAGE= .1818E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    129.42    230.00      1.74      5.00    129.42    230.00        1.74


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9625E+01 EXCESS= .0000E+00 OUTFLOW= .9631E+01 BASIN STORAGE= .2290E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    127.58    230.00      1.71      5.00    127.58    230.00        1.71


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9483E+01 EXCESS= .0000E+00 OUTFLOW= .9489E+01 BASIN STORAGE= .2277E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    126.30    230.00      1.69      5.00    126.30    230.00        1.69
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .9384E+01 EXCESS= .0000E+00 OUTFLOW= .9389E+01 BASIN STORAGE= .2269E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	125.09	230.00	1.68	5.00	125.09	230.00	1.68	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9314E+01 EXCESS= .0000E+00 OUTFLOW= .9320E+01 BASIN STORAGE= .1672E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	64.16	235.00	.86	5.00	64.16	235.00	.86	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4751E+01 EXCESS= .0000E+00 OUTFLOW= .4753E+01 BASIN STORAGE= .1709E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.85	329.94	232.90	1.80	5.00	321.01	235.00	1.80	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2826E+02 EXCESS= .0000E+00 OUTFLOW= .2826E+02 BASIN STORAGE= .1149E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.88	323.06	234.09	1.76	5.00	318.94	230.00	1.76	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2767E+02 EXCESS= .0000E+00 OUTFLOW= .2767E+02 BASIN STORAGE= .1292E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.92	312.30	231.19	1.70	5.00	306.32	235.00	1.70	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2669E+02 EXCESS= .0000E+00 OUTFLOW= .2669E+02 BASIN STORAGE= .1408E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.97	300.87	233.39	1.64	5.00	294.28	235.00	1.64	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2571E+02 EXCESS= .0000E+00 OUTFLOW= .2571E+02 BASIN STORAGE= .1230E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.98	296.45	234.25	1.61	5.00	292.72	235.00	1.61	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2531E+02 EXCESS= .0000E+00 OUTFLOW= .2532E+02 BASIN STORAGE= .1061E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	5.00	293.42	234.86	1.60	5.00	292.62	235.00	1.60	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2504E+02 EXCESS= .0000E+00 OUTFLOW= .2504E+02 BASIN STORAGE= .1471E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	5.00	290.93	235.00	1.58	5.00	290.93	235.00	1.58	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2485E+02 EXCESS= .0000E+00 OUTFLOW= .2485E+02 BASIN STORAGE= .1559E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	5.00	147.28	235.00	.79	5.00	147.28	235.00	.79	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1231E+02 EXCESS= .0000E+00 OUTFLOW= .1231E+02 BASIN STORAGE= .1434E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04	MANE	4.56	680.74	232.35	1.70	5.00	669.09	230.00	1.70	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6054E+02 EXCESS= .0000E+00 OUTFLOW= .6055E+02 BASIN STORAGE= .1200E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04	MANE	4.57	672.26	233.08	1.67	5.00	664.12	230.00	1.67	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5942E+02 EXCESS= .0000E+00 OUTFLOW= .5942E+02 BASIN STORAGE= .1419E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04	MANE	4.62	644.44	230.78	1.61	5.00	636.64	235.00	1.61	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5725E+02 EXCESS= .0000E+00 OUTFLOW= .5726E+02 BASIN STORAGE= .1407E-02 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.66    620.28    233.07      1.55      5.00    609.06    230.00        1.54


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5497E+02 EXCESS= .0000E+00 OUTFLOW= .5498E+02 BASIN STORAGE= .1216E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.67    617.58    233.35      1.53      5.00    607.02    230.00        1.52


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5422E+02 EXCESS= .0000E+00 OUTFLOW= .5423E+02 BASIN STORAGE= .1179E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.67    613.46    233.67      1.51      5.00    602.44    230.00        1.51


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5363E+02 EXCESS= .0000E+00 OUTFLOW= .5364E+02 BASIN STORAGE= .1629E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.69    607.93    234.27      1.50      5.00    601.06    230.00        1.50


CONTINUITY SUMMARY (AC-FT) - INFLOW= .5324E+02 EXCESS= .0000E+00 OUTFLOW= .5325E+02 BASIN STORAGE= .1584E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         5.00    291.91    235.00       .72      5.00    291.91    235.00         .72


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2563E+02 EXCESS= .0000E+00 OUTFLOW= .2563E+02 BASIN STORAGE= .1176E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.30     35.05    217.61      1.91      5.00     33.79    215.00        1.91


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2343E+01 EXCESS= .0000E+00 OUTFLOW= .2343E+01 BASIN STORAGE= .5146E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.31     34.06    218.65      1.87      5.00     33.22    215.00        1.87


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2295E+01 EXCESS= .0000E+00 OUTFLOW= .2296E+01 BASIN STORAGE= .4096E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.34     33.22    217.11      1.81      5.00     31.97    215.00        1.81


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2216E+01 EXCESS= .0000E+00 OUTFLOW= .2217E+01 BASIN STORAGE= .4067E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.37     31.63    218.95      1.74      5.00     30.91    215.00        1.74


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2137E+01 EXCESS= .0000E+00 OUTFLOW= .2138E+01 BASIN STORAGE= .4000E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.38     31.40    216.33      1.72      5.00     30.40    215.00        1.72


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2106E+01 EXCESS= .0000E+00 OUTFLOW= .2106E+01 BASIN STORAGE= .4997E-03 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.39     31.33    216.86      1.70      5.00     30.15    215.00        1.70


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2084E+01 EXCESS= .0000E+00 OUTFLOW= .2085E+01 BASIN STORAGE= .4402E-03 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.39     31.15    217.24      1.69      5.00     29.90    215.00        1.69


CONTINUITY SUMMARY (AC-FT) - INFLOW= .2068E+01 EXCESS= .0000E+00 OUTFLOW= .2068E+01 BASIN STORAGE= .4073E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.98     16.64    218.67       .86      5.00     16.08    220.00         .86


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1057E+01 EXCESS= .0000E+00 OUTFLOW= .1058E+01 BASIN STORAGE= .4453E-03 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCCA05f  MANE        1.30     51.68    216.64       .89      5.00     50.21    215.00         .89
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .3690E+01 EXCESS= .0000E+00 OUTFLOW= .3690E+01 BASIN STORAGE= .1110E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.30     50.65    216.15       .87      5.00     49.31    215.00         .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3615E+01 EXCESS= .0000E+00 OUTFLOW= .3615E+01 BASIN STORAGE= .1242E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.31     49.07    216.35       .84      5.00     47.67    215.00         .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3490E+01 EXCESS= .0000E+00 OUTFLOW= .3489E+01 BASIN STORAGE= .1192E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.32     47.38    216.53       .81      5.00     45.95    215.00         .81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3365E+01 EXCESS= .0000E+00 OUTFLOW= .3364E+01 BASIN STORAGE= .1150E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.32     46.55    217.17       .80      5.00     45.21    215.00         .80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3314E+01 EXCESS= .0000E+00 OUTFLOW= .3314E+01 BASIN STORAGE= .1155E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.33     46.22    216.26       .79      5.00     44.89    215.00         .79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3280E+01 EXCESS= .0000E+00 OUTFLOW= .3279E+01 BASIN STORAGE= .1212E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.33     45.88    216.59       .78      5.00     44.49    215.00         .78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3255E+01 EXCESS= .0000E+00 OUTFLOW= .3254E+01 BASIN STORAGE= .1135E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05f  MANE         1.51     23.98    218.02       .40      5.00     23.38    220.00         .40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1655E+01 EXCESS= .0000E+00 OUTFLOW= .1655E+01 BASIN STORAGE= .1214E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
              RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
              RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
              RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
              RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
              RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
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            RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
            RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.24    206.04    222.63      1.94      5.00    205.02    225.00        1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1792E+02 EXCESS= .0000E+00 OUTFLOW= .1792E+02 BASIN STORAGE= .1417E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.25    202.76    222.05      1.91      5.00    201.75    225.00        1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1764E+02 EXCESS= .0000E+00 OUTFLOW= .1764E+02 BASIN STORAGE= .1373E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.25    197.56    221.93      1.85      5.00    196.63    225.00        1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1716E+02 EXCESS= .0000E+00 OUTFLOW= .1716E+02 BASIN STORAGE= .1376E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.26    192.38    221.84      1.80      5.00    191.53    225.00        1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1668E+02 EXCESS= .0000E+00 OUTFLOW= .1668E+02 BASIN STORAGE= .1374E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.26    190.71    222.31      1.78      5.00    189.68    225.00        1.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1650E+02 EXCESS= .0000E+00 OUTFLOW= .1649E+02 BASIN STORAGE= .1420E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.27    189.33    222.64      1.77      5.00    188.27    225.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1636E+02 EXCESS= .0000E+00 OUTFLOW= .1636E+02 BASIN STORAGE= .1493E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.27    188.06    222.88      1.76      5.00    187.09    225.00        1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1627E+02 EXCESS= .0000E+00 OUTFLOW= .1626E+02 BASIN STORAGE= .1421E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.38    120.75    222.82      1.09      5.00    119.54    225.00        1.10

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1013E+02 EXCESS= .0000E+00 OUTFLOW= .1013E+02 BASIN STORAGE= .1455E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE       1.85    208.12    223.86      1.94      5.00    208.06    225.00        1.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1843E+02 EXCESS= .0000E+00 OUTFLOW= .1843E+02 BASIN STORAGE= .2390E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE       1.86    204.90    224.59      1.90      5.00    204.88    225.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1813E+02 EXCESS= .0000E+00 OUTFLOW= .1813E+02 BASIN STORAGE= .2450E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE       1.87    199.56    223.89      1.85      5.00    199.48    225.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1764E+02 EXCESS= .0000E+00 OUTFLOW= .1764E+02 BASIN STORAGE= .2295E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE       1.88    194.50    225.07      1.80      5.00    194.46    225.00        1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1715E+02 EXCESS= .0000E+00 OUTFLOW= .1714E+02 BASIN STORAGE= .2114E-03 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         1.88    192.34    225.51      1.78      5.00    192.32    225.00        1.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1695E+02 EXCESS= .0000E+00 OUTFLOW= .1695E+02 BASIN STORAGE= .2350E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         1.88    191.09    223.97      1.77      5.00    190.98    225.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1681E+02 EXCESS= .0000E+00 OUTFLOW= .1681E+02 BASIN STORAGE= .2181E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         1.88    189.90    224.25      1.76      5.00    189.84    225.00        1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1671E+02 EXCESS= .0000E+00 OUTFLOW= .1671E+02 BASIN STORAGE= .2037E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         2.06    121.16    224.80      1.09      5.00    121.13    225.00        1.09

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1036E+02 EXCESS= .0000E+00 OUTFLOW= .1036E+02 BASIN STORAGE= .2306E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.02    715.09    221.59      1.50      5.00    712.99    225.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8460E+02 EXCESS= .0000E+00 OUTFLOW= .8460E+02 BASIN STORAGE= .1676E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.02    710.11    221.19      1.47      5.00    708.28    225.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8336E+02 EXCESS= .0000E+00 OUTFLOW= .8336E+02 BASIN STORAGE= .1604E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.03    702.40    222.18      1.44      5.00    700.60    225.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8144E+02 EXCESS= .0000E+00 OUTFLOW= .8143E+02 BASIN STORAGE= .1607E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.03    694.94    222.16      1.40      5.00    693.03    225.00        1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7905E+02 EXCESS= .0000E+00 OUTFLOW= .7905E+02 BASIN STORAGE= .1561E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.04    691.66    221.49      1.38      5.00    690.05    225.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7814E+02 EXCESS= .0000E+00 OUTFLOW= .7814E+02 BASIN STORAGE= .1619E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.04    689.83    221.79      1.37      5.00    688.14    225.00        1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7753E+02 EXCESS= .0000E+00 OUTFLOW= .7753E+02 BASIN STORAGE= .1721E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.04    688.28    222.04      1.36      5.00    686.36    225.00        1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7718E+02 EXCESS= .0000E+00 OUTFLOW= .7718E+02 BASIN STORAGE= .1667E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.22    453.22    231.50       .76      5.00    448.54    235.00         .76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4295E+02 EXCESS= .0000E+00 OUTFLOW= .4295E+02 BASIN STORAGE= .1599E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RDCH58  MANE         5.00    148.50    220.00      1.85      5.00    148.50    220.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2104E+02 EXCESS= .0000E+00 OUTFLOW= .2104E+02 BASIN STORAGE= .7182E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RDCH58  MANE         5.00    147.32    220.00      1.83      5.00    147.32    220.00        1.83
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .2077E+02 EXCESS= .0000E+00 OUTFLOW= .2076E+02 BASIN STORAGE= .7096E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	146.84	225.00	1.79	5.00	146.84	225.00	1.79	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2031E+02 EXCESS= .0000E+00 OUTFLOW= .2030E+02 BASIN STORAGE= .6953E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	147.70	225.00	1.75	5.00	147.70	225.00	1.75	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1985E+02 EXCESS= .0000E+00 OUTFLOW= .1985E+02 BASIN STORAGE= .6809E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.04	225.00	1.73	5.00	148.04	225.00	1.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1967E+02 EXCESS= .0000E+00 OUTFLOW= .1966E+02 BASIN STORAGE= .6751E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.28	225.00	1.72	5.00	148.28	225.00	1.72	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1954E+02 EXCESS= .0000E+00 OUTFLOW= .1954E+02 BASIN STORAGE= .6710E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.46	225.00	1.71	5.00	148.46	225.00	1.71	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1945E+02 EXCESS= .0000E+00 OUTFLOW= .1944E+02 BASIN STORAGE= .6681E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	125.19	235.00	1.04	5.00	125.19	235.00	1.04	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1180E+02 EXCESS= .0000E+00 OUTFLOW= .1179E+02 BASIN STORAGE= .9285E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	1.00	157.21	232.00	-1.00	5.00	138.67	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	1.00	158.34	232.00	-1.00	5.00	144.32	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	1.00	151.40	233.00	-1.00	5.00	147.96	230.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	136.60	231.75	-1.00	5.00	119.31	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	135.85	232.50	-1.00	5.00	121.02	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	138.90	232.50	-1.00	5.00	122.17	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	139.64	232.50	-1.00	5.00	122.80	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.50	37.75	245.50	-1.00	5.00	27.17	245.00	-1.00	

FOR PLAN = 1 RATIO= .00

RCBN03	MANE	1.68	866.89	221.60	1.70	5.00	861.29	230.00	1.71	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7993E+02 EXCESS= .0000E+00 OUTFLOW= .7993E+02 BASIN STORAGE= .3011E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

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  RCBN03  MANE         1.68    855.96    230.61      1.67      5.00    852.94    230.00        1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7828E+02 EXCESS= .0000E+00 OUTFLOW= .7828E+02 BASIN STORAGE= .3203E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.68    860.43    231.19      1.61      5.00    851.77    230.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7536E+02 EXCESS= .0000E+00 OUTFLOW= .7536E+02 BASIN STORAGE= .3272E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.72    807.10    230.52      1.54      5.00    802.66    230.00        1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7227E+02 EXCESS= .0000E+00 OUTFLOW= .7227E+02 BASIN STORAGE= .3142E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.73    798.71    231.57      1.52      5.00    794.48    230.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7110E+02 EXCESS= .0000E+00 OUTFLOW= .7110E+02 BASIN STORAGE= .2925E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.74    788.84    230.91      1.50      5.00    782.60    230.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7026E+02 EXCESS= .0000E+00 OUTFLOW= .7027E+02 BASIN STORAGE= .2809E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.74    779.81    231.88      1.49      5.00    778.15    230.00        1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6966E+02 EXCESS= .0000E+00 OUTFLOW= .6967E+02 BASIN STORAGE= .3284E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         2.41    354.20    223.74       .65      5.00    352.78    225.00         .65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3055E+02 EXCESS= .0000E+00 OUTFLOW= .3055E+02 BASIN STORAGE= .2984E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.27   1080.00    230.00      1.74      5.00   1080.00    230.00        1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1012E+03 EXCESS= .0000E+00 OUTFLOW= .1012E+03 BASIN STORAGE= .2419E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.28   1065.17    231.08      1.71      5.00   1065.09    230.00        1.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9916E+02 EXCESS= .0000E+00 OUTFLOW= .9916E+02 BASIN STORAGE= .2506E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.28   1053.18    230.51      1.64      5.00   1049.79    230.00        1.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9551E+02 EXCESS= .0000E+00 OUTFLOW= .9551E+02 BASIN STORAGE= .2383E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.31    999.17    230.35      1.58      5.00    997.57    230.00        1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9170E+02 EXCESS= .0000E+00 OUTFLOW= .9170E+02 BASIN STORAGE= .2431E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.31    988.12    231.36      1.55      5.00    986.80    230.00        1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9023E+02 EXCESS= .0000E+00 OUTFLOW= .9023E+02 BASIN STORAGE= .2643E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.32    975.16    231.35      1.54      5.00    973.87    230.00        1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8921E+02 EXCESS= .0000E+00 OUTFLOW= .8921E+02 BASIN STORAGE= .2656E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.33    968.29    230.58      1.52      5.00    965.76    230.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8845E+02 EXCESS= .0000E+00 OUTFLOW= .8845E+02 BASIN STORAGE= .2644E-02 PERCENT ERROR=    .0
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FOR PLAN = 1 RATIO= .00

RCBN08	MANE	1.80	452.05	226.71	.69	5.00	444.73	225.00	.69	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4009E+02 EXCESS= .0000E+00 OUTFLOW= .4009E+02 BASIN STORAGE= .2375E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.91	1136.56	229.62	.97	5.00	1136.37	230.00	.97	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1619E+03 EXCESS= .0000E+00 OUTFLOW= .1619E+03 BASIN STORAGE= .1334E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.92	1125.80	230.32	.96	5.00	1125.53	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1595E+03 EXCESS= .0000E+00 OUTFLOW= .1595E+03 BASIN STORAGE= .1491E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.93	1107.85	229.55	.93	5.00	1107.68	230.00	.93	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1556E+03 EXCESS= .0000E+00 OUTFLOW= .1556E+03 BASIN STORAGE= .1425E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.94	1090.07	230.72	.91	5.00	1089.80	230.00	.91	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1512E+03 EXCESS= .0000E+00 OUTFLOW= .1512E+03 BASIN STORAGE= .1441E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.94	1082.98	229.23	.90	5.00	1082.94	230.00	.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1495E+03 EXCESS= .0000E+00 OUTFLOW= .1495E+03 BASIN STORAGE= .1309E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.95	1078.51	229.55	.89	5.00	1078.34	230.00	.89	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1483E+03 EXCESS= .0000E+00 OUTFLOW= .1483E+03 BASIN STORAGE= .1382E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.95	1075.02	229.80	.88	5.00	1074.91	230.00	.88	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1475E+03 EXCESS= .0000E+00 OUTFLOW= .1475E+03 BASIN STORAGE= .1467E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	2.20	730.90	235.18	.51	5.00	730.63	235.00	.51	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8518E+02 EXCESS= .0000E+00 OUTFLOW= .8518E+02 BASIN STORAGE= .1374E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.27	1237.49	229.25	.99	5.00	1236.60	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1716E+03 EXCESS= .0000E+00 OUTFLOW= .1716E+03 BASIN STORAGE= .9055E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.27	1224.24	228.77	.97	5.00	1224.22	230.00	.97	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1690E+03 EXCESS= .0000E+00 OUTFLOW= .1690E+03 BASIN STORAGE= .9352E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.28	1202.53	230.06	.95	5.00	1202.52	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1647E+03 EXCESS= .0000E+00 OUTFLOW= .1647E+03 BASIN STORAGE= .9408E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1180.82	230.08	.92	5.00	1180.80	230.00	.92	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1600E+03 EXCESS= .0000E+00 OUTFLOW= .1600E+03 BASIN STORAGE= .9223E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1171.92	229.31	.91	5.00	1171.53	230.00	.91	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1581E+03 EXCESS= .0000E+00 OUTFLOW= .1581E+03 BASIN STORAGE= .9560E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1166.29	229.65	.90	5.00	1165.88	230.00	.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1568E+03 EXCESS= .0000E+00 OUTFLOW= .1568E+03 BASIN STORAGE= .9627E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1162.30	229.91	.90	5.00	1162.15	230.00	.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1560E+03 EXCESS= .0000E+00 OUTFLOW= .1560E+03 BASIN STORAGE= .8355E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.47	761.29	235.90	.51	5.00	760.08	235.00	.51	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8898E+02 EXCESS= .0000E+00 OUTFLOW= .8897E+02 BASIN STORAGE= .8349E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.23	1278.90	230.13	1.00	5.00	1278.88	230.00	1.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1761E+03 EXCESS= .0000E+00 OUTFLOW= .1761E+03 BASIN STORAGE= .8990E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.23	1265.57	229.67	.99	5.00	1264.88	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1734E+03 EXCESS= .0000E+00 OUTFLOW= .1734E+03 BASIN STORAGE= .9791E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.24	1242.30	229.80	.96	5.00	1241.85	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1689E+03 EXCESS= .0000E+00 OUTFLOW= .1689E+03 BASIN STORAGE= .9337E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.25	1218.50	229.94	.93	5.00	1218.38	230.00	.93	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1640E+03 EXCESS= .0000E+00 OUTFLOW= .1640E+03 BASIN STORAGE= .9065E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.25	1207.29	230.55	.92	5.00	1207.01	230.00	.92	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1620E+03 EXCESS= .0000E+00 OUTFLOW= .1620E+03 BASIN STORAGE= .9105E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.25	1201.17	229.66	.91	5.00	1200.98	230.00	.91	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1607E+03 EXCESS= .0000E+00 OUTFLOW= .1607E+03 BASIN STORAGE= .1035E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.26	1197.78	229.91	.91	5.00	1197.65	230.00	.91	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1598E+03 EXCESS= .0000E+00 OUTFLOW= .1598E+03 BASIN STORAGE= .9290E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.45	771.56	235.81	.52	5.00	769.67	235.00	.52	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9085E+02 EXCESS= .0000E+00 OUTFLOW= .9084E+02 BASIN STORAGE= .9672E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.26	1305.66	230.49	1.01	5.00	1304.41	230.00	1.01	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1795E+03 EXCESS= .0000E+00 OUTFLOW= .1795E+03 BASIN STORAGE= .1764E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.27	1290.07	231.32	.99	5.00	1288.74	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1767E+03 EXCESS= .0000E+00 OUTFLOW= .1767E+03 BASIN STORAGE= .1821E-02 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.28   1266.39    230.44       .97      5.00   1264.97    230.00         .97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1721E+03 EXCESS= .0000E+00 OUTFLOW= .1721E+03 BASIN STORAGE= .1756E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.30   1240.95    231.89       .94      5.00   1238.80    230.00         .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1672E+03 EXCESS= .0000E+00 OUTFLOW= .1671E+03 BASIN STORAGE= .1801E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.30   1228.05    232.59       .93      5.00   1225.74    230.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1651E+03 EXCESS= .0000E+00 OUTFLOW= .1651E+03 BASIN STORAGE= .1994E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.31   1221.15    230.67       .92      5.00   1217.93    230.00         .92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1637E+03 EXCESS= .0000E+00 OUTFLOW= .1637E+03 BASIN STORAGE= .1671E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.31   1218.02    230.89       .92      5.00   1214.32    230.00         .92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1629E+03 EXCESS= .0000E+00 OUTFLOW= .1629E+03 BASIN STORAGE= .1772E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.67    778.33    237.60       .52      5.00    775.05    240.00         .52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9245E+02 EXCESS= .0000E+00 OUTFLOW= .9244E+02 BASIN STORAGE= .2054E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.37   1392.72    230.89      1.03      5.00   1388.81    230.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1882E+03 EXCESS= .0000E+00 OUTFLOW= .1882E+03 BASIN STORAGE= .1017E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.37   1374.30    231.81      1.01      5.00   1371.46    230.00        1.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1852E+03 EXCESS= .0000E+00 OUTFLOW= .1852E+03 BASIN STORAGE= .9707E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.38   1347.56    231.87       .99      5.00   1343.55    230.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1803E+03 EXCESS= .0000E+00 OUTFLOW= .1803E+03 BASIN STORAGE= .9948E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.39   1317.81    232.08       .96      5.00   1312.99    230.00         .96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1750E+03 EXCESS= .0000E+00 OUTFLOW= .1750E+03 BASIN STORAGE= .9244E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.39   1306.44    231.48       .95      5.00   1298.14    230.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1728E+03 EXCESS= .0000E+00 OUTFLOW= .1728E+03 BASIN STORAGE= .1077E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.40   1296.28    231.97       .94      5.00   1288.27    230.00         .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1714E+03 EXCESS= .0000E+00 OUTFLOW= .1714E+03 BASIN STORAGE= .1075E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.40   1291.18    232.21       .93      5.00   1284.22    230.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1705E+03 EXCESS= .0000E+00 OUTFLOW= .1705E+03 BASIN STORAGE= .1090E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA11  MANE         1.62    805.34    238.87       .53      5.00    804.03    240.00         .53
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9616E+02 EXCESS= .0000E+00 OUTFLOW= .9616E+02 BASIN STORAGE= .9315E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.39	1451.20	231.56	1.05	5.00	1444.66	230.00	1.05	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1952E+03 EXCESS= .0000E+00 OUTFLOW= .1952E+03 BASIN STORAGE= .1081E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.39	1432.29	231.10	1.03	5.00	1426.23	230.00	1.03	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1921E+03 EXCESS= .0000E+00 OUTFLOW= .1921E+03 BASIN STORAGE= .1127E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.40	1403.06	231.23	1.01	5.00	1395.66	230.00	1.01	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1870E+03 EXCESS= .0000E+00 OUTFLOW= .1869E+03 BASIN STORAGE= .1099E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.41	1371.26	231.53	.98	5.00	1361.57	230.00	.98	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1815E+03 EXCESS= .0000E+00 OUTFLOW= .1815E+03 BASIN STORAGE= .1027E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.42	1353.42	232.36	.96	5.00	1343.27	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1792E+03 EXCESS= .0000E+00 OUTFLOW= .1792E+03 BASIN STORAGE= .9526E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.42	1345.80	231.50	.96	5.00	1334.35	235.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1777E+03 EXCESS= .0000E+00 OUTFLOW= .1777E+03 BASIN STORAGE= .1103E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.42	1340.77	231.74	.95	5.00	1330.02	235.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1767E+03 EXCESS= .0000E+00 OUTFLOW= .1767E+03 BASIN STORAGE= .9508E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.66	823.68	238.76	.54	5.00	823.64	240.00	.54	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9953E+02 EXCESS= .0000E+00 OUTFLOW= .9952E+02 BASIN STORAGE= .9785E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.35	1268.66	230.26	6.50	5.00	1266.61	230.00	6.50	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8913E+02 EXCESS= .0000E+00 OUTFLOW= .8913E+02 BASIN STORAGE= .5338E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.37	1243.83	232.02	6.32	5.00	1240.66	230.00	6.32	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8665E+02 EXCESS= .0000E+00 OUTFLOW= .8666E+02 BASIN STORAGE= .4720E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.39	1210.68	231.93	6.00	5.00	1200.20	230.00	6.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8231E+02 EXCESS= .0000E+00 OUTFLOW= .8231E+02 BASIN STORAGE= .4667E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.45	1145.81	232.36	5.68	5.00	1140.75	230.00	5.68	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7787E+02 EXCESS= .0000E+00 OUTFLOW= .7787E+02 BASIN STORAGE= .4998E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.46	1125.87	231.27	5.55	5.00	1116.14	230.00	5.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7610E+02 EXCESS= .0000E+00 OUTFLOW= .7612E+02 BASIN STORAGE= .4861E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN10-C MANE 2.48 1111.15 232.68 5.47 5.00 1104.59 230.00 5.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7494E+02 EXCESS= .0000E+00 OUTFLOW= .7495E+02 BASIN STORAGE= .4727E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN10-C MANE 2.49 1098.06 231.13 5.40 5.00 1088.80 230.00 5.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7406E+02 EXCESS= .0000E+00 OUTFLOW= .7406E+02 BASIN STORAGE= .4887E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN10-C MANE 3.76 392.09 229.47 1.59 5.00 391.76 230.00 1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2171E+02 EXCESS= .0000E+00 OUTFLOW= .2173E+02 BASIN STORAGE= .5384E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.27 1534.71 233.69 3.74 5.00 1521.33 235.00 3.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1157E+03 EXCESS= .0000E+00 OUTFLOW= .1157E+03 BASIN STORAGE= .5074E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.29 1504.10 233.38 3.64 5.00 1491.37 235.00 3.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1127E+03 EXCESS= .0000E+00 OUTFLOW= .1127E+03 BASIN STORAGE= .5290E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.32 1452.94 234.27 3.47 5.00 1443.95 235.00 3.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1073E+03 EXCESS= .0000E+00 OUTFLOW= .1073E+03 BASIN STORAGE= .5373E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.37 1383.31 234.17 3.29 5.00 1374.26 235.00 3.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1019E+03 EXCESS= .0000E+00 OUTFLOW= .1019E+03 BASIN STORAGE= .5223E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.39 1356.21 233.74 3.22 5.00 1346.26 235.00 3.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9961E+02 EXCESS= .0000E+00 OUTFLOW= .9961E+02 BASIN STORAGE= .5818E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.40 1342.61 232.35 3.18 5.00 1338.57 235.00 3.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9826E+02 EXCESS= .0000E+00 OUTFLOW= .9826E+02 BASIN STORAGE= .4723E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.41 1324.91 233.59 3.14 5.00 1315.97 235.00 3.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9708E+02 EXCESS= .0000E+00 OUTFLOW= .9708E+02 BASIN STORAGE= .5886E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 3.55 499.29 234.61 1.04 5.00 497.51 235.00 1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3221E+02 EXCESS= .0000E+00 OUTFLOW= .3223E+02 BASIN STORAGE= .4880E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCBN15-C MANE .84 1753.05 231.22 3.01 5.00 1750.20 235.00 3.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1386E+03 EXCESS= .0000E+00 OUTFLOW= .1386E+03 BASIN STORAGE= .1899E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN15-C MANE .84 1715.83 234.87 2.93 5.00 1715.19 235.00 2.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1350E+03 EXCESS= .0000E+00 OUTFLOW= .1350E+03 BASIN STORAGE= .1902E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN15-C MANE .86 1658.68 234.58 2.80 5.00 1657.90 235.00 2.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1288E+03 EXCESS= .0000E+00 OUTFLOW= .1288E+03 BASIN STORAGE= .1966E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.87	1580.87	234.78	2.66	5.00	1580.18	235.00	2.66	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1225E+03 EXCESS= .0000E+00 OUTFLOW= .1225E+03 BASIN STORAGE= .1968E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.88	1548.94	234.92	2.60	5.00	1548.68	235.00	2.60	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1197E+03 EXCESS= .0000E+00 OUTFLOW= .1197E+03 BASIN STORAGE= .1901E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.88	1538.11	234.65	2.57	5.00	1537.70	235.00	2.57	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1183E+03 EXCESS= .0000E+00 OUTFLOW= .1183E+03 BASIN STORAGE= .1936E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.89	1513.74	235.26	2.54	5.00	1513.48	235.00	2.54	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1168E+03 EXCESS= .0000E+00 OUTFLOW= .1168E+03 BASIN STORAGE= .1908E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	1.30	585.74	235.78	.89	5.00	581.76	235.00	.89	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4112E+02 EXCESS= .0000E+00 OUTFLOW= .4112E+02 BASIN STORAGE= .1852E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.64	3242.18	233.36	1.45	5.00	3240.23	235.00	1.45	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3420E+03 EXCESS= .0000E+00 OUTFLOW= .3419E+03 BASIN STORAGE= .1930E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.65	3185.23	234.77	1.42	5.00	3182.35	235.00	1.42	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3351E+03 EXCESS= .0000E+00 OUTFLOW= .3351E+03 BASIN STORAGE= .2056E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.67	3095.22	233.75	1.37	5.00	3092.31	235.00	1.37	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3234E+03 EXCESS= .0000E+00 OUTFLOW= .3234E+03 BASIN STORAGE= .2129E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.69	2986.75	234.86	1.32	5.00	2985.30	235.00	1.32	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3115E+03 EXCESS= .0000E+00 OUTFLOW= .3114E+03 BASIN STORAGE= .2054E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.70	2936.37	234.33	1.30	5.00	2933.55	235.00	1.30	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3062E+03 EXCESS= .0000E+00 OUTFLOW= .3062E+03 BASIN STORAGE= .1821E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.70	2918.63	234.86	1.29	5.00	2917.47	235.00	1.29	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3033E+03 EXCESS= .0000E+00 OUTFLOW= .3033E+03 BASIN STORAGE= .1834E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.71	2884.94	233.93	1.28	5.00	2884.53	235.00	1.28	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3007E+03 EXCESS= .0000E+00 OUTFLOW= .3007E+03 BASIN STORAGE= .2093E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	2.16	1412.01	237.41	.61	5.00	1408.14	240.00	.61	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1447E+03 EXCESS= .0000E+00 OUTFLOW= .1447E+03 BASIN STORAGE= .2041E-02 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

Interim Condition HEC-1 Model

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1****************************************
 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *               JUN   1998             *
 *            VERSION 4.1               *
 *                                      *
 *  RUN DATE   17AUG15  TIME  13:48:41  *
 *                                      *
 ****************************************
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****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*            (916) 756-1104            *
*                                      *
****************************************
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
                    *DIAGRAM
 *** FREE ***
             1      ID    LAS VEGAS WASH CENTRAL-CEDAR AVENUE
             2      ID
             3      ID    INPUT FILE = CEDAR_INT.DAT
             4      ID    INPUT FILE DATE =  APRIL 2014
             5      ID    DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
             6      ID    STORM DISTRIBUTION = SDN #3
             7      ID    MODELED BY ATKINS (MANOGYA KHANAL)
             8      ID    CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
             9      ID    NO STORM CENTERING
            10      ID    REFERENCED HYDROLOGIC MODELS:
            11      ID    2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
            12      ID    MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
            13      ID    CENTRAL NEIGHBORHOOD STUDY
            14      ID
            15      ID
            16      ID    JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
            17      ID
            18      ID                        AREA       DARF
            19      ID                        SQ. MI.
            20      ID                        0-0.5     0.990
            21      ID                        0.5-1      0.975
            22      ID                        1-2       0.950
            23      ID                        2-3        0.925
            24      ID                       3-4        0.915
            25      ID                        4-5        0.908
            26      ID                        5-6        0.903
            27      ID
            28      IT       5       0       0     300
            29      IO       5       0       0
            30      IN       5       0       0
            31      JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908   0.903    0.57
                    *
            32      KK   CA03a
            33      BA   0.095
            34      PB    2.77
            35      PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
            36      PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
            37      PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
            38      PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
            39      PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
            40      PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
            41      PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
            42      PC   0.998   0.999   1.000
            43      LS       0    87.8
            44      UD   0.234
                    *
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          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
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```
   45          KK   CA03c
   46          BA   0.022
   47          PB    2.77
   48          LS       0    87.9
   49          UD   0.238
               *

   50          KK  CCA03c
   51          KM  COMBINE CA03a AND CA03c
   52          KM  EASTERN AND STEWART
   53          HC       2
               *

   54          KK   CA03b
   55          BA   0.079
   56          PB    2.77
   57          LS       0    87.9
   58          UD   0.257
               *

   59          KK   CCA03
   60          KM  COMBINE CCA03c AND CA03b
   61          KM  EASTERN AND STEWART
   62          HC       2
               *

   63          KK  RCCA03
   64          KM  ROUTE CCA03 TO CCA04b
   65          KM  STEWART
   66          RD    1240 0.01371   0.016       0    TRAP       0      50
               *

   67          KK   CA04b
   68          BA   0.060
   69          PB    2.77
   70          LS       0    88.1
   71          UD   0.203
               *

   72          KK  CCA04b
   73          KM  COMBINE RCCA03, CA04a AND CA04b
   74          KM  STEWART AT 28th STREET
   75          HC       2
               *

   76          KK RCCA04b
   77          KM  ROUTE CCA04b TO CCA04
   78          KM  STEWART
   79          RD    1780 0.00955   0.016       0    TRAP       0      50
               *
1                                      HEC-1 INPUT                                          PAGE  3

 LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   80          KK   CA04a
   81          BA   0.039
   82          PB    2.77
   83          LS       0    87.5
   84          UD   0.224
               *

   85          KK   CA04c
   86          BA   0.031
   87          PB    2.77
   88          LS       0    90.7
   89          UD   0.199
               *

   90          KK CCA04-1
   91          KM  COMBINE RCCA04b, CA04a AND CA04c
   92          KM  STEWART AT MOJAVE
   93          HC       3
               *

   94          KK   CA04g
   95          BA   0.052
   96          PB    2.77
   97          LS       0    92.4
   98          UD   0.156
               *

   99          KK  RCA04g
  100          KM  ROUTE CA04g TO CCA04d
  101          KM  SUNRISE
  102          RD    3500   0.014   0.016       0    TRAP       0      50
               *

  103          KK   CA04d
  104          BA   0.052
  105          PB    2.77
  106          LS       0    91.2
  107          UD   0.191
               *
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 108          KK  CCA04d
 109          KM  COMBINE RCA04g AND CA04d
 110          KM  SUNRISE AND EASTERN
 111          HC       2
              *

 112          KK  RCA04d
 113          KM  ROUTE CA04c TO CCA04d
 114          KM  SUNRISE
 115          RD    3050 0.01148   0.016       0    TRAP       0      50
              *
1                                    HEC-1 INPUT                                          PAGE  4

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 116          KK   CA04e
 117          BA   0.190
 118          PB    2.77
 119          LS       0    90.0
 120          UD   0.349
              *

 121          KK  CCA04e
 122          KM  COMBINE RCBN03 AND BN08
 123          KM  SUNRISE AND MOJAVE
 124          HC       2
              *

 125          KK RCCA04e
 126          KM  ROUTE CCA04e TO CCA04f
 127          KM  MOJAVE
 128          RD    1360 0.00368   0.016       0    TRAP       0      50
              *

 129          KK   CA04f
 130          BA   0.046
 131          PB    2.77
 132          LS       0    91.6
 133          UD   0.209
              *

 134          KK  CCA04f
 135          KM  COMBINE RCCA04d AND CA04e
 136          KM  MOJAVE AT STEWART
 137          HC       2
              *

 138          KK   CCA04
 139          KM  COMBINE CCA04 AND CCA04e
 140          KM  STEWART AT MOJAVE
 141          HC       2
              *

 142          KK  RCCA04
 143          KM  ROUTE CCA04 TO CCA05
 144          KM  STEWART
 145          RD    2130 0.00892   0.016       0    TRAP       0      50
              *

 146          KK   CA05a
 147          BA   0.036
 148          PB    2.77
 149          LS       0    91.0
 150          UD   0.215
              *
1                                    HEC-1 INPUT                                          PAGE  5

        LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 151          KK   CA05b
 152          BA   0.050
 153          PB    2.77
 154          LS       0    91.9
 155          UD   0.232
              *

 156          KK CCA05-1
 157          KM  COMBINE RCCA04, CA05a AND CA05b
 158          KM  STEWART AT PECOS
 159          HC       3
              *

 160          KK  DCCA05
 161          KM  DIVERT BYPASS FLOW ON STEWART THAT CONTINUES EAST ON STEWART
 162          KM  REMAINING FLOW IS THE FLOW COLLECTED IN INLETS
 163          DT  DSTEWQ
 164          DI       0     200     400     430     600     745     900
 165          DQ       0       0       0       0     170     315     470
              *

 166          KK   CA05c
 167          BA   0.023
 168          PB    2.77
```

```
 169          LS       0    91.9
 170          UD   0.146
              *

 171          KK  RCA05c
 172          KM  ROUTE CA05c TO CCA05e
 173          KM  SUNRISE
 174          RD     750 0.00933   0.016       0    TRAP       0      50
              *

 175          KK   CA05d
 176          BA   0.043
 177          PB    2.77
 178          LS       0    91.5
 179          UD   0.202
              *

 180          KK   CA05e
 181          BA   0.003
 182          PB    2.77
 183          LS       0    92.0
 184          UD   0.104
              *

 185          KK  CCA05e
 186          KM  COMBINE RCA05d AND CA05c
 187          KM  SUNRISE AT PECOS
 188          HC       3
              *
1                                      HEC-1 INPUT                                          PAGE  6

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 189          KKDTCCA05e
 190          KM  DIVERT FLOW INTO THE STREET.
 191          KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
 192          KM  AT PECOS NORTH OF SUNRISE
 193          DT  DTA05e
 194          DI       0    49.5      99
 195          DQ       0    26.5      53
              *

 196          KK   CA05f
 197          BA   0.009
 198          PB    2.77
 199          LS       0    92.0
 200          UD   0.123
              *

 201          KK DTCAO5f
 202          KM  DIVERT FLOW INTO THE STREET.
 203          KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
 204          KM  AT PECOS NORTH OF SUNRISE
 205          DT  DTA05f
 206          DI       0     3.5       7
 207          DQ       0    1.75     3.5
              *

 208          KK  CCA05f
 209          KM  COMBINE RCA05e AND CA05f
 210          HC       2
              *

 211          KK RCCA05f
 212          KM  ROUTE CCA05f TO CCA05f
 213          KM  PECOS
 214          RD     820 0.00732   0.013       0    CIRC       3       0
              *

 215          KK   CA05h
 216          BA   0.003
 217          PB    2.77
 218          LS       0    92.0
 219          UD   0.101
              *

 220          KK   CA05i
 221          BA   0.004
 222          PB    2.77
 223          LS       0    92.0
 224          UD   0.093
              *
1                                      HEC-1 INPUT                                          PAGE  7

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 225          KK   CA05k
 226          BA   0.010
 227          PB    2.77
 228          LS       0    91.9
 229          UD   0.105
              *
```

```
230          KK  CCA05k
231          KM  COMBINE RCCA05f, CA05h, CA05i AND CA05k
232          KM  UNDEVELOPED PARCEL AT STEWART AND PECOS
233          HC       4
             *

234          KK   CA05g
235          BA   0.007
236          PB    2.77
237          LS       0    92.0
238          UD   0.101
             *

239          KK   CA05j
240          BA   0.005
241          PB    2.77
242          LS       0    92.0
243          UD   0.083
             *

244          KK   CA05p
245          BA   0.006
246          PB    2.77
247          LS       0    91.1
248          UD   0.183
             *

249          KK  CCA05p
250          KM  COMBINE CA05g, CA05j AND CA05p
251          KM  ON PECOS SOUTH OF STEWART
252          HC       3
             *

253          KK  DRA05e
254          KM  RETURN FLOW FROM DIVERTED
255          KM  FLOW ON THE STREET
256          DR  DTA05e
             *

257          KK  DRA05f
258          KM  RETURN FLOW FROM DIVERTED
259          KM  FLOW ON THE STREET
260          DR  DTA05f
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

261          KK CCA05-3
262          KM  COMBINE DRA05f, DRA05e AND CCA05p
263          KM  ON PECOS SOUTH OF STEWART
264          HC       3
             *

265          KKDTCCA053
266          KM  DIVERT FLOW INTO THE STREET.
267          KM  REMIANING WILL FLOW INTO THE DROPINTET
268          KM  AT PECOS SOUTH OF STEWART, WEST
269          DT DTA05-3
270          DI       0    43.5      87
271          DQ       0      40      80
             *

272          KK CCA05-2
273          KM  COMBINE CCA05-1 AND CCA05p
274          KM  ON PECOS SOUTH OF STEWART
275          HC       2
             *

276          KKCCA05-2a
277          KM  COMBINE CCA05-2 AND CCA05-1
278          KM  ON STEWART AND PECOS
279          HC       2
             *

280          KK    CHAR
281          BA  0.0365
282          QI     0.0     0.0     0.0     0.0     0.0     0.3     0.8     1.3     1.8     1.5
283          QI     1.3     0.8     0.5     0.5     0.5     0.8     1.0     1.3     2.3     2.8
284          QI     3.1     2.8     2.6     2.1     1.8     1.8     2.3     3.6     3.9     3.6
285          QI     3.6     3.6     3.6     3.6     3.6     4.6    11.3    18.0    27.0    36.0
286          QI    42.2    43.0    39.4    33.7    27.3    17.8    14.2    11.3     9.3     8.2
287          QI     8.5     9.3     9.8    10.0     9.8     9.0     7.7     6.4     4.9     3.9
288          QI     3.1     2.3     1.8     1.3     1.3     1.0     1.0     0.8     0.5     0.5
289          QI     0.3     0.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
290          QI     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
             *

291          KK   RCHAR
292          KM  ROUTE CHAR TO CH70-C
293          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
294          RD    4600  0.0098   0.016       0    TRAP       0      50
             *
```

```
 295          KK  CH70-C
 296          BA   0.137
 297          PB    2.77
 298          LS       0    92.7
 299          UD   0.305
              *
1                                        HEC-1 INPUT                                                PAGE  9

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 300          KK   CCHAR
 301          KM  COMBINE CHAR AND CH70-C
 302          HC       2
              *

 303          KK  RCCHAR
 304          KM  ROUTE CCHAR TO CCA05-2
 305          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 306          KM  LINING = RCP
 307          RD    1250  0.0096   0.013       0    CIRC     5.5       0
              *

 308          KK   CA05m
 309          BA   0.005
 310          PB    2.77
 311          LS       0    91.5
 312          UD   0.134
              *

 313          KK  CCA05n
 314          KM  COMBINE CHAR AND CA05m
 315          KM  ON PECOS AND SUNRISE
 316          HC       2
              *

 317          KK RCCA05m
 318          KM  ROUTE CCA05n TO CCA05-2
 319          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 320          KM  LINING = RCP
 321          RD    1580 0.00633   0.013       0    CIRC     5.5       0
              *

 322          KK CCA05-4
 323          KM  COMBINE CCA05n AND CA05m
 324          KM  ON PECOS AND SUNRISE
 325          HC       2
              *

 326          KK   CA05n
 327          BA   0.004
 328          PB    2.77
 329          LS       0    91.4
 330          UD   0.106
              *

 331          KK   CA05q
 332          BA   0.013
 333          PB    2.77
 334          LS       0    82.5
 335          UD   0.215
              *
1                                        HEC-1 INPUT                                                PAGE 10

LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 336          KK  CCA05q
 337          KM  COMBINED FLOW IN EXISTING STORM DRAIN
 338          KM  STEWART AND PECOS
 339          HC       2
              *

 340          KK   CCA05
 341          KM  TOTAL FLOW ON SURFACE AND SYSTEM
 342          KM  STEWART AND PECOS
 343          HC       2
              *

 344          KK  RCCA05
 345          KM  ROUTE CCA05 TO CCA08
 346          KM  PROPOSED FACILITY IN PECOS ROAD
 347          KM  LINING = RCB
 348          RD    1310   0.005   0.013       0    TRAP      14       0
              *

 349          KK  CA06-C
 350          BA   0.407
 351          PB    2.77
 352          LS       0    82.5
 353          UD   0.465
              *

 354          KK  CH59-C
 355          BA   0.213
```

```
 356          PB    2.77
 357          LS       0    94.4
 358          UD   0.371
              *

 359          KK DCH58-C
 360          KM  FLOW SPLIT TO CH58-C
 361          KM  SPLIT TO FLAMINGO WASH SYSTEM
 362          KM  DEVELOPED FROM CWH MODEL
 363          KM  CAPACITY = 144 CFS (100 YR STORM DRAIN CAPACITY)
 364          DT   DFLAM
 365          DI       0     144    1000
 366          DQ       0       0     856
              *

 367          KK  RDCH58
 368          KM  ROUTE DCH58-C TO CCH58-C
 369          KM  LAS VEGAS BLVD STORM DRAIN
 370          RD    5900    0.01   0.013       0    CIRC       4       0
              *
1                                      HEC-1 INPUT                                          PAGE 11

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 371          KK  CH58-C
 372          BA   0.128
 373          PB    2.77
 374          LS       0    93.4
 375          UD   0.312
              *

 376          KK CCH58-C
 377          KM  COMBINE DCH58-C AND CH58-C
 378          KM  US 95
 379          HC       2
              *

 380          KKDDCH59-C
 381          KM  FLOW SPLIT TO BN03-C
 382          KM  DIVERT Q EXCEEDING LAS VEGAS BLVD DRAIN CAPACITY:  48" PIPE, 167 CFS
 383          KM  DBN00 IN CWH
 384          DT   DBN03
 385          DI       0     167    1000
 386          DQ       0       0     833
              *

 387          KK  DDCH59
 388          KM  DIVERT FLOW OUT OF PECOS/BONANZA SYSTEM
 389          DT  DBN03a
 390          DI       0     167    1000
 391          DQ       0     167    1000
              *

 392          KK  BN06-C
 393          BA   0.340
 394          PB    2.77
 395          LS       0    89.1
 396          UD   0.201
              *

 397          KK  BN03-C
 398          BA   0.539
 399          PB    2.77
 400          LS       0    87.3
 401          UD   0.344
              *

 402          KK   DBN03
 403          KM  RETREIVE DBN03
 404          DR   DBN03
              *

 405          KK  RDBN03
 406          KM  ROUTE DBN03 TO CBN03
 407          KM  BONANZA
 408          RD    5900  0.0264   0.016       0    TRAP       0      50
              *
1                                      HEC-1 INPUT                                          PAGE 12

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 409          KK   CBN03
 410          KM  COMBINE BN06-C, BN03-C, AND RDBN03
 411          KM  BONANZA AND EASTERN
 412          HC       3
              *

 413          KK  RCBN03
 414          KM  ROUTE CBN03 TO CBN08
 415          KM  FACILITY = LAS VEGAS WASH - BONANZA
 416          KM  FACILITY # = LVBZ 0211,0224
 417          KM  LINING = RCB
 418          RD    2980  0.0072   0.015       0    TRAP       8       0
```

```
                *
  419           KK    BN08
  420           BA   0.210
  421           PB    2.77
  422           LS       0    91.8
  423           UD   0.378
                *
  424           KK   CBN08
  425           KM  COMBINE RCBN03 AND BN08
  426           KM  BONANZA AND MOJAVE
  427           HC       2
                *
  428           KK  RCBN08
  429           KM  ROUTE CBN08 TO CBN09
  430           KM  FACILITY = LAS VEGAS WASH - BONANZA
  431           KM  FACILITY # = LVBZ 0167, 0188
  432           KM  LINING = RCB
  433           RD    2330   0.007   0.015       0    TRAP       9       0
                *
  434           KK    BN09
  435           BA   0.233
  436           PB    2.77
  437           LS       0    83.9
  438           UD   0.411
                *
  439           KK   CBN09
  440           KM  COMBINE RCBN08 AND BN09
  441           KM  BONANZA AND PECOS
  442           HC       2
                *
  443           KK   DBN09
  444           KM  FLOW SPLIT TO PECOS
  445           KM  DIVERT Q EXCEEDING 60" PIPE, 202 CFS
  446           DT  DBN09a
  447           DI       0     202    1000    2000
  448           DQ       0       0     798    1798
                *
1                                      HEC-1 INPUT                                                PAGE 13

             LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  449           KK  CCBN09
  450           KM  COMBINE DDCH59 AND DBN09
  451           KM  SHOULD BE THE SAME AS CBN09
  452           KM  DDCH59 HAS ZERO FLOW
  453           KM  BONANZA AND PECOS
  454           HC       2
                *
  455           KK CCA06-1
  456           KM  BONANZA FLOW AND CA06-C
  457           HC       2
                *
  458           KK   CCA06
  459           KM  CEDAR AND PECOS
  460           HC       2
                *
  461           KK  RCCA06
  462           KM  ROUTE CCA05 TO CCA08
  463           KM  FACILITY = CEDAR AVENUE CHANNEL
  464           KM  FACILITY # = CACH 0127,0129,0146,0148
  465           KM  LINING = CONCRETE
  466           RD    1545  0.0026   0.015       0    TRAP      10     1.5
                *
  467           KK    CA08
  468           BA   0.073
  469           PB    2.77
  470           LS       0    85.4
  471           UD   0.258
                *
  472           KK   CA08a
  473           BA  0.0478
  474           PB    2.77
  475           LS       0    89.1
  476           UD   0.215
                *
  477           KK   CCA08
  478           KM  CEDAR AND HONOLULU
  479           HC       3
                *
  480           KK  RCCA08
  481           KM  ROUTE CCA08 TO CCA09
```

```
 482          KM  FACILITY = CEDAR AVENUE CHANNEL
 483          KM  FACILITY # = CACH 0079,0081
 484          KM  LINING = CONCRETE
 485          RD    1050  0.0026   0.015       0    TRAP      10     1.5
              *
1                                    HEC-1 INPUT                                        PAGE 14

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 486          KK    CA09
 487          BA   0.048
 488          PB    2.77
 489          LS       0    89.6
 490          UD   0.225
              *

 491          KK   CCA09
 492          KM  CEDAR AND SANDHILL
 493          HC       2
              *

 494          KK  RCCA09
 495          KM  ROUTE CCA09 TO CCA10
 496          KM  FACILITY = CEDAR AVENUE CHANNEL
 497          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 498          KM  LINING = CONCRETE
 499          RD     935   0.002   0.015       0    TRAP      12     1.5
              *

 500          KK    CA10
 501          BA   0.032
 502          PB    2.77
 503          LS       0    93.0
 504          UD   0.221
              *

 505          KK   CCA10
 506          KM  CEDAR AVE CHANNEL
 507          HC       2
              *

 508          KK  RCCA10
 509          KM  ROUTE CCA10 TO CCA11
 510          KM  FACILITY = CEDAR AVENUE CHANNEL
 511          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 512          KM  LINING = CONCRETE
 513          RD    1730   0.002   0.015       0    TRAP      12     1.5
              *

 514          KK    CA11
 515          BA   0.092
 516          PB    2.77
 517          LS       0    90.2
 518          UD   0.288
              *

 519          KK   CCA11
 520          KM  CEDAR AND LAMB
 521          HC       2
              *
1                                    HEC-1 INPUT                                        PAGE 15

      LINE    ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 522          KK  RCCA11
 523          KM  ROUTE CCA11 TO CCA12
 524          KM  FACILITY = CEDAR AVENUE CHANNEL
 525          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 526          KM  LINING = CONCRETE
 527          RD    1340  0.0038   0.015       0    TRAP      10     1.5
              *

 528          KK    CA12
 529          BA   0.062
 530          PB    2.77
 531          LS       0    94.1
 532          UD   0.245
              *

 533          KK   CCA12
 534          KM  CEDAR AND PAGE
 535          HC       2
              *

 536          KK  RCCA12
 537          KM  ROUTE CCA12 TO CCA13
 538          KM  FACILITY = CEDAR AVENUE CHANNEL
 539          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
 540          KM  LINING = CONCRETE
 541          RD    1365  0.0037   0.015       0    TRAP      10     1.5
              *

 542          KK    CA13
```

```
            543           BA   0.065
            544           PB    2.77
            545           LS       0    95.9
            546           UD   0.247
                          *

            547           KK   CCA13
            548           KM  CEDAR AND MARION
            549           HC       2
                          *

            550           KK  RCCA13
            551           KM  ROUTE CCA13 TO CCA14
            552           KM  FACILITY = CEDAR AVENUE CHANNEL
            553           KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
            554           KM  LINING = CONCRETE
            555           RD    1680   0.002   0.015       0    TRAP      14     1.5
                          *

            556           KK    CA14
            557           BA   0.055
            558           PB    2.77
            559           LS       0    97.7
            560           UD   0.233
                          *
1                                                HEC-1 INPUT                                                PAGE 16

          LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


            561           KK   CCA14
            562           KM  CEDAR CHANNEL AT WASH
            563           HC       2
                          *

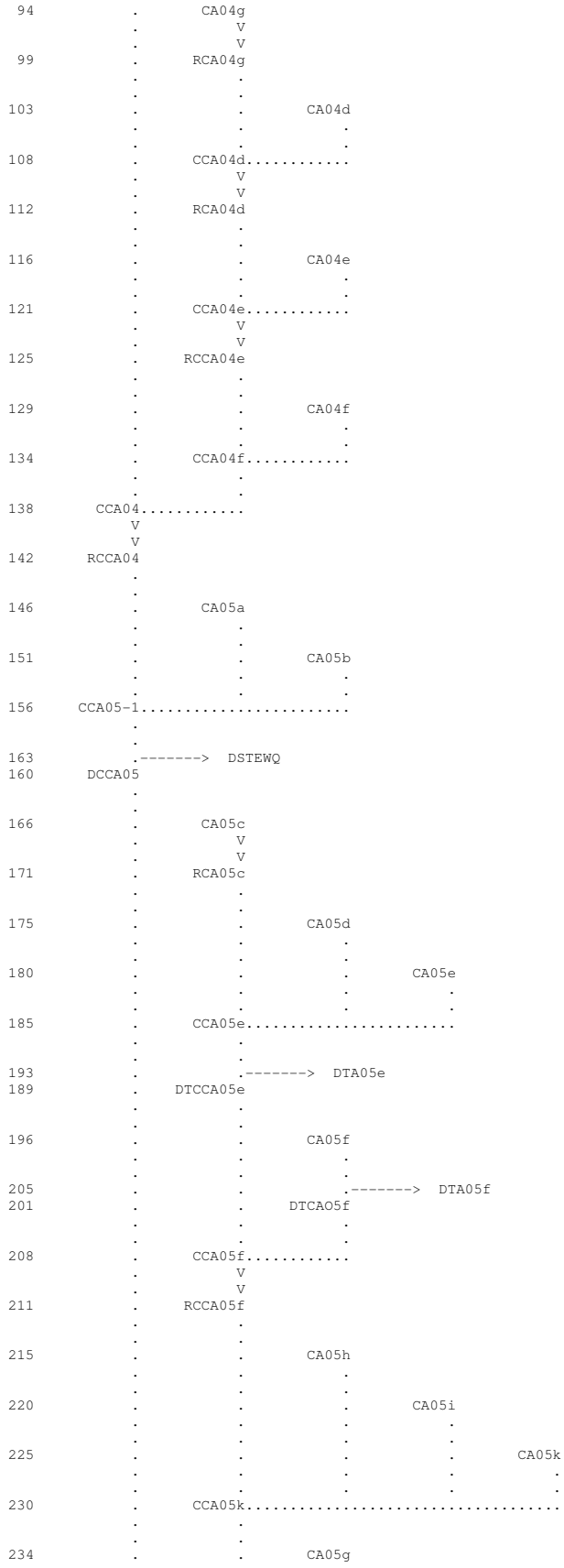
            564           KK DRDTA05
            565           KM  RETURN FLOW FROM DIVERTED
            566           KM  FLOW ON THE STREET FROM PECOS
            567           DR DTA05-3
                          *

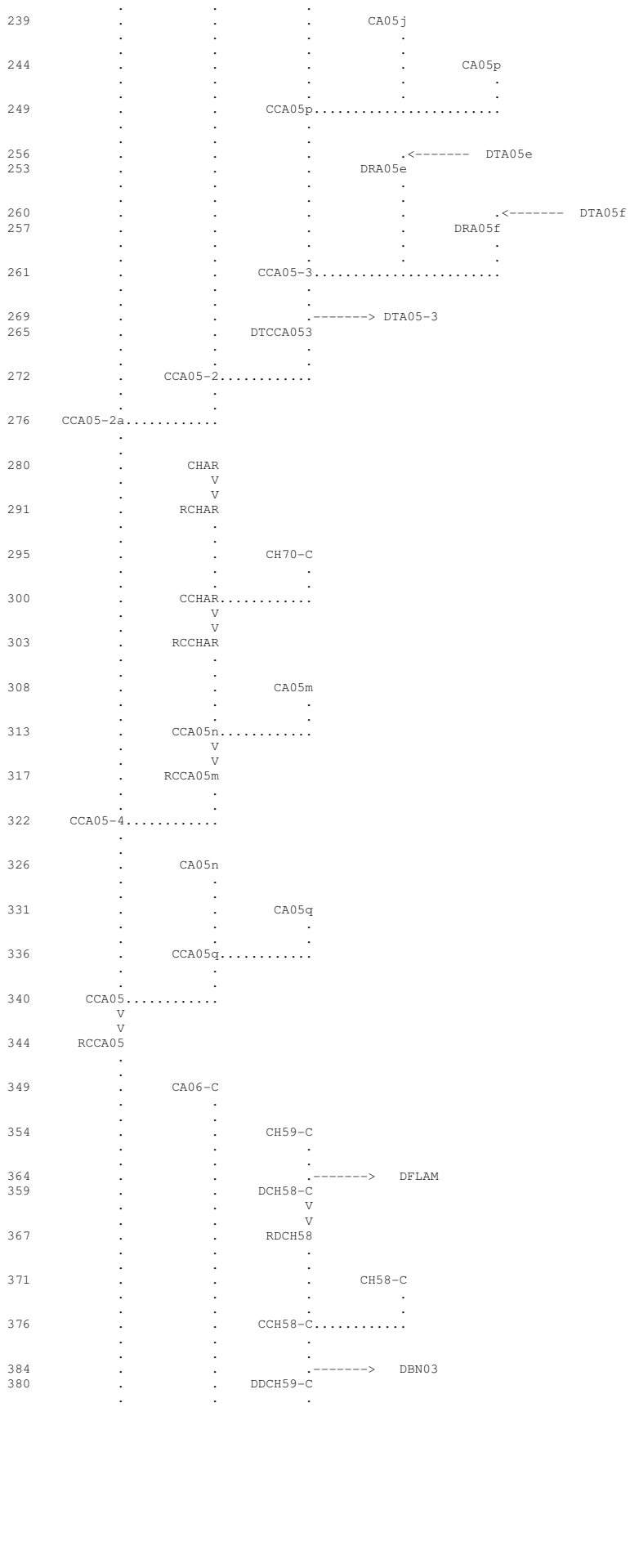
            568           KK DRDSTEW
            569           KM  RETURN FLOW FROM DIVERTED
            570           KM  FLOW ON THE STREET FROM STEWART
            571           DR  DSTEWQ
                          *

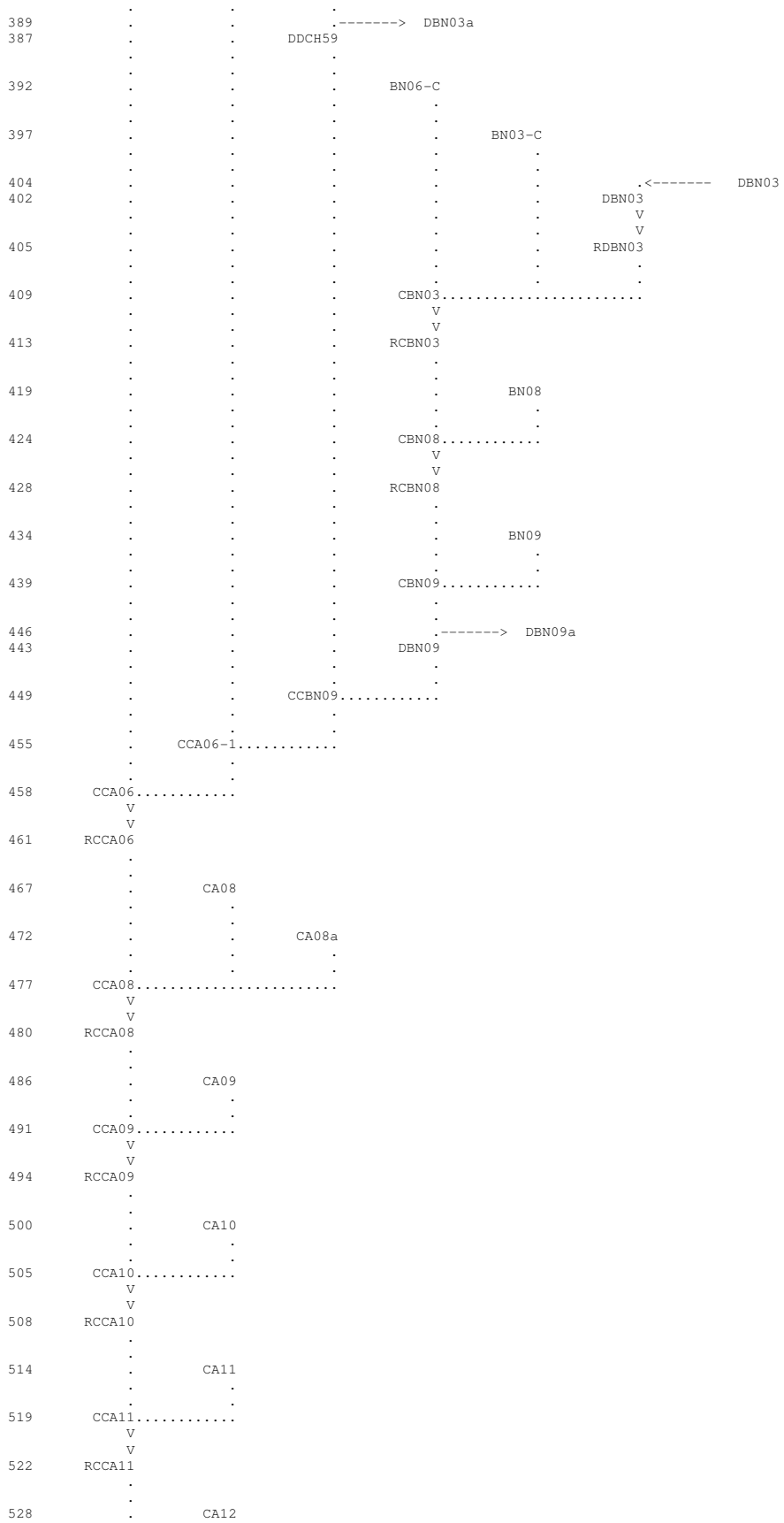
            572           KK CSTEWBY
            573           KM  BYPASS FLOW ON STEWART
            574           HC       2
                          *
            575           ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

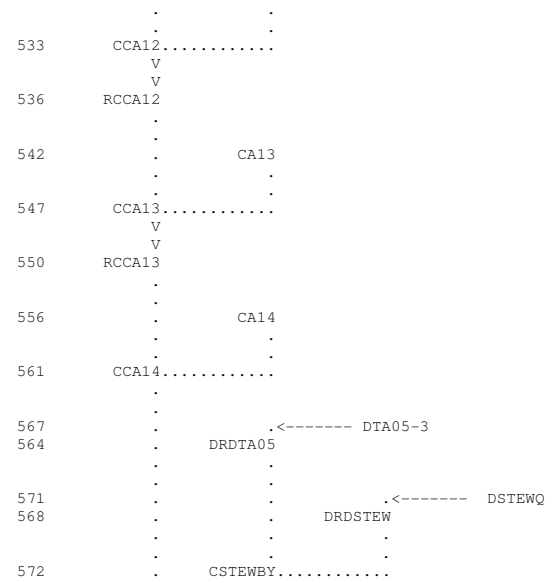
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    32       CA03a
                .
                .
    45          .       CA03c
                .          .
                .          .
    50      CCA03c..........
                .
                .
    54          .       CA03b
                .          .
                .          .
    59       CCA03..........
                V
                V
    63      RCCA03
                .
                .
    67          .       CA04b
                .          .
                .          .
    72      CCA04b..........
                V
                V
    76     RCCA04b
                .
                .
    80          .       CA04a
                .          .
                .          .
    85          .          .       CA04c
                .          .          .
                .          .          .
    90     CCA04-1.....................
                .
                .
```


94 CA04g
99 RCA04g
103 CA04d
108 CCA04d
112 RCA04d
116 CA04e
121 CCA04e
125 RCCA04e
129 CA04f
134 CCA04f
138 CCA04
142 RCCA04
146 CA05a
151 CA05b
156 CCA05-1
163 DSTEWQ
160 DCCA05
166 CA05c
171 RCA05c
175 CA05d
180 CA05e
185 CCA05e
193 DTA05e
189 DTCCA05e
196 CA05f
205 DTA05f
201 DTCAO5f
208 CCA05f
211 RCCA05f
215 CA05h
220 CA05i
225 CA05k
230 CCA05k
234 CA05g


CA05j
CA05p
CCA05p
DTA05e
DRA05e
DTA05f
DRA05f
CCA05-3
DTA05-3
DTCCA053
CCA05-2
CCA05-2a
CHAR
RCHAR
CH70-C
CCHAR
RCCHAR
CA05m
CCA05n
RCCA05m
CCA05-4
CA05n
CA05q
CCA05q
CCA05
RCCA05
CA06-C
CH59-C
DFLAM
DCH58-C
RDCH58
CH58-C
CCH58-C
DBN03
DDCH59-C


389
387 DDCH59
392 BN06-C
397 BN03-C
404
402 DBN03
405 RDBN03
409 CBN03
413 RCBN03
419 BN08
424 CBN08
428 RCBN08
434 BN09
439 CBN09
446
443 DBN09
449 CCBN09
455 CCA06-1
458 CCA06
461 RCCA06
467 CA08
472 CA08a
477 CCA08
480 RCCA08
486 CA09
491 CCA09
494 RCCA09
500 CA10
505 CCA10
508 RCCA10
514 CA11
519 CCA11
522 RCCA11
528 CA12
DBN03a
DBN09a
.<-------
DBN03



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   17AUG15  TIME  13:48:41   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

LAS VEGAS WASH CENTRAL-CEDAR AVENUE

INPUT FILE = CEDAR_INT.DAT
INPUT FILE DATE = APRIL 2014
DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY ATKINS (MANOGYA KHANAL)
CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
NO STORM CENTERING
REFERENCED HYDROLOGIC MODELS:
2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
CENTRAL NEIGHBORHOOD STUDY

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA SQ. MI.	DARF
0-0.5	0.990
0.5-1	0.975
1-2	0.950
2-3	0.925
3-4	0.915
4-5	0.908
5-6	0.903

```
  29 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           5  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

     IT          HYDROGRAPH TIME DATA
                       NMIN           5  MINUTES IN COMPUTATION INTERVAL
                      IDATE      1    0  STARTING DATE
                      ITIME        0000  STARTING TIME
                         NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2    0  ENDING DATE
                     NDTIME        0055  ENDING TIME
                     ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL     .08 HOURS
                        TOTAL TIME BASE   24.92 HOURS

          ENGLISH UNITS
               DRAINAGE AREA         SQUARE MILES
```

PRECIPITATION DEPTH INCHES
LENGTH, ELEVATION FEET
FLOW CUBIC FEET PER SECOND
STORAGE VOLUME ACRE-FEET
SURFACE AREA ACRES
TEMPERATURE DEGREES FAHRENHEIT

JP MULTI-PLAN OPTION
NPLAN 1 NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.99 .98 .95 .93 .92 .91 .90 .57
1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

					RATIOS APPLIED TO PRECIPITATION							
OPERATION	STATION	AREA	PLAN		RATIO 1 .99	RATIO 2 .98	RATIO 3 .95	RATIO 4 .93	RATIO 5 .92	RATIO 6 .91	RATIO 7 .90	RATIO 8 .57
HYDROGRAPH AT												
+	CA03a	.09	1	FLOW	107.	104.	100.	96.	95.	94.	93.	43.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03c	.02	1	FLOW	25.	24.	23.	22.	22.	22.	22.	10.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03c	.12	1	FLOW	131.	128.	123.	119.	117.	115.	115.	53.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03b	.08	1	FLOW	86.	84.	81.	77.	76.	75.	75.	35.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03	.20	1	FLOW	217.	212.	204.	196.	193.	191.	189.	88.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO												
+	RCCA03	.20	1	FLOW	211.	205.	199.	191.	188.	185.	183.	86.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04b	.06	1	FLOW	71.	69.	66.	64.	63.	62.	62.	29.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT												
+	CCA04b	.26	1	FLOW	278.	272.	262.	251.	248.	245.	242.	112.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCCA04b	.26	1	FLOW	271.	270.	256.	248.	249.	243.	238.	113.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	CA04a	.04	1	FLOW	44.	43.	41.	40.	39.	38.	38.	18.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA04c	.03	1	FLOW	41.	40.	39.	38.	37.	37.	36.	18.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA04-1	.33	1	FLOW	345.	342.	326.	315.	315.	308.	303.	143.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04g	.05	1	FLOW	81.	79.	77.	74.	73.	73.	72.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO												
+	RCA04g	.05	1	FLOW	79.	77.	75.	71.	70.	69.	69.	38.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04d	.05	1	FLOW	72.	70.	68.	66.	65.	64.	64.	33.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA04d	.10	1	FLOW	140.	137.	133.	129.	127.	125.	123.	65.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCA04d	.10	1	FLOW	142.	139.	135.	129.	128.	126.	125.	64.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA04e	.19	1	FLOW	194.	190.	184.	177.	174.	172.	171.	85.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83

2 COMBINED AT													
+	CCA04e	.29	1	FLOW	333.	326.	315.	304.	299.	296.	294.	148.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCCA04e	.29	1	FLOW	321.	319.	306.	294.	293.	293.	291.	147.
				TIME	3.92	3.83	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT													
+	CA04f	.05	1	FLOW	61.	60.	58.	56.	55.	55.	54.	29.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT													
+	CCA04f	.34	1	FLOW	363.	360.	344.	331.	329.	330.	328.	163.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CCA04	.67	1	FLOW	683.	675.	648.	623.	620.	617.	611.	292.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCCA04	.67	1	FLOW	669.	664.	637.	609.	607.	602.	601.	292.
				TIME	3.83	3.83	3.92	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT													
+	CA05a	.04	1	FLOW	47.	46.	44.	43.	42.	42.	41.	21.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	CA05b	.05	1	FLOW	66.	65.	62.	60.	60.	59.	59.	31.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT													
+	CCA05-1	.75	1	FLOW	751.	745.	714.	685.	682.	676.	674.	323.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
DIVERSION TO													
+	DSTEWQ	.75	1	FLOW	321.	315.	284.	255.	252.	246.	244.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
HYDROGRAPH AT													
+	DCCA05	.75	1	FLOW	430.	430.	430.	430.	430.	430.	430.	323.
				TIME	3.58	3.67	3.67	3.67	3.67	3.67	3.67	3.92
HYDROGRAPH AT													
+	CA05c	.02	1	FLOW	36.	35.	34.	33.	32.	32.	32.	17.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCA05c	.02	1	FLOW	34.	33.	32.	31.	30.	30.	30.	16.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05d	.04	1	FLOW	58.	57.	55.	53.	53.	52.	52.	27.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05e	.00	1	FLOW	5.	5.	5.	5.	4.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT													
+	CCA05e	.07	1	FLOW	97.	95.	92.	89.	87.	86.	86.	44.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05e	.07	1	FLOW	52.	51.	49.	47.	47.	46.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCCA05e	.07	1	FLOW	45.	44.	43.	41.	41.	40.	40.	21.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	CA05f	.01	1	FLOW	14.	14.	14.	13.	13.	13.	13.	7.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05f	.08	1	FLOW	52.	51.	49.	48.	47.	47.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCCA05f	.08	1	FLOW	50.	49.	48.	46.	45.	45.	44.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05h	.00	1	FLOW	5.	5.	5.	5.	5.	4.	4.	2.

				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05i	.00	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05k	.01	1	FLOW	16.	16.	16.	15.	15.	15.	15.	8.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
4 COMBINED AT													
+	CCA05k	.09	1	FLOW	77.	75.	73.	70.	69.	69.	68.	36.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	CA05g	.01	1	FLOW	12.	11.	11.	11.	11.	10.	10.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05j	.00	1	FLOW	9.	9.	8.	8.	8.	8.	8.	4.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05p	.01	1	FLOW	8.	8.	8.	8.	8.	8.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT													
+	CCA05p	.02	1	FLOW	28.	27.	26.	25.	25.	25.	25.	13.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	DRA05e	.00	1	FLOW	52.	51.	49.	47.	47.	46.	46.	24.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DRA05f	.00	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT													
+	CCA05-3	.02	1	FLOW	86.	84.	81.	79.	77.	77.	76.	40.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05-3	.02	1	FLOW	79.	77.	75.	72.	71.	71.	70.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCCA053	.02	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05-2	.11	1	FLOW	84.	82.	79.	77.	75.	75.	74.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05-2a	.86	1	FLOW	514.	502.	500.	498.	497.	496.	496.	340.
				TIME	3.58	3.67	3.67	3.67	3.67	3.67	3.67	3.92
HYDROGRAPH AT													
+	CHAR	.04	1	FLOW	43.	43.	43.	43.	43.	43.	43.	43.
				TIME	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42
ROUTED TO													
+	RCHAR	.04	1	FLOW	44.	44.	44.	44.	44.	44.	44.	44.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	CH70-C	.14	1	FLOW	165.	162.	156.	151.	149.	148.	147.	79.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCHAR	.17	1	FLOW	206.	203.	198.	192.	190.	189.	188.	121.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO													
+	RCCHAR	.17	1	FLOW	205.	202.	197.	192.	190.	188.	187.	120.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT													
+	CA05m	.00	1	FLOW	8.	8.	7.	7.	7.	7.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05n	.18	1	FLOW	210.	206.	201.	196.	194.	192.	191.	122.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO													
+	RCCA05m	.18	1	FLOW	208.	205.	199.	194.	192.	191.	190.	121.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCA05-4	1.04	1	FLOW	699.	695.	688.	681.	678.	676.	674.	450.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													

+	CA05n	.00	1	FLOW	6.	6.	6.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05q	.01	1	FLOW	12.	11.	11.	10.	10.	10.	10.	4.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA05q	.02	1	FLOW	17.	17.	16.	16.	15.	15.	15.	6.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05	1.06	1	FLOW	715.	710.	702.	694.	692.	689.	687.	454.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.83
ROUTED TO												
+	RCCA05	1.06	1	FLOW	713.	708.	701.	693.	690.	688.	686.	449.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT												
+	CA06-C	.41	1	FLOW	255.	248.	237.	226.	222.	219.	217.	83.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT												
+	CH59-C	.21	1	FLOW	246.	242.	234.	227.	224.	222.	221.	124.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO												
+	DFLAM	.21	1	FLOW	102.	98.	90.	83.	80.	78.	77.	0.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	.00
HYDROGRAPH AT												
+	DCH58-C	.21	1	FLOW	144.	144.	144.	144.	144.	144.	144.	124.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.83
ROUTED TO												
+	RDCH58	.21	1	FLOW	149.	147.	147.	148.	148.	148.	148.	125.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT												
+	CH58-C	.13	1	FLOW	156.	153.	149.	144.	142.	141.	140.	77.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCH58-C	.34	1	FLOW	302.	299.	295.	292.	290.	289.	288.	194.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO												
+	DBN03	.34	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	DDCH59-C	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
DIVERSION TO												
+	DBN03a	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
HYDROGRAPH AT												
+	DDCH59	.34	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	.00	.00	.00	.00	.00	.00	.00	.00
HYDROGRAPH AT												
+	BN06-C	.34	1	FLOW	420.	411.	396.	382.	376.	371.	368.	179.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT												
+	BN03-C	.54	1	FLOW	496.	485.	466.	448.	440.	435.	431.	197.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	DBN03	.00	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
ROUTED TO												
+	RDBN03	.00	1	FLOW	139.	144.	148.	119.	121.	122.	123.	27.
				TIME	3.92	3.92	3.83	3.92	3.92	3.92	3.92	4.08
3 COMBINED AT												
+	CBN03	.88	1	FLOW	868.	862.	873.	817.	807.	798.	790.	353.
				TIME	3.67	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO												
+	RCBN03	.88	1	FLOW	861.	853.	852.	803.	794.	783.	778.	353.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT												
+	BN08	.21	1	FLOW	220.	216.	209.	202.	199.	197.	196.	103.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT												
+	CBN08	1.09	1	FLOW	1082.	1069.	1061.	1005.	994.	980.	974.	453.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75

ROUTED TO												
+	RCBN08	1.09	1	FLOW	1080.	1065.	1050.	998.	987.	974.	966.	445.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT												
+	BN09	.23	1	FLOW	167.	163.	156.	149.	146.	144.	143.	59.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT												
+	CBN09	1.32	1	FLOW	1247.	1228.	1206.	1147.	1133.	1118.	1109.	499.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
DIVERSION TO												
+	DBN09a	1.32	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	DBN09	1.32	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCBN09	1.66	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCA06-1	2.07	1	FLOW	457.	450.	439.	428.	424.	421.	419.	285.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
2 COMBINED AT												
+	CCA06	3.13	1	FLOW	1138.	1128.	1110.	1092.	1085.	1080.	1077.	733.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA06	3.13	1	FLOW	1136.	1126.	1108.	1090.	1083.	1078.	1075.	731.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA08	.07	1	FLOW	71.	69.	66.	63.	62.	61.	61.	26.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT												
+	CA08a	.05	1	FLOW	58.	56.	54.	52.	52.	51.	51.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT												
+	CCA08	3.25	1	FLOW	1238.	1224.	1203.	1181.	1173.	1167.	1163.	764.
				TIME	3.75	3.75	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA08	3.25	1	FLOW	1237.	1224.	1203.	1181.	1172.	1166.	1162.	760.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA09	.05	1	FLOW	58.	57.	55.	53.	52.	52.	51.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA09	3.30	1	FLOW	1280.	1267.	1243.	1220.	1210.	1204.	1200.	775.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA09	3.30	1	FLOW	1279.	1265.	1242.	1218.	1207.	1201.	1198.	770.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA10	.03	1	FLOW	44.	43.	42.	41.	40.	40.	39.	22.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA10	3.33	1	FLOW	1310.	1296.	1272.	1247.	1236.	1229.	1226.	782.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA10	3.33	1	FLOW	1304.	1289.	1265.	1239.	1226.	1218.	1214.	775.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA11	.09	1	FLOW	103.	101.	97.	94.	92.	91.	91.	46.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCA11	3.42	1	FLOW	1397.	1380.	1353.	1324.	1310.	1301.	1297.	806.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA11	3.42	1	FLOW	1389.	1371.	1344.	1313.	1298.	1288.	1284.	804.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA12	.06	1	FLOW	86.	85.	82.	80.	79.	78.	77.	43.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA12	3.49	1	FLOW	1456.	1437.	1407.	1375.	1359.	1349.	1344.	825.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00

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 ROUTED TO
+                RCCA12      3.49     1   FLOW        1445.    1426.    1396.    1362.    1343.    1334.    1330.     824.
                                          TIME         3.83     3.83     3.83     3.83     3.83     3.92     3.92     4.00

 HYDROGRAPH AT
+                  CA13       .06     1   FLOW          95.      93.      91.      88.      87.      86.      86.      50.
                                          TIME         3.67     3.67     3.67     3.67     3.67     3.67     3.67     3.67

  2 COMBINED AT
+                 CCA13      3.55     1   FLOW        1518.    1498.    1466.    1430.    1410.    1401.    1395.     848.
                                          TIME         3.83     3.83     3.83     3.83     3.83     3.83     3.83     4.00

 ROUTED TO
+                RCCA13      3.55     1   FLOW        1496.    1476.    1448.    1415.    1398.    1389.    1384.     843.
                                          TIME         3.92     3.92     3.92     3.92     3.92     3.92     3.92     4.00

 HYDROGRAPH AT
+                  CA14       .05     1   FLOW          85.      83.      81.      79.      78.      77.      77.      47.
                                          TIME         3.67     3.67     3.67     3.67     3.67     3.67     3.67     3.67

  2 COMBINED AT
+                 CCA14      3.61     1   FLOW        1557.    1535.    1499.    1459.    1442.    1432.    1428.     863.
                                          TIME         3.83     3.83     3.83     3.92     3.92     3.92     3.92     4.00

 HYDROGRAPH AT
+                DRDTA05       .00     1   FLOW          79.      77.      75.      72.      71.      71.      70.      37.
                                          TIME         3.58     3.58     3.58     3.58     3.58     3.58     3.58     3.58

 HYDROGRAPH AT
+                DRDSTEW       .00     1   FLOW         321.     315.     284.     255.     252.     246.     244.       0.
                                          TIME         3.83     3.83     3.83     3.83     3.83     3.83     3.83      .00

  2 COMBINED AT
+                CSTEWBY       .00     1   FLOW         364.     357.     325.     294.     290.     285.     283.      37.
                                          TIME         3.83     3.83     3.83     3.83     3.83     3.83     3.83     3.58
1
                                      SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
                                          (FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)
                                                                                    INTERPOLATED TO
                                                                                  COMPUTATION INTERVAL
            ISTAQ    ELEMENT      DT       PEAK    TIME TO     VOLUME      DT       PEAK    TIME TO     VOLUME
                                                      PEAK                                    PEAK

                                  (MIN)     (CFS)      (MIN)     (IN)     (MIN)     (CFS)     (MIN)       (IN)

          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.01    214.35    222.58      1.58      5.00    210.67    225.00        1.58


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1651E+02 EXCESS= .0000E+00 OUTFLOW= .1651E+02 BASIN STORAGE= .6123E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.02    207.43    223.82      1.54      5.00    205.18    225.00        1.54


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1614E+02 EXCESS= .0000E+00 OUTFLOW= .1614E+02 BASIN STORAGE= .6428E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.05    202.14    222.91      1.48      5.00    198.71    225.00        1.48


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1551E+02 EXCESS= .0000E+00 OUTFLOW= .1551E+02 BASIN STORAGE= .5685E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.08    193.56    222.04      1.42      5.00    190.55    225.00        1.42


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1489E+02 EXCESS= .0000E+00 OUTFLOW= .1489E+02 BASIN STORAGE= .6849E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.10    191.29    222.94      1.40      5.00    188.06    225.00        1.40


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1464E+02 EXCESS= .0000E+00 OUTFLOW= .1464E+02 BASIN STORAGE= .7695E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.11    187.84    223.58      1.38      5.00    185.46    225.00        1.38


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1446E+02 EXCESS= .0000E+00 OUTFLOW= .1447E+02 BASIN STORAGE= .6824E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.11    185.03    224.05      1.37      5.00    183.37    225.00        1.37


 CONTINUITY SUMMARY (AC-FT) - INFLOW= .1434E+02 EXCESS= .0000E+00 OUTFLOW= .1434E+02 BASIN STORAGE= .6084E-03 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
            RCCA03  MANE         3.77     86.22    222.19       .63      5.00     86.13    225.00         .63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6604E+01 EXCESS= .0000E+00 OUTFLOW= .6605E+01 BASIN STORAGE= .5828E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.65    272.99    227.61      1.58      5.00    271.38    225.00        1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2158E+02 EXCESS= .0000E+00 OUTFLOW= .2158E+02 BASIN STORAGE= .1072E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.67    271.88    224.20      1.55      5.00    270.39    225.00        1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2116E+02 EXCESS= .0000E+00 OUTFLOW= .2117E+02 BASIN STORAGE= .1322E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.71    260.73    226.28      1.49      5.00    256.48    225.00        1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2030E+02 EXCESS= .0000E+00 OUTFLOW= .2031E+02 BASIN STORAGE= .1397E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.77    249.01    224.07      1.43      5.00    248.18    225.00        1.43

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1951E+02 EXCESS= .0000E+00 OUTFLOW= .1951E+02 BASIN STORAGE= .1361E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.78    249.56    224.75      1.41      5.00    249.10    225.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1922E+02 EXCESS= .0000E+00 OUTFLOW= .1923E+02 BASIN STORAGE= .1142E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.80    245.35    225.49      1.39      5.00    243.07    225.00        1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1896E+02 EXCESS= .0000E+00 OUTFLOW= .1897E+02 BASIN STORAGE= .1033E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        4.81    241.94    226.01      1.38      5.00    238.21    225.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1878E+02 EXCESS= .0000E+00 OUTFLOW= .1879E+02 BASIN STORAGE= .9380E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04b  MANE        5.00    112.72    230.00       .63      5.00    112.72    230.00         .63

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8665E+01 EXCESS= .0000E+00 OUTFLOW= .8669E+01 BASIN STORAGE= .1337E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCA04g  MANE         3.75     78.66    225.00      1.95      5.00     78.66    225.00        1.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5415E+01 EXCESS= .0000E+00 OUTFLOW= .5422E+01 BASIN STORAGE= .1736E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCA04g  MANE         3.75     77.21    225.00      1.92      5.00     77.21    225.00        1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5307E+01 EXCESS= .0000E+00 OUTFLOW= .5313E+01 BASIN STORAGE= .1720E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCA04g  MANE         3.75     74.80    225.00      1.85      5.00     74.80    225.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5127E+01 EXCESS= .0000E+00 OUTFLOW= .5133E+01 BASIN STORAGE= .1693E-02 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
              RCA04g  MANE         4.00     71.83    224.00      1.79      5.00     71.07    225.00        1.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4948E+01 EXCESS= .0000E+00 OUTFLOW= .4955E+01 BASIN STORAGE= .1801E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
              RCA04g  MANE         4.00     70.84    224.00      1.76      5.00     70.11    225.00        1.76
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .4876E+01 EXCESS= .0000E+00 OUTFLOW= .4884E+01 BASIN STORAGE= .1789E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         4.00     70.15    224.00      1.74      5.00     69.44    225.00        1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4826E+01 EXCESS= .0000E+00 OUTFLOW= .4833E+01 BASIN STORAGE= .1780E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         4.25     69.31    225.25      1.73      5.00     69.11    225.00        1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4787E+01 EXCESS= .0000E+00 OUTFLOW= .4794E+01 BASIN STORAGE= .1838E-02 PERCENT ERROR=   -.2


          FOR PLAN = 1  RATIO=  .00
            RCA04g  MANE         5.00     37.92    225.00       .90      5.00     37.92    225.00         .90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2480E+01 EXCESS= .0000E+00 OUTFLOW= .2485E+01 BASIN STORAGE= .1892E-02 PERCENT ERROR=   -.3


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    142.13    230.00      1.90      5.00    142.13    230.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1054E+02 EXCESS= .0000E+00 OUTFLOW= .1055E+02 BASIN STORAGE= .1760E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    139.29    230.00      1.86      5.00    139.29    230.00        1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1033E+02 EXCESS= .0000E+00 OUTFLOW= .1034E+02 BASIN STORAGE= .1881E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    134.72    230.00      1.80      5.00    134.72    230.00        1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9974E+01 EXCESS= .0000E+00 OUTFLOW= .9979E+01 BASIN STORAGE= .1818E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    129.42    230.00      1.74      5.00    129.42    230.00        1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9625E+01 EXCESS= .0000E+00 OUTFLOW= .9631E+01 BASIN STORAGE= .2290E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    127.58    230.00      1.71      5.00    127.58    230.00        1.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9483E+01 EXCESS= .0000E+00 OUTFLOW= .9489E+01 BASIN STORAGE= .2277E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    126.30    230.00      1.69      5.00    126.30    230.00        1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9384E+01 EXCESS= .0000E+00 OUTFLOW= .9389E+01 BASIN STORAGE= .2269E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00    125.09    230.00      1.68      5.00    125.09    230.00        1.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9314E+01 EXCESS= .0000E+00 OUTFLOW= .9320E+01 BASIN STORAGE= .1672E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCA04d  MANE         5.00     64.16    235.00       .86      5.00     64.16    235.00         .86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4751E+01 EXCESS= .0000E+00 OUTFLOW= .4753E+01 BASIN STORAGE= .1709E-02 PERCENT ERROR=   -.1


          FOR PLAN = 1  RATIO=  .00
            RCCA04e  MANE        4.85    329.94    232.90      1.80      5.00    321.01    235.00        1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2826E+02 EXCESS= .0000E+00 OUTFLOW= .2826E+02 BASIN STORAGE= .1149E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA04e  MANE        4.88    323.06    234.09      1.76      5.00    318.94    230.00        1.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2767E+02 EXCESS= .0000E+00 OUTFLOW= .2767E+02 BASIN STORAGE= .1292E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
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          RCCA04e  MANE         4.92    312.30    231.19      1.70      5.00    306.32    235.00        1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2669E+02 EXCESS= .0000E+00 OUTFLOW= .2669E+02 BASIN STORAGE= .1408E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCA04e  MANE         4.97    300.87    233.39      1.64      5.00    294.28    235.00        1.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2571E+02 EXCESS= .0000E+00 OUTFLOW= .2571E+02 BASIN STORAGE= .1230E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCA04e  MANE         4.98    296.45    234.25      1.61      5.00    292.72    235.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2531E+02 EXCESS= .0000E+00 OUTFLOW= .2532E+02 BASIN STORAGE= .1061E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCA04e  MANE         5.00    293.42    234.86      1.60      5.00    292.62    235.00        1.60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2504E+02 EXCESS= .0000E+00 OUTFLOW= .2504E+02 BASIN STORAGE= .1471E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCA04e  MANE         5.00    290.93    235.00      1.58      5.00    290.93    235.00        1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2485E+02 EXCESS= .0000E+00 OUTFLOW= .2485E+02 BASIN STORAGE= .1559E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
          RCCA04e  MANE         5.00    147.28    235.00       .79      5.00    147.28    235.00         .79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1231E+02 EXCESS= .0000E+00 OUTFLOW= .1231E+02 BASIN STORAGE= .1434E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.56    680.74    232.35      1.70      5.00    669.09    230.00        1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6054E+02 EXCESS= .0000E+00 OUTFLOW= .6055E+02 BASIN STORAGE= .1200E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.57    672.26    233.08      1.67      5.00    664.12    230.00        1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5942E+02 EXCESS= .0000E+00 OUTFLOW= .5942E+02 BASIN STORAGE= .1419E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.62    644.44    230.78      1.61      5.00    636.64    235.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5725E+02 EXCESS= .0000E+00 OUTFLOW= .5726E+02 BASIN STORAGE= .1407E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.66    620.28    233.07      1.55      5.00    609.06    230.00        1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5497E+02 EXCESS= .0000E+00 OUTFLOW= .5498E+02 BASIN STORAGE= .1216E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.67    617.58    233.35      1.53      5.00    607.02    230.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5422E+02 EXCESS= .0000E+00 OUTFLOW= .5423E+02 BASIN STORAGE= .1179E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.67    613.46    233.67      1.51      5.00    602.44    230.00        1.51

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5363E+02 EXCESS= .0000E+00 OUTFLOW= .5364E+02 BASIN STORAGE= .1629E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.69    607.93    234.27      1.50      5.00    601.06    230.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5324E+02 EXCESS= .0000E+00 OUTFLOW= .5325E+02 BASIN STORAGE= .1584E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         5.00    291.91    235.00       .72      5.00    291.91    235.00         .72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2563E+02 EXCESS= .0000E+00 OUTFLOW= .2563E+02 BASIN STORAGE= .1176E-02 PERCENT ERROR=    .0
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FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.30 35.05 217.61 1.91 5.00 33.79 215.00 1.91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2343E+01 EXCESS= .0000E+00 OUTFLOW= .2343E+01 BASIN STORAGE= .5146E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.31 34.06 218.65 1.87 5.00 33.22 215.00 1.87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2295E+01 EXCESS= .0000E+00 OUTFLOW= .2296E+01 BASIN STORAGE= .4096E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.34 33.22 217.11 1.81 5.00 31.97 215.00 1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2216E+01 EXCESS= .0000E+00 OUTFLOW= .2217E+01 BASIN STORAGE= .4067E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.37 31.63 218.95 1.74 5.00 30.91 215.00 1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2137E+01 EXCESS= .0000E+00 OUTFLOW= .2138E+01 BASIN STORAGE= .4000E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.38 31.40 216.33 1.72 5.00 30.40 215.00 1.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2106E+01 EXCESS= .0000E+00 OUTFLOW= .2106E+01 BASIN STORAGE= .4997E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.39 31.33 216.86 1.70 5.00 30.15 215.00 1.70

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2084E+01 EXCESS= .0000E+00 OUTFLOW= .2085E+01 BASIN STORAGE= .4402E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.39 31.15 217.24 1.69 5.00 29.90 215.00 1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2068E+01 EXCESS= .0000E+00 OUTFLOW= .2068E+01 BASIN STORAGE= .4073E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCA05c MANE 3.98 16.64 218.67 .86 5.00 16.08 220.00 .86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1057E+01 EXCESS= .0000E+00 OUTFLOW= .1058E+01 BASIN STORAGE= .4453E-03 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCCA05f MANE 1.30 51.68 216.64 .89 5.00 50.21 215.00 .89

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3690E+01 EXCESS= .0000E+00 OUTFLOW= .3690E+01 BASIN STORAGE= .1110E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCCA05f MANE 1.30 50.65 216.15 .87 5.00 49.31 215.00 .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3615E+01 EXCESS= .0000E+00 OUTFLOW= .3615E+01 BASIN STORAGE= .1242E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCCA05f MANE 1.31 49.07 216.35 .84 5.00 47.67 215.00 .84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3490E+01 EXCESS= .0000E+00 OUTFLOW= .3489E+01 BASIN STORAGE= .1192E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCCA05f MANE 1.32 47.38 216.53 .81 5.00 45.95 215.00 .81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3365E+01 EXCESS= .0000E+00 OUTFLOW= .3364E+01 BASIN STORAGE= .1150E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCCA05f MANE 1.32 46.55 217.17 .80 5.00 45.21 215.00 .80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3314E+01 EXCESS= .0000E+00 OUTFLOW= .3314E+01 BASIN STORAGE= .1155E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCCA05f MANE 1.33 46.22 216.26 .79 5.00 44.89 215.00 .79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3280E+01 EXCESS= .0000E+00 OUTFLOW= .3279E+01 BASIN STORAGE= .1212E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.33	45.88	216.59	.78	5.00	44.49	215.00	.78	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3255E+01 EXCESS= .0000E+00 OUTFLOW= .3254E+01 BASIN STORAGE= .1135E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.51	23.98	218.02	.40	5.00	23.38	220.00	.40	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1655E+01 EXCESS= .0000E+00 OUTFLOW= .1655E+01 BASIN STORAGE= .1214E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.24	206.04	222.63	1.94	5.00	205.02	225.00	1.94	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1792E+02 EXCESS= .0000E+00 OUTFLOW= .1792E+02 BASIN STORAGE= .1417E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.25	202.76	222.05	1.91	5.00	201.75	225.00	1.91	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1764E+02 EXCESS= .0000E+00 OUTFLOW= .1764E+02 BASIN STORAGE= .1373E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.25	197.56	221.93	1.85	5.00	196.63	225.00	1.86	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1716E+02 EXCESS= .0000E+00 OUTFLOW= .1716E+02 BASIN STORAGE= .1376E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.26	192.38	221.84	1.80	5.00	191.53	225.00	1.80	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1668E+02 EXCESS= .0000E+00 OUTFLOW= .1668E+02 BASIN STORAGE= .1374E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.26	190.71	222.31	1.78	5.00	189.68	225.00	1.78	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1650E+02 EXCESS= .0000E+00 OUTFLOW= .1649E+02 BASIN STORAGE= .1420E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.27	189.33	222.64	1.77	5.00	188.27	225.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1636E+02 EXCESS= .0000E+00 OUTFLOW= .1636E+02 BASIN STORAGE= .1493E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.27	188.06	222.88	1.76	5.00	187.09	225.00	1.76	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1627E+02 EXCESS= .0000E+00 OUTFLOW= .1626E+02 BASIN STORAGE= .1421E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCHAR	MANE	1.38	120.75	222.82	1.09	5.00	119.54	225.00	1.10	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1013E+02 EXCESS= .0000E+00 OUTFLOW= .1013E+02 BASIN STORAGE= .1455E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.85	208.12	223.86	1.94	5.00	208.06	225.00	1.94	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1843E+02 EXCESS= .0000E+00 OUTFLOW= .1843E+02 BASIN STORAGE= .2390E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.86	204.90	224.59	1.90	5.00	204.88	225.00	1.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1813E+02 EXCESS= .0000E+00 OUTFLOW= .1813E+02 BASIN STORAGE= .2450E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.87	199.56	223.89	1.85	5.00	199.48	225.00	1.85	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1764E+02 EXCESS= .0000E+00 OUTFLOW= .1764E+02 BASIN STORAGE= .2295E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.88	194.50	225.07	1.80	5.00	194.46	225.00	1.80	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1715E+02 EXCESS= .0000E+00 OUTFLOW= .1714E+02 BASIN STORAGE= .2114E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.88	192.34	225.51	1.78	5.00	192.32	225.00	1.78	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1695E+02 EXCESS= .0000E+00 OUTFLOW= .1695E+02 BASIN STORAGE= .2350E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.88	191.09	223.97	1.77	5.00	190.98	225.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1681E+02 EXCESS= .0000E+00 OUTFLOW= .1681E+02 BASIN STORAGE= .2181E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	1.88	189.90	224.25	1.76	5.00	189.84	225.00	1.76	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1671E+02 EXCESS= .0000E+00 OUTFLOW= .1671E+02 BASIN STORAGE= .2037E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05m	MANE	2.06	121.16	224.80	1.09	5.00	121.13	225.00	1.09	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1036E+02 EXCESS= .0000E+00 OUTFLOW= .1036E+02 BASIN STORAGE= .2306E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.02	715.09	221.59	1.50	5.00	712.99	225.00	1.50	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8460E+02 EXCESS= .0000E+00 OUTFLOW= .8460E+02 BASIN STORAGE= .1676E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.02	710.11	221.19	1.47	5.00	708.28	225.00	1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8336E+02 EXCESS= .0000E+00 OUTFLOW= .8336E+02 BASIN STORAGE= .1604E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.03	702.40	222.18	1.44	5.00	700.60	225.00	1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8144E+02 EXCESS= .0000E+00 OUTFLOW= .8143E+02 BASIN STORAGE= .1607E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.03	694.94	222.16	1.40	5.00	693.03	225.00	1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7905E+02 EXCESS= .0000E+00 OUTFLOW= .7905E+02 BASIN STORAGE= .1561E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.04	691.66	221.49	1.38	5.00	690.05	225.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7814E+02 EXCESS= .0000E+00 OUTFLOW= .7814E+02 BASIN STORAGE= .1619E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.04	689.83	221.79	1.37	5.00	688.14	225.00	1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7753E+02 EXCESS= .0000E+00 OUTFLOW= .7753E+02 BASIN STORAGE= .1721E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.04	688.28	222.04	1.36	5.00	686.36	225.00	1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7718E+02 EXCESS= .0000E+00 OUTFLOW= .7718E+02 BASIN STORAGE= .1667E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05	MANE	1.22	453.22	231.50	.76	5.00	448.54	235.00	.76

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4295E+02 EXCESS= .0000E+00 OUTFLOW= .4295E+02 BASIN STORAGE= .1599E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.50	220.00	1.85	5.00	148.50	220.00	1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2104E+02 EXCESS= .0000E+00 OUTFLOW= .2104E+02 BASIN STORAGE= .7182E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	147.32	220.00	1.83	5.00	147.32	220.00	1.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2077E+02 EXCESS= .0000E+00 OUTFLOW= .2076E+02 BASIN STORAGE= .7096E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	146.84	225.00	1.79	5.00	146.84	225.00	1.79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2031E+02 EXCESS= .0000E+00 OUTFLOW= .2030E+02 BASIN STORAGE= .6953E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	147.70	225.00	1.75	5.00	147.70	225.00	1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1985E+02 EXCESS= .0000E+00 OUTFLOW= .1985E+02 BASIN STORAGE= .6809E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.04	225.00	1.73	5.00	148.04	225.00	1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1967E+02 EXCESS= .0000E+00 OUTFLOW= .1966E+02 BASIN STORAGE= .6751E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.28	225.00	1.72	5.00	148.28	225.00	1.72

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1954E+02 EXCESS= .0000E+00 OUTFLOW= .1954E+02 BASIN STORAGE= .6710E-03 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .00
            RDCH58  MANE         5.00    148.46    225.00      1.71      5.00    148.46    225.00        1.71


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1945E+02 EXCESS= .0000E+00 OUTFLOW= .1944E+02 BASIN STORAGE= .6681E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RDCH58  MANE         5.00    125.19    235.00      1.04      5.00    125.19    235.00        1.04


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1180E+02 EXCESS= .0000E+00 OUTFLOW= .1179E+02 BASIN STORAGE= .9285E-03 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE         1.00    157.21    232.00     -1.00      5.00    138.67    235.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE         1.00    158.34    232.00     -1.00      5.00    144.32    235.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE         1.00    151.40    233.00     -1.00      5.00    147.96    230.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE          .75    136.60    231.75     -1.00      5.00    119.31    235.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE          .75    135.85    232.50     -1.00      5.00    121.02    235.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE          .75    138.90    232.50     -1.00      5.00    122.17    235.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE          .75    139.64    232.50     -1.00      5.00    122.80    235.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RDBN03  MANE          .50     37.75    245.50     -1.00      5.00     27.17    245.00       -1.00


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.68    866.89    221.60      1.70      5.00    861.29    230.00        1.71


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7993E+02 EXCESS= .0000E+00 OUTFLOW= .7993E+02 BASIN STORAGE= .3011E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.68    855.96    230.61      1.67      5.00    852.94    230.00        1.67


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7828E+02 EXCESS= .0000E+00 OUTFLOW= .7828E+02 BASIN STORAGE= .3203E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.68    860.43    231.19      1.61      5.00    851.77    230.00        1.61


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7536E+02 EXCESS= .0000E+00 OUTFLOW= .7536E+02 BASIN STORAGE= .3272E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.72    807.10    230.52      1.54      5.00    802.66    230.00        1.54


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7227E+02 EXCESS= .0000E+00 OUTFLOW= .7227E+02 BASIN STORAGE= .3142E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.73    798.71    231.57      1.52      5.00    794.48    230.00        1.52


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7110E+02 EXCESS= .0000E+00 OUTFLOW= .7110E+02 BASIN STORAGE= .2925E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.74    788.84    230.91      1.50      5.00    782.60    230.00        1.50


CONTINUITY SUMMARY (AC-FT) - INFLOW= .7026E+02 EXCESS= .0000E+00 OUTFLOW= .7027E+02 BASIN STORAGE= .2809E-02 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         1.74    779.81    231.88      1.49      5.00    778.15    230.00        1.49


CONTINUITY SUMMARY (AC-FT) - INFLOW= .6966E+02 EXCESS= .0000E+00 OUTFLOW= .6967E+02 BASIN STORAGE= .3284E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN03  MANE         2.41    354.20    223.74       .65      5.00    352.78    225.00         .65


CONTINUITY SUMMARY (AC-FT) - INFLOW= .3055E+02 EXCESS= .0000E+00 OUTFLOW= .3055E+02 BASIN STORAGE= .2984E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.27   1080.00    230.00      1.74      5.00   1080.00    230.00        1.74


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1012E+03 EXCESS= .0000E+00 OUTFLOW= .1012E+03 BASIN STORAGE= .2419E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.28   1065.17    231.08      1.71      5.00   1065.09    230.00        1.71


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9916E+02 EXCESS= .0000E+00 OUTFLOW= .9916E+02 BASIN STORAGE= .2506E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.28   1053.18    230.51      1.64      5.00   1049.79    230.00        1.65


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9551E+02 EXCESS= .0000E+00 OUTFLOW= .9551E+02 BASIN STORAGE= .2383E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.31    999.17    230.35      1.58      5.00    997.57    230.00        1.58


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9170E+02 EXCESS= .0000E+00 OUTFLOW= .9170E+02 BASIN STORAGE= .2431E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.31    988.12    231.36      1.55      5.00    986.80    230.00        1.55


CONTINUITY SUMMARY (AC-FT) - INFLOW= .9023E+02 EXCESS= .0000E+00 OUTFLOW= .9023E+02 BASIN STORAGE= .2643E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.32    975.16    231.35      1.54      5.00    973.87    230.00        1.54


CONTINUITY SUMMARY (AC-FT) - INFLOW= .8921E+02 EXCESS= .0000E+00 OUTFLOW= .8921E+02 BASIN STORAGE= .2656E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.33    968.29    230.58      1.52      5.00    965.76    230.00        1.52


CONTINUITY SUMMARY (AC-FT) - INFLOW= .8845E+02 EXCESS= .0000E+00 OUTFLOW= .8845E+02 BASIN STORAGE= .2644E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.80    452.05    226.71       .69      5.00    444.73    225.00         .69


CONTINUITY SUMMARY (AC-FT) - INFLOW= .4009E+02 EXCESS= .0000E+00 OUTFLOW= .4009E+02 BASIN STORAGE= .2375E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.91   1136.56    229.62       .97      5.00   1136.37    230.00         .97


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1619E+03 EXCESS= .0000E+00 OUTFLOW= .1619E+03 BASIN STORAGE= .1334E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.92   1125.80    230.32       .96      5.00   1125.53    230.00         .96


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1595E+03 EXCESS= .0000E+00 OUTFLOW= .1595E+03 BASIN STORAGE= .1491E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.93   1107.85    229.55       .93      5.00   1107.68    230.00         .93


CONTINUITY SUMMARY (AC-FT) - INFLOW= .1556E+03 EXCESS= .0000E+00 OUTFLOW= .1556E+03 BASIN STORAGE= .1425E-02 PERCENT ERROR=    .0


          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.94   1090.07    230.72       .91      5.00   1089.80    230.00         .91
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1512E+03 EXCESS= .0000E+00 OUTFLOW= .1512E+03 BASIN STORAGE= .1441E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.94	1082.98	229.23	.90	5.00	1082.94	230.00	.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1495E+03 EXCESS= .0000E+00 OUTFLOW= .1495E+03 BASIN STORAGE= .1309E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.95	1078.51	229.55	.89	5.00	1078.34	230.00	.89	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1483E+03 EXCESS= .0000E+00 OUTFLOW= .1483E+03 BASIN STORAGE= .1382E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	1.95	1075.02	229.80	.88	5.00	1074.91	230.00	.88	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1475E+03 EXCESS= .0000E+00 OUTFLOW= .1475E+03 BASIN STORAGE= .1467E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA06	MANE	2.20	730.90	235.18	.51	5.00	730.63	235.00	.51	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8518E+02 EXCESS= .0000E+00 OUTFLOW= .8518E+02 BASIN STORAGE= .1374E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.27	1237.49	229.25	.99	5.00	1236.60	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1716E+03 EXCESS= .0000E+00 OUTFLOW= .1716E+03 BASIN STORAGE= .9055E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.27	1224.24	228.77	.97	5.00	1224.22	230.00	.97	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1690E+03 EXCESS= .0000E+00 OUTFLOW= .1690E+03 BASIN STORAGE= .9352E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.28	1202.53	230.06	.95	5.00	1202.52	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1647E+03 EXCESS= .0000E+00 OUTFLOW= .1647E+03 BASIN STORAGE= .9408E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1180.82	230.08	.92	5.00	1180.80	230.00	.92	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1600E+03 EXCESS= .0000E+00 OUTFLOW= .1600E+03 BASIN STORAGE= .9223E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1171.92	229.31	.91	5.00	1171.53	230.00	.91	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1581E+03 EXCESS= .0000E+00 OUTFLOW= .1581E+03 BASIN STORAGE= .9560E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1166.29	229.65	.90	5.00	1165.88	230.00	.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1568E+03 EXCESS= .0000E+00 OUTFLOW= .1568E+03 BASIN STORAGE= .9627E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.29	1162.30	229.91	.90	5.00	1162.15	230.00	.90	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1560E+03 EXCESS= .0000E+00 OUTFLOW= .1560E+03 BASIN STORAGE= .8355E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.47	761.29	235.90	.51	5.00	760.08	235.00	.51	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8898E+02 EXCESS= .0000E+00 OUTFLOW= .8897E+02 BASIN STORAGE= .8349E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.23	1278.90	230.13	1.00	5.00	1278.88	230.00	1.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1761E+03 EXCESS= .0000E+00 OUTFLOW= .1761E+03 BASIN STORAGE= .8990E-03 PERCENT ERROR= .0

```
          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.23   1265.57    229.67       .99      5.00   1264.88    230.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1734E+03 EXCESS= .0000E+00 OUTFLOW= .1734E+03 BASIN STORAGE= .9791E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.24   1242.30    229.80       .96      5.00   1241.85    230.00         .96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1689E+03 EXCESS= .0000E+00 OUTFLOW= .1689E+03 BASIN STORAGE= .9337E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.25   1218.50    229.94       .93      5.00   1218.38    230.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1640E+03 EXCESS= .0000E+00 OUTFLOW= .1640E+03 BASIN STORAGE= .9065E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.25   1207.29    230.55       .92      5.00   1207.01    230.00         .92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1620E+03 EXCESS= .0000E+00 OUTFLOW= .1620E+03 BASIN STORAGE= .9105E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.25   1201.17    229.66       .91      5.00   1200.98    230.00         .91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1607E+03 EXCESS= .0000E+00 OUTFLOW= .1607E+03 BASIN STORAGE= .1035E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.26   1197.78    229.91       .91      5.00   1197.65    230.00         .91

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1598E+03 EXCESS= .0000E+00 OUTFLOW= .1598E+03 BASIN STORAGE= .9290E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA09  MANE         1.45    771.56    235.81       .52      5.00    769.67    235.00         .52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9085E+02 EXCESS= .0000E+00 OUTFLOW= .9084E+02 BASIN STORAGE= .9672E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.26   1305.66    230.49      1.01      5.00   1304.41    230.00        1.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1795E+03 EXCESS= .0000E+00 OUTFLOW= .1795E+03 BASIN STORAGE= .1764E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.27   1290.07    231.32       .99      5.00   1288.74    230.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1767E+03 EXCESS= .0000E+00 OUTFLOW= .1767E+03 BASIN STORAGE= .1821E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.28   1266.39    230.44       .97      5.00   1264.97    230.00         .97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1721E+03 EXCESS= .0000E+00 OUTFLOW= .1721E+03 BASIN STORAGE= .1756E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.30   1240.95    231.89       .94      5.00   1238.80    230.00         .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1672E+03 EXCESS= .0000E+00 OUTFLOW= .1671E+03 BASIN STORAGE= .1801E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.30   1228.05    232.59       .93      5.00   1225.74    230.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1651E+03 EXCESS= .0000E+00 OUTFLOW= .1651E+03 BASIN STORAGE= .1994E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.31   1221.15    230.67       .92      5.00   1217.93    230.00         .92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1637E+03 EXCESS= .0000E+00 OUTFLOW= .1637E+03 BASIN STORAGE= .1671E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA10  MANE         2.31   1218.02    230.89       .92      5.00   1214.32    230.00         .92
```

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1629E+03 EXCESS= .0000E+00 OUTFLOW= .1629E+03 BASIN STORAGE= .1772E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.67	778.33	237.60	.52	5.00	775.05	240.00	.52	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9245E+02 EXCESS= .0000E+00 OUTFLOW= .9244E+02 BASIN STORAGE= .2054E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.37	1392.72	230.89	1.03	5.00	1388.81	230.00	1.03	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1882E+03 EXCESS= .0000E+00 OUTFLOW= .1882E+03 BASIN STORAGE= .1017E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.37	1374.30	231.81	1.01	5.00	1371.46	230.00	1.01	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1852E+03 EXCESS= .0000E+00 OUTFLOW= .1852E+03 BASIN STORAGE= .9707E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.38	1347.56	231.87	.99	5.00	1343.55	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1803E+03 EXCESS= .0000E+00 OUTFLOW= .1803E+03 BASIN STORAGE= .9948E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.39	1317.81	232.08	.96	5.00	1312.99	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1750E+03 EXCESS= .0000E+00 OUTFLOW= .1750E+03 BASIN STORAGE= .9244E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.39	1306.44	231.48	.95	5.00	1298.14	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1728E+03 EXCESS= .0000E+00 OUTFLOW= .1728E+03 BASIN STORAGE= .1077E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.40	1296.28	231.97	.94	5.00	1288.27	230.00	.94	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1714E+03 EXCESS= .0000E+00 OUTFLOW= .1714E+03 BASIN STORAGE= .1075E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.40	1291.18	232.21	.93	5.00	1284.22	230.00	.93	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1705E+03 EXCESS= .0000E+00 OUTFLOW= .1705E+03 BASIN STORAGE= .1090E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.62	805.34	238.87	.53	5.00	804.03	240.00	.53	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9616E+02 EXCESS= .0000E+00 OUTFLOW= .9616E+02 BASIN STORAGE= .9315E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.39	1451.20	231.56	1.05	5.00	1444.66	230.00	1.05	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1952E+03 EXCESS= .0000E+00 OUTFLOW= .1952E+03 BASIN STORAGE= .1081E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.39	1432.29	231.10	1.03	5.00	1426.23	230.00	1.03	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1921E+03 EXCESS= .0000E+00 OUTFLOW= .1921E+03 BASIN STORAGE= .1127E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.40	1403.06	231.23	1.01	5.00	1395.66	230.00	1.01	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1870E+03 EXCESS= .0000E+00 OUTFLOW= .1869E+03 BASIN STORAGE= .1099E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.41	1371.26	231.53	.98	5.00	1361.57	230.00	.98	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1815E+03 EXCESS= .0000E+00 OUTFLOW= .1815E+03 BASIN STORAGE= .1027E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

```
            RCCA12  MANE         1.42   1353.42    232.36       .96      5.00   1343.27    230.00         .96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1792E+03 EXCESS= .0000E+00 OUTFLOW= .1792E+03 BASIN STORAGE= .9526E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA12  MANE         1.42   1345.80    231.50       .96      5.00   1334.35    235.00         .96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1777E+03 EXCESS= .0000E+00 OUTFLOW= .1777E+03 BASIN STORAGE= .1103E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA12  MANE         1.42   1340.77    231.74       .95      5.00   1330.02    235.00         .95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1767E+03 EXCESS= .0000E+00 OUTFLOW= .1767E+03 BASIN STORAGE= .9508E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA12  MANE         1.66    823.68    238.76       .54      5.00    823.64    240.00         .54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9953E+02 EXCESS= .0000E+00 OUTFLOW= .9952E+02 BASIN STORAGE= .9785E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.11   1508.43    232.33      1.07      5.00   1495.51    235.00        1.07

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2031E+03 EXCESS= .0000E+00 OUTFLOW= .2031E+03 BASIN STORAGE= .2053E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.12   1485.37    233.32      1.06      5.00   1476.38    235.00        1.06

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1999E+03 EXCESS= .0000E+00 OUTFLOW= .1999E+03 BASIN STORAGE= .1997E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.14   1455.33    232.88      1.03      5.00   1447.71    235.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1945E+03 EXCESS= .0000E+00 OUTFLOW= .1945E+03 BASIN STORAGE= .2234E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.15   1420.76    232.65      1.00      5.00   1414.60    235.00        1.00

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1888E+03 EXCESS= .0000E+00 OUTFLOW= .1888E+03 BASIN STORAGE= .2029E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.16   1402.16    233.68       .98      5.00   1397.79    235.00         .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1864E+03 EXCESS= .0000E+00 OUTFLOW= .1864E+03 BASIN STORAGE= .1989E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.17   1392.47    232.03       .98      5.00   1388.91    235.00         .98

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1849E+03 EXCESS= .0000E+00 OUTFLOW= .1848E+03 BASIN STORAGE= .2128E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.17   1388.22    232.34       .97      5.00   1384.45    235.00         .97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1839E+03 EXCESS= .0000E+00 OUTFLOW= .1838E+03 BASIN STORAGE= .2199E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA13  MANE         2.56    843.88    240.50       .55      5.00    842.88    240.00         .55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1036E+03 EXCESS= .0000E+00 OUTFLOW= .1036E+03 BASIN STORAGE= .1973E-02 PERCENT ERROR=    .0



*** NORMAL END OF HEC-1 ***
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Ultimate Condition HEC-1 Model

(2014 Soils)

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1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN  1998               *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   02NOV16  TIME  15:40:40  *
*                                      *
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*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
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X     X  XXXXXXX   XXXXX           X
X     X  X        X     X         XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


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          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

                    *DIAGRAM
 *** FREE ***
               1    ID    LAS VEGAS WASH CENTRAL-CEDAR AVENUE
               2    ID
               3    ID    INPUT FILE = CEDAR_ULT.DAT
               4    ID    INPUT FILE DATE =  APRIL 2014
               5    ID    DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
               6    ID    STORM DISTRIBUTION = SDN #3
               7    ID    MODELED BY ATKINS (MANOGYA KHANAL)
               8    ID    CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
               9    ID    NO STORM CENTERING
              10    ID    REFERENCED HYDROLOGIC MODELS:
              11    ID    2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
              12    ID    MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
              13    ID    CENTRAL NEIGHBORHOOD STUDY
              14    ID
              15    ID
              16    ID    JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:
              17    ID
              18    ID                        AREA       DARF
              19    ID                        SQ. MI.
              20    ID                        0-0.5     0.990
              21    ID                        0.5-1      0.975
              22    ID                        1-2       0.950
              23    ID                        2-3        0.925
              24    ID                        3-4        0.915
              25    ID                        4-5        0.908
              26    ID                        5-6        0.903
              27    ID
              28    IT       5       0       0     300
              29    IO       5       0       0
              30    IN       5       0       0
              31    JR    PREC    0.99   0.975    0.95   0.925   0.915   0.908   0.903    0.57
                    *

              32    KK   CA03a
              33    BA   0.095
              34    PB    2.77
              35    PC   0.000   0.020   0.057   0.070   0.087   0.108   0.124   0.130   0.130   0.130
              36    PC   0.130   0.130   0.130   0.133   0.140   0.142   0.148   0.158   0.172   0.181
              37    PC   0.190   0.197   0.199   0.200   0.201   0.204   0.214   0.229   0.241   0.249
              38    PC   0.251   0.256   0.270   0.278   0.281   0.283   0.295   0.322   0.352   0.409
              39    PC   0.499   0.590   0.710   0.744   0.781   0.812   0.819   0.835   0.851   0.856
              40    PC   0.860   0.868   0.876   0.888   0.910   0.926   0.937   0.950   0.970   0.976
              41    PC   0.982   0.985   0.987   0.989   0.990   0.993   0.993   0.994   0.995   0.998
              42    PC   0.998   0.999   1.000
              43    LS       0    91.2
              44    UD   0.226
                    *
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          LINE      ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

              45    KK   CA03c
              46    BA   0.022
              47    PB    2.77
```

```
 48          LS       0    91.6
 49          UD   0.230
             *

 50          KK  CCA03c
 51          KM  COMBINE CA03a AND CA03c
 52          KM  EASTERN AND STEWART
 53          HC       2
             *

 54          KK   CA03b
 55          BA   0.079
 56          PB    2.77
 57          LS       0    91.2
 58          UD   0.249
             *

 59          KK   CCA03
 60          KM  COMBINE CCA03c AND CA03b
 61          KM  EASTERN AND STEWART
 62          HC       2
             *

 63          KK  RCCA03
 64          KM  ROUTE CCA03 TO CCA04b
 65          KM  STEWART
 66          RD    1240 0.01371   0.016       0    TRAP       0      50
             *

 67          KK   CA04b
 68          BA   0.060
 69          PB    2.77
 70          LS       0    91.1
 71          UD   0.196
             *

 72          KK  CCA04b
 73          KM  COMBINE RCCA03, CA04a AND CA04b
 74          KM  STEWART AT 28th STREET
 75          HC       2
             *

 76          KK RCCA04b
 77          KM  ROUTE CCA04b TO CCA04
 78          KM  STEWART
 79          RD    1780 0.00955   0.016       0    TRAP       0      50
             *
1                                        HEC-1 INPUT                                              PAGE  3

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 80          KK   CA04a
 81          BA   0.039
 82          PB    2.77
 83          LS       0    90.2
 84          UD   0.217
             *

 85          KK   CA04c
 86          BA   0.031
 87          PB    2.77
 88          LS       0    91.1
 89          UD   0.199
             *

 90          KK CCA04-1
 91          KM  COMBINE RCCA04b, CA04a AND CA04c
 92          KM  STEWART AT MOJAVE
 93          HC       3
             *

 94          KK   CA04g
 95          BA   0.052
 96          PB    2.77
 97          LS       0    93.2
 98          UD   0.154
             *

 99          KK  RCA04g
100          KM  ROUTE CA04g TO CCA04d
101          KM  SUNRISE
102          RD    3500   0.014   0.016       0    TRAP       0      50
             *

103          KK   CA04d
104          BA   0.052
105          PB    2.77
106          LS       0    93.3
107          UD   0.186
             *

108          KK  CCA04d
109          KM  COMBINE RCA04g AND CA04d
110          KM  SUNRISE AND EASTERN
```

```
          111          HC       2
                       *

          112          KK  RCA04d
          113          KM  ROUTE CA04c TO CCA04d
          114          KM  SUNRISE
          115          RD    3050 0.01148   0.016       0    TRAP       0      50
                       *
1                                        HEC-1 INPUT                                                PAGE  4

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          116          KK   CA04e
          117          BA   0.190
          118          PB    2.77
          119          LS       0    90.5
          120          UD   0.348
                       *

          121          KK  CCA04e
          122          KM  COMBINE RCBN03 AND BN08
          123          KM  SUNRISE AND MOJAVE
          124          HC       2
                       *

          125          KK RCCA04e
          126          KM  ROUTE CCA04e TO CCA04f
          127          KM  MOJAVE
          128          RD    1360 0.00368   0.016       0    TRAP       0      50
                       *

          129          KK   CA04f
          130          BA   0.046
          131          PB    2.77
          132          LS       0    91.6
          133          UD   0.209
                       *

          134          KK  CCA04f
          135          KM  COMBINE RCCA04d AND CA04e
          136          KM  MOJAVE AT STEWART
          137          HC       2
                       *

          138          KK   CCA04
          139          KM  COMBINE CCA04 AND CCA04e
          140          KM  STEWART AT MOJAVE
          141          HC       2
                       *

          142          KK  RCCA04
          143          KM  ROUTE CCA04 TO CCA05
          144          KM  STEWART
          145          RD    2130 0.00892   0.016       0    TRAP       0      50
                       *

          146          KK   CA05a
          147          BA   0.036
          148          PB    2.77
          149          LS       0    91.0
          150          UD   0.215
                       *
1                                        HEC-1 INPUT                                                PAGE  5

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

          151          KK   CA05b
          152          BA   0.050
          153          PB    2.77
          154          LS       0    91.9
          155          UD   0.232
                       *

          156          KK CCA05-1
          157          KM  COMBINE RCCA04, CA05a AND CA05b
          158          KM  STEWART AT PECOS
          159          HC       3
          160          KO       1
                       *

          161          KK  DCCA05
          162          KM  DIVERT BYPASS FLOW ON STEWART THAT CONTINUES EAST ON STEWART
          163          KM  REMAINING FLOW IS THE FLOW COLLECTED IN INLETS
          164          DT  DSTEWQ
          165          DI       0     200     400     430     600     745     900
          166          DQ       0       0       0       0     170     315     470
                       *

          167          KK   CA05c
          168          BA   0.023
          169          PB    2.77
          170          LS       0    91.8
          171          UD   0.146
```

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                *
  172           KK  RCA05c
  173           KM  ROUTE CA05c TO CCA05e
  174           KM  SUNRISE
  175           RD     750 0.00933   0.016       0    TRAP       0      50
                *
  176           KK   CA05d
  177           BA   0.043
  178           PB    2.77
  179           LS       0    90.9
  180           UD   0.204
                *
  181           KK   CA05e
  182           BA   0.003
  183           PB    2.77
  184           LS       0    92.0
  185           UD   0.104
                *
1                                       HEC-1 INPUT                                                PAGE  6

 LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  186           KK  CCA05e
  187           KM  COMBINE RCA05d AND CA05c
  188           KM  SUNRISE AT PECOS
  189           HC       3
                *
  190           KKDTCCA05e
  191           KM  DIVERT FLOW INTO THE STREET.
  192           KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
  193           KM  AT PECOS NORTH OF SUNRISE
  194           DT  DTA05e
  195           DI       0    49.5      99
  196           DQ       0    26.5      53
                *
  197           KK   CA05f
  198           BA   0.009
  199           PB    2.77
  200           LS       0    92.0
  201           UD   0.123
                *
  202           KK DTCAO5f
  203           KM  DIVERT FLOW INTO THE STREET.
  204           KM  REMIANING WILL FLOW INTO 29"X45" RCEP.
  205           KM  AT PECOS NORTH OF SUNRISE
  206           DT  DTA05f
  207           DI       0     3.5       7
  208           DQ       0    1.75     3.5
                *
  209           KK  CCA05f
  210           KM  COMBINE RCA05e AND CA05f
  211           HC       2
                *
  212           KK RCCA05f
  213           KM  ROUTE CCA05f TO CCA05f
  214           KM  PECOS
  215           RD     820 0.00732   0.013       0    CIRC       3       0
                *
  216           KK   CA05h
  217           BA   0.003
  218           PB    2.77
  219           LS       0    92.0
  220           UD   0.101
                *
1                                       HEC-1 INPUT                                                PAGE  7

 LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  221           KK   CA05i
  222           BA   0.004
  223           PB    2.77
  224           LS       0    92.0
  225           UD   0.093
                *
  226           KK   CA05k
  227           BA   0.010
  228           PB    2.77
  229           LS       0    91.9
  230           UD   0.105
                *
  231           KK  CCA05k
  232           KM  COMBINE RCCA05f, CA05h, CA05i AND CA05k
```

```
 233          KM  UNDEVELOPED PARCEL AT STEWART AND PECOS
 234          HC       4
              *

 235          KK   CA05g
 236          BA   0.007
 237          PB    2.77
 238          LS       0    92.0
 239          UD   0.101
              *

 240          KK   CA05j
 241          BA   0.005
 242          PB    2.77
 243          LS       0    92.0
 244          UD   0.083
              *

 245          KK   CA05p
 246          BA   0.006
 247          PB    2.77
 248          LS       0    91.1
 249          UD   0.183
              *

 250          KK  CCA05p
 251          KM  COMBINE CA05g, CA05j AND CA05p
 252          KM  ON PECOS SOUTH OF STEWART
 253          HC       3
              *

 254          KK  DRA05e
 255          KM  RETURN FLOW FROM DIVERTED
 256          KM  FLOW ON THE STREET
 257          DR  DTA05e
              *
1                                   HEC-1 INPUT                                        PAGE  8

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 258          KK  DRA05f
 259          KM  RETURN FLOW FROM DIVERTED
 260          KM  FLOW ON THE STREET
 261          DR  DTA05f
              *

 262          KK CCA05-3
 263          KM  COMBINE DRA05f, DRA05e AND CCA05p
 264          KM  ON PECOS SOUTH OF STEWART
 265          HC       3
              *

 266          KKDTCCA053
 267          KM  DIVERT FLOW INTO THE STREET.
 268          KM  REMIANING WILL FLOW INTO THE DROPINTET
 269          KM  AT PECOS SOUTH OF STEWART, WEST
 270          DT DTA05-3
 271          DI       0    43.5      87
 272          DQ       0      40      80
              *

 273          KK CCA05-2
 274          KM  COMBINE CCA05-1 AND CCA05p
 275          KM  ON PECOS SOUTH OF STEWART
 276          HC       2
              *

 277          KKCCA05-2a
 278          KM  COMBINE CCA05-2 AND CCA05-1
 279          KM  ON STEWART AND PECOS
 280          HC       2
              *

 281          KK    CHAR
 282          BA  0.0365
 283          QI     0.0     0.0     0.0     0.0     0.0     0.3     0.8     1.3     1.8     1.5
 284          QI     1.3     0.8     0.5     0.5     0.5     0.8     1.0     1.3     2.3     2.8
 285          QI     3.1     2.8     2.6     2.1     1.8     1.8     2.3     3.6     3.9     3.6
 286          QI     3.6     3.6     3.6     3.6     3.6     4.6    11.3    18.0    27.0    36.0
 287          QI    42.2    43.0    39.4    33.7    27.3    17.8    14.2    11.3     9.3     8.2
 288          QI     8.5     9.3     9.8    10.0     9.8     9.0     7.7     6.4     4.9     3.9
 289          QI     3.1     2.3     1.8     1.3     1.3     1.0     1.0     0.8     0.5     0.5
 290          QI     0.3     0.3     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
 291          QI     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0     0.0
              *

 292          KK   RCHAR
 293          KM  ROUTE CHAR TO CH70-C
 294          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 295          RD    4600  0.0098   0.016       0    TRAP       0      50
              *
1                                   HEC-1 INPUT                                        PAGE  9

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10
```

```
 296          KK  CH70-C
 297          BA   0.137
 298          PB    2.77
 299          LS       0    87.8
 300          UD   0.317
              *

 301          KK   CCHAR
 302          KM  COMBINE CHAR AND CH70-C
 303          HC       2
              *

 304          KK  RCCHAR
 305          KM  ROUTE CCHAR TO CCA05-2
 306          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 307          KM  LINING = RCP
 308          RD    1250  0.0096   0.013       0    CIRC     5.5       0
              *

 309          KK   CA05m
 310          BA   0.005
 311          PB    2.77
 312          LS       0    91.5
 313          UD   0.134
              *

 314          KK  CCA05n
 315          KM  COMBINE CHAR AND CA05m
 316          KM  ON PECOS AND SUNRISE
 317          HC       2
              *

 318          KK RCCA05m
 319          KM  ROUTE CCA05n TO CCA05-2
 320          KM  LOCAL FACILITY PECOS ROAD STORM DRAIN
 321          KM  LINING = RCP
 322          RD    1580 0.00633   0.013       0    CIRC     5.5       0
              *

 323          KK CCA05-4
 324          KM  COMBINE CCA05n AND CA05m
 325          KM  ON PECOS AND SUNRISE
 326          HC       2
              *

 327          KK   CA05n
 328          BA   0.004
 329          PB    2.77
 330          LS       0    91.4
 331          UD   0.106
              *
1                                        HEC-1 INPUT                                                PAGE 10

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 332          KK   CA05q
 333          BA   0.013
 334          PB    2.77
 335          LS       0    89.4
 336          UD   0.199
              *

 337          KK  CCA05q
 338          KM  COMBINED FLOW IN EXISTING STORM DRAIN
 339          KM  STEWART AND PECOS
 340          HC       2
              *

 341          KK   CCA05
 342          KM  TOTAL FLOW ON SURFACE AND SYSTEM
 343          KM  STEWART AND PECOS
 344          HC       2
              *

 345          KK  RCCA05
 346          KM  ROUTE CCA05 TO CCA08
 347          KM  PROPOSED FACILITY IN PECOS ROAD
 348          KM  LINING = RCB
 349          RD    1310   0.005   0.013       0    TRAP      14       0
              *

 350          KK  CA06-C
 351          BA   0.407
 352          PB    2.77
 353          LS       0    86.5
 354          UD   0.465
              *

 355          KK  CH59-C
 356          BA   0.213
 357          PB    2.77
 358          LS       0    94.4
```

```
 359          UD   0.371
              *

 360          KK DCH58-C
 361          KM  FLOW SPLIT TO CH58-C
 362          KM  SPLIT TO FLAMINGO WASH SYSTEM
 363          KM  DEVELOPED FROM CWH MODEL
 364          KM  CAPACITY = 144 CFS (100 YR STORM DRAIN CAPACITY)
 365          DT   DFLAM
 366          DI       0     144    1000
 367          DQ       0       0     856
              *
1                                      HEC-1 INPUT                                                PAGE 11

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 368          KK  RDCH58
 369          KM  ROUTE DCH58-C TO CCH58-C
 370          KM  LAS VEGAS BLVD STORM DRAIN
 371          RD    5900    0.01   0.013       0    CIRC       4       0
              *

 372          KK  CH58-C
 373          BA   0.128
 374          PB    2.77
 375          LS       0    93.4
 376          UD   0.312
              *

 377          KK CCH58-C
 378          KM  COMBINE DCH58-C AND CH58-C
 379          KM  US 95
 380          HC       2
              *

 381          KKDDCH59-C
 382          KM  FLOW SPLIT TO BN03-C
 383          KM  DIVERT Q EXCEEDING LAS VEGAS BLVD DRAIN CAPACITY:  48" PIPE, 167 CFS
 384          KM  DBN00 IN CWH
 385          DT   DBN03
 386          DI       0     167    1000
 387          DQ       0       0     833
              *

 388          KK  DDCH59
 389          KM  DIVERT FLOW OUT OF PECOS/BONANZA SYSTEM
 390          DT  DBN03a
 391          DI       0     167    1000
 392          DQ       0     167    1000
              *

 393          KK  BN06-C
 394          BA   0.340
 395          PB    2.77
 396          LS       0    89.1
 397          UD   0.201
              *

 398          KK  BN03-C
 399          BA   0.539
 400          PB    2.77
 401          LS       0    87.3
 402          UD   0.344
              *
1                                      HEC-1 INPUT                                                PAGE 12

            LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 403          KK   DBN03
 404          KM  RETREIVE DBN03
 405          DR   DBN03
              *

 406          KK  RDBN03
 407          KM  ROUTE DBN03 TO CBN03
 408          KM  BONANZA
 409          RD    5900  0.0264   0.016       0    TRAP       0      50
              *

 410          KK   CBN03
 411          KM  COMBINE BN06-C, BN03-C, AND RDBN03
 412          KM  BONANZA AND EASTERN
 413          HC       3
              *

 414          KK  RCBN03
 415          KM  ROUTE CBN03 TO CBN08
 416          KM  FACILITY = LAS VEGAS WASH - BONANZA
 417          KM  FACILITY # = LVBZ 0211,0224
 418          KM  LINING = RCB
 419          RD    2980  0.0072   0.015       0    TRAP       8       0
              *
```

```
 420          KK    BN08
 421          BA   0.210
 422          PB    2.77
 423          LS       0    91.8
 424          UD   0.378
              *

 425          KK   CBN08
 426          KM  COMBINE RCBN03 AND BN08
 427          KM  BONANZA AND MOJAVE
 428          HC       2
              *

 429          KK  RCBN08
 430          KM  ROUTE CBN08 TO CBN09
 431          KM  FACILITY = LAS VEGAS WASH - BONANZA
 432          KM  FACILITY # = LVBZ 0167, 0188
 433          KM  LINING = RCB
 434          RD    2330   0.007   0.015       0    TRAP       9       0
              *

 435          KK    BN09
 436          BA   0.233
 437          PB    2.77
 438          LS       0    83.9
 439          UD   0.411
              *
1                                        HEC-1 INPUT                                          PAGE 13

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 440          KK   CBN09
 441          KM  COMBINE RCBN08 AND BN09
 442          KM  BONANZA AND PECOS
 443          HC       2
              *

 444          KK   DBN09
 445          KM  FLOW SPLIT TO PECOS
 446          KM  DIVERT Q EXCEEDING 60" PIPE, 202 CFS
 447          DT  DBN09a
 448          DI       0     202    1000    2000
 449          DQ       0       0     798    1798
              *

 450          KK  CCBN09
 451          KM  COMBINE DDCH59 AND DBN09
 452          KM  SHOULD BE THE SAME AS CBN09
 453          KM  DDCH59 HAS ZERO FLOW
 454          KM  BONANZA AND PECOS
 455          HC       2
 456          KO       1
              *

 457          KK CCA06-1
 458          KM  BONANZA FLOW AND CA06-C
 459          HC       2
              *

 460          KK   CCA06
 461          KM  CEDAR AND PECOS
 462          HC       2
              *

 463          KK  RCCA06
 464          KM  ROUTE CCA05 TO CCA08
 465          KM  FACILITY = CEDAR AVENUE CHANNEL
 466          KM  FACILITY # = CACH 0127,0129,0146,0148
 467          KM  LINING = CONCRETE
 468          RD    1545  0.0026   0.015       0    TRAP      10     1.5
              *

 469          KK    CA08
 470          BA   0.073
 471          PB    2.77
 472          LS       0    88.8
 473          UD   0.258
              *

 474          KK   CA08a
 475          BA  0.0478
 476          PB    2.77
 477          LS       0    89.1
 478          UD   0.215
              *
1                                        HEC-1 INPUT                                          PAGE 14

         LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 479          KK   CCA08
 480          KM  CEDAR AND HONOLULU
 481          HC       3
              *
```

```
482          KK  RCCA08
483          KM  ROUTE CCA08 TO CCA09
484          KM  FACILITY = CEDAR AVENUE CHANNEL
485          KM  FACILITY # = CACH 0079,0081
486          KM  LINING = CONCRETE
487          RD    1050  0.0026   0.015       0    TRAP      10     1.5
             *

488          KK    CA09
489          BA   0.048
490          PB    2.77
491          LS       0    84.2
492          UD   0.225
             *

493          KK   CCA09
494          KM  CEDAR AND SANDHILL
495          HC       2
             *

496          KK  RCCA09
497          KM  ROUTE CCA09 TO CCA10
498          KM  FACILITY = CEDAR AVENUE CHANNEL
499          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
500          KM  LINING = CONCRETE
501          RD     935   0.002   0.015       0    TRAP      12     1.5
             *

502          KK    CA10
503          BA   0.032
504          PB    2.77
505          LS       0    89.5
506          UD   0.221
             *

507          KK   CCA10
508          KM  CEDAR AVE CHANNEL
509          HC       2
             *

510          KK  RCCA10
511          KM  ROUTE CCA10 TO CCA11
512          KM  FACILITY = CEDAR AVENUE CHANNEL
513          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
514          KM  LINING = CONCRETE
515          RD    1730   0.002   0.015       0    TRAP      12     1.5
             *
```



```
LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

516          KK    CA11
517          BA   0.092
518          PB    2.77
519          LS       0    94.2
520          UD   0.288
             *

521          KK   CCA11
522          KM  CEDAR AND LAMB
523          HC       2
             *

524          KK  RCCA11
525          KM  ROUTE CCA11 TO CCA12
526          KM  FACILITY = CEDAR AVENUE CHANNEL
527          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
528          KM  LINING = CONCRETE
529          RD    1340  0.0038   0.015       0    TRAP      10     1.5
             *

530          KK    CA12
531          BA   0.062
532          PB    2.77
533          LS       0    92.8
534          UD   0.245
             *

535          KK   CCA12
536          KM  CEDAR AND PAGE
537          HC       2
             *

538          KK  RCCA12
539          KM  ROUTE CCA12 TO CCA13
540          KM  FACILITY = CEDAR AVENUE CHANNEL
541          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
542          KM  LINING = CONCRETE
543          RD    1365  0.0037   0.015       0    TRAP      10     1.5
             *

544          KK   CA13a
545          BA   0.065
```

```
 546          PB    2.77
 547          LS       0    90.4
 548          UD   0.247
              *

 549          KK  CCA13a
 550          KM  CEDAR AND MARION
 551          HC       2
              *
1                                      HEC-1 INPUT                                          PAGE 16

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 552          KK  BN10-C
 553          BA   0.257
 554          PB    2.77
 555          LS       0    88.8
 556          UD   0.406
              *

 557          KK  DBN09a
 558          KM  RETREIVE DBN09a
 559          DR  DBN09a
              *

 560          KK CBN10-C
 561          KM  COMBINE DBN09a AND BN10-C
 562          KM  BONANZA AND SANDHILL
 563          HC       2
              *

 564          KKRCBN10-C
 565          KM  ROUTE CBN10-C TO CBN12-C
 566          KM  FACILITY = LAS VEGAS WASH - BONANZA
 567          KM  FACILITY # = LVBZ 0064
 568          KM  LINING = RCB
 569          RD    2630   0.004   0.015       0    TRAP      24       0
              *

 570          KK  BN12-C
 571          BA   0.323
 572          PB    2.77
 573          LS       0    87.4
 574          UD   0.397
              *

 575          KK CBN12-C
 576          KM  COMBINE RCBN10-C AND BN12-C
 577          KM  BONANZA AND LAMB
 578          HC       2
              *

 579          KKRCBN12-C
 580          KM  ROUTE CBN12-C TO CBN15-C
 581          KM  FACILITY = LAS VEGAS WASH - BONANZA
 582          KM  FACILITY # = LVBZ 0000
 583          KM  LINING = RCB
 584          RD    2740   0.004   0.015       0    TRAP      24       0
              *

 585          KK  BN15-C
 586          BA   0.283
 587          PB    2.77
 588          LS       0    87.0
 589          UD   0.414
              *
1                                      HEC-1 INPUT                                          PAGE 17

          LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10


 590          KK CBN15-C
 591          KM  COMBINE  RCBN12-C AND BN15-C
 592          KM  LAS VEGAS WASH AND BONANZA
 593          HC       2
 594          KO       1
              *

 595          KKRCBN15-C
 596          KM  ROUTE CCBN15-C TO CCA13a
 597          KM  TO CEDAR CHANNEL FROM MARION DRIVE
 598          KM  LINING = RCB
 599          RD    1371  0.0073   0.015       0    TRAP      20       0
              *

 600          KK   CCA13
 601          KM  CEDAR CHANNEL AT MARION DRIVE
 602          KM  COMBINES FLOWS FROM CEDAR CHANNEL AND BONANZA
 603          HC       2
              *

 604          KK  RCCA13
 605          KM  ROUTE CCA13 TO CCA14
 606          KM  FACILITY = CEDAR AVENUE CHANNEL
```

```
            607          KM  FACILITY # = CACH 0000,0027,0029,0051,0053,0079
            608          KM  LINING = CONCRETE
            609          RD    1680   0.002   0.015       0    TRAP      14     1.5
                         *

            610          KK    CA14
            611          BA   0.055
            612          PB    2.77
            613          LS       0    89.1
            614          UD   0.233
                         *

            615          KK   CCA14
            616          KM  CEDAR CHANNEL AT WASH
            617          HC       2
                         *

            618          KK DRDTA05
            619          KM  RETURN FLOW FROM DIVERTED
            620          KM  FLOW ON THE STREET FROM PECOS
            621          DR DTA05-3
                         *

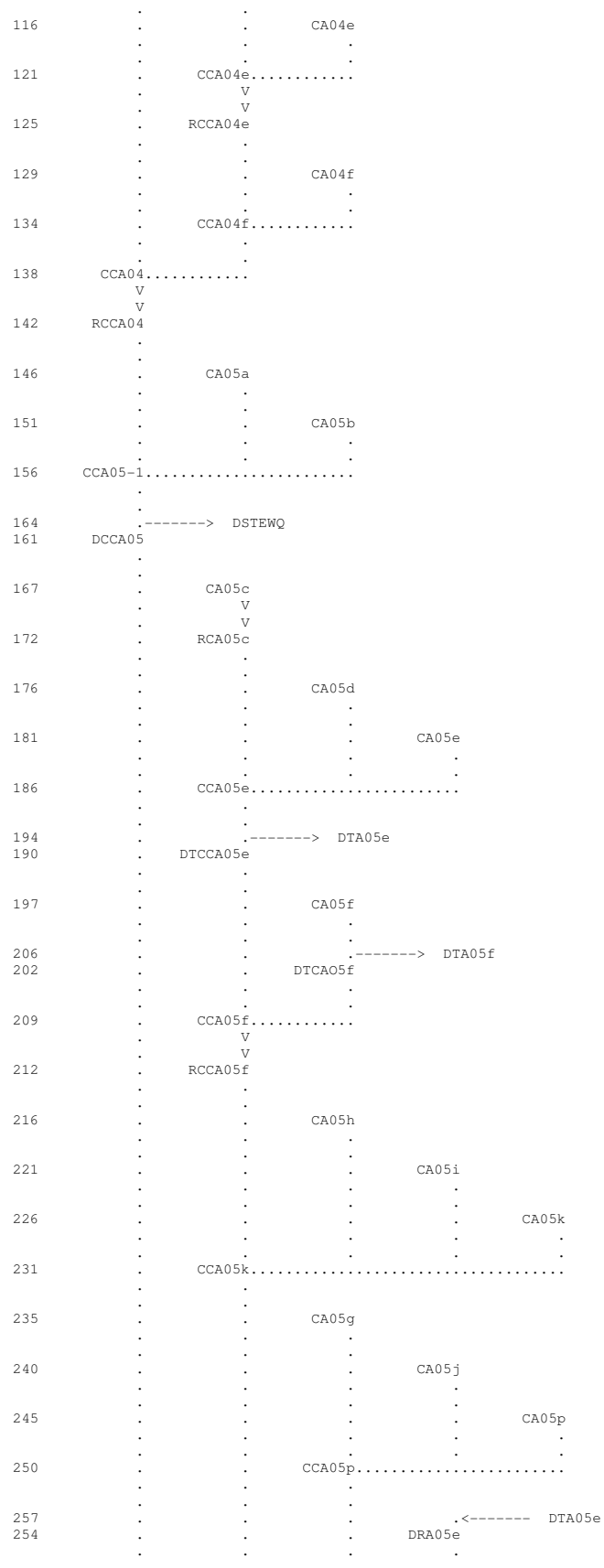
            622          KK DRDSTEW
            623          KM  RETURN FLOW FROM DIVERTED
            624          KM  FLOW ON THE STREET FROM STEWART
            625          DR  DSTEWQ
                         *
1                                                HEC-1 INPUT                                                PAGE 18

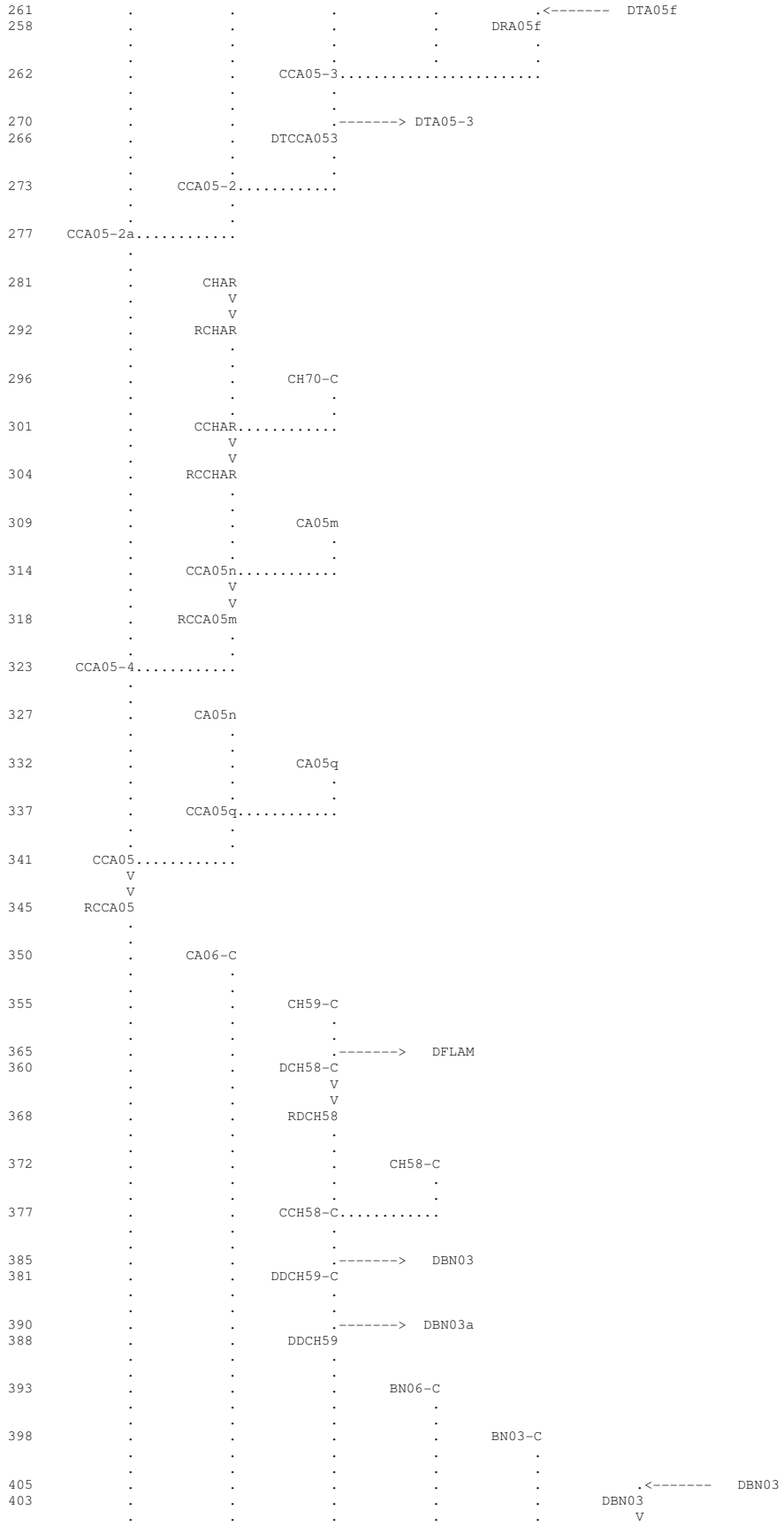
          LINE           ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

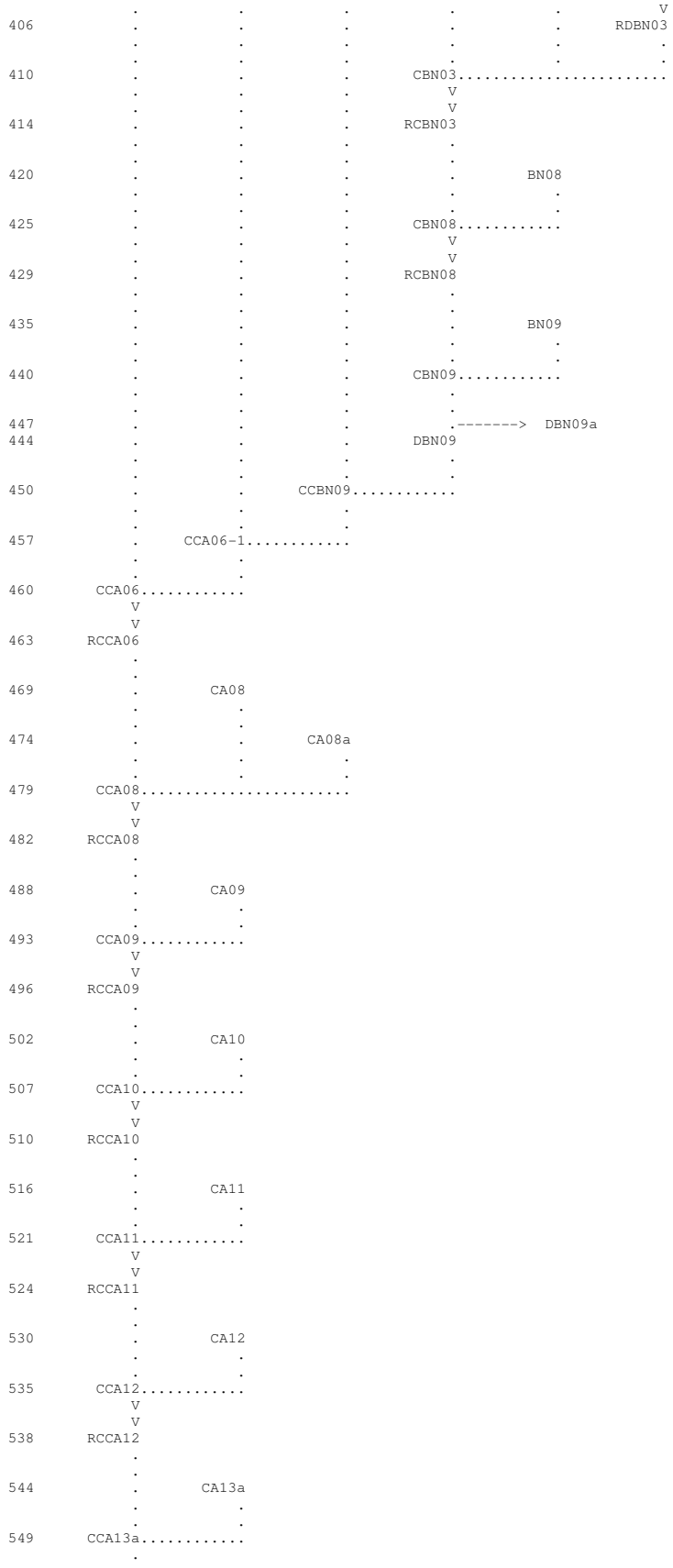

            626          KK CSTEWBY
            627          KM  BYPASS FLOW ON STEWART
            628          HC       2
                         *
            629          ZZ
1
                 SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

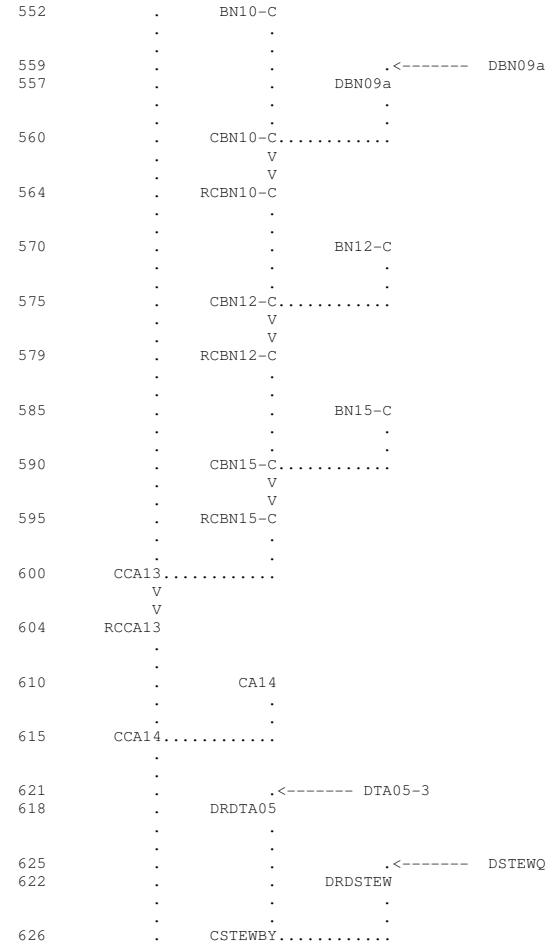
   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

     32       CA03a
                  .
                  .
     45           .       CA03c
                  .           .
                  .           .
     50      CCA03c............
                  .
                  .
     54           .       CA03b
                  .           .
                  .           .
     59       CCA03............
                  V
                  V
     63      RCCA03
                  .
                  .
     67           .       CA04b
                  .           .
                  .           .
     72      CCA04b............
                  V
                  V
     76     RCCA04b
                  .
                  .
     80           .       CA04a
                  .           .
                  .           .
     85           .           .       CA04c
                  .           .           .
                  .           .           .
     90     CCA04-1.......................
                  .
                  .
     94           .       CA04g
                  .           V
                  .           V
     99           .      RCA04g
                  .           .
                  .           .
    103           .           .       CA04d
                  .           .           .
                  .           .           .
    108           .      CCA04d............
                  .           V
                  .           V
    112           .      RCA04d
                  .           .
```


CA04e
CCA04e
RCCA04e
CA04f
CCA04f
CCA04
RCCA04
CA05a
CA05b
CCA05-1
DSTEWQ
DCCA05
CA05c
RCA05c
CA05d
CA05e
CCA05e
DTA05e
DTCCA05e
CA05f
DTA05f
DTCAO5f
CCA05f
RCCA05f
CA05h
CA05i
CA05k
CCA05k
CA05g
CA05j
CA05p
CCA05p
DTA05e
DRA05e


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350
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365
360
368
372
377
385
381
390
388
393
398
405
403
DTA05f
DRA05f
CCA05-3
DTA05-3
DTCCA053
CCA05-2
CCA05-2a
CHAR
RCHAR
CH70-C
CCHAR
RCCHAR
CA05m
CCA05n
RCCA05m
CCA05-4
CA05n
CA05q
CCA05q
CCA05
RCCA05
CA06-C
CH59-C
DFLAM
DCH58-C
RDCH58
CH58-C
CCH58-C
DBN03
DDCH59-C
DBN03a
DDCH59
BN06-C
BN03-C
DBN03
DBN03


406 RDBN03
410 CBN03
414 RCBN03
420 BN08
425 CBN08
429 RCBN08
435 BN09
440 CBN09
447 DBN09a
444 DBN09
450 CCBN09
457 CCA06-1
460 CCA06
463 RCCA06
469 CA08
474 CA08a
479 CCA08
482 RCCA08
488 CA09
493 CCA09
496 RCCA09
502 CA10
507 CCA10
510 RCCA10
516 CA11
521 CCA11
524 RCCA11
530 CA12
535 CCA12
538 RCCA12
544 CA13a
549 CCA13a



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN   1998              *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   02NOV16  TIME  15:40:40   *
*                                       *
*****************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

LAS VEGAS WASH CENTRAL-CEDAR AVENUE

INPUT FILE = CEDAR_ULT.DAT
INPUT FILE DATE = APRIL 2014
DESIGN STORM = 100-YEAR 6-HR STORM AND 100-YEAR 6-HR STORM
STORM DISTRIBUTION = SDN #3
MODELED BY ATKINS (MANOGYA KHANAL)
CHECKED BY ATKINS (BRIAN ROWLEY, PE, CFM)
NO STORM CENTERING
REFERENCED HYDROLOGIC MODELS:
2008 LAS VEGAS VALLEY FLOOD CONTROL DISTRICT
MASTER PLAN UPDATE (PBS&J, SEPTEMBER 2008)
CENTRAL NEIGHBORHOOD STUDY

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

AREA SQ. MI.	DARF
0-0.5	0.990
0.5-1	0.975
1-2	0.950
2-3	0.925
3-4	0.915
4-5	0.908
5-6	0.903

```
 29 IO          OUTPUT CONTROL VARIABLES
                     IPRNT           5  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN           5  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1    0  STARTING DATE
                     ITIME        0000  STARTING TIME
                        NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                    NDDATE      2    0  ENDING DATE
                    NDTIME        0055  ENDING TIME
                     ICENT          19  CENTURY MARK

                  COMPUTATION INTERVAL     .08 HOURS
                       TOTAL TIME BASE   24.92 HOURS

         ENGLISH UNITS
              DRAINAGE AREA         SQUARE MILES
              PRECIPITATION DEPTH   INCHES
              LENGTH, ELEVATION     FEET
              FLOW                  CUBIC FEET PER SECOND
              STORAGE VOLUME        ACRE-FEET
              SURFACE AREA          ACRES
              TEMPERATURE           DEGREES FAHRENHEIT

    JP          MULTI-PLAN OPTION
                     NPLAN           1  NUMBER OF PLANS

    JR          MULTI-RATIO OPTION
                    RATIOS OF PRECIPITATION
                    .99       .98       .95       .93       .92       .91       .90       .57


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***


           **************
           *            *
156 KK     *   CCA05-1  *
           *            *
           **************

160 KO          OUTPUT CONTROL VARIABLES
                     IPRNT           1  PRINT CONTROL
                     IPLOT           0  PLOT CONTROL
                     QSCAL          0.  HYDROGRAPH PLOT SCALE

159 HC          HYDROGRAPH COMBINATION
                     ICOMP           3  NUMBER OF HYDROGRAPHS TO COMBINE

                                                  ***
```

****

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .99

****

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	22.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	19.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	1.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	2.	*	1		0645	82	7.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	4.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	6.	*	1		0655	84	4.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	8.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	10.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	13.	*	1		0710	87	2.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	15.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	16.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	16.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	15.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	14.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	14.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	15.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	17.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	21.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	25.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	30.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	35.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	40.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	42.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	42.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	41.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	41.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	43.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.

1	0230	31	46.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	50.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	55.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	61.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	65.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	66.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	66.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	68.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	75.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	91.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	124.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	192.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	316.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	492.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	666.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	780.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	813.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	774.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	688.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	581.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	476.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	385.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	313.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	257.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	217.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	192.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	181.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	180.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	184.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	192.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	196.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	194.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	185.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	169.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	150.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	127.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	106.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	87.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	72.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	59.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	49.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	41.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	35.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	30.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	26.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 813.	3.83	150.	38.	36.	36.
		(INCHES) 1.850	1.857	1.857	1.857
		(AC-FT) 74.	74.	74.	74.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .98

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0615	76	22.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	19.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	16.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	1.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	2.	*	1		0645	82	7.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	4.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	6.	*	1		0655	84	4.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	7.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	9.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	12.	*	1		0710	87	2.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	14.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	15.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	15.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	14.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	13.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	13.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	14.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	16.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	20.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	24.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	29.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	34.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	38.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	40.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.

1	0210	27	41.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	40.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	40.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	42.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	44.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	48.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	53.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	59.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	63.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	64.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	64.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	66.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	73.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	89.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	122.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	191.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	313.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	481.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	653.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	769.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	801.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	759.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	673.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	571.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	470.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	381.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	308.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	252.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	213.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	189.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	178.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	177.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	182.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	188.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	193.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	191.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	183.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	168.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	148.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	126.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	105.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	86.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	71.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	58.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	48.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	40.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	34.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	29.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	25.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 801.	3.83	147.	37.	36.	36.
		(INCHES) 1.817	1.823	1.823	1.823
		(AC-FT) 73.	73.	73.	73.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .95

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	21.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	19.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	16.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	2.	1		0645	82	7.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	5.	1		0655	84	4.	1		1310	159	0.	1		1925	234	0.
1		0045	10	7.	1		0700	85	3.	1		1315	160	0.	1		1930	235	0.
1		0050	11	8.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	10.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	12.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	14.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	14.	1		0725	90	1.	1		1340	165	0.	1		1955	240	0.
1		0115	16	13.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	12.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	12.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	13.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	15.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	18.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	22.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.

1	0150	23	27.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	32.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	36.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	38.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	38.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	38.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	38.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	40.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	42.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	45.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	50.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	56.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	60.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	61.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	61.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	63.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	69.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	83.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	113.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	178.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	297.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	459.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	619.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	733.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	778.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	747.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	659.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	555.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	455.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	370.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	301.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	247.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	209.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	185.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	173.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	171.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	176.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	183.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	187.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	185.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	176.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	162.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	143.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	122.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	102.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	84.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	69.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	57.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	47.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	40.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	34.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	29.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	25.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 778.	3.83	142.	36.	34.	34.
		(INCHES) 1.753	1.759	1.759	1.759
		(AC-FT) 70.	71.	71.	71.

CUMULATIVE AREA = .75 SQ MI

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .93

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	21.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	18.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	16.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	8.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	7.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	3.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	4.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	6.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	7.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	8.	*	1		0710	87	2.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	10.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	11.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	12.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	12.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	11.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	11.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.

1	0130	19	12.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	14.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	18.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	21.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	25.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	29.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	33.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	35.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	35.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	35.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	36.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	38.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	40.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	43.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	48.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	53.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	57.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	58.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	58.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	60.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	67.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	81.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	110.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	170.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	280.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	439.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	600.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	710.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	744.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	710.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	633.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	538.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	444.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	360.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	291.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	238.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	201.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	178.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	168.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	166.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	170.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	177.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	181.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	179.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	172.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	158.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	140.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	120.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	99.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	82.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	67.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	55.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	46.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	38.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	33.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	28.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	24.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 744.	3.83	136.	34.	33.	33.
		(INCHES) 1.687	1.693	1.693	1.693
		(AC-FT) 68.	68.	68.	68.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .92

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	21.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	18.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	16.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	7.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	4.	1		0655	84	4.	1		1310	159	0.	1		1925	234	0.
1		0045	10	5.	1		0700	85	3.	1		1315	160	0.	1		1930	235	0.
1		0050	11	7.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	8.	1		0710	87	2.	1		1325	162	0.	1		1940	237	0.
1		0100	13	10.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	11.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0110	15	11.	1		0725	90	1.	1		1340	165	0.	1		1955	240	0.
1		0115	16	11.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	10.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	10.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	11.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	14.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	17.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	21.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	24.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	29.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	32.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	34.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	34.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	34.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	35.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	37.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	39.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	42.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	47.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	52.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	56.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	57.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	57.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	58.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	65.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	79.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	110.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	171.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	280.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	433.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	592.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	704.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	738.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	702.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	624.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	531.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	439.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	357.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	289.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	237.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	199.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	176.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	165.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	164.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	169.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	175.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	178.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	177.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	169.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	155.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	138.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	118.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	98.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	81.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	67.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	55.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	45.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	38.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	32.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	28.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	24.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 738.	3.83	135.	34.	33.	33.
		(INCHES) 1.666	1.672	1.672	1.672
		(AC-FT) 67.	67.	67.	67.

CUMULATIVE AREA = .75 SQ MI

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .91

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	21.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	18.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	15.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	4.	1		0655	84	4.	1		1310	159	0.	1		1925	234	0.
1		0045	10	5.	1		0700	85	3.	1		1315	160	0.	1		1930	235	0.

1	0050	11	6.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	8.	*	1	0710	87	2.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	9.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	10.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	11.	*	1	0725	90	1.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	11.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	10.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	10.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	11.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	14.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	17.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	20.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	24.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	28.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	31.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	33.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	34.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	34.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	35.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	36.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	39.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	42.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	46.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	51.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	55.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	57.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	56.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	57.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	64.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	78.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	108.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	170.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	280.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	430.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	583.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	694.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	735.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	701.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	620.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	526.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	435.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	354.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	288.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	236.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	199.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	176.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	165.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	163.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	167.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	174.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	177.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	175.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	167.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	154.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	136.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	117.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	98.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	81.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	66.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	54.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	45.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	38.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	32.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	28.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	24.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
	(CFS)				
+ 735.	3.83	134.	34.	32.	32.
	(INCHES)	1.653	1.659	1.659	1.659
	(AC-FT)	66.	67.	67.	67.

CUMULATIVE AREA = .75 SQ MI

HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .90

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	21.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	18.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	15.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.

1	0030	7	1.	*	1	0645	82	7.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	2.	*	1	0650	83	5.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	4.	*	1	0655	84	4.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	5.	*	1	0700	85	3.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	6.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	7.	*	1	0710	87	2.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	9.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	10.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	11.	*	1	0725	90	1.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	11.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	10.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	10.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	11.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	13.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	17.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	20.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	24.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	28.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	31.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	33.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	34.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	34.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	34.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	36.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	38.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	41.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	45.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	50.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	54.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	56.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	55.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	57.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	63.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	77.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	106.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	168.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	278.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	427.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	575.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	681.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	722.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	696.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	619.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	523.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	431.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	351.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	285.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	235.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	198.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	176.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	165.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	163.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	166.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	172.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	176.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	175.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	167.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	153.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	136.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	116.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	97.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	80.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	66.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	54.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	45.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	38.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	32.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	27.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	24.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 722.	3.83	132.	33.	32.	32.
		(INCHES) 1.638	1.644	1.644	1.644
		(AC-FT) 66.	66.	66.	66.

CUMULATIVE AREA = .75 SQ MI

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HYDROGRAPH AT STATION CCA05-1
SUM OF 3 HYDROGRAPHS
PLAN 1, RATIO = .57

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1	0000	1	0.	*	1	0615	76	13.	*	1	1230	151	0.	*	1	1845	226	0.
1	0005	2	0.	*	1	0620	77	11.	*	1	1235	152	0.	*	1	1850	227	0.

1	0010	3	0.	*	1	0625	78	10.	*	1	1240	153	0.	*	1	1855	228	0.
1	0015	4	0.	*	1	0630	79	8.	*	1	1245	154	0.	*	1	1900	229	0.
1	0020	5	0.	*	1	0635	80	7.	*	1	1250	155	0.	*	1	1905	230	0.
1	0025	6	0.	*	1	0640	81	5.	*	1	1255	156	0.	*	1	1910	231	0.
1	0030	7	0.	*	1	0645	82	4.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	0.	*	1	0650	83	3.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	2.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	0.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	0.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	0.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	0.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	0.	*	1	0725	90	1.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	0.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	1.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	1.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	1.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	2.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	2.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	3.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	4.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	5.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	6.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	7.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	8.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	9.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	10.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	11.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	11.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	12.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	13.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	15.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	18.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	20.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	21.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	21.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	23.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	28.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	39.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	60.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	98.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	165.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	249.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	324.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	365.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	368.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	343.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	299.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	251.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	205.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	168.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	138.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	117.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	102.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	94.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	91.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	92.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	96.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	99.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	99.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	95.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	89.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	81.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	71.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	60.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	50.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	41.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	34.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	29.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	24.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	21.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	17.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	15.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 368.	3.92	67.	17.	16.	16.
		(INCHES) .826	.827	.827	.827
		(AC-FT) 33.	33.	33.	33.

CUMULATIVE AREA = .75 SQ MI

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450 KK * CCBN09 *

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 456 KO           OUTPUT CONTROL VARIABLES
                        IPRNT           1  PRINT CONTROL
                        IPLOT           0  PLOT CONTROL
                        QSCAL          0.  HYDROGRAPH PLOT SCALE

 455 HC           HYDROGRAPH COMBINATION
                        ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .99

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	30.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	24.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	19.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	14.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	10.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	7.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	5.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	7.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	11.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	13.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	12.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	10.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	8.	1		0720	89	0.	1		1335	164	0.	1		1950	239	0.
1		0110	15	6.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	5.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	6.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	9.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	13.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	19.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	28.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	38.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	46.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	50.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	50.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	45.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	39.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	35.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	39.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	51.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	66.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	77.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	80.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	81.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	83.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	87.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	87.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	86.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	96.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	137.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	202.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	202.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	202.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	202.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	202.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	202.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	202.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	202.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	202.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	202.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	202.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	202.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	202.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	202.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	202.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	202.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	202.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	202.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	202.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	202.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	202.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	202.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	202.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	202.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	202.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	170.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	137.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	110.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	89.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	72.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	60.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	52.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.

1	0600	73	46.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	41.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	35.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.33	102.	26.	25.	25.
		(INCHES) .573	.575	.575	.575
		(AC-FT) 51.	51.	51.	51.

CUMULATIVE AREA = 1.66 SQ MI

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HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .98

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DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	29.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	24.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	18.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	14.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	10.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	7.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	5.	1		1300	157	0.	1		1915	232	0.
1		0035	8	3.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	6.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	10.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	12.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	11.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	9.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	7.	1		0720	89	0.	1		1335	164	0.	1		1950	239	0.
1		0110	15	5.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	5.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	6.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	8.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	12.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	18.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	27.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	36.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	44.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	48.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	48.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	43.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	37.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	34.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	37.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	49.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	64.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	74.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	78.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	78.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	80.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	84.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	84.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	83.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	93.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	132.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	202.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	202.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	202.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	202.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	202.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	202.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	202.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	202.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	202.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	202.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	202.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	202.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	202.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	202.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	202.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	202.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	202.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	202.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	202.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	202.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	202.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	202.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	202.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	202.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	202.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	167.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	134.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	108.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.

1	0540	69	88.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.	
1	0545	70	71.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.	
1	0550	71	59.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.	
1	0555	72	51.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.	
1	0600	73	45.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.	
1	0605	74	40.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.	
1	0610	75	35.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.	
				*					*					*					

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)				
		(CFS)			
202.	3.33	101.	25.	25.	25.
		(INCHES) .567	.569	.569	.569
		(AC-FT) 50.	51.	51.	51.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .95

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	29.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	23.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	10.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	7.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	5.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	9.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	10.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	10.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	8.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	6.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	5.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	4.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	5.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	8.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	11.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	16.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	24.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	33.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	41.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	45.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	44.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	40.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	35.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	32.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	35.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	46.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	60.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	70.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	73.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	74.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	76.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	79.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	79.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	79.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	88.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	125.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	202.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.
1		0420	53	202.	*	1		1035	128	0.	*	1		1650	203	0.	*	1		2305	278	0.
1		0425	54	202.	*	1		1040	129	0.	*	1		1655	204	0.	*	1		2310	279	0.
1		0430	55	202.	*	1		1045	130	0.	*	1		1700	205	0.	*	1		2315	280	0.
1		0435	56	202.	*	1		1050	131	0.	*	1		1705	206	0.	*	1		2320	281	0.
1		0440	57	202.	*	1		1055	132	0.	*	1		1710	207	0.	*	1		2325	282	0.
1		0445	58	202.	*	1		1100	133	0.	*	1		1715	208	0.	*	1		2330	283	0.
1		0450	59	202.	*	1		1105	134	0.	*	1		1720	209	0.	*	1		2335	284	0.
1		0455	60	202.	*	1		1110	135	0.	*	1		1725	210	0.	*	1		2340	285	0.
1		0500	61	202.	*	1		1115	136	0.	*	1		1730	211	0.	*	1		2345	286	0.
1		0505	62	202.	*	1		1120	137	0.	*	1		1735	212	0.	*	1		2350	287	0.
1		0510	63	202.	*	1		1125	138	0.	*	1		1740	213	0.	*	1		2355	288	0.
1		0515	64	202.	*	1		1130	139	0.	*	1		1745	214	0.	*	2		0000	289	0.

1	0520	65	198.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	162.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	130.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	105.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	85.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	69.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	57.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	49.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	44.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	39.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	34.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.33	100.	25.	24.	24.
		(INCHES) .558	.560	.560	.560
		(AC-FT) 49.	50.	50.	50.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .93

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0615	76	28.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	23.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	9.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	7.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	1.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	7.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	9.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	9.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	7.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	5.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	4.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	4.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	5.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	7.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	10.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	14.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	22.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	30.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	37.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	41.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	41.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	37.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	32.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	29.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	32.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	42.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	56.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	65.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	69.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	69.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	71.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	75.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	75.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	74.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	83.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	118.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	202.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.
1		0420	53	202.	*	1		1035	128	0.	*	1		1650	203	0.	*	1		2305	278	0.
1		0425	54	202.	*	1		1040	129	0.	*	1		1655	204	0.	*	1		2310	279	0.
1		0430	55	202.	*	1		1045	130	0.	*	1		1700	205	0.	*	1		2315	280	0.
1		0435	56	202.	*	1		1050	131	0.	*	1		1705	206	0.	*	1		2320	281	0.
1		0440	57	202.	*	1		1055	132	0.	*	1		1710	207	0.	*	1		2325	282	0.
1		0445	58	202.	*	1		1100	133	0.	*	1		1715	208	0.	*	1		2330	283	0.
1		0450	59	202.	*	1		1105	134	0.	*	1		1720	209	0.	*	1		2335	284	0.
1		0455	60	202.	*	1		1110	135	0.	*	1		1725	210	0.	*	1		2340	285	0.

1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	192.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	157.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	126.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	102.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	83.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	67.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	55.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	48.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	42.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	37.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	33.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	98.	25.	24.	24.
		(INCHES) .549	.550	.550	.550
		(AC-FT) 49.	49.	49.	49.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .92

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	27.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	22.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	9.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	6.	1		1255	156	0.	1		1910	231	0.
1		0030	7	1.	1		0645	82	5.	1		1300	157	0.	1		1915	232	0.
1		0035	8	2.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	4.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	7.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	8.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	8.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	7.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	5.	1		0720	89	0.	1		1335	164	0.	1		1950	239	0.
1		0110	15	4.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	4.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	4.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	6.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	9.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	14.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	21.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	29.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	36.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	40.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	40.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	36.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	31.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	28.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	31.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	41.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	54.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	64.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	67.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	67.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	70.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	73.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	73.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	73.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	81.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	115.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	197.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	202.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	202.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	202.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	202.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	202.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	202.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	202.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	202.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	202.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	202.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	202.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	202.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	202.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	202.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	202.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.

1	0440	57	202.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	202.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	202.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	202.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	190.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	155.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	125.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	101.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	82.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	66.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	54.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	47.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	42.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	37.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	32.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	97.	24.	24.	24.
		(INCHES) .544	.546	.546	.546
		(AC-FT) 48.	48.	48.	48.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .91

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	27.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	17.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	13.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	9.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	6.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	5.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	2.	*	1		0650	83	3.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	4.	*	1		0655	84	2.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	6.	*	1		0700	85	2.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	8.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	8.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	6.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	5.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	4.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	3.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	4.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	6.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	9.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	13.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	20.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	28.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	35.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	39.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	39.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	35.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	30.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	28.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	31.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	40.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	53.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	62.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	66.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	66.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	68.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	72.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	72.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	71.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	79.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	113.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	194.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	202.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.
1		0340	45	202.	*	1		0955	120	0.	*	1		1610	195	0.	*	1		2225	270	0.
1		0345	46	202.	*	1		1000	121	0.	*	1		1615	196	0.	*	1		2230	271	0.
1		0350	47	202.	*	1		1005	122	0.	*	1		1620	197	0.	*	1		2235	272	0.
1		0355	48	202.	*	1		1010	123	0.	*	1		1625	198	0.	*	1		2240	273	0.
1		0400	49	202.	*	1		1015	124	0.	*	1		1630	199	0.	*	1		2245	274	0.
1		0405	50	202.	*	1		1020	125	0.	*	1		1635	200	0.	*	1		2250	275	0.
1		0410	51	202.	*	1		1025	126	0.	*	1		1640	201	0.	*	1		2255	276	0.
1		0415	52	202.	*	1		1030	127	0.	*	1		1645	202	0.	*	1		2300	277	0.

1	0420	53	202.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	202.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	202.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	202.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	202.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	202.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	202.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	202.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	188.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	153.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	124.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	100.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	81.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	65.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	54.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	47.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	42.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	37.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	32.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.42	97.	24.	23.	23.
		(INCHES) .542	.543	.543	.543
		(AC-FT) 48.	48.	48.	48.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .90

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	27.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	22.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	12.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	9.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	6.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	4.	1		1300	157	0.	1		1915	232	0.
1		0035	8	2.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	4.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	6.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	8.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	7.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	6.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	5.	1		0720	89	0.	1		1335	164	0.	1		1950	239	0.
1		0110	15	4.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	3.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	4.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	6.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	9.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	13.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	20.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	28.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	34.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	38.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	38.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	35.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	30.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	27.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	30.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	40.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	52.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	62.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	65.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	65.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	67.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	71.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	71.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	70.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	78.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	111.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	191.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	202.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	202.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	202.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	202.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	202.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	202.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	202.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.

1	0400	49	202.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	202.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	202.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	202.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	202.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	202.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	202.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	202.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	202.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	202.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	202.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	202.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	202.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	202.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	202.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	202.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	187.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	152.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	123.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	99.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	80.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	65.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	54.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	46.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	41.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	36.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	32.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*				

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
	(CFS)				
+ 202.	3.42	97.	24.	23.	23.
	(INCHES)	.540	.541	.541	.541
	(AC-FT)	48.	48.	48.	48.

CUMULATIVE AREA = 1.66 SQ MI

HYDROGRAPH AT STATION CCBN09
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .57

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	16.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	13.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	10.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	8.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	6.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	4.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	3.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	0.	*	1		0650	83	2.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	0.	*	1		0655	84	1.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	0.	*	1		0700	85	1.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	0.	*	1		0705	86	1.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	0.	*	1		0710	87	0.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	0.	*	1		0715	88	0.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	0.	*	1		0720	89	0.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	0.	*	1		0725	90	0.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	0.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	0.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	0.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	0.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.
1		0135	20	1.	*	1		0750	95	0.	*	1		1405	170	0.	*	1		2020	245	0.
1		0140	21	1.	*	1		0755	96	0.	*	1		1410	171	0.	*	1		2025	246	0.
1		0145	22	2.	*	1		0800	97	0.	*	1		1415	172	0.	*	1		2030	247	0.
1		0150	23	3.	*	1		0805	98	0.	*	1		1420	173	0.	*	1		2035	248	0.
1		0155	24	4.	*	1		0810	99	0.	*	1		1425	174	0.	*	1		2040	249	0.
1		0200	25	5.	*	1		0815	100	0.	*	1		1430	175	0.	*	1		2045	250	0.
1		0205	26	5.	*	1		0820	101	0.	*	1		1435	176	0.	*	1		2050	251	0.
1		0210	27	5.	*	1		0825	102	0.	*	1		1440	177	0.	*	1		2055	252	0.
1		0215	28	4.	*	1		0830	103	0.	*	1		1445	178	0.	*	1		2100	253	0.
1		0220	29	5.	*	1		0835	104	0.	*	1		1450	179	0.	*	1		2105	254	0.
1		0225	30	6.	*	1		0840	105	0.	*	1		1455	180	0.	*	1		2110	255	0.
1		0230	31	10.	*	1		0845	106	0.	*	1		1500	181	0.	*	1		2115	256	0.
1		0235	32	13.	*	1		0850	107	0.	*	1		1505	182	0.	*	1		2120	257	0.
1		0240	33	15.	*	1		0855	108	0.	*	1		1510	183	0.	*	1		2125	258	0.
1		0245	34	16.	*	1		0900	109	0.	*	1		1515	184	0.	*	1		2130	259	0.
1		0250	35	17.	*	1		0905	110	0.	*	1		1520	185	0.	*	1		2135	260	0.
1		0255	36	19.	*	1		0910	111	0.	*	1		1525	186	0.	*	1		2140	261	0.
1		0300	37	20.	*	1		0915	112	0.	*	1		1530	187	0.	*	1		2145	262	0.
1		0305	38	20.	*	1		0920	113	0.	*	1		1535	188	0.	*	1		2150	263	0.
1		0310	39	22.	*	1		0925	114	0.	*	1		1540	189	0.	*	1		2155	264	0.
1		0315	40	29.	*	1		0930	115	0.	*	1		1545	190	0.	*	1		2200	265	0.
1		0320	41	52.	*	1		0935	116	0.	*	1		1550	191	0.	*	1		2205	266	0.
1		0325	42	111.	*	1		0940	117	0.	*	1		1555	192	0.	*	1		2210	267	0.
1		0330	43	202.	*	1		0945	118	0.	*	1		1600	193	0.	*	1		2215	268	0.
1		0335	44	202.	*	1		0950	119	0.	*	1		1605	194	0.	*	1		2220	269	0.

1	0340	45	202.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	202.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	202.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	202.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	202.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	202.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	202.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	202.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	202.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	177.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	152.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	141.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	142.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	150.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	156.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	159.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	160.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	155.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	142.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	124.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	104.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	86.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	69.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	56.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	46.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	37.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	31.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	26.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	23.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	21.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	18.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 202.	3.50	67.	17.	16.	16.
		(INCHES) .376	.376	.376	.376
		(AC-FT) 33.	33.	33.	33.

CUMULATIVE AREA = 1.66 SQ MI

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590 KK

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* *
* CBN15-C *
* *
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594 KO OUTPUT CONTROL VARIABLES

IPRNT	1	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

593 HC HYDROGRAPH COMBINATION

ICOMP	2	NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .99

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DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
					*						*						*					
1		0000	1	0.	*	1		0615	76	26.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	9.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	6.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	0.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	1.	*	1		0655	84	3.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	1.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	2.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	3.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	3.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	3.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	3.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.
1		0115	16	3.	*	1		0730	91	0.	*	1		1345	166	0.	*	1		2000	241	0.
1		0120	17	3.	*	1		0735	92	0.	*	1		1350	167	0.	*	1		2005	242	0.
1		0125	18	4.	*	1		0740	93	0.	*	1		1355	168	0.	*	1		2010	243	0.
1		0130	19	5.	*	1		0745	94	0.	*	1		1400	169	0.	*	1		2015	244	0.

1	0135	20	7.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	10.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	15.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	19.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	24.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	26.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	27.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	27.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	25.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	25.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	27.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	32.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	37.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	43.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	47.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	49.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	51.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	52.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	54.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	57.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	68.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	93.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	150.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	392.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	873.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1317.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1619.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1753.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1751.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1631.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1428.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1196.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	978.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	787.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	626.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	499.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	410.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	358.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	339.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	341.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	349.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	354.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	350.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	330.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	293.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	242.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	188.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	138.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	105.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	83.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	68.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	56.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	47.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	40.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	34.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	30.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1753.	3.83	279.	70.	67.	67.
		(INCHES) 3.009	3.012	3.012	3.012
		(AC-FT) 139.	139.	139.	139.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .98

DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW	*	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	*	1		0615	76	25.	*	1		1230	151	0.	*	1		1845	226	0.
1		0005	2	0.	*	1		0620	77	22.	*	1		1235	152	0.	*	1		1850	227	0.
1		0010	3	0.	*	1		0625	78	18.	*	1		1240	153	0.	*	1		1855	228	0.
1		0015	4	0.	*	1		0630	79	14.	*	1		1245	154	0.	*	1		1900	229	0.
1		0020	5	0.	*	1		0635	80	11.	*	1		1250	155	0.	*	1		1905	230	0.
1		0025	6	0.	*	1		0640	81	8.	*	1		1255	156	0.	*	1		1910	231	0.
1		0030	7	0.	*	1		0645	82	6.	*	1		1300	157	0.	*	1		1915	232	0.
1		0035	8	0.	*	1		0650	83	5.	*	1		1305	158	0.	*	1		1920	233	0.
1		0040	9	0.	*	1		0655	84	3.	*	1		1310	159	0.	*	1		1925	234	0.
1		0045	10	1.	*	1		0700	85	3.	*	1		1315	160	0.	*	1		1930	235	0.
1		0050	11	2.	*	1		0705	86	2.	*	1		1320	161	0.	*	1		1935	236	0.
1		0055	12	2.	*	1		0710	87	1.	*	1		1325	162	0.	*	1		1940	237	0.
1		0100	13	3.	*	1		0715	88	1.	*	1		1330	163	0.	*	1		1945	238	0.
1		0105	14	3.	*	1		0720	89	1.	*	1		1335	164	0.	*	1		1950	239	0.
1		0110	15	3.	*	1		0725	90	1.	*	1		1340	165	0.	*	1		1955	240	0.

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0115	16	3.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	3.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	3.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	4.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	6.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	10.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	14.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	18.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	22.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	25.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	26.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	25.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	24.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	24.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	26.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	30.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	36.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	41.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	45.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	48.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	50.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	51.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	52.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	55.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	66.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	91.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	147.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	374.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	838.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	1278.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	1577.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	1713.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	1716.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	1600.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	1399.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	1170.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	956.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	769.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	610.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	486.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	398.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	348.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	328.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	330.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	338.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	344.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	340.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	321.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	284.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	235.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	183.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	132.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	102.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	82.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	67.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	55.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	46.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	39.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	34.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	29.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

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PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)				
		(CFS)			
1716.	3.92	272.	68.	66.	66.
		(INCHES) 2.931	2.933	2.933	2.933
		(AC-FT) 135.	135.	135.	135.

CUMULATIVE AREA = .86 SQ MI

****

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .95

****

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	25.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	21.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	14.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	5.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	3.	1		1310	159	0.	1		1925	234	0.
1		0045	10	1.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	1.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.

1	0055	12	2.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	2.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	2.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	3.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	4.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	6.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	8.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	12.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	16.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	20.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	23.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	24.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	23.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	22.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	22.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	24.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	28.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	34.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	38.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	42.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	45.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	47.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	48.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	49.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	52.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	62.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	85.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	135.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	330.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	783.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1213.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1513.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1653.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1660.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1540.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1339.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1119.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	915.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	735.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	585.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	466.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	382.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	330.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	309.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	311.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	320.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	326.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	323.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	304.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	270.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	223.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	173.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	126.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	98.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	79.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	65.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	53.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	45.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	38.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	33.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	28.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
		(CFS)			
+ 1660.	3.92	259.	65.	63.	63.
		(INCHES) 2.796	2.798	2.798	2.798
		(AC-FT) 129.	129.	129.	129.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .93

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	24.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	20.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	11.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.

1	0035	8	0.	*	1	0650	83	4.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	3.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	1.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	1.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	2.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	2.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	2.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	3.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	5.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	7.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	11.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	15.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	18.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	21.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	22.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	21.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	21.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	20.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	22.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	26.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	31.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	36.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	39.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	42.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	44.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	45.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	46.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	49.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	59.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	81.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	125.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	282.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	727.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1151.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1440.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1576.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1582.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1473.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1287.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1077.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	880.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	707.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	560.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	445.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	364.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	314.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	293.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	294.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	302.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	308.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	306.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	290.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	256.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	212.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	165.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	123.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	95.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	77.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	63.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	52.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	43.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	37.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	32.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	28.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)				
	(CFS)				
+ 1582.	3.92	247.	62.	59.	59.
	(INCHES)	2.659	2.660	2.660	2.660
	(AC-FT)	122.	122.	122.	122.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .92

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	24.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	20.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	17.	1		1240	153	0.	1		1855	228	0.

1	0015	4	0.	*	1	0630	79	13.	*	1	1245	154	0.	*	1	1900	229	0.
1	0020	5	0.	*	1	0635	80	10.	*	1	1250	155	0.	*	1	1905	230	0.
1	0025	6	0.	*	1	0640	81	8.	*	1	1255	156	0.	*	1	1910	231	0.
1	0030	7	0.	*	1	0645	82	6.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	0.	*	1	0650	83	4.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	3.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	1.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	1.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	1.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	2.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	2.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	3.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	5.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	7.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	10.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	14.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	17.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	20.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	21.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	21.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	20.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	20.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	22.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	25.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	30.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	35.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	38.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	41.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	43.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	44.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	45.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	48.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	57.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	79.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	121.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	261.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	703.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1118.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1402.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1539.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1551.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1446.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1264.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1059.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	865.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	694.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	550.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	437.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	356.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	306.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	285.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	286.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	295.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	301.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	299.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	284.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	252.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	207.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	161.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	120.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	94.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	76.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	62.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	51.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	43.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	36.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	31.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	27.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.
				*					*					*					

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PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1551.	3.92		241.	60.	58.	58.
		(INCHES)	2.599	2.600	2.600	2.600
		(AC-FT)	120.	120.	120.	120.

CUMULATIVE AREA = .86 SQ MI

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HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .91

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DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW	*	DA MON HRMN	ORD	FLOW

1	0000	1	0.	*	1	0615	76	23.	*	1	1230	151	0.	*	1	1845	226	0.
1	0005	2	0.	*	1	0620	77	20.	*	1	1235	152	0.	*	1	1850	227	0.
1	0010	3	0.	*	1	0625	78	16.	*	1	1240	153	0.	*	1	1855	228	0.
1	0015	4	0.	*	1	0630	79	13.	*	1	1245	154	0.	*	1	1900	229	0.
1	0020	5	0.	*	1	0635	80	10.	*	1	1250	155	0.	*	1	1905	230	0.
1	0025	6	0.	*	1	0640	81	8.	*	1	1255	156	0.	*	1	1910	231	0.
1	0030	7	0.	*	1	0645	82	6.	*	1	1300	157	0.	*	1	1915	232	0.
1	0035	8	0.	*	1	0650	83	4.	*	1	1305	158	0.	*	1	1920	233	0.
1	0040	9	0.	*	1	0655	84	3.	*	1	1310	159	0.	*	1	1925	234	0.
1	0045	10	0.	*	1	0700	85	2.	*	1	1315	160	0.	*	1	1930	235	0.
1	0050	11	1.	*	1	0705	86	2.	*	1	1320	161	0.	*	1	1935	236	0.
1	0055	12	1.	*	1	0710	87	1.	*	1	1325	162	0.	*	1	1940	237	0.
1	0100	13	1.	*	1	0715	88	1.	*	1	1330	163	0.	*	1	1945	238	0.
1	0105	14	1.	*	1	0720	89	1.	*	1	1335	164	0.	*	1	1950	239	0.
1	0110	15	2.	*	1	0725	90	0.	*	1	1340	165	0.	*	1	1955	240	0.
1	0115	16	2.	*	1	0730	91	0.	*	1	1345	166	0.	*	1	2000	241	0.
1	0120	17	2.	*	1	0735	92	0.	*	1	1350	167	0.	*	1	2005	242	0.
1	0125	18	2.	*	1	0740	93	0.	*	1	1355	168	0.	*	1	2010	243	0.
1	0130	19	3.	*	1	0745	94	0.	*	1	1400	169	0.	*	1	2015	244	0.
1	0135	20	4.	*	1	0750	95	0.	*	1	1405	170	0.	*	1	2020	245	0.
1	0140	21	7.	*	1	0755	96	0.	*	1	1410	171	0.	*	1	2025	246	0.
1	0145	22	10.	*	1	0800	97	0.	*	1	1415	172	0.	*	1	2030	247	0.
1	0150	23	13.	*	1	0805	98	0.	*	1	1420	173	0.	*	1	2035	248	0.
1	0155	24	17.	*	1	0810	99	0.	*	1	1425	174	0.	*	1	2040	249	0.
1	0200	25	19.	*	1	0815	100	0.	*	1	1430	175	0.	*	1	2045	250	0.
1	0205	26	20.	*	1	0820	101	0.	*	1	1435	176	0.	*	1	2050	251	0.
1	0210	27	20.	*	1	0825	102	0.	*	1	1440	177	0.	*	1	2055	252	0.
1	0215	28	19.	*	1	0830	103	0.	*	1	1445	178	0.	*	1	2100	253	0.
1	0220	29	19.	*	1	0835	104	0.	*	1	1450	179	0.	*	1	2105	254	0.
1	0225	30	21.	*	1	0840	105	0.	*	1	1455	180	0.	*	1	2110	255	0.
1	0230	31	25.	*	1	0845	106	0.	*	1	1500	181	0.	*	1	2115	256	0.
1	0235	32	30.	*	1	0850	107	0.	*	1	1505	182	0.	*	1	2120	257	0.
1	0240	33	34.	*	1	0855	108	0.	*	1	1510	183	0.	*	1	2125	258	0.
1	0245	34	38.	*	1	0900	109	0.	*	1	1515	184	0.	*	1	2130	259	0.
1	0250	35	40.	*	1	0905	110	0.	*	1	1520	185	0.	*	1	2135	260	0.
1	0255	36	42.	*	1	0910	111	0.	*	1	1525	186	0.	*	1	2140	261	0.
1	0300	37	43.	*	1	0915	112	0.	*	1	1530	187	0.	*	1	2145	262	0.
1	0305	38	44.	*	1	0920	113	0.	*	1	1535	188	0.	*	1	2150	263	0.
1	0310	39	47.	*	1	0925	114	0.	*	1	1540	189	0.	*	1	2155	264	0.
1	0315	40	56.	*	1	0930	115	0.	*	1	1545	190	0.	*	1	2200	265	0.
1	0320	41	78.	*	1	0935	116	0.	*	1	1550	191	0.	*	1	2205	266	0.
1	0325	42	120.	*	1	0940	117	0.	*	1	1555	192	0.	*	1	2210	267	0.
1	0330	43	268.	*	1	0945	118	0.	*	1	1600	193	0.	*	1	2215	268	0.
1	0335	44	690.	*	1	0950	119	0.	*	1	1605	194	0.	*	1	2220	269	0.
1	0340	45	1103.	*	1	0955	120	0.	*	1	1610	195	0.	*	1	2225	270	0.
1	0345	46	1390.	*	1	1000	121	0.	*	1	1615	196	0.	*	1	2230	271	0.
1	0350	47	1529.	*	1	1005	122	0.	*	1	1620	197	0.	*	1	2235	272	0.
1	0355	48	1541.	*	1	1010	123	0.	*	1	1625	198	0.	*	1	2240	273	0.
1	0400	49	1436.	*	1	1015	124	0.	*	1	1630	199	0.	*	1	2245	274	0.
1	0405	50	1252.	*	1	1020	125	0.	*	1	1635	200	0.	*	1	2250	275	0.
1	0410	51	1047.	*	1	1025	126	0.	*	1	1640	201	0.	*	1	2255	276	0.
1	0415	52	855.	*	1	1030	127	0.	*	1	1645	202	0.	*	1	2300	277	0.
1	0420	53	686.	*	1	1035	128	0.	*	1	1650	203	0.	*	1	2305	278	0.
1	0425	54	543.	*	1	1040	129	0.	*	1	1655	204	0.	*	1	2310	279	0.
1	0430	55	430.	*	1	1045	130	0.	*	1	1700	205	0.	*	1	2315	280	0.
1	0435	56	349.	*	1	1050	131	0.	*	1	1705	206	0.	*	1	2320	281	0.
1	0440	57	299.	*	1	1055	132	0.	*	1	1710	207	0.	*	1	2325	282	0.
1	0445	58	278.	*	1	1100	133	0.	*	1	1715	208	0.	*	1	2330	283	0.
1	0450	59	280.	*	1	1105	134	0.	*	1	1720	209	0.	*	1	2335	284	0.
1	0455	60	290.	*	1	1110	135	0.	*	1	1725	210	0.	*	1	2340	285	0.
1	0500	61	296.	*	1	1115	136	0.	*	1	1730	211	0.	*	1	2345	286	0.
1	0505	62	294.	*	1	1120	137	0.	*	1	1735	212	0.	*	1	2350	287	0.
1	0510	63	278.	*	1	1125	138	0.	*	1	1740	213	0.	*	1	2355	288	0.
1	0515	64	246.	*	1	1130	139	0.	*	1	1745	214	0.	*	2	0000	289	0.
1	0520	65	204.	*	1	1135	140	0.	*	1	1750	215	0.	*	2	0005	290	0.
1	0525	66	159.	*	1	1140	141	0.	*	1	1755	216	0.	*	2	0010	291	0.
1	0530	67	120.	*	1	1145	142	0.	*	1	1800	217	0.	*	2	0015	292	0.
1	0535	68	93.	*	1	1150	143	0.	*	1	1805	218	0.	*	2	0020	293	0.
1	0540	69	75.	*	1	1155	144	0.	*	1	1810	219	0.	*	2	0025	294	0.
1	0545	70	62.	*	1	1200	145	0.	*	1	1815	220	0.	*	2	0030	295	0.
1	0550	71	51.	*	1	1205	146	0.	*	1	1820	221	0.	*	2	0035	296	0.
1	0555	72	42.	*	1	1210	147	0.	*	1	1825	222	0.	*	2	0040	297	0.
1	0600	73	36.	*	1	1215	148	0.	*	1	1830	223	0.	*	2	0045	298	0.
1	0605	74	31.	*	1	1220	149	0.	*	1	1835	224	0.	*	2	0050	299	0.
1	0610	75	27.	*	1	1225	150	0.	*	1	1840	225	0.	*	2	0055	300	0.

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 1541.	3.92		238.	60.	57.	57.
		(INCHES)	2.569	2.570	2.570	2.570
		(AC-FT)	118.	118.	118.	118.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .90

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	23.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	20.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	16.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	13.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	10.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	8.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	6.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	4.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	3.	1		1310	159	0.	1		1925	234	0.
1		0045	10	0.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	1.	1		0705	86	2.	1		1320	161	0.	1		1935	236	0.
1		0055	12	1.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	1.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	1.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	1.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	1.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	2.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	2.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	3.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	4.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	6.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	10.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	13.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	17.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	19.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	20.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	20.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	19.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	19.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	21.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	24.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	29.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	33.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	37.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	39.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	41.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	42.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	44.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	47.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	55.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	76.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	117.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	260.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	680.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	1087.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	1368.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	1503.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	1516.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	1416.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	1238.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	1037.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	847.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	680.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	538.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	426.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	347.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	298.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	277.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	278.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	286.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	292.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	290.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	275.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	244.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	201.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	156.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	117.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	93.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	75.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	61.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	50.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	42.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	36.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	31.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	27.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
(CFS)	(HR)					
		(CFS)				
1516.	3.92		235.	59.	57.	57.
		(INCHES)	2.535	2.537	2.537	2.537
		(AC-FT)	117.	117.	117.	117.

CUMULATIVE AREA = .86 SQ MI

HYDROGRAPH AT STATION CBN15-C
SUM OF 2 HYDROGRAPHS
PLAN 1, RATIO = .57

DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW	DA	MON	HRMN	ORD	FLOW
1		0000	1	0.	1		0615	76	14.	1		1230	151	0.	1		1845	226	0.
1		0005	2	0.	1		0620	77	12.	1		1235	152	0.	1		1850	227	0.
1		0010	3	0.	1		0625	78	10.	1		1240	153	0.	1		1855	228	0.
1		0015	4	0.	1		0630	79	8.	1		1245	154	0.	1		1900	229	0.
1		0020	5	0.	1		0635	80	7.	1		1250	155	0.	1		1905	230	0.
1		0025	6	0.	1		0640	81	5.	1		1255	156	0.	1		1910	231	0.
1		0030	7	0.	1		0645	82	4.	1		1300	157	0.	1		1915	232	0.
1		0035	8	0.	1		0650	83	3.	1		1305	158	0.	1		1920	233	0.
1		0040	9	0.	1		0655	84	2.	1		1310	159	0.	1		1925	234	0.
1		0045	10	0.	1		0700	85	2.	1		1315	160	0.	1		1930	235	0.
1		0050	11	0.	1		0705	86	1.	1		1320	161	0.	1		1935	236	0.
1		0055	12	0.	1		0710	87	1.	1		1325	162	0.	1		1940	237	0.
1		0100	13	0.	1		0715	88	1.	1		1330	163	0.	1		1945	238	0.
1		0105	14	0.	1		0720	89	1.	1		1335	164	0.	1		1950	239	0.
1		0110	15	0.	1		0725	90	0.	1		1340	165	0.	1		1955	240	0.
1		0115	16	0.	1		0730	91	0.	1		1345	166	0.	1		2000	241	0.
1		0120	17	0.	1		0735	92	0.	1		1350	167	0.	1		2005	242	0.
1		0125	18	0.	1		0740	93	0.	1		1355	168	0.	1		2010	243	0.
1		0130	19	0.	1		0745	94	0.	1		1400	169	0.	1		2015	244	0.
1		0135	20	0.	1		0750	95	0.	1		1405	170	0.	1		2020	245	0.
1		0140	21	0.	1		0755	96	0.	1		1410	171	0.	1		2025	246	0.
1		0145	22	0.	1		0800	97	0.	1		1415	172	0.	1		2030	247	0.
1		0150	23	0.	1		0805	98	0.	1		1420	173	0.	1		2035	248	0.
1		0155	24	0.	1		0810	99	0.	1		1425	174	0.	1		2040	249	0.
1		0200	25	0.	1		0815	100	0.	1		1430	175	0.	1		2045	250	0.
1		0205	26	0.	1		0820	101	0.	1		1435	176	0.	1		2050	251	0.
1		0210	27	1.	1		0825	102	0.	1		1440	177	0.	1		2055	252	0.
1		0215	28	1.	1		0830	103	0.	1		1445	178	0.	1		2100	253	0.
1		0220	29	1.	1		0835	104	0.	1		1450	179	0.	1		2105	254	0.
1		0225	30	2.	1		0840	105	0.	1		1455	180	0.	1		2110	255	0.
1		0230	31	3.	1		0845	106	0.	1		1500	181	0.	1		2115	256	0.
1		0235	32	4.	1		0850	107	0.	1		1505	182	0.	1		2120	257	0.
1		0240	33	5.	1		0855	108	0.	1		1510	183	0.	1		2125	258	0.
1		0245	34	6.	1		0900	109	0.	1		1515	184	0.	1		2130	259	0.
1		0250	35	7.	1		0905	110	0.	1		1520	185	0.	1		2135	260	0.
1		0255	36	9.	1		0910	111	0.	1		1525	186	0.	1		2140	261	0.
1		0300	37	10.	1		0915	112	0.	1		1530	187	0.	1		2145	262	0.
1		0305	38	11.	1		0920	113	0.	1		1535	188	0.	1		2150	263	0.
1		0310	39	12.	1		0925	114	0.	1		1540	189	0.	1		2155	264	0.
1		0315	40	15.	1		0930	115	0.	1		1545	190	0.	1		2200	265	0.
1		0320	41	22.	1		0935	116	0.	1		1550	191	0.	1		2205	266	0.
1		0325	42	35.	1		0940	117	0.	1		1555	192	0.	1		2210	267	0.
1		0330	43	60.	1		0945	118	0.	1		1600	193	0.	1		2215	268	0.
1		0335	44	106.	1		0950	119	0.	1		1605	194	0.	1		2220	269	0.
1		0340	45	226.	1		0955	120	0.	1		1610	195	0.	1		2225	270	0.
1		0345	46	435.	1		1000	121	0.	1		1615	196	0.	1		2230	271	0.
1		0350	47	557.	1		1005	122	0.	1		1620	197	0.	1		2235	272	0.
1		0355	48	589.	1		1010	123	0.	1		1625	198	0.	1		2240	273	0.
1		0400	49	550.	1		1015	124	0.	1		1630	199	0.	1		2245	274	0.
1		0405	50	483.	1		1020	125	0.	1		1635	200	0.	1		2250	275	0.
1		0410	51	406.	1		1025	126	0.	1		1640	201	0.	1		2255	276	0.
1		0415	52	332.	1		1030	127	0.	1		1645	202	0.	1		2300	277	0.
1		0420	53	263.	1		1035	128	0.	1		1650	203	0.	1		2305	278	0.
1		0425	54	202.	1		1040	129	0.	1		1655	204	0.	1		2310	279	0.
1		0430	55	153.	1		1045	130	0.	1		1700	205	0.	1		2315	280	0.
1		0435	56	121.	1		1050	131	0.	1		1705	206	0.	1		2320	281	0.
1		0440	57	106.	1		1055	132	0.	1		1710	207	0.	1		2325	282	0.
1		0445	58	100.	1		1100	133	0.	1		1715	208	0.	1		2330	283	0.
1		0450	59	100.	1		1105	134	0.	1		1720	209	0.	1		2335	284	0.
1		0455	60	101.	1		1110	135	0.	1		1725	210	0.	1		2340	285	0.
1		0500	61	102.	1		1115	136	0.	1		1730	211	0.	1		2345	286	0.
1		0505	62	102.	1		1120	137	0.	1		1735	212	0.	1		2350	287	0.
1		0510	63	99.	1		1125	138	0.	1		1740	213	0.	1		2355	288	0.
1		0515	64	93.	1		1130	139	0.	1		1745	214	0.	2		0000	289	0.
1		0520	65	85.	1		1135	140	0.	1		1750	215	0.	2		0005	290	0.
1		0525	66	75.	1		1140	141	0.	1		1755	216	0.	2		0010	291	0.
1		0530	67	64.	1		1145	142	0.	1		1800	217	0.	2		0015	292	0.
1		0535	68	54.	1		1150	143	0.	1		1805	218	0.	2		0020	293	0.
1		0540	69	45.	1		1155	144	0.	1		1810	219	0.	2		0025	294	0.
1		0545	70	37.	1		1200	145	0.	1		1815	220	0.	2		0030	295	0.
1		0550	71	30.	1		1205	146	0.	1		1820	221	0.	2		0035	296	0.
1		0555	72	25.	1		1210	147	0.	1		1825	222	0.	2		0040	297	0.
1		0600	73	21.	1		1215	148	0.	1		1830	223	0.	2		0045	298	0.
1		0605	74	18.	1		1220	149	0.	1		1835	224	0.	2		0050	299	0.
1		0610	75	16.	1		1225	150	0.	1		1840	225	0.	2		0055	300	0.

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	24.92-HR
+ (CFS)	(HR)					
		(CFS)				
+ 589.	3.92		83.	21.	20.	20.
		(INCHES)	.893	.894	.894	.894
		(AC-FT)	41.	41.	41.	41.

CUMULATIVE AREA = .86 SQ MI

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PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .99	RATIO 2 .98	RATIO 3 .95	RATIO 4 .93	RATIO 5 .92	RATIO 6 .91	RATIO 7 .90	RATIO 8 .57
HYDROGRAPH AT												
+	CA03a	.09	1	FLOW	123.	120.	116.	112.	111.	110.	109.	56.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03c	.02	1	FLOW	29.	28.	27.	26.	26.	26.	25.	13.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03c	.12	1	FLOW	151.	148.	144.	139.	137.	135.	134.	70.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA03b	.08	1	FLOW	99.	97.	94.	91.	89.	88.	88.	45.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA03	.20	1	FLOW	250.	246.	237.	229.	226.	224.	222.	115.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO												
+	RCCA03	.20	1	FLOW	245.	239.	232.	223.	221.	218.	216.	111.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
HYDROGRAPH AT												
+	CA04b	.06	1	FLOW	82.	80.	77.	75.	73.	73.	72.	37.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA04b	.26	1	FLOW	324.	316.	307.	295.	292.	289.	286.	146.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
ROUTED TO												
+	RCCA04b	.26	1	FLOW	317.	315.	298.	293.	291.	284.	279.	147.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04a	.04	1	FLOW	49.	48.	46.	45.	44.	44.	43.	22.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA04c	.03	1	FLOW	42.	41.	40.	38.	38.	37.	37.	19.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA04-1	.33	1	FLOW	395.	391.	371.	364.	362.	354.	348.	183.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04g	.05	1	FLOW	83.	82.	79.	77.	76.	75.	75.	41.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO												
+	RCA04g	.05	1	FLOW	79.	78.	76.	73.	74.	73.	72.	39.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA04d	.05	1	FLOW	78.	77.	75.	72.	71.	71.	70.	38.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA04d	.10	1	FLOW	149.	146.	141.	136.	134.	133.	132.	70.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
ROUTED TO												
+	RCA04d	.10	1	FLOW	148.	146.	141.	136.	135.	134.	133.	70.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	CA04e	.19	1	FLOW	199.	195.	188.	181.	179.	177.	175.	88.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCA04e	.29	1	FLOW	343.	336.	325.	314.	310.	307.	305.	158.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO												
+	RCCA04e	.29	1	FLOW	336.	327.	322.	305.	299.	296.	295.	158.
				TIME	3.83	3.83	3.83	3.83	3.92	3.92	3.92	3.92
HYDROGRAPH AT												
+	CA04f	.05	1	FLOW	61.	60.	58.	56.	55.	55.	54.	29.

				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT													
+	CCA04f	.34	1	FLOW	378.	368.	362.	344.	337.	333.	332.	173.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CCA04	.67	1	FLOW	744.	732.	704.	680.	671.	659.	652.	338.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
ROUTED TO													
+	RCCA04	.67	1	FLOW	731.	721.	700.	668.	664.	661.	649.	338.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT													
+	CA05a	.04	1	FLOW	47.	46.	44.	43.	42.	42.	41.	21.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT													
+	CA05b	.05	1	FLOW	66.	65.	62.	60.	60.	59.	59.	31.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT													
+	CCA05-1	.75	1	FLOW	813.	801.	778.	744.	738.	735.	722.	368.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
DIVERSION TO													
+	DSTEWQ	.75	1	FLOW	383.	371.	348.	314.	308.	305.	292.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
HYDROGRAPH AT													
+	DCCA05	.75	1	FLOW	430.	430.	430.	430.	430.	430.	430.	368.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.67	3.92
HYDROGRAPH AT													
+	CA05c	.02	1	FLOW	36.	35.	34.	33.	32.	32.	32.	17.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCA05c	.02	1	FLOW	34.	33.	32.	31.	30.	30.	30.	16.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05d	.04	1	FLOW	57.	56.	54.	52.	51.	50.	50.	26.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05e	.00	1	FLOW	5.	5.	5.	5.	4.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
3 COMBINED AT													
+	CCA05e	.07	1	FLOW	95.	93.	90.	87.	86.	85.	84.	43.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
DIVERSION TO													
+	DTA05e	.07	1	FLOW	51.	50.	48.	46.	46.	45.	45.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	DTCCA05e	.07	1	FLOW	44.	43.	42.	40.	40.	39.	39.	20.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05f	.01	1	FLOW	14.	14.	14.	13.	13.	13.	13.	7.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO													
+	DTA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DTCA05f	.01	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT													
+	CCA05f	.08	1	FLOW	51.	50.	49.	47.	46.	46.	45.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
ROUTED TO													
+	RCCA05f	.08	1	FLOW	49.	48.	47.	45.	44.	44.	44.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	CA05h	.00	1	FLOW	5.	5.	5.	5.	5.	4.	4.	2.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05i	.00	1	FLOW	7.	7.	7.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT													
+	CA05k	.01	1	FLOW	16.	16.	16.	15.	15.	15.	15.	8.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
4 COMBINED AT													

+	CCA05k	.09	1	FLOW	76.	74.	72.	69.	68.	68.	67.	35.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	CA05g	.01	1	FLOW	12.	11.	11.	11.	11.	10.	10.	5.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05j	.00	1	FLOW	9.	9.	8.	8.	8.	8.	8.	4.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05p	.01	1	FLOW	8.	8.	8.	8.	8.	8.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA05p	.02	1	FLOW	28.	27.	26.	25.	25.	25.	25.	13.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	DRA05e	.00	1	FLOW	51.	50.	48.	46.	46.	45.	45.	23.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT												
+	DRA05f	.00	1	FLOW	7.	7.	7.	7.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
3 COMBINED AT												
+	CCA05-3	.02	1	FLOW	85.	83.	80.	78.	77.	76.	75.	39.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
DIVERSION TO												
+	DTA05-3	.02	1	FLOW	78.	76.	74.	71.	70.	70.	69.	36.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT												
+	DTCCA053	.02	1	FLOW	7.	7.	6.	6.	6.	6.	6.	3.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05-2	.11	1	FLOW	83.	81.	78.	76.	75.	74.	73.	38.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05-2a	.86	1	FLOW	513.	511.	508.	506.	505.	504.	500.	387.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.83
HYDROGRAPH AT												
+	CHAR	.04	1	FLOW	43.	43.	43.	43.	43.	43.	43.	43.
				TIME	3.42	3.42	3.42	3.42	3.42	3.42	3.42	3.42
ROUTED TO												
+	RCHAR	.04	1	FLOW	44.	44.	44.	44.	44.	44.	44.	44.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CH70-C	.14	1	FLOW	134.	132.	127.	122.	120.	118.	117.	55.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCHAR	.17	1	FLOW	175.	172.	167.	162.	160.	159.	158.	95.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO												
+	RCCHAR	.17	1	FLOW	174.	171.	166.	161.	159.	158.	157.	95.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
HYDROGRAPH AT												
+	CA05m	.00	1	FLOW	8.	8.	7.	7.	7.	7.	7.	4.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
2 COMBINED AT												
+	CCA05n	.18	1	FLOW	179.	175.	170.	165.	164.	162.	161.	97.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
ROUTED TO												
+	RCCA05m	.18	1	FLOW	176.	173.	168.	163.	161.	160.	159.	96.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT												
+	CCA05-4	1.04	1	FLOW	667.	662.	655.	649.	646.	644.	643.	481.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT												
+	CA05n	.00	1	FLOW	6.	6.	6.	6.	6.	6.	6.	3.
				TIME	3.50	3.50	3.50	3.50	3.50	3.50	3.50	3.50
HYDROGRAPH AT												
+	CA05q	.01	1	FLOW	16.	16.	15.	15.	15.	14.	14.	7.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
2 COMBINED AT												
+	CCA05q	.02	1	FLOW	23.	22.	21.	21.	20.	20.	20.	10.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58

2 COMBINED AT													
+	CCA05	1.06	1	FLOW	685.	681.	673.	665.	662.	660.	659.	487.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.83
ROUTED TO													
+	RCCA05	1.06	1	FLOW	684.	679.	672.	664.	661.	659.	658.	482.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	CA06-C	.41	1	FLOW	309.	302.	290.	278.	273.	270.	268.	119.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT													
+	CH59-C	.21	1	FLOW	246.	242.	234.	227.	224.	222.	221.	124.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO													
+	DFLAM	.21	1	FLOW	102.	98.	90.	83.	80.	78.	77.	0.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	.00
HYDROGRAPH AT													
+	DCH58-C	.21	1	FLOW	144.	144.	144.	144.	144.	144.	144.	124.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.83
ROUTED TO													
+	RDCH58	.21	1	FLOW	149.	147.	147.	148.	148.	148.	148.	125.
				TIME	3.67	3.67	3.75	3.75	3.75	3.75	3.75	3.92
HYDROGRAPH AT													
+	CH58-C	.13	1	FLOW	156.	153.	149.	144.	142.	141.	140.	77.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.75
2 COMBINED AT													
+	CCH58-C	.34	1	FLOW	302.	299.	295.	292.	290.	289.	288.	194.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
DIVERSION TO													
+	DBN03	.34	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	DDCH59-C	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
DIVERSION TO													
+	DBN03a	.34	1	FLOW	167.	167.	167.	167.	167.	167.	167.	167.
				TIME	3.50	3.50	3.50	3.58	3.58	3.58	3.58	3.75
HYDROGRAPH AT													
+	DDCH59	.34	1	FLOW	0.	0.	0.	0.	0.	0.	0.	0.
				TIME	.00	.00	.00	.00	.00	.00	.00	.00
HYDROGRAPH AT													
+	BN06-C	.34	1	FLOW	420.	411.	396.	382.	376.	371.	368.	179.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.67
HYDROGRAPH AT													
+	BN03-C	.54	1	FLOW	496.	485.	466.	448.	440.	435.	431.	197.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
HYDROGRAPH AT													
+	DBN03	.00	1	FLOW	135.	132.	128.	125.	123.	122.	121.	27.
				TIME	3.75	3.75	3.75	3.75	3.75	3.75	3.75	3.83
ROUTED TO													
+	RDBN03	.00	1	FLOW	139.	144.	148.	119.	121.	122.	123.	27.
				TIME	3.92	3.92	3.83	3.92	3.92	3.92	3.92	4.08
3 COMBINED AT													
+	CBN03	.88	1	FLOW	868.	862.	873.	817.	807.	798.	790.	353.
				TIME	3.67	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO													
+	RCBN03	.88	1	FLOW	861.	853.	852.	803.	794.	783.	778.	353.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT													
+	BN08	.21	1	FLOW	220.	216.	209.	202.	199.	197.	196.	103.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CBN08	1.09	1	FLOW	1082.	1069.	1061.	1005.	994.	980.	974.	453.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
ROUTED TO													
+	RCBN08	1.09	1	FLOW	1080.	1065.	1050.	998.	987.	974.	966.	445.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.75
HYDROGRAPH AT													
+	BN09	.23	1	FLOW	167.	163.	156.	149.	146.	144.	143.	59.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CBN09	1.32	1	FLOW	1247.	1228.	1206.	1147.	1133.	1118.	1109.	499.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83

DIVERSION TO												
+	DBN09a	1.32	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT												
+	DBN09	1.32	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCBN09	1.66	1	FLOW	202.	202.	202.	202.	202.	202.	202.	202.
				TIME	3.33	3.33	3.33	3.42	3.42	3.42	3.42	3.50
2 COMBINED AT												
+	CCA06-1	2.07	1	FLOW	511.	504.	492.	480.	475.	472.	470.	321.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
2 COMBINED AT												
+	CCA06	3.13	1	FLOW	1168.	1157.	1138.	1120.	1112.	1107.	1103.	798.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA06	3.13	1	FLOW	1164.	1153.	1134.	1116.	1108.	1104.	1100.	797.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA08	.07	1	FLOW	82.	80.	77.	74.	73.	72.	72.	34.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
HYDROGRAPH AT												
+	CA08a	.05	1	FLOW	58.	56.	54.	52.	52.	51.	51.	25.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
3 COMBINED AT												
+	CCA08	3.25	1	FLOW	1273.	1260.	1238.	1215.	1207.	1201.	1197.	836.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA08	3.25	1	FLOW	1272.	1258.	1236.	1214.	1205.	1200.	1195.	833.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA09	.05	1	FLOW	46.	45.	43.	41.	41.	40.	40.	17.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA09	3.30	1	FLOW	1307.	1293.	1269.	1246.	1237.	1230.	1226.	844.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA09	3.30	1	FLOW	1305.	1290.	1266.	1243.	1234.	1228.	1223.	838.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
HYDROGRAPH AT												
+	CA10	.03	1	FLOW	39.	38.	37.	36.	35.	35.	34.	17.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA10	3.33	1	FLOW	1333.	1318.	1293.	1269.	1260.	1253.	1248.	848.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA10	3.33	1	FLOW	1326.	1311.	1285.	1260.	1250.	1244.	1239.	836.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA11	.09	1	FLOW	119.	117.	113.	110.	108.	107.	107.	59.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.75
2 COMBINED AT												
+	CCA11	3.42	1	FLOW	1431.	1415.	1385.	1357.	1347.	1339.	1334.	878.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
ROUTED TO												
+	RCCA11	3.42	1	FLOW	1423.	1407.	1377.	1348.	1337.	1331.	1325.	873.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA12	.06	1	FLOW	83.	81.	79.	76.	75.	74.	74.	40.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA12	3.49	1	FLOW	1488.	1470.	1438.	1408.	1396.	1389.	1383.	893.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
ROUTED TO												
+	RCCA12	3.49	1	FLOW	1478.	1458.	1427.	1395.	1383.	1376.	1370.	892.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT												
+	CA13a	.06	1	FLOW	79.	78.	75.	72.	71.	71.	70.	35.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT												
+	CCA13a	3.55	1	FLOW	1541.	1520.	1487.	1453.	1440.	1433.	1426.	910.

				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	4.00
HYDROGRAPH AT													
+	BN10-C	.26	1	FLOW	232.	227.	219.	211.	208.	205.	204.	97.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT													
+	DBN09a	.00	1	FLOW	1045.	1026.	1004.	945.	931.	916.	907.	297.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CBN10-C	.26	1	FLOW	1278.	1254.	1223.	1156.	1139.	1122.	1111.	394.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCBN10-C	.26	1	FLOW	1267.	1241.	1200.	1141.	1116.	1105.	1089.	392.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
HYDROGRAPH AT													
+	BN12-C	.32	1	FLOW	278.	272.	262.	251.	247.	244.	242.	111.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
2 COMBINED AT													
+	CBN12-C	.58	1	FLOW	1545.	1513.	1462.	1392.	1363.	1349.	1331.	503.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.83
ROUTED TO													
+	RCBN12-C	.58	1	FLOW	1521.	1491.	1444.	1374.	1346.	1339.	1316.	498.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
HYDROGRAPH AT													
+	BN15-C	.28	1	FLOW	234.	229.	220.	211.	208.	205.	203.	92.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.92
2 COMBINED AT													
+	CBN15-C	.86	1	FLOW	1753.	1716.	1660.	1582.	1551.	1541.	1516.	589.
				TIME	3.83	3.92	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO													
+	RCBN15-C	.86	1	FLOW	1750.	1715.	1658.	1580.	1549.	1538.	1513.	582.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	3.92
2 COMBINED AT													
+	CCA13	4.41	1	FLOW	3276.	3215.	3122.	3014.	2971.	2952.	2922.	1481.
				TIME	3.83	3.83	3.92	3.92	3.92	3.92	3.92	3.92
ROUTED TO													
+	RCCA13	4.41	1	FLOW	3260.	3204.	3118.	3006.	2964.	2943.	2917.	1468.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT													
+	CA14	.05	1	FLOW	65.	64.	61.	59.	58.	58.	57.	28.
				TIME	3.67	3.67	3.67	3.67	3.67	3.67	3.67	3.67
2 COMBINED AT													
+	CCA14	4.47	1	FLOW	3298.	3242.	3155.	3041.	2998.	2977.	2951.	1482.
				TIME	3.92	3.92	3.92	3.92	3.92	3.92	3.92	4.00
HYDROGRAPH AT													
+	DRDTA05	.00	1	FLOW	78.	76.	74.	71.	70.	70.	69.	36.
				TIME	3.58	3.58	3.58	3.58	3.58	3.58	3.58	3.58
HYDROGRAPH AT													
+	DRDSTEW	.00	1	FLOW	383.	371.	348.	314.	308.	305.	292.	0.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	.00
2 COMBINED AT													
+	CSTEWBY	.00	1	FLOW	426.	413.	388.	353.	347.	343.	330.	36.
				TIME	3.83	3.83	3.83	3.83	3.83	3.83	3.83	3.58

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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

						INTERPOLATED TO COMPUTATION INTERVAL		
ISTAQ	ELEMENT	DT	PEAK	TIME TO PEAK	VOLUME	DT	PEAK	TIME TO PEAK	VOLUME
		(MIN)	(CFS)	(MIN)	(IN)	(MIN)	(CFS)	(MIN)	(IN)
FOR PLAN = 1 RATIO= .00									
RCCA03	MANE	2.90	247.37	220.47	1.85	5.00	245.26	220.00	1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1937E+02 EXCESS= .0000E+00 OUTFLOW= .1937E+02 BASIN STORAGE= .5645E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCA03	MANE	2.92	243.30	221.56	1.82	5.00	238.99	220.00	1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1897E+02 EXCESS= .0000E+00 OUTFLOW= .1897E+02 BASIN STORAGE= .6041E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00								
RCCA03	MANE	2.94	234.29	220.50	1.75	5.00	232.11	220.00	1.75

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1830E+02 EXCESS= .0000E+00 OUTFLOW= .1831E+02 BASIN STORAGE= .7607E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	2.97	226.83	222.43	1.69	5.00	223.26	220.00	1.69	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1764E+02 EXCESS= .0000E+00 OUTFLOW= .1764E+02 BASIN STORAGE= .6939E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	2.98	222.20	223.23	1.66	5.00	220.90	220.00	1.66	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1737E+02 EXCESS= .0000E+00 OUTFLOW= .1738E+02 BASIN STORAGE= .5734E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	2.98	221.33	220.81	1.64	5.00	218.27	220.00	1.64	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1719E+02 EXCESS= .0000E+00 OUTFLOW= .1719E+02 BASIN STORAGE= .7083E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	2.99	220.11	221.22	1.63	5.00	216.24	220.00	1.63	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1706E+02 EXCESS= .0000E+00 OUTFLOW= .1706E+02 BASIN STORAGE= .6337E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA03	MANE	3.52	113.83	222.01	.82	5.00	110.85	225.00	.82	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8573E+01 EXCESS= .0000E+00 OUTFLOW= .8574E+01 BASIN STORAGE= .6911E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.47	320.98	223.59	1.85	5.00	316.89	225.00	1.85	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2528E+02 EXCESS= .0000E+00 OUTFLOW= .2528E+02 BASIN STORAGE= .1242E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.50	315.31	224.96	1.81	5.00	315.13	225.00	1.82	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2476E+02 EXCESS= .0000E+00 OUTFLOW= .2477E+02 BASIN STORAGE= .1448E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.53	298.52	226.67	1.75	5.00	297.52	225.00	1.74	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2383E+02 EXCESS= .0000E+00 OUTFLOW= .2384E+02 BASIN STORAGE= .1001E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.58	295.44	224.24	1.69	5.00	292.90	225.00	1.69	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2304E+02 EXCESS= .0000E+00 OUTFLOW= .2304E+02 BASIN STORAGE= .1041E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.59	291.89	224.89	1.66	5.00	291.46	225.00	1.67	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2270E+02 EXCESS= .0000E+00 OUTFLOW= .2271E+02 BASIN STORAGE= .9325E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.60	286.00	225.54	1.64	5.00	284.35	225.00	1.65	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2243E+02 EXCESS= .0000E+00 OUTFLOW= .2244E+02 BASIN STORAGE= .1303E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	4.61	281.55	226.04	1.63	5.00	279.39	225.00	1.63	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2223E+02 EXCESS= .0000E+00 OUTFLOW= .2224E+02 BASIN STORAGE= .1145E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04b	MANE	5.00	147.29	225.00	.82	5.00	147.29	225.00	.82	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1117E+02 EXCESS= .0000E+00 OUTFLOW= .1117E+02 BASIN STORAGE= .1181E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	4.00	80.56	224.00	2.03	5.00	79.42	225.00	2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5617E+01 EXCESS= .0000E+00 OUTFLOW= .5625E+01 BASIN STORAGE= .1837E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	4.00	79.10	224.00	1.99	5.00	78.00	225.00	1.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5507E+01 EXCESS= .0000E+00 OUTFLOW= .5515E+01 BASIN STORAGE= .1820E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	4.00	76.65	224.00	1.92	5.00	75.63	225.00	1.92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5325E+01 EXCESS= .0000E+00 OUTFLOW= .5333E+01 BASIN STORAGE= .1791E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	4.00	74.20	224.00	1.86	5.00	73.26	225.00	1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5143E+01 EXCESS= .0000E+00 OUTFLOW= .5151E+01 BASIN STORAGE= .1762E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	3.75	73.65	225.00	1.83	5.00	73.65	225.00	1.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5070E+01 EXCESS= .0000E+00 OUTFLOW= .5076E+01 BASIN STORAGE= .1616E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	3.75	72.97	225.00	1.81	5.00	72.97	225.00	1.81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5020E+01 EXCESS= .0000E+00 OUTFLOW= .5026E+01 BASIN STORAGE= .1609E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	3.75	72.49	225.00	1.80	5.00	72.49	225.00	1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4983E+01 EXCESS= .0000E+00 OUTFLOW= .4989E+01 BASIN STORAGE= .1603E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCA04g	MANE	4.50	39.30	225.00	.95	5.00	39.30	225.00	.95

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2632E+01 EXCESS= .0000E+00 OUTFLOW= .2636E+01 BASIN STORAGE= .1833E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	148.18	230.00	2.03	5.00	148.18	230.00	2.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1127E+02 EXCESS= .0000E+00 OUTFLOW= .1128E+02 BASIN STORAGE= .2226E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	145.50	230.00	1.99	5.00	145.50	230.00	1.99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1105E+02 EXCESS= .0000E+00 OUTFLOW= .1106E+02 BASIN STORAGE= .2209E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	141.01	230.00	1.93	5.00	141.01	230.00	1.93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1069E+02 EXCESS= .0000E+00 OUTFLOW= .1070E+02 BASIN STORAGE= .2179E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	136.05	230.00	1.86	5.00	136.05	230.00	1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1032E+02 EXCESS= .0000E+00 OUTFLOW= .1033E+02 BASIN STORAGE= .2253E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	134.96	230.00	1.83	5.00	134.96	230.00	1.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1017E+02 EXCESS= .0000E+00 OUTFLOW= .1018E+02 BASIN STORAGE= .1756E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	133.69	230.00	1.82	5.00	133.69	230.00	1.82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1007E+02 EXCESS= .0000E+00 OUTFLOW= .1007E+02 BASIN STORAGE= .1749E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	132.78	230.00	1.80	5.00	132.78	230.00	1.80	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9997E+01 EXCESS= .0000E+00 OUTFLOW= .1000E+02 BASIN STORAGE= .1745E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCA04d	MANE	5.00	70.17	230.00	.96	5.00	70.17	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5300E+01 EXCESS= .0000E+00 OUTFLOW= .5303E+01 BASIN STORAGE= .2007E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.82	342.53	231.23	1.88	5.00	335.72	230.00	1.88	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2941E+02 EXCESS= .0000E+00 OUTFLOW= .2941E+02 BASIN STORAGE= .1397E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.84	334.52	232.35	1.84	5.00	326.56	230.00	1.84	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2881E+02 EXCESS= .0000E+00 OUTFLOW= .2881E+02 BASIN STORAGE= .1078E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.88	321.90	229.40	1.77	5.00	321.87	230.00	1.77	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2781E+02 EXCESS= .0000E+00 OUTFLOW= .2781E+02 BASIN STORAGE= .1185E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.92	313.14	231.46	1.71	5.00	305.26	230.00	1.71	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2681E+02 EXCESS= .0000E+00 OUTFLOW= .2681E+02 BASIN STORAGE= .1108E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.94	308.20	232.14	1.68	5.00	299.29	235.00	1.68	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2640E+02 EXCESS= .0000E+00 OUTFLOW= .2640E+02 BASIN STORAGE= .1111E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.95	304.79	232.72	1.67	5.00	296.26	235.00	1.67	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2612E+02 EXCESS= .0000E+00 OUTFLOW= .2612E+02 BASIN STORAGE= .1552E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	4.96	302.39	233.13	1.65	5.00	294.60	235.00	1.65	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2592E+02 EXCESS= .0000E+00 OUTFLOW= .2593E+02 BASIN STORAGE= .1463E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04e	MANE	5.00	157.66	235.00	.84	5.00	157.66	235.00	.84	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1315E+02 EXCESS= .0000E+00 OUTFLOW= .1316E+02 BASIN STORAGE= .1062E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04	MANE	4.46	737.57	231.88	1.86	5.00	731.14	230.00	1.85	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6595E+02 EXCESS= .0000E+00 OUTFLOW= .6596E+02 BASIN STORAGE= .1181E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04	MANE	4.48	721.44	232.85	1.82	5.00	720.58	230.00	1.82	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6473E+02 EXCESS= .0000E+00 OUTFLOW= .6474E+02 BASIN STORAGE= .1400E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA04	MANE	4.52	705.35	230.57	1.75	5.00	699.86	230.00	1.76	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6232E+02 EXCESS= .0000E+00 OUTFLOW= .6233E+02 BASIN STORAGE= .1404E-02 PERCENT ERROR= .0

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          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.56    673.16    232.65      1.69      5.00    668.40    230.00        1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6014E+02 EXCESS= .0000E+00 OUTFLOW= .6015E+02 BASIN STORAGE= .1321E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.58    664.63    228.84      1.67      5.00    663.96    230.00        1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5936E+02 EXCESS= .0000E+00 OUTFLOW= .5936E+02 BASIN STORAGE= .1283E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.60    661.86    229.82      1.65      5.00    661.46    230.00        1.66

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5876E+02 EXCESS= .0000E+00 OUTFLOW= .5877E+02 BASIN STORAGE= .1602E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         4.61    653.49    230.49      1.64      5.00    648.95    230.00        1.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .5822E+02 EXCESS= .0000E+00 OUTFLOW= .5823E+02 BASIN STORAGE= .1407E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA04  MANE         5.00    337.75    235.00       .83      5.00    337.75    235.00         .83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2931E+02 EXCESS= .0000E+00 OUTFLOW= .2932E+02 BASIN STORAGE= .1330E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.30     34.95    217.79      1.90      5.00     33.71    215.00        1.90

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2332E+01 EXCESS= .0000E+00 OUTFLOW= .2333E+01 BASIN STORAGE= .4960E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.32     33.73    218.84      1.86      5.00     33.03    215.00        1.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2285E+01 EXCESS= .0000E+00 OUTFLOW= .2285E+01 BASIN STORAGE= .3947E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.34     33.12    217.30      1.80      5.00     31.85    215.00        1.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2206E+01 EXCESS= .0000E+00 OUTFLOW= .2206E+01 BASIN STORAGE= .5678E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.37     31.44    215.78      1.73      5.00     30.74    215.00        1.73

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2127E+01 EXCESS= .0000E+00 OUTFLOW= .2127E+01 BASIN STORAGE= .5595E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.38     31.38    216.53      1.71      5.00     30.30    215.00        1.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2096E+01 EXCESS= .0000E+00 OUTFLOW= .2096E+01 BASIN STORAGE= .4807E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.39     31.24    217.06      1.69      5.00     30.00    215.00        1.69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2073E+01 EXCESS= .0000E+00 OUTFLOW= .2074E+01 BASIN STORAGE= .4214E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.40     31.06    217.44      1.68      5.00     29.79    215.00        1.68

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2057E+01 EXCESS= .0000E+00 OUTFLOW= .2058E+01 BASIN STORAGE= .5712E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
            RCA05c  MANE         3.98     16.55    219.03       .86      5.00     16.11    220.00         .86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1050E+01 EXCESS= .0000E+00 OUTFLOW= .1050E+01 BASIN STORAGE= .4180E-03 PERCENT ERROR=   -.1

          FOR PLAN = 1  RATIO=  .00
            RCCA05f  MANE        1.30     50.74    217.32       .87      5.00     49.40    215.00         .87
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .3630E+01 EXCESS= .0000E+00 OUTFLOW= .3630E+01 BASIN STORAGE= .1144E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.31	49.85	216.89	.85	5.00	48.36	215.00	.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3555E+01 EXCESS= .0000E+00 OUTFLOW= .3555E+01 BASIN STORAGE= .1085E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.32	48.11	217.08	.82	5.00	46.70	215.00	.83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3431E+01 EXCESS= .0000E+00 OUTFLOW= .3430E+01 BASIN STORAGE= .1202E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.32	46.43	217.29	.79	5.00	45.07	215.00	.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3307E+01 EXCESS= .0000E+00 OUTFLOW= .3306E+01 BASIN STORAGE= .1152E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.33	45.88	216.59	.78	5.00	44.46	215.00	.78

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3257E+01 EXCESS= .0000E+00 OUTFLOW= .3257E+01 BASIN STORAGE= .1171E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.33	45.34	217.03	.77	5.00	43.95	215.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3222E+01 EXCESS= .0000E+00 OUTFLOW= .3221E+01 BASIN STORAGE= .1219E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.33	44.96	217.35	.77	5.00	43.65	215.00	.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3197E+01 EXCESS= .0000E+00 OUTFLOW= .3197E+01 BASIN STORAGE= .1139E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA05f	MANE	1.52	23.36	217.69	.39	5.00	22.88	220.00	.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1612E+01 EXCESS= .0000E+00 OUTFLOW= .1612E+01 BASIN STORAGE= .1147E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

RCHAR	MANE	4.00	43.95	220.00	1.77	5.00	43.95	220.00	1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR= -.2

FOR PLAN = 1 RATIO= .00

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            RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
            RCHAR  MANE         4.00     43.95    220.00      1.77      5.00     43.95    220.00        1.77

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3446E+01 EXCESS= .0000E+00 OUTFLOW= .3452E+01 BASIN STORAGE= .2427E-02 PERCENT ERROR=   -.2

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.29    174.04    226.18      1.62      5.00    174.01    225.00        1.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1496E+02 EXCESS= .0000E+00 OUTFLOW= .1496E+02 BASIN STORAGE= .1470E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.29    171.15    225.66      1.59      5.00    170.85    225.00        1.59

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1470E+02 EXCESS= .0000E+00 OUTFLOW= .1470E+02 BASIN STORAGE= .1419E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.30    166.24    225.68      1.54      5.00    165.94    225.00        1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1426E+02 EXCESS= .0000E+00 OUTFLOW= .1426E+02 BASIN STORAGE= .1368E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.30    161.35    225.74      1.49      5.00    161.05    225.00        1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1383E+02 EXCESS= .0000E+00 OUTFLOW= .1383E+02 BASIN STORAGE= .1507E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.31    159.36    224.98      1.48      5.00    159.36    225.00        1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1365E+02 EXCESS= .0000E+00 OUTFLOW= .1365E+02 BASIN STORAGE= .1521E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.31    158.08    225.37      1.46      5.00    157.83    225.00        1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1353E+02 EXCESS= .0000E+00 OUTFLOW= .1353E+02 BASIN STORAGE= .1414E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.31    157.07    225.65      1.45      5.00    156.76    225.00        1.45

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1345E+02 EXCESS= .0000E+00 OUTFLOW= .1345E+02 BASIN STORAGE= .1501E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCHAR  MANE        1.45     94.65    223.65       .87      5.00     94.58    225.00         .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8045E+01 EXCESS= .0000E+00 OUTFLOW= .8045E+01 BASIN STORAGE= .1415E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE        1.91    177.11    227.33      1.62      5.00    176.05    225.00        1.62

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1547E+02 EXCESS= .0000E+00 OUTFLOW= .1547E+02 BASIN STORAGE= .2233E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE        1.92    173.74    226.25      1.60      5.00    173.02    225.00        1.60

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1519E+02 EXCESS= .0000E+00 OUTFLOW= .1519E+02 BASIN STORAGE= .2258E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE        1.93    168.67    227.57      1.55      5.00    167.87    225.00        1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1474E+02 EXCESS= .0000E+00 OUTFLOW= .1474E+02 BASIN STORAGE= .2035E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05m  MANE        1.94    164.26    227.00      1.50      5.00    163.15    225.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1429E+02 EXCESS= .0000E+00 OUTFLOW= .1428E+02 BASIN STORAGE= .2253E-03 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         1.94    162.03    227.48      1.48      5.00    161.11    225.00        1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1411E+02 EXCESS= .0000E+00 OUTFLOW= .1411E+02 BASIN STORAGE= .2425E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         1.95    160.18    225.97      1.47      5.00    159.76    225.00        1.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1398E+02 EXCESS= .0000E+00 OUTFLOW= .1398E+02 BASIN STORAGE= .2246E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         1.95    159.35    226.28      1.46      5.00    158.74    225.00        1.46

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1389E+02 EXCESS= .0000E+00 OUTFLOW= .1389E+02 BASIN STORAGE= .2074E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
           RCCA05m  MANE         2.16     95.85    226.72       .87      5.00     95.72    225.00         .87

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8271E+01 EXCESS= .0000E+00 OUTFLOW= .8270E+01 BASIN STORAGE= .2267E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.04    685.23    221.26      1.50      5.00    683.53    225.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8476E+02 EXCESS= .0000E+00 OUTFLOW= .8476E+02 BASIN STORAGE= .1690E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.04    680.41    221.89      1.48      5.00    679.20    225.00        1.48

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8361E+02 EXCESS= .0000E+00 OUTFLOW= .8361E+02 BASIN STORAGE= .1686E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.05    672.97    221.82      1.44      5.00    671.73    225.00        1.44

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8149E+02 EXCESS= .0000E+00 OUTFLOW= .8149E+02 BASIN STORAGE= .1708E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.05    665.34    221.80      1.40      5.00    664.46    225.00        1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7944E+02 EXCESS= .0000E+00 OUTFLOW= .7944E+02 BASIN STORAGE= .1600E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.05    662.37    222.19      1.39      5.00    661.32    225.00        1.39

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7871E+02 EXCESS= .0000E+00 OUTFLOW= .7871E+02 BASIN STORAGE= .1687E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.05    660.31    221.42      1.38      5.00    659.28    225.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7824E+02 EXCESS= .0000E+00 OUTFLOW= .7824E+02 BASIN STORAGE= .1711E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.06    658.64    221.65      1.38      5.00    657.80    225.00        1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7782E+02 EXCESS= .0000E+00 OUTFLOW= .7782E+02 BASIN STORAGE= .1666E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA05  MANE         1.19    485.53    231.01       .79      5.00    481.53    230.00         .79

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4471E+02 EXCESS= .0000E+00 OUTFLOW= .4471E+02 BASIN STORAGE= .1735E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RDCH58  MANE         5.00    148.50    220.00      1.85      5.00    148.50    220.00        1.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2104E+02 EXCESS= .0000E+00 OUTFLOW= .2104E+02 BASIN STORAGE= .7182E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RDCH58  MANE         5.00    147.32    220.00      1.83      5.00    147.32    220.00        1.83
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .2077E+02 EXCESS= .0000E+00 OUTFLOW= .2076E+02 BASIN STORAGE= .7096E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	146.84	225.00	1.79	5.00	146.84	225.00	1.79	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2031E+02 EXCESS= .0000E+00 OUTFLOW= .2030E+02 BASIN STORAGE= .6953E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	147.70	225.00	1.75	5.00	147.70	225.00	1.75	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1985E+02 EXCESS= .0000E+00 OUTFLOW= .1985E+02 BASIN STORAGE= .6809E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.04	225.00	1.73	5.00	148.04	225.00	1.73	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1967E+02 EXCESS= .0000E+00 OUTFLOW= .1966E+02 BASIN STORAGE= .6751E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.28	225.00	1.72	5.00	148.28	225.00	1.72	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1954E+02 EXCESS= .0000E+00 OUTFLOW= .1954E+02 BASIN STORAGE= .6710E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	148.46	225.00	1.71	5.00	148.46	225.00	1.71	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1945E+02 EXCESS= .0000E+00 OUTFLOW= .1944E+02 BASIN STORAGE= .6681E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDCH58	MANE	5.00	125.19	235.00	1.04	5.00	125.19	235.00	1.04	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1180E+02 EXCESS= .0000E+00 OUTFLOW= .1179E+02 BASIN STORAGE= .9285E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	1.00	157.21	232.00	-1.00	5.00	138.67	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	1.00	158.34	232.00	-1.00	5.00	144.32	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	1.00	151.40	233.00	-1.00	5.00	147.96	230.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	136.60	231.75	-1.00	5.00	119.31	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	135.85	232.50	-1.00	5.00	121.02	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	138.90	232.50	-1.00	5.00	122.17	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.75	139.64	232.50	-1.00	5.00	122.80	235.00	-1.00	

FOR PLAN = 1 RATIO= .00

RDBN03	MANE	.50	37.75	245.50	-1.00	5.00	27.17	245.00	-1.00	

FOR PLAN = 1 RATIO= .00

RCBN03	MANE	1.68	866.89	221.60	1.70	5.00	861.29	230.00	1.71	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7993E+02 EXCESS= .0000E+00 OUTFLOW= .7993E+02 BASIN STORAGE= .3011E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

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  RCBN03  MANE         1.68    855.96    230.61      1.67      5.00    852.94    230.00        1.67

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7828E+02 EXCESS= .0000E+00 OUTFLOW= .7828E+02 BASIN STORAGE= .3203E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.68    860.43    231.19      1.61      5.00    851.77    230.00        1.61

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7536E+02 EXCESS= .0000E+00 OUTFLOW= .7536E+02 BASIN STORAGE= .3272E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.72    807.10    230.52      1.54      5.00    802.66    230.00        1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7227E+02 EXCESS= .0000E+00 OUTFLOW= .7227E+02 BASIN STORAGE= .3142E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.73    798.71    231.57      1.52      5.00    794.48    230.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7110E+02 EXCESS= .0000E+00 OUTFLOW= .7110E+02 BASIN STORAGE= .2925E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.74    788.84    230.91      1.50      5.00    782.60    230.00        1.50

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7026E+02 EXCESS= .0000E+00 OUTFLOW= .7027E+02 BASIN STORAGE= .2809E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         1.74    779.81    231.88      1.49      5.00    778.15    230.00        1.49

CONTINUITY SUMMARY (AC-FT) - INFLOW= .6966E+02 EXCESS= .0000E+00 OUTFLOW= .6967E+02 BASIN STORAGE= .3284E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN03  MANE         2.41    354.20    223.74       .65      5.00    352.78    225.00         .65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3055E+02 EXCESS= .0000E+00 OUTFLOW= .3055E+02 BASIN STORAGE= .2984E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.27   1080.00    230.00      1.74      5.00   1080.00    230.00        1.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1012E+03 EXCESS= .0000E+00 OUTFLOW= .1012E+03 BASIN STORAGE= .2419E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.28   1065.17    231.08      1.71      5.00   1065.09    230.00        1.71

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9916E+02 EXCESS= .0000E+00 OUTFLOW= .9916E+02 BASIN STORAGE= .2506E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.28   1053.18    230.51      1.64      5.00   1049.79    230.00        1.65

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9551E+02 EXCESS= .0000E+00 OUTFLOW= .9551E+02 BASIN STORAGE= .2383E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.31    999.17    230.35      1.58      5.00    997.57    230.00        1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9170E+02 EXCESS= .0000E+00 OUTFLOW= .9170E+02 BASIN STORAGE= .2431E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.31    988.12    231.36      1.55      5.00    986.80    230.00        1.55

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9023E+02 EXCESS= .0000E+00 OUTFLOW= .9023E+02 BASIN STORAGE= .2643E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.32    975.16    231.35      1.54      5.00    973.87    230.00        1.54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8921E+02 EXCESS= .0000E+00 OUTFLOW= .8921E+02 BASIN STORAGE= .2656E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
  RCBN08  MANE         1.33    968.29    230.58      1.52      5.00    965.76    230.00        1.52

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8845E+02 EXCESS= .0000E+00 OUTFLOW= .8845E+02 BASIN STORAGE= .2644E-02 PERCENT ERROR=    .0
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          FOR PLAN = 1  RATIO=  .00
            RCBN08  MANE         1.80    452.05    226.71       .69      5.00    444.73    225.00         .69

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4009E+02 EXCESS= .0000E+00 OUTFLOW= .4009E+02 BASIN STORAGE= .2375E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.90   1164.68    231.59      1.01      5.00   1163.90    230.00        1.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1679E+03 EXCESS= .0000E+00 OUTFLOW= .1679E+03 BASIN STORAGE= .1502E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.90   1153.38    230.39       .99      5.00   1152.66    230.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1655E+03 EXCESS= .0000E+00 OUTFLOW= .1655E+03 BASIN STORAGE= .1469E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.91   1135.14    231.56       .97      5.00   1134.30    230.00         .97

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1613E+03 EXCESS= .0000E+00 OUTFLOW= .1613E+03 BASIN STORAGE= .1388E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.92   1116.71    230.83       .94      5.00   1115.67    230.00         .94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1571E+03 EXCESS= .0000E+00 OUTFLOW= .1571E+03 BASIN STORAGE= .1398E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.93   1109.57    231.30       .93      5.00   1108.47    230.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1555E+03 EXCESS= .0000E+00 OUTFLOW= .1555E+03 BASIN STORAGE= .1413E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.93   1104.50    231.64       .93      5.00   1103.67    230.00         .93

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1545E+03 EXCESS= .0000E+00 OUTFLOW= .1544E+03 BASIN STORAGE= .1258E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         1.93   1100.81    231.89       .92      5.00   1100.30    230.00         .92

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1536E+03 EXCESS= .0000E+00 OUTFLOW= .1536E+03 BASIN STORAGE= .1222E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA06  MANE         2.14    797.06    235.38       .54      5.00    796.93    235.00         .54

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9045E+02 EXCESS= .0000E+00 OUTFLOW= .9044E+02 BASIN STORAGE= .1280E-02 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA08  MANE         1.26   1272.24    229.74      1.03      5.00   1271.84    230.00        1.03

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1786E+03 EXCESS= .0000E+00 OUTFLOW= .1786E+03 BASIN STORAGE= .8540E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA08  MANE         1.26   1258.59    229.25      1.01      5.00   1258.22    230.00        1.02

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1760E+03 EXCESS= .0000E+00 OUTFLOW= .1760E+03 BASIN STORAGE= .8791E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA08  MANE         1.27   1236.29    229.27       .99      5.00   1236.03    230.00         .99

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1714E+03 EXCESS= .0000E+00 OUTFLOW= .1713E+03 BASIN STORAGE= .8863E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA08  MANE         1.27   1214.35    229.31       .96      5.00   1213.96    230.00         .96

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1668E+03 EXCESS= .0000E+00 OUTFLOW= .1668E+03 BASIN STORAGE= .9767E-03 PERCENT ERROR=    .0

          FOR PLAN = 1  RATIO=  .00
            RCCA08  MANE         1.28   1205.74    229.83       .95      5.00   1205.49    230.00         .95
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CONTINUITY SUMMARY (AC-FT) - INFLOW= .1651E+03 EXCESS= .0000E+00 OUTFLOW= .1651E+03 BASIN STORAGE= .9381E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.28	1199.63	230.18	.95	5.00	1199.53	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1639E+03 EXCESS= .0000E+00 OUTFLOW= .1639E+03 BASIN STORAGE= .8666E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.28	1195.00	230.43	.94	5.00	1194.94	230.00	.94	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1630E+03 EXCESS= .0000E+00 OUTFLOW= .1630E+03 BASIN STORAGE= .8614E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA08	MANE	1.43	833.08	235.10	.55	5.00	832.88	235.00	.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9487E+02 EXCESS= .0000E+00 OUTFLOW= .9486E+02 BASIN STORAGE= .9524E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.22	1305.30	229.78	1.03	5.00	1304.95	230.00	1.03	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1820E+03 EXCESS= .0000E+00 OUTFLOW= .1820E+03 BASIN STORAGE= .1025E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.23	1290.09	229.38	1.02	5.00	1289.97	230.00	1.02	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1793E+03 EXCESS= .0000E+00 OUTFLOW= .1793E+03 BASIN STORAGE= .1051E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.23	1266.60	229.51	.99	5.00	1266.38	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1745E+03 EXCESS= .0000E+00 OUTFLOW= .1745E+03 BASIN STORAGE= .1005E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.24	1243.39	229.65	.97	5.00	1243.12	230.00	.97	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1698E+03 EXCESS= .0000E+00 OUTFLOW= .1698E+03 BASIN STORAGE= .9626E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.24	1234.61	230.19	.95	5.00	1234.33	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1681E+03 EXCESS= .0000E+00 OUTFLOW= .1680E+03 BASIN STORAGE= .9350E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.25	1227.67	230.58	.95	5.00	1227.55	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1668E+03 EXCESS= .0000E+00 OUTFLOW= .1668E+03 BASIN STORAGE= .9902E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.25	1222.73	229.62	.94	5.00	1222.57	230.00	.94	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1659E+03 EXCESS= .0000E+00 OUTFLOW= .1659E+03 BASIN STORAGE= .9437E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA09	MANE	1.41	838.96	236.51	.55	5.00	838.32	235.00	.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9609E+02 EXCESS= .0000E+00 OUTFLOW= .9608E+02 BASIN STORAGE= .1038E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.25	1327.43	231.45	1.04	5.00	1325.51	230.00	1.04	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1850E+03 EXCESS= .0000E+00 OUTFLOW= .1850E+03 BASIN STORAGE= .2190E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.26	1311.46	232.33	1.03	5.00	1311.10	230.00	1.03	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1822E+03 EXCESS= .0000E+00 OUTFLOW= .1821E+03 BASIN STORAGE= .2102E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.27	1287.25	231.47	1.00	5.00	1284.59	230.00	1.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1773E+03 EXCESS= .0000E+00 OUTFLOW= .1772E+03 BASIN STORAGE= .2015E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.28	1262.42	230.60	.97	5.00	1260.10	230.00	.97	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1725E+03 EXCESS= .0000E+00 OUTFLOW= .1725E+03 BASIN STORAGE= .1834E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.29	1253.64	231.14	.96	5.00	1250.45	230.00	.96	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1707E+03 EXCESS= .0000E+00 OUTFLOW= .1707E+03 BASIN STORAGE= .1791E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.29	1246.97	231.56	.95	5.00	1244.03	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1694E+03 EXCESS= .0000E+00 OUTFLOW= .1694E+03 BASIN STORAGE= .2085E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.30	1241.92	231.87	.95	5.00	1239.10	230.00	.95	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1684E+03 EXCESS= .0000E+00 OUTFLOW= .1684E+03 BASIN STORAGE= .2021E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA10	MANE	2.60	840.32	236.62	.55	5.00	836.48	240.00	.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9731E+02 EXCESS= .0000E+00 OUTFLOW= .9729E+02 BASIN STORAGE= .1784E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.36	1425.60	230.54	1.07	5.00	1423.07	230.00	1.07	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1954E+03 EXCESS= .0000E+00 OUTFLOW= .1954E+03 BASIN STORAGE= .1097E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.36	1411.40	231.37	1.05	5.00	1406.78	230.00	1.05	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1924E+03 EXCESS= .0000E+00 OUTFLOW= .1924E+03 BASIN STORAGE= .9573E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.37	1381.30	231.54	1.03	5.00	1376.96	230.00	1.03	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1871E+03 EXCESS= .0000E+00 OUTFLOW= .1871E+03 BASIN STORAGE= .9614E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.38	1353.61	231.64	1.00	5.00	1348.18	230.00	1.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1820E+03 EXCESS= .0000E+00 OUTFLOW= .1820E+03 BASIN STORAGE= .1065E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.38	1341.69	230.84	.99	5.00	1337.14	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1801E+03 EXCESS= .0000E+00 OUTFLOW= .1801E+03 BASIN STORAGE= .9857E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.38	1336.04	231.23	.98	5.00	1330.91	230.00	.98	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1788E+03 EXCESS= .0000E+00 OUTFLOW= .1788E+03 BASIN STORAGE= .1040E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.39	1330.44	231.54	.97	5.00	1325.19	230.00	.97	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1777E+03 EXCESS= .0000E+00 OUTFLOW= .1777E+03 BASIN STORAGE= .9965E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA11	MANE	1.58	876.12	237.28	.56	5.00	873.30	240.00	.56	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1023E+03 EXCESS= .0000E+00 OUTFLOW= .1023E+03 BASIN STORAGE= .1071E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.38	1484.10	231.35	1.09	5.00	1478.39	230.00	1.09	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2020E+03 EXCESS= .0000E+00 OUTFLOW= .2020E+03 BASIN STORAGE= .9632E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.38	1463.82	230.83	1.07	5.00	1458.07	230.00	1.07	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1988E+03 EXCESS= .0000E+00 OUTFLOW= .1988E+03 BASIN STORAGE= .1055E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.39	1433.29	231.03	1.04	5.00	1426.80	230.00	1.04	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1934E+03 EXCESS= .0000E+00 OUTFLOW= .1934E+03 BASIN STORAGE= .9887E-03 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.40	1403.47	231.21	1.01	5.00	1395.44	230.00	1.01	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1881E+03 EXCESS= .0000E+00 OUTFLOW= .1881E+03 BASIN STORAGE= .1084E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.40	1391.47	231.82	1.00	5.00	1383.39	230.00	1.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1861E+03 EXCESS= .0000E+00 OUTFLOW= .1861E+03 BASIN STORAGE= .1040E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.41	1383.06	232.18	.99	5.00	1376.33	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1847E+03 EXCESS= .0000E+00 OUTFLOW= .1847E+03 BASIN STORAGE= .1116E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.41	1378.02	231.09	.99	5.00	1370.35	230.00	.99	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1836E+03 EXCESS= .0000E+00 OUTFLOW= .1836E+03 BASIN STORAGE= .1052E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA12	MANE	1.62	892.27	239.35	.57	5.00	891.69	240.00	.57	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1054E+03 EXCESS= .0000E+00 OUTFLOW= .1054E+03 BASIN STORAGE= .1163E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.35	1268.66	230.26	6.50	5.00	1266.61	230.00	6.50	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8913E+02 EXCESS= .0000E+00 OUTFLOW= .8913E+02 BASIN STORAGE= .5338E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.37	1243.83	232.02	6.32	5.00	1240.66	230.00	6.32	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8665E+02 EXCESS= .0000E+00 OUTFLOW= .8666E+02 BASIN STORAGE= .4720E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.39	1210.68	231.93	6.00	5.00	1200.20	230.00	6.00	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8231E+02 EXCESS= .0000E+00 OUTFLOW= .8231E+02 BASIN STORAGE= .4667E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.45	1145.81	232.36	5.68	5.00	1140.75	230.00	5.68	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7787E+02 EXCESS= .0000E+00 OUTFLOW= .7787E+02 BASIN STORAGE= .4998E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN10-C	MANE	2.46	1125.87	231.27	5.55	5.00	1116.14	230.00	5.55	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7610E+02 EXCESS= .0000E+00 OUTFLOW= .7612E+02 BASIN STORAGE= .4861E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN10-C MANE 2.48 1111.15 232.68 5.47 5.00 1104.59 230.00 5.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7494E+02 EXCESS= .0000E+00 OUTFLOW= .7495E+02 BASIN STORAGE= .4727E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN10-C MANE 2.49 1098.06 231.13 5.40 5.00 1088.80 230.00 5.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .7406E+02 EXCESS= .0000E+00 OUTFLOW= .7406E+02 BASIN STORAGE= .4887E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN10-C MANE 3.76 392.09 229.47 1.59 5.00 391.76 230.00 1.58

CONTINUITY SUMMARY (AC-FT) - INFLOW= .2171E+02 EXCESS= .0000E+00 OUTFLOW= .2173E+02 BASIN STORAGE= .5384E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.27 1534.71 233.69 3.74 5.00 1521.33 235.00 3.74

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1157E+03 EXCESS= .0000E+00 OUTFLOW= .1157E+03 BASIN STORAGE= .5074E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.29 1504.10 233.38 3.64 5.00 1491.37 235.00 3.64

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1127E+03 EXCESS= .0000E+00 OUTFLOW= .1127E+03 BASIN STORAGE= .5290E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.32 1452.94 234.27 3.47 5.00 1443.95 235.00 3.47

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1073E+03 EXCESS= .0000E+00 OUTFLOW= .1073E+03 BASIN STORAGE= .5373E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.37 1383.31 234.17 3.29 5.00 1374.26 235.00 3.29

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1019E+03 EXCESS= .0000E+00 OUTFLOW= .1019E+03 BASIN STORAGE= .5223E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.39 1356.21 233.74 3.22 5.00 1346.26 235.00 3.21

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9961E+02 EXCESS= .0000E+00 OUTFLOW= .9961E+02 BASIN STORAGE= .5818E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.40 1342.61 232.35 3.18 5.00 1338.57 235.00 3.18

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9826E+02 EXCESS= .0000E+00 OUTFLOW= .9826E+02 BASIN STORAGE= .4723E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 2.41 1324.91 233.59 3.14 5.00 1315.97 235.00 3.13

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9708E+02 EXCESS= .0000E+00 OUTFLOW= .9708E+02 BASIN STORAGE= .5886E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN12-C MANE 3.55 499.29 234.61 1.04 5.00 497.51 235.00 1.04

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3221E+02 EXCESS= .0000E+00 OUTFLOW= .3223E+02 BASIN STORAGE= .4880E-02 PERCENT ERROR= -.1

FOR PLAN = 1 RATIO= .00
RCBN15-C MANE .84 1753.05 231.22 3.01 5.00 1750.20 235.00 3.01

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1386E+03 EXCESS= .0000E+00 OUTFLOW= .1386E+03 BASIN STORAGE= .1899E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN15-C MANE .84 1715.83 234.87 2.93 5.00 1715.19 235.00 2.94

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1350E+03 EXCESS= .0000E+00 OUTFLOW= .1350E+03 BASIN STORAGE= .1902E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00
RCBN15-C MANE .86 1658.68 234.58 2.80 5.00 1657.90 235.00 2.80

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1288E+03 EXCESS= .0000E+00 OUTFLOW= .1288E+03 BASIN STORAGE= .1966E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.87	1580.87	234.78	2.66	5.00	1580.18	235.00	2.66	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1225E+03 EXCESS= .0000E+00 OUTFLOW= .1225E+03 BASIN STORAGE= .1968E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.88	1548.94	234.92	2.60	5.00	1548.68	235.00	2.60	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1197E+03 EXCESS= .0000E+00 OUTFLOW= .1197E+03 BASIN STORAGE= .1901E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.88	1538.11	234.65	2.57	5.00	1537.70	235.00	2.57	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1183E+03 EXCESS= .0000E+00 OUTFLOW= .1183E+03 BASIN STORAGE= .1936E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	.89	1513.74	235.26	2.54	5.00	1513.48	235.00	2.54	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1168E+03 EXCESS= .0000E+00 OUTFLOW= .1168E+03 BASIN STORAGE= .1908E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCBN15-C	MANE	1.30	585.74	235.78	.89	5.00	581.76	235.00	.89	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .4112E+02 EXCESS= .0000E+00 OUTFLOW= .4112E+02 BASIN STORAGE= .1852E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.64	3265.39	234.45	1.47	5.00	3259.59	235.00	1.47	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3470E+03 EXCESS= .0000E+00 OUTFLOW= .3469E+03 BASIN STORAGE= .1938E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.65	3209.81	234.25	1.44	5.00	3204.43	235.00	1.44	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3401E+03 EXCESS= .0000E+00 OUTFLOW= .3400E+03 BASIN STORAGE= .1800E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.67	3119.90	234.86	1.39	5.00	3118.31	235.00	1.39	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3282E+03 EXCESS= .0000E+00 OUTFLOW= .3281E+03 BASIN STORAGE= .1965E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.69	3009.76	234.22	1.34	5.00	3006.00	235.00	1.34	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3163E+03 EXCESS= .0000E+00 OUTFLOW= .3163E+03 BASIN STORAGE= .1842E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.69	2963.97	235.32	1.32	5.00	2963.57	235.00	1.32	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3114E+03 EXCESS= .0000E+00 OUTFLOW= .3114E+03 BASIN STORAGE= .1893E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.70	2945.14	234.12	1.31	5.00	2942.55	235.00	1.31	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3085E+03 EXCESS= .0000E+00 OUTFLOW= .3085E+03 BASIN STORAGE= .2028E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	1.70	2917.33	234.93	1.30	5.00	2916.72	235.00	1.30	

CONTINUITY SUMMARY (AC-FT) - INFLOW= .3060E+03 EXCESS= .0000E+00 OUTFLOW= .3059E+03 BASIN STORAGE= .2076E-02 PERCENT ERROR= .0

FOR PLAN = 1 RATIO= .00

RCCA13	MANE	2.13	1472.49	238.46	.63	5.00	1468.44	240.00	.63	

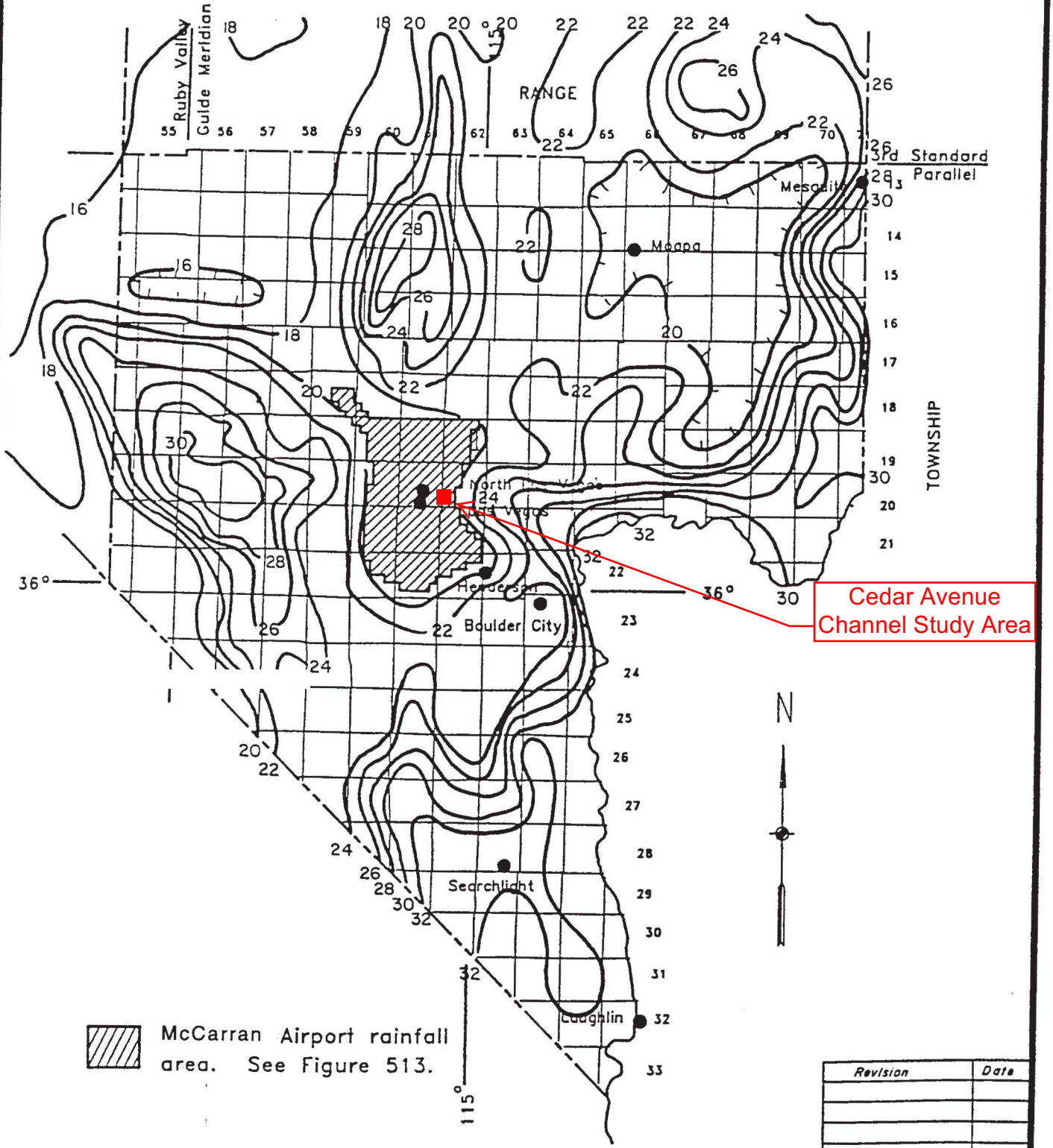
CONTINUITY SUMMARY (AC-FT) - INFLOW= .1492E+03 EXCESS= .0000E+00 OUTFLOW= .1492E+03 BASIN STORAGE= .1896E-02 PERCENT ERROR= .0

*** NORMAL END OF HEC-1 ***

Appendix B-4

CCRFCD Design Manual Tables

RAINFALL DEPTH-DURATION-FREQUENCY
100-YEAR, 6-HOUR
(DEPTHS IN TENTHS OF INCHES)



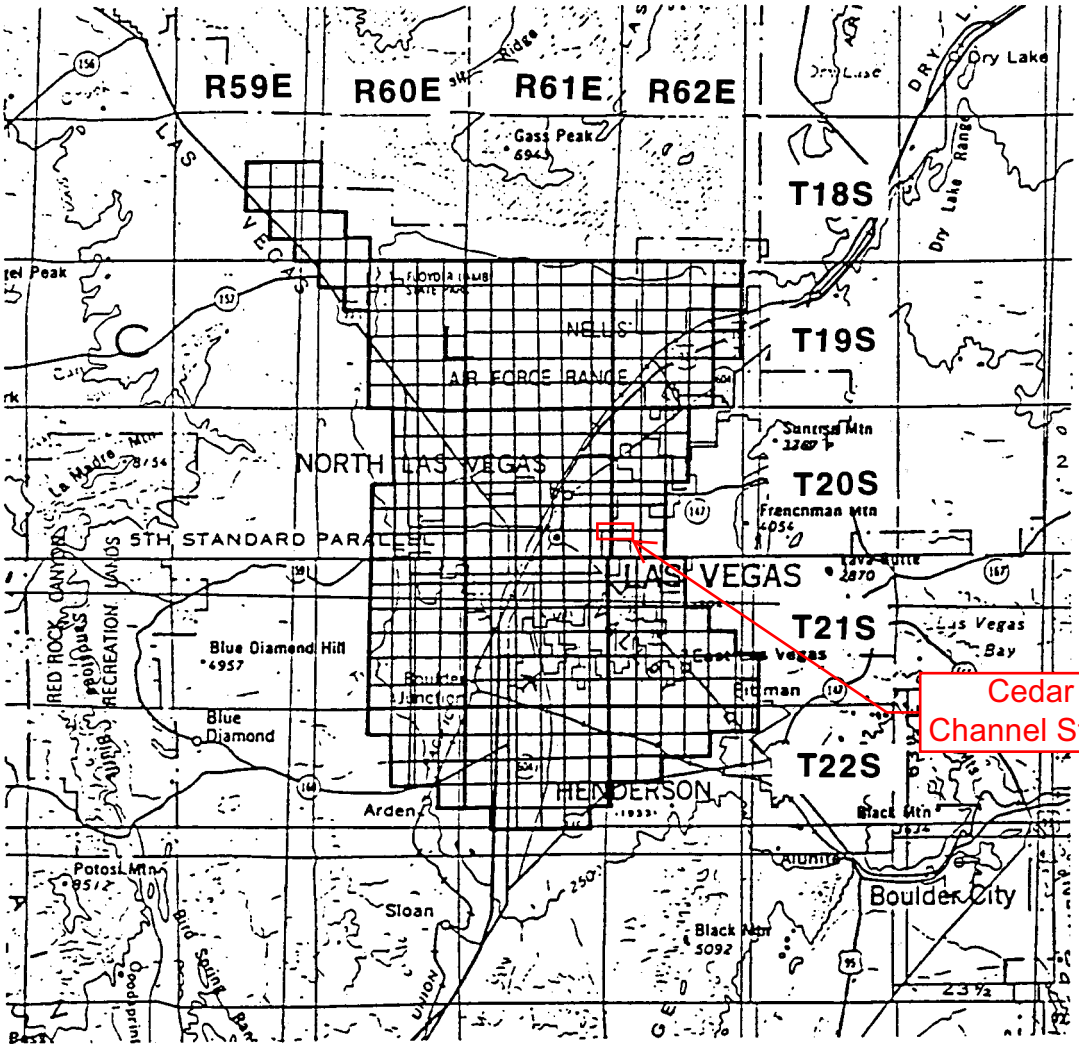
Revision	Date

WRC ENGINEERING

REFERENCE:
NOAA ATLAS 2, VOLUME VII NEVADA, 1973

FIGURE 506

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP	RANGE	SECTIONS	TOWNSHIP	RANGE	SECTIONS
18 South	59 East	13-15,22-26,36	20 South	62 East	4-9,16-20,29-32
18 South	60 East	30-32	21 South	60 East	1-4,9-16,21-28,33-36
19 South	60 East	1-6,8-16,21-28,33-36	21 South	61 East	ALL SECTIONS
19 South	61 East	ALL SECTIONS	21 South	62 East	4-9,15-23, 25-36
19 South	62 East	2-11,14-23,27-34	22 South	60 East	1-4,10-15,24
20 South	60 East	1-3,10-15,21-28,33-36	22 South	61 East	1-24,26-29
20 South	61 East	ALL SECTIONS	22 South	62 East	1-10,17-18

Notes:
1. Refer to Table 505 and Figure 516 Depth-Duration- Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

WRC ENGINEERING

REFERENCE:
USACE, Los Angeles District, 1988

FIGURE 513

DEPTH-DURATION-FREQUENCY VALUES FOR McCARRAN AIRPORT RAINFALL AREA

(IN INCHES)

	RECURRENCE INTERVAL					
TIME	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5 min.	0.15	0.27	0.35	0.46	0.54	0.63
10 min.	0.25	0.44	0.57	0.74	0.89	1.02
15 min.	0.33	0.57	0.74	0.97	1.15	1.32
30 min.	0.44	0.78	1.01	1.31	1.55	1.79
1 hour	0.52	0.89	1.15	1.50	1.78	2.06
2 hour	0.59	1.01	1.30	1.70	2.01	2.30
3 hour	0.64	1.08	1.39	1.82	2.15	2.48
6 hour	0.72	1.22	1.58	2.05	2.41	2.77
24 hour (TR-55)	1.20	1.60	1.80	2.40	2.70	2.96

NOTE: 1. Refer to Figure 513 for a description and drawing of the area included in the McCarran Airport Rainfall Area.

2. The 24 hour values presented above are for use with TR-55 only.

3. Table 501 adjustments not required.

Revision	Date

SIX-HOUR STORM DISTRIBUTIONS

Storm Time (In Minutes)	Percent of Total Storm Depth SDN3	SDN4	SDN5
0	0.0	0.0	0.0
5	2.0	2.0	2.0
10	5.7	5.8	5.9
15	7.0	7.5	8.0
20	8.7	9.9	11.0
25	10.8	12.6	14.4
30	12.4	13.7	15.0
35	13.0	14.5	16.0
40	13.0	14.9	16.8
45	13.0	15.1	17.1
50	13.0	15.5	18.0
55	13.0	15.6	18.2
60	13.0	15.9	18.7
65	13.3	16.2	19.0
70	14.0	16.9	19.7
75	14.2	17.2	20.2
80	14.8	17.9	21.0
85	15.8	18.9	22.0
90	17.2	20.1	23.0
95	18.1	21.1	24.1
100	19.0	22.0	25.0
105	19.7	22.8	25.9
110	19.9	23.2	26.5
115	20.0	24.0	28.0
120	20.1	24.6	29.0
125	20.4	25.2	30.0
130	21.4	26.0	30.5
135	22.9	26.9	30.9
140	24.1	27.6	31.0
145	24.9	28.3	31.7
150	25.1	28.6	32.1
155	25.6	29.2	32.7
160	27.0	30.2	33.3
165	27.8	31.2	34.6
170	28.1	32.1	36.1
175	28.3	33.2	38.1
180	29.5	35.2	40.8
185	32.2	37.6	43.0
190	35.2	41.5	47.7
195	40.9	46.2	51.4
200	49.9	53.0	56.1
205	59.0	61.0	63.0
210	71.0	71.0	71.0
215	74.4	73.2	72.0
220	78.1	75.6	73.1
225	81.2	78.2	75.2
230	81.9	79.9	77.9
235	83.5	81.3	79.0
240	85.1	82.3	79.5
245	85.6	83.0	80.4
250	86.0	83.5	81.0
255	86.8	84.4	82.0
260	87.6	85.1	82.6
265	88.8	86.4	84.0
270	91.0	88.5	85.9
275	92.6	90.8	88.9
280	93.7	92.4	91.0
285	95.0	94.4	93.8
290	97.0	96.8	96.6
295	97.6	97.3	97.0
300	98.2	97.8	97.4
305	98.5	98.2	97.9
310	98.7	98.4	98.1
315	98.9	98.6	98.3
320	99.0	98.8	98.5
325	99.3	99.1	98.9
330	99.3	99.2	99.0
335	99.4	99.3	99.2
340	99.5	99.4	99.3
345	99.8	99.7	99.6
350	99.8	99.8	99.7
355	99.9	99.9	99.9
360	100.0	100.0	100.0

Notes:
1. For drainage areas less than 8 square miles in size, use SDN 3.
2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
4. A graphical representation of these values is presented on **Figure 515**.

Revision	Date

REFERENCE:

TABLE 503

SIX HOUR DEPTH-AREA REDUCTION FACTORS

Drainage Area (Square Miles)	Six-Hour Depth-Area Reduction Factor
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

NOTES: 1. A graphical representation of these factors is presented in Figure 514.

2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

Revision	Date

Appendix B-5

Hydrologic Parameters

Design Storm

The rainfall values used in the hydrologic model are intended to produce runoff discharges for 100-year recurrence interval events. The 100-year recurrence interval is defined as having a 1-percent chance of being equalled or exceeded in any given year. Storm duration of six hours was used in accordance with the Design Manual.

Precipitation Depths

All subbasins contributing runoff to the study area are within the McCarran Airport rainfall area as defined in the Design Manual. Therefore, the 100-year, 6-hour rainfall depth is 2.77 inches for all subbasins (see Figure 506, Figure 513, and Table 505 of the Design Manual in this Appendix).

Storm Distribution

The 100-year, 6-hour rainfall depth was distributed over the 6-hour design storm period using the SDN 3 storm distribution (see Table 503 of the Design Manual in this Appendix). According to established CCRFCD methodology, SDN 3 is used for drainage areas less than 8 square miles which is all combination points and subbasins in the Cedar Avenue Channel analysis.

Depth-Area Reduction Factors

The precipitation depths obtained for the McCarran Airport Rainfall Area from the Design Manual represent rainfall frequency at isolated points. Storms, however, cause rainfall to occur over widespread areas simultaneously, with the most intense rainfall typically occurring near the center of the storm. To account for the rainfall variation, standard precipitation analysis methods require adjusting point precipitation depths downward in order to better represent the average depth of rainfall over the entire storm area. This is done using depth-area reduction curves that relate point precipitation reduction factors to storm area and duration. The reduction factors cause the rainfall depth to decrease as the tributary area increases.

The six hour depth-area reduction factors (DARFs) from Table 502 in the Design Manual were applied to the rainfall depths in the HEC-1 models at each subbasin and concentration point based on upstream tributary area. Rather than interpolating precise reduction factors at every concentration point, an average DARF value was used for a range of tributary areas to be consistent with the 2008 MPU models and methodology. The DARF values applied to the model are shown below. The depth-area reduction factor table from the Design Manual is included in this Appendix**.**

Depth-Area Reduction Factors

Tributary Area (sq mi)	DARF
0 ≤ Area < 0.5	0.99
0.5 ≤ Area < 1	0.975
1 ≤ Area < 2	0.95
2 ≤ Area < 3	0.925
3 ≤ Area < 4	0.915
4 ≤ Area < 5	0.908

Land Use

Land use information was based on the land use data that was compiled for the 2008 MPU. The land use is based on the ultimate condition and assumes that the full "build out" condition has been reached and that available land within the watershed is fully developed. Minor updates and revisions were made to the land use data based on aerial imagery and coordination with the City to reflect changes that have occurred or to better represent actual land use conditions in the watershed.

The land use data consists of 13 categories of land use as defined in table below. Each category is defined by a specified percentage of impervious area, percentage of ground cover in good hydrologic condition, and percentage of desert shrub in poor hydrologic condition. Land use data was obtained in GIS format, with polygon areas delineated to represent specific land use categories in the study area. The land use data is shown in **Figure A-1.**

It should be noted that in the 2008 MPU, land use categories were adjusted to reflect restrictions on the amount of allowable grass landscaping per the Southern Nevada Water Authority drought ordinance. The drought ordinance requirements are only applied to certain areas as determined by CCRFCD. The Cedar Avenue Channel study area does not fall within the drought ordinance area, and therefore, the nine additional land use categories from the 2008 MPU representing the drought ordinance revision are not included in this analysis.

Land Use Categories

Land Use Index Number	Description - Typical Land Uses	Directly Connected Impervious (%)	Open Landscaped Good Condition (%)	Open Desert Shrub Poor Condition (%)
1	Undeveloped Land, Open Desert	0	0	100
2	Parks, Golf Courses	5	85	10
5	Medium Density Residential, 2-4 units per acre	29	71	0
6	High Density Residential, 4-8 units per acre	62	38	0
7	Public Facility and Residential, 8-12 units/acre	72	28	0
8	Very High Density Residential, 12 units/acre or more	85	15	0
9	Commercial, Retail, Casino, High Rise Condominiums	90	10	0
10	Light Industrial	70	15	15

Soils

Soils data for the Cedar Avenue Channel hydrologic analysis comes from the Soil Survey of the Las Vegas Valley Area by the National Conservation Resources Service (NRCS), dated July 1985. Soils data was obtained in GIS format for the study area, and the limits of each soil type are delineated in the GIS layer and assigned a soil map unit number. NRCS methodology divides soils into four hydrological groups, as defined below:

A. High infiltration rate, low runoff potential

B. Moderate infiltration rate, moderately low runoff potential

C. Slow infiltration rate, moderately high runoff potential

D. Very slow infiltration rate, high runoff potential

Each soil map unit number is made up of a certain percentage of hydrologic soil group A, B, C, and D. Curve number calculations for each of the subbasins were based on the individual breakdown of each soil type into the percentages of the minor hydrologic soil group components (A, B, C, or D). Detailed soils data and the soil boundaries are shown on **Figure A-2**.

Curve Numbers

Rainfall losses due to soil infiltration, depression storage, and other factors are computed using the NRCS curve number (CN) method described in the Design Manual. The curve number method is a function of soil type, land cover, and antecedent moisture condition. Based on the Design Manual, the average antecedent moisture condition (AMC II) is used for computing losses. Curve number information was compiled using GIS polygon processing of subbasin delineations, soil map unit delineations, and land use layers. To calculate a curve number for a given subbasin, the following procedure was used:

1. Base curve numbers are taken from the CCRFCD Design Manual for the three assumed land cover conditions (directly connected impervious area, open landscaped area in good condition, open desert shrub in poor condition) for each of the four Hydrologic Soil Groups. In addition, a curve number of 90 is assumed for rock outcrop, and directly connected impervious is assumed to have a curve number of 98 for all soil types.
2. A curve number matrix is compiled to calculate a base curve number for a given combination of soil map unit and land use type.
3. The land use, soils, and subbasin polygons were overlaid in GIS to subdivide each subbasin into polygons (subareas) of unique land use and soil type combinations.
4. The curve number matrix is then used to assign a curve number for each subarea, and an area-weighted composite curve number is calculated for the whole subbasin based on the areas of the subdivided polygons and their associated curve numbers. The curve number and total area of each subbasin is then used in the hydrologic models input files.

Supporting information for the curve number calculations (including the curve number matrix) is included in this Appendix**.**

Lag Time

All subbasins within the Cedar Avenue Channel watershed are less than 0.5 square miles. The time of concentration for subbasins of this size was computed with the time of concentration equation (velocity method) from the Design Manual. This method is explained below. Note that initial length (overland flow) was set to 100 feet for all subbasins to represent urbanized drainage patterns and to be consistent with the 2008 MPU.

The lag time is related to the time of concentration by the following empirical relationship:

$$T_{lag} = 0.6T_c$$

Where:

T_{lag}	=	Lag Time
T_c	=	Time of concentration

The time of concentration is calculated as follows:

$$T_c = T_i + T_t$$

Where:

T_c	=	Time of concentration
T_i	=	Initial, inlet, or overland flow time
T_t	=	Travel time in the ditch, gutter, etc.

Initial flow time is calculated as follows:

$$T_i = 1.8(1.1 - K)L_o^{1/2}/S^{1/3}$$

Where:

T_i	=	Initial overland flow time (minutes)
K	=	0.0132 * CN - 0.39
CN	=	Curve number
L_o	=	Length of overland flow (ft, maximum 500 feet)
S	=	Average basin slope (percent)

Travel time is calculated as follows:

$$T_t = 500/(60\ V_1) + (L_t - 500)/(60\ V_2)$$

Where:

T_t	=	Travel time in the ditch, gutter, etc. (minutes)
L_t	=	Travel length (feet)
V_1	=	Average velocity of flow for the first 500 feet of travel distance (feet/second)
V_2	=	Average velocity of flow for the remaining travel distance (feet/second)

V_1 and V_2 are calculated as follows:

$$V_1 = C_1 * (S/100)^{1/2}$$
$$V_2 = C_2 * (S/100)^{1/2}$$

Where:

C1	=	20.2 for developed areas and 14.8 for undeveloped areas

C2	=	30.6 for developed areas and 29.4 for undeveloped areas
S	=	Average slope for the flow path (percent)

In urbanized areas, the time of concentration calculated above should not exceed the time of concentration calculated by the following equation:

$$T_c = (L / 180) + 10$$

Where:

T_c	=	Time of concentration at the first design point in an urban watershed (minutes)
L	=	Watershed length (feet)

The smaller of the two calculations for time of concentration controls minimum T_c for any watershed and should not be less than 5 minutes. Standard Form 4 from the Design Manual was used to compute lag times and is included in this Appendix.

Routing

In this study all routings in the model were through streets or storm drains, and therefore, only Muskingum-Cunge method for floodwave routing was used in the HEC-1 model to be consistent with the 2008 MPU. Muskingum-Cunge routing requires the following input parameters: roughness coefficient, base width, side-slope, slope, and reach length.

LAS VEGAS WASH CENTRAL
Cedar Avenue Channel

PERVIOUS AREA CURVE NUMBERS

CONDITION 1: ----------> DESERT SHRUB POOR HYDROLOGIC CONDITION
CONDITION 2: ----------> LANDSCAPED, LAWNS, TREES, GOOD HYDROLOGIC CONDITION

CN VALUES

	HYDROLOGIC SOIL GROUP				
CONDITION	A	B	C	D	ROCK
1 ---------->	63	77	85	88	90
2 ---------->	39	61	74	80	90

						CONDITION	CONDITION
MAP	HYDROLOGIC SOIL GROUP					1	2
UNIT	%A	%B	%C	%D	%ROCK	CN	CN
200	3	88	9	0	0	77	62
270	0	100	0	0	0	77	61
282	0	10	90	0	0	84	73
325	5	90	0	5	0	77	61
326	0	100	0	0	0	77	61
341	0	0	100	0	0	85	74
615	0	0	100	0	0	85	74

LAS VEGAS WASH CENTRAL
Cedar Avenue Channel

Curve Number Matrix												
MAP #	COMPONENTS			LAND USE CLASSIFICATION INDEX NUMBER								
	OPEN DESERT	OPEN GOOD	% IMP	1	2	5	6	7	8	9	10	12
	% --->			100	10	0	0	0	0	0	15	0
		% --->		0	85	71	38	28	15	10	15	50
			% --->	0	5	29	62	72	85	90	70	50
	CN	CN	CN	SOIL TYPE COMPOSITE CN FOR LAND USE TYPE								
200	77	62	98	77.0	65.0	72.0	84.0	88.0	93.0	94.0	89.0	80.0
270	77	61	98	77.0	64.0	72.0	84.0	88.0	92.0	94.0	89.0	80.0
282	84	73	98	84.0	75.0	80.0	89.0	91.0	94.0	96.0	92.0	86.0
325	77	61	98	77.0	64.0	72.0	84.0	88.0	92.0	94.0	89.0	80.0
326	77	61	98	77.0	64.0	72.0	84.0	88.0	92.0	94.0	89.0	80.0
341	85	74	98	85.0	76.0	81.0	89.0	91.0	94.0	96.0	92.0	86.0
615	85	74	98	85.0	76.0	81.0	89.0	91.0	94.0	96.0	92.0	86.0

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

BASIN ID	LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CA03a	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	1401035	2651085	52.8%	52.8%	44.39	44.39	
CA03a	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	11703	2651085	0.4%	53.3%	0.39	44.78	
CA03a	7	Public Facility and Residential, 8-12 units/acre	270	88	448715	2651085	16.9%	70.2%	14.89	59.68	
CA03a	7	Public Facility and Residential, 8-12 units/acre	615	91	42035	2651085	1.6%	71.8%	1.44	61.12	
CA03a	8	Very High Density Residential, 12 units/acre or more	270	92	191074	2651085	7.2%	79.0%	6.63	67.75	
CA03a	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	125038	2651085	4.7%	83.7%	4.43	72.19	
CA03a	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	431485	2651085	16.3%	100.0%	15.62	87.81	**87.8**
CA03b	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	1026874	2206782	46.5%	46.5%	39.09	39.09	
CA03b	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7656	2206782	0.3%	46.9%	0.31	39.40	
CA03b	7	Public Facility and Residential, 8-12 units/acre	270	88	581794	2206782	26.4%	73.2%	23.20	62.60	
CA03b	7	Public Facility and Residential, 8-12 units/acre	615	91	87076	2206782	3.9%	77.2%	3.59	66.19	
CA03b	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	209423	2206782	9.5%	86.7%	8.92	75.11	
CA03b	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	293959	2206782	13.3%	100.0%	12.79	87.90	**87.9**
CA03c	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	359884	605203	59.5%	59.5%	49.95	49.95	
CA03c	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	7569	605203	1.3%	60.7%	1.11	51.06	
CA03c	7	Public Facility and Residential, 8-12 units/acre	270	88	17295	605203	2.9%	63.6%	2.51	53.58	
CA03c	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	198962	605203	32.9%	96.4%	30.90	84.48	
CA03c	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	21493	605203	3.6%	100.0%	3.41	87.89	**87.9**
CA03d	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	1098617	1266640	86.7%	86.7%	72.86	72.86	
CA03d	7	Public Facility and Residential, 8-12 units/acre	270	88	11123	1266640	0.9%	87.6%	0.77	73.63	
CA03d	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	156900	1266640	12.4%	100.0%	11.64	85.27	**85.3**
CA04a	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	340883	1095013	31.1%	31.1%	26.15	26.15	
CA04a	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	84704	1095013	7.7%	38.9%	6.88	33.03	
CA04a	7	Public Facility and Residential, 8-12 units/acre	270	88	424871	1095013	38.8%	77.7%	34.14	67.18	
CA04a	7	Public Facility and Residential, 8-12 units/acre	282	91	243620	1095013	22.2%	99.9%	20.25	87.42	
CA04a	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	934	1095013	0.1%	100.0%	0.08	87.50	**87.5**
CA04b	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	149	1669105	0.0%	0.0%	0.01	0.01	
CA04b	7	Public Facility and Residential, 8-12 units/acre	270	88	1610638	1669105	96.5%	96.5%	84.92	84.92	
CA04b	7	Public Facility and Residential, 8-12 units/acre	282	91	23313	1669105	1.4%	97.9%	1.27	86.20	
CA04b	8	Very High Density Residential, 12 units/acre or more	270	92	19243	1669105	1.2%	99.1%	1.06	87.26	
CA04b	8	Very High Density Residential, 12 units/acre or more	282	94	15762	1669105	0.9%	100.0%	0.89	88.14	**88.1**
CA04c	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	5801	873595	0.7%	0.7%	0.56	0.56	
CA04c	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	5092	873595	0.6%	1.2%	0.52	1.08	
CA04c	7	Public Facility and Residential, 8-12 units/acre	270	88	93711	873595	10.7%	12.0%	9.44	10.52	
CA04c	7	Public Facility and Residential, 8-12 units/acre	282	91	737858	873595	84.5%	96.4%	76.86	87.38	
CA04c	8	Very High Density Residential, 12 units/acre or more	282	94	31133	873595	3.6%	100.0%	3.35	90.73	**90.7**
CA04d	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	129415	1458124	8.9%	8.9%	7.46	7.46	
CA04d	7	Public Facility and Residential, 8-12 units/acre	270	88	564058	1458124	38.7%	47.6%	34.04	41.50	
CA04d	7	Public Facility and Residential, 8-12 units/acre	615	91	35216	1458124	2.4%	50.0%	2.20	43.69	
CA04d	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	379303	1458124	26.0%	76.0%	24.45	68.15	
CA04d	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	350132	1458124	24.0%	100.0%	23.05	91.20	**91.2**

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

BASIN ID	LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CA04e	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	883487	5294449	16.7%	16.7%	14.02	14.02	
CA04e	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	21346	5294449	0.4%	17.1%	0.36	14.38	
CA04e	7	Public Facility and Residential, 8-12 units/acre	270	88	662010	5294449	12.5%	29.6%	11.00	25.38	
CA04e	7	Public Facility and Residential, 8-12 units/acre	282	91	126488	5294449	2.4%	32.0%	2.17	27.55	
CA04e	7	Public Facility and Residential, 8-12 units/acre	325	88	310298	5294449	5.9%	37.8%	5.16	32.71	
CA04e	7	Public Facility and Residential, 8-12 units/acre	615	91	58612	5294449	1.1%	39.0%	1.01	33.72	
CA04e	8	Very High Density Residential, 12 units/acre or more	270	92	844166	5294449	15.9%	54.9%	14.67	48.39	
CA04e	8	Very High Density Residential, 12 units/acre or more	282	94	298373	5294449	5.6%	60.5%	5.30	53.68	
CA04e	8	Very High Density Residential, 12 units/acre or more	325	92	55083	5294449	1.0%	61.6%	0.96	54.64	
CA04e	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	858166	5294449	16.2%	77.8%	15.24	69.88	
CA04e	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	75017	5294449	1.4%	79.2%	1.33	71.21	
CA04e	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	80339	5294449	1.5%	80.7%	1.46	72.67	
CA04e	10	Light Industrial	270	89	18407	5294449	0.3%	81.1%	0.31	72.98	
CA04e	10	Light Industrial	282	92	215939	5294449	4.1%	85.1%	3.75	76.73	
CA04e	10	Light Industrial	325	89	786716	5294449	14.9%	100.0%	13.22	89.95	**90.0**
CA04f	7	Public Facility and Residential, 8-12 units/acre	282	91	554550	1290284	43.0%	43.0%	39.11	39.11	
CA04f	8	Very High Density Residential, 12 units/acre or more	282	94	6609	1290284	0.5%	43.5%	0.48	39.59	
CA04f	10	Light Industrial	282	92	729125	1290284	56.5%	100.0%	51.99	91.58	**91.6**
CA04g	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	228689	1452065	15.7%	15.7%	13.23	13.23	
CA04g	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	107532	1452065	7.4%	23.2%	6.59	19.82	
CA04g	7	Public Facility and Residential, 8-12 units/acre	270	88	13797	1452065	1.0%	24.1%	0.84	20.66	
CA04g	7	Public Facility and Residential, 8-12 units/acre	615	91	317347	1452065	21.9%	46.0%	19.89	40.54	
CA04g	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	1588	1452065	0.1%	46.1%	0.10	40.65	
CA04g	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	783112	1452065	53.9%	100.0%	51.77	92.42	**92.4**
CA05a	7	Public Facility and Residential, 8-12 units/acre	282	91	995364	995364	100.0%	100.0%	91.00	91.00	**91.00**
CA05b	7	Public Facility and Residential, 8-12 units/acre	282	91	197771	1381174	14.3%	14.3%	13.03	13.03	
CA05b	10	Light Industrial	282	92	1183403	1381174	85.7%	100.0%	78.83	91.86	**91.9**
CA05c	7	Public Facility and Residential, 8-12 units/acre	282	91	95114	642952	14.8%	14.8%	13.46	13.46	
CA05c	10	Light Industrial	282	92	547786	642952	85.2%	100.0%	78.38	91.84	
CA05c	10	Light Industrial	325	89	52	642952	0.0%	100.0%	0.01	91.85	**91.9**
CA05d	7	Public Facility and Residential, 8-12 units/acre	282	91	129453	1206589	10.7%	10.7%	9.76	9.76	
CA05d	7	Public Facility and Residential, 8-12 units/acre	325	88	14783	1206589	1.2%	12.0%	1.08	10.84	
CA05d	10	Light Industrial	282	92	931143	1206589	77.2%	89.1%	71.00	81.84	
CA05d	10	Light Industrial	325	89	131210	1206589	10.9%	100.0%	9.68	91.52	**91.5**
CA05e	7	Public Facility and Residential, 8-12 units/acre	282	91	177	83379	0.2%	0.2%	0.19	0.19	
CA05e	10	Light Industrial	282	92	83202	83379	99.8%	100.0%	91.80	92.00	**92.0**
CA05f	7	Public Facility and Residential, 8-12 units/acre	282	91	1122	238847	0.5%	0.5%	0.43	0.43	
CA05f	10	Light Industrial	282	92	237725	238847	99.5%	100.0%	91.57	92.00	**92.0**
CA05g	7	Public Facility and Residential, 8-12 units/acre	282	91	805	199861	0.4%	0.4%	0.37	0.37	
CA05g	10	Light Industrial	282	92	199056	199861	99.6%	100.0%	91.63	92.00	**92.0**

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

BASIN ID	LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CA05h	10	Light Industrial	282	92	83909	83909	100.0%	100.0%	92.00	92.00	**92.0**
CA05i	7	Public Facility and Residential, 8-12 units/acre	282	91	581	98074	0.6%	0.6%	0.54	0.54	
CA05i	10	Light Industrial	282	92	97493	98074	99.4%	100.0%	91.46	91.99	**92.0**
CA05j	7	Public Facility and Residential, 8-12 units/acre	282	91	3036	131463	2.3%	2.3%	2.10	2.10	
CA05j	10	Light Industrial	282	92	128427	131463	97.7%	100.0%	89.88	91.98	**92.0**
CA05k	7	Public Facility and Residential, 8-12 units/acre	282	91	14198	278126	5.1%	5.1%	4.65	4.65	
CA05k	10	Light Industrial	282	92	263927	278126	94.9%	100.0%	87.30	91.95	**91.9**
CA05m	7	Public Facility and Residential, 8-12 units/acre	282	91	123082	147734	83.3%	83.3%	75.81	75.81	
CA05m	8	Very High Density Residential, 12 units/acre or more	282	94	24637	147734	16.7%	100.0%	15.68	91.49	
CA05m	10	Light Industrial	282	92	15	147734	0.0%	100.0%	0.01	91.50	**91.5**
CA05n	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	26896	98113	27.4%	27.4%	24.40	24.40	
CA05n	7	Public Facility and Residential, 8-12 units/acre	282	91	40038	98113	40.8%	68.2%	37.14	61.53	
CA05n	8	Very High Density Residential, 12 units/acre or more	282	94	31179	98113	31.8%	100.0%	29.87	91.41	**91.4**
CA05p	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	6607	165859	4.0%	4.0%	3.55	3.55	
CA05p	7	Public Facility and Residential, 8-12 units/acre	282	91	148182	165859	89.3%	93.3%	81.30	84.85	
CA05p	8	Very High Density Residential, 12 units/acre or more	282	94	11070	165859	6.7%	100.0%	6.27	91.12	**91.1**
CA05q	2	Parks, Golf Courses	282	75	362597	680958	53.2%	53.2%	39.94	39.94	
CA05q	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	29	680958	0.0%	53.3%	0.00	39.94	
CA05q	7	Public Facility and Residential, 8-12 units/acre	282	91	318331	680958	46.7%	100.0%	42.54	82.48	**82.5**
CA06-C	2	Parks, Golf Courses	282	75	3906784	11023434	35.4%	35.4%	26.58	26.58	
CA06-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	270	84	268927	11023434	2.4%	37.9%	2.05	28.63	
CA06-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	90200	11023434	0.8%	38.7%	0.73	29.36	
CA06-C	7	Public Facility and Residential, 8-12 units/acre	270	88	1621882	11023434	14.7%	53.4%	12.95	42.31	
CA06-C	7	Public Facility and Residential, 8-12 units/acre	282	91	1439354	11023434	13.1%	66.5%	11.88	54.19	
CA06-C	8	Very High Density Residential, 12 units/acre or more	270	92	1784633	11023434	16.2%	82.7%	14.89	69.08	
CA06-C	8	Very High Density Residential, 12 units/acre or more	282	94	990757	11023434	9.0%	91.6%	8.45	77.53	
CA06-C	9	Commercial, Retail, Casino, High Rise Condominiums	270	94	820957	11023434	7.4%	99.1%	7.00	84.53	
CA06-C	9	Commercial, Retail, Casino, High Rise Condominiums	282	96	99941	11023434	0.9%	100.0%	0.87	85.40	**85.4**
CA08	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	632998	2023089	31.3%	31.3%	27.85	27.85	
CA08	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	341	89	243973	2023089	12.1%	43.3%	10.73	38.58	
CA08	7	Public Facility and Residential, 8-12 units/acre	282	91	265594	2023089	13.1%	56.5%	11.95	50.53	
CA08	7	Public Facility and Residential, 8-12 units/acre	341	91	494869	2023089	24.5%	80.9%	22.26	72.79	
CA08	8	Very High Density Residential, 12 units/acre or more	282	94	194379	2023089	9.6%	90.5%	9.03	81.82	
CA08	9	Commercial, Retail, Casino, High Rise Condominiums	282	96	187523	2023089	9.3%	99.8%	8.90	90.72	
CA08	12	Schools	341	86	3752	2023089	0.2%	100.0%	0.16	90.88	**90.9**
CA09	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	69502	1343561	5.2%	5.2%	4.60	4.60	
CA09	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	341	89	284548	1343561	21.2%	26.4%	18.85	23.45	
CA09	7	Public Facility and Residential, 8-12 units/acre	282	91	140990	1343561	10.5%	36.8%	9.55	33.00	
CA09	7	Public Facility and Residential, 8-12 units/acre	341	91	88523	1343561	6.6%	43.4%	6.00	39.00	
CA09	12	Schools	282	86	455375	1343561	33.9%	77.3%	29.15	68.15	
CA09	12	Schools	341	86	304623	1343561	22.7%	100.0%	19.50	87.64	**87.6**

LAS VEGAS WASH CENTRAL, CEDAR AVENUE CHANNEL

CN Calculation Summary

BASIN ID	LAND USE INDEX NUMBER	LAND USE DESCRIPTION	SOIL MAP UNIT #	SUBREGION CN	SUBREGION AREA (SQ FT)	SUBBASIN AREA (SQ FT)	PERCENT OF SUBBASIN	CUMULATIVE PERCENT	AREAL WEIGHTED CN	CUMULATIVE CN	COMPOSITE CN
CA10	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	665843	901919	73.8%	73.8%	65.70	65.70	
CA10	7	Public Facility and Residential, 8-12 units/acre	282	91	235656	901919	26.1%	100.0%	23.78	89.48	
CA10	9	Commercial, Retail, Casino, High Rise Condominiums	282	96	420	901919	0.0%	100.0%	0.04	89.53	**89.5**
CA11	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	413258	2562276	16.1%	16.1%	14.35	14.35	
CA11	7	Public Facility and Residential, 8-12 units/acre	282	91	157109	2562276	6.1%	22.3%	5.58	19.93	
CA11	8	Very High Density Residential, 12 units/acre or more	282	94	413586	2562276	16.1%	38.4%	15.17	35.11	
CA11	9	Commercial, Retail, Casino, High Rise Condominiums	282	96	1578323	2562276	61.6%	100.0%	59.13	94.24	**94.2**
CA12	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	396478	1736783	22.8%	22.8%	20.32	20.32	
CA12	7	Public Facility and Residential, 8-12 units/acre	282	91	326946	1736783	18.8%	41.7%	17.13	37.45	
CA12	8	Very High Density Residential, 12 units/acre or more	282	94	536473	1736783	30.9%	72.5%	29.04	66.48	
CA12	9	Commercial, Retail, Casino, High Rise Condominiums	282	96	476886	1736783	27.5%	100.0%	26.36	92.84	**92.8**
CA13	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	859672	1822470	47.2%	47.2%	41.98	41.98	
CA13	7	Public Facility and Residential, 8-12 units/acre	282	91	826266	1822470	45.3%	92.5%	41.26	83.24	
CA13	9	Commercial, Retail, Casino, High Rise Condominiums	282	96	136531	1822470	7.5%	100.0%	7.19	90.43	**90.4**
CA14	1	Undeveloped Land, Open Desert	200	77	121689	1542930	7.9%	7.9%	6.07	6.07	
CA14	1	Undeveloped Land, Open Desert	282	84	27562	1542930	1.8%	9.7%	1.50	7.57	
CA14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	200	84	347890	1542930	22.5%	32.2%	18.94	26.51	
CA14	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	700972	1542930	45.4%	77.7%	40.43	66.95	
CA14	7	Public Facility and Residential, 8-12 units/acre	200	88	110372	1542930	7.2%	84.8%	6.29	73.24	
CA14	7	Public Facility and Residential, 8-12 units/acre	282	91	234444	1542930	15.2%	100.0%	13.83	87.07	**87.1**
CH70-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	497604	3814154	13.0%	13.0%	11.61	11.61	
CH70-C	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	615	89	15002	3814154	0.4%	13.4%	0.35	11.96	
CH70-C	7	Public Facility and Residential, 8-12 units/acre	282	91	241707	3814154	6.3%	19.8%	5.77	17.73	
CH70-C	7	Public Facility and Residential, 8-12 units/acre	325	88	557610	3814154	14.6%	34.4%	12.87	30.59	
CH70-C	7	Public Facility and Residential, 8-12 units/acre	615	91	125282	3814154	3.3%	37.7%	2.99	33.58	
CH70-C	8	Very High Density Residential, 12 units/acre or more	282	94	699248	3814154	18.3%	56.0%	17.23	50.82	
CH70-C	9	Commercial, Retail, Casino, High Rise Condominiums	325	94	653160	3814154	17.1%	73.1%	16.10	66.91	
CH70-C	9	Commercial, Retail, Casino, High Rise Condominiums	615	96	1023306	3814154	26.8%	100.0%	25.76	92.67	
CH70-C	10	Light Industrial	282	92	1235	3814154	0.0%	100.0%	0.03	92.70	**92.7**
CA08a	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	531	1334079	0.0%	0.0%	0.04	0.04	
CA08a	6	High Density Residential, 4-8 units/acre (uses 6 units/acre)	282	89	1274882	1334079	95.6%	95.6%	85.05	85.09	
CA08a	7	Public Facility and Residential, 8-12 units/acre	282	91	58665	1334079	4.4%	100.0%	4.00	89.09	**89.1**

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

PBS&J — **Las Vegas Wash Central Cedar Avenue Channel**

File: FORM4.XLS — **Ultimate Condition**

BY: BR

DATE: 3/24/14

SUB-BASIN DATA						INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc Check	Tlag	REMARKS
DESIG: (1)	DEV./EX. (D or E)	CN	K (2)	AREA Ac (3)	AREA Mi^2	INITIAL LENGTH Feet (4)	SLOPE % (5)	Ti Min (6)	TRAVEL LENGTH Feet (7)	SLOPE % (8)	V1 VELOCITY FPS (9a)	V2 VELOCITY FPS (9b)	Tt Min (10)	Min (13)	Min (14)	Tlag= 0.6Tc/60 Hours	RAINFALL Q_{100} Inches
CA03a	D	87.8	0.7691	60.86	0.095	100	1.0	6.0	5010	2.7	3.3	5.0	17.4	23.4	38.4	**0.234**	2.77
CA03b	D	87.9	0.7702	50.66	0.079	100	1.0	5.9	4000	1.4	2.4	3.6	19.8	25.7	32.8	**0.257**	2.77
CA03c	D	87.9	0.7702	13.89	0.022	100	1.0	5.9	5000	2.6	3.2	4.9	17.9	23.8	38.3	**0.238**	2.77
CA03d	D	85.3	0.7356	29.08	0.045	100	1.0	6.6	4220	3.0	3.5	5.3	14.0	20.6	34.0	**0.206**	2.77
CA04a	D	87.5	0.7651	25.14	0.039	100	1.0	6.0	2930	1.1	2.1	3.2	16.4	22.4	26.8	**0.224**	2.77
CA04b	D	88.1	0.7735	38.32	0.060	100	1.0	5.9	2360	1.0	2.0	3.0	14.4	20.3	23.7	**0.203**	2.77
CA04c	D	90.7	0.8076	20.06	0.031	100	1.0	5.3	2460	1.0	2.0	3.1	14.7	19.9	24.2	**0.199**	2.77
CA04d	D	91.2	0.8138	33.47	0.052	100	1.0	5.2	2640	1.3	2.3	3.5	13.9	19.1	25.2	**0.191**	2.77
CA04e	D	90.0	0.7974	121.54	0.190	100	1.0	5.4	5100	1.0	2.0	3.0	29.5	34.9	38.9	**0.349**	2.77
CA04f	D	91.6	0.8189	29.62	0.046	100	1.0	5.1	2160	0.7	1.7	2.6	15.8	20.9	22.6	**0.209**	2.77
CA04g	D	92.4	0.8300	33.34	0.052	100	1.0	4.9	3030	2.8	3.4	5.1	10.7	15.6	27.4	**0.156**	2.77
CA05a	D	91.0	0.8112	22.85	0.036	100	1.0	5.2	2450	0.8	1.8	2.8	16.3	21.5	24.2	**0.215**	2.77
CA05b	D	91.9	0.8225	31.71	0.050	100	1.0	5.0	2870	0.9	1.9	2.9	18.3	23.2	26.5	**0.232**	2.77
CA05c	D	91.9	0.8224	14.76	0.023	100	1.0	5.0	1380	0.9	1.9	2.9	9.6	14.6	18.2	**0.146**	2.77
CA05d	D	91.5	0.8180	27.70	0.043	100	1.0	5.1	2440	0.9	2.0	3.0	15.1	20.2	24.1	**0.202**	2.77
CA05e	D	92.0	0.8244	1.91	0.003	100	1.0	5.0	760	1.1	2.1	3.1	5.4	10.4	14.8	**0.104**	2.77
CA05f	D	92.0	0.8243	5.48	0.009	100	1.0	5.0	1130	1.1	2.1	3.2	7.3	12.3	16.8	**0.123**	2.77
CA05g	D	92.0	0.8243	4.59	0.007	100	1.0	5.0	690	1.0	2.0	3.1	5.1	10.1	14.4	**0.101**	2.77
CA05h	D	92.0	0.8244	1.93	0.003	100	1.0	5.0	650	0.9	1.9	2.9	5.1	10.1	14.2	**0.101**	2.77
CA05i	D	92.0	0.8243	2.25	0.004	100	1.0	5.0	520	1.0	2.0	3.0	4.3	9.3	13.4	**0.093**	2.77
CA05j	D	92.0	0.8241	3.02	0.005	100	1.0	5.0	540	1.7	2.6	4.0	3.4	8.3	13.6	**0.083**	2.77
CA05k	D	91.9	0.8237	6.38	0.010	100	1.0	5.0	961	1.5	2.4	3.7	5.5	10.5	15.9	**0.105**	2.77
CA05m	D	91.5	0.8178	3.39	0.005	100	1.0	5.1	1240	1.0	2.0	3.0	8.3	13.4	17.4	**0.134**	2.77
CA05n	D	91.4	0.8165	2.25	0.004	100	1.0	5.1	690	0.9	1.9	2.9	5.5	10.6	14.4	**0.106**	2.77
CA05p	D	91.1	0.8128	3.81	0.006	100	1.0	5.2	1630	0.6	1.6	2.4	13.1	18.3	19.6	**0.183**	2.77
CA05q	D	82.5	0.6987	15.63	0.024	100	1.0	7.2	2380	1.0	2.0	3.1	14.3	21.5	23.8	**0.215**	2.77
CA06-C	D	82.5	0.6987	253.06	0.395	100	1.0	7.2	6470	0.6	1.6	2.4	46.0	53.3	46.5	**0.465**	2.77
CA08	D	85.4	0.7373	46.44	0.073	100	1.0	6.5	2750	0.6	1.5	2.3	21.5	28.0	25.8	**0.258**	2.77
CA09	D	89.6	0.7923	30.84	0.048	100	1.0	5.5	2150	0.6	1.5	2.3	17.6	23.1	22.5	**0.225**	2.77
CA10	D	93.0	0.8379	20.71	0.032	100	1.0	4.7	2080	0.5	1.4	2.1	18.4	23.1	22.1	**0.221**	2.77
CA11	D	90.2	0.8013	58.82	0.092	100	1.0	5.4	3280	0.5	1.4	2.1	28.5	33.9	28.8	**0.288**	2.77
CA12	D	94.1	0.8515	39.87	0.062	100	1.0	4.5	2510	0.4	1.3	2.0	22.8	27.2	24.5	**0.245**	2.77
CA13	D	95.9	0.8753	41.84	0.065	100	1.0	4.0	2545	0.5	1.4	2.2	21.4	25.4	24.7	**0.247**	2.77
CA14	D	97.7	0.8990	35.42	0.055	100	1.0	3.6	2290	0.5	1.4	2.1	20.0	23.6	23.3	**0.233**	2.77
CH70-C	D	92.7	0.8336	87.56	0.137	100	1.0	4.8	4300	0.9	1.9	3.0	25.7	30.5	34.4	**0.305**	2.77
CA08a	D	89.1	0.7861	30.59	0.048	100	1.0	5.6	2000	0.6	1.6	2.4	15.9	21.5	21.7	**0.215**	2.77

Tc = Ti + Tt Tlag = 0.6 Tc

Ti = 1.8 (1.1 - K) L^1/2 / S^1/3

K = 0.0132 (CN) - 0.39

Tc Check = L/180+10

For the travel time (Tt) calculations,
V1 applies to the first 500 feet of travel distance;
V2 applies to the remaining travel distance.

Existing V1 = 14.8*(S/100)^1/2 Developed V1 = 20.2*(S/100)^1/2

Existing V2 = 29.4*(S/100)^1/2 Developed V2 = 30.6*(S/100)^1/2

REFERENCE : **STANDARD FORM 4**

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

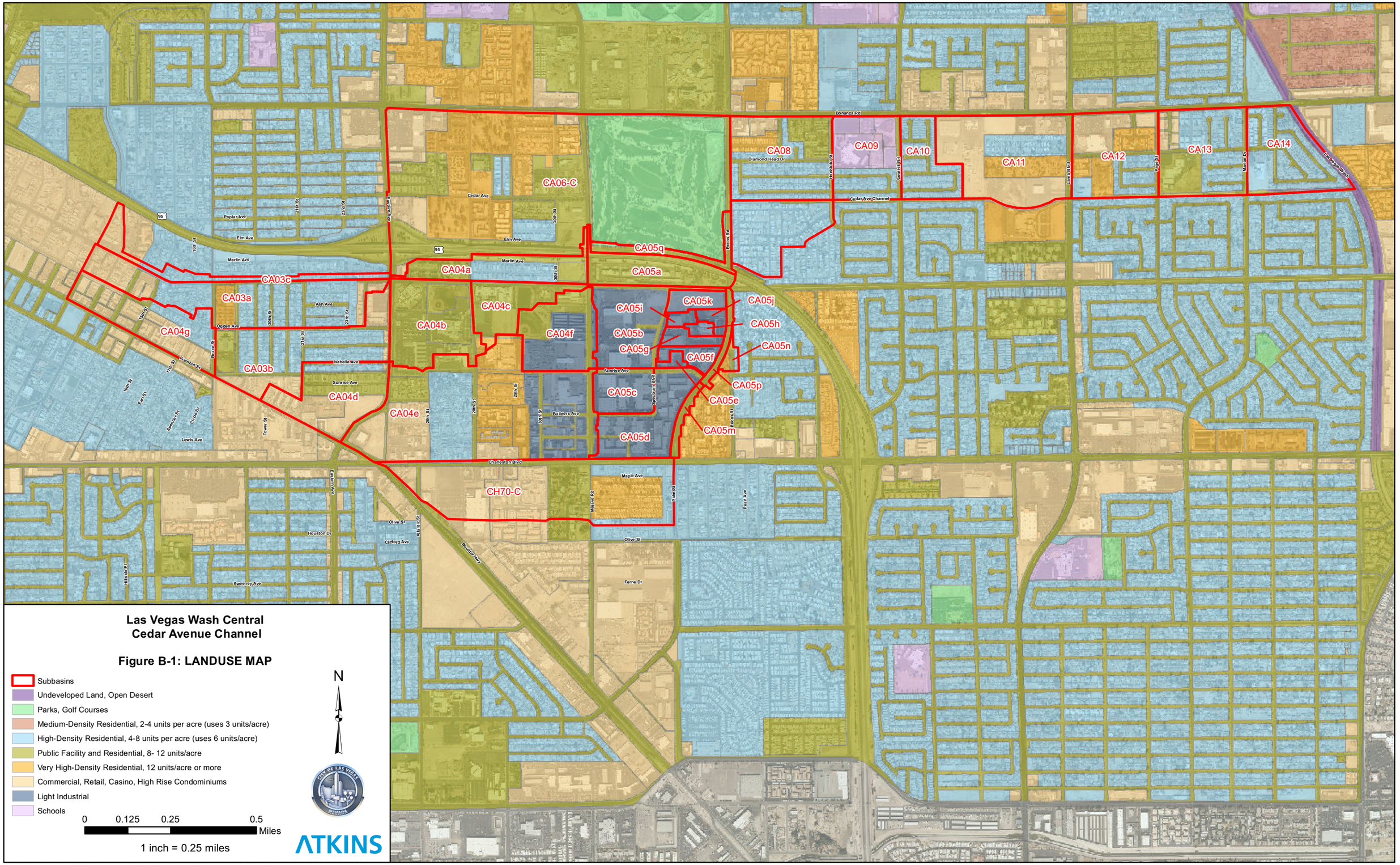
Muskingum-Cunge Routing Summary

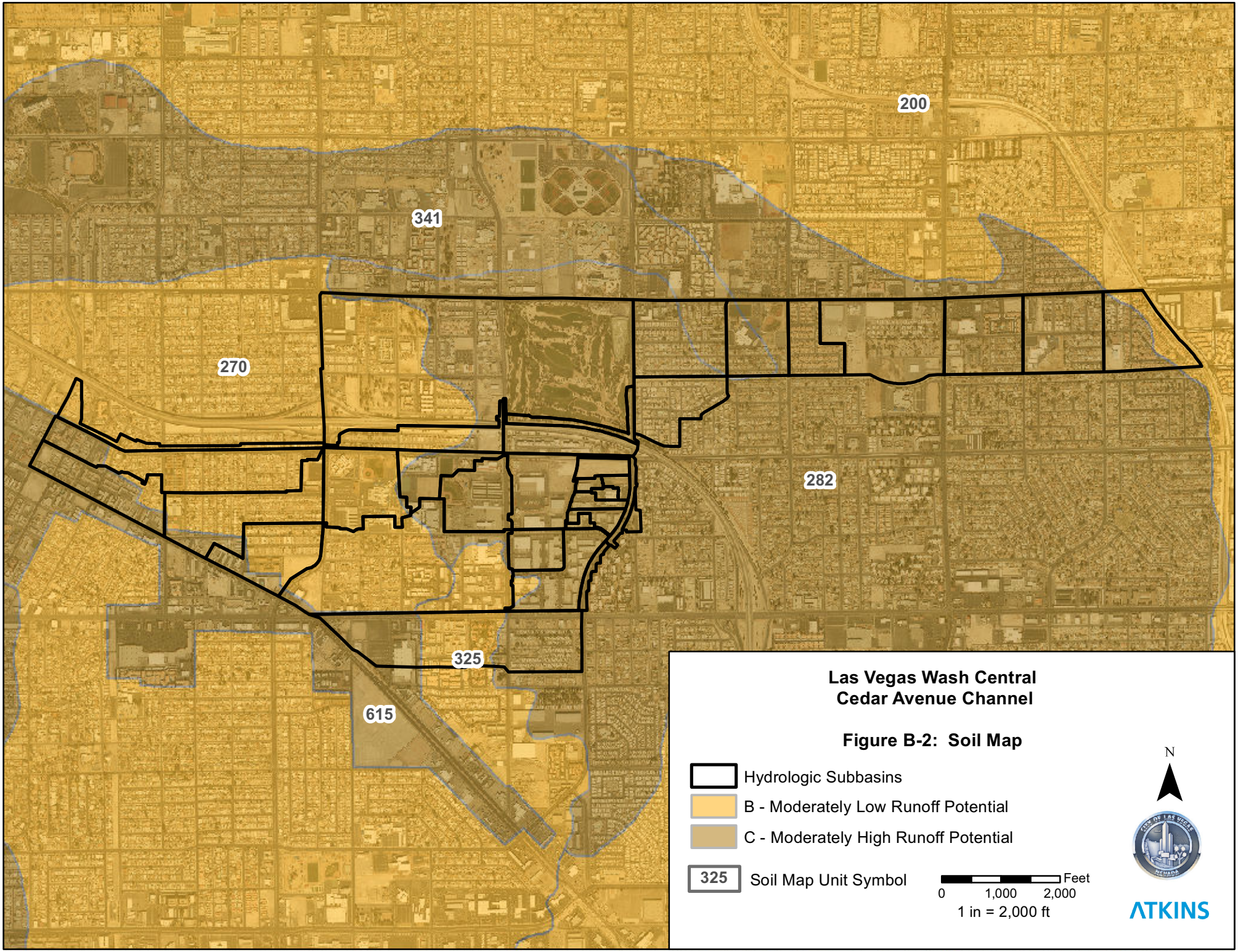
Ultimate Model

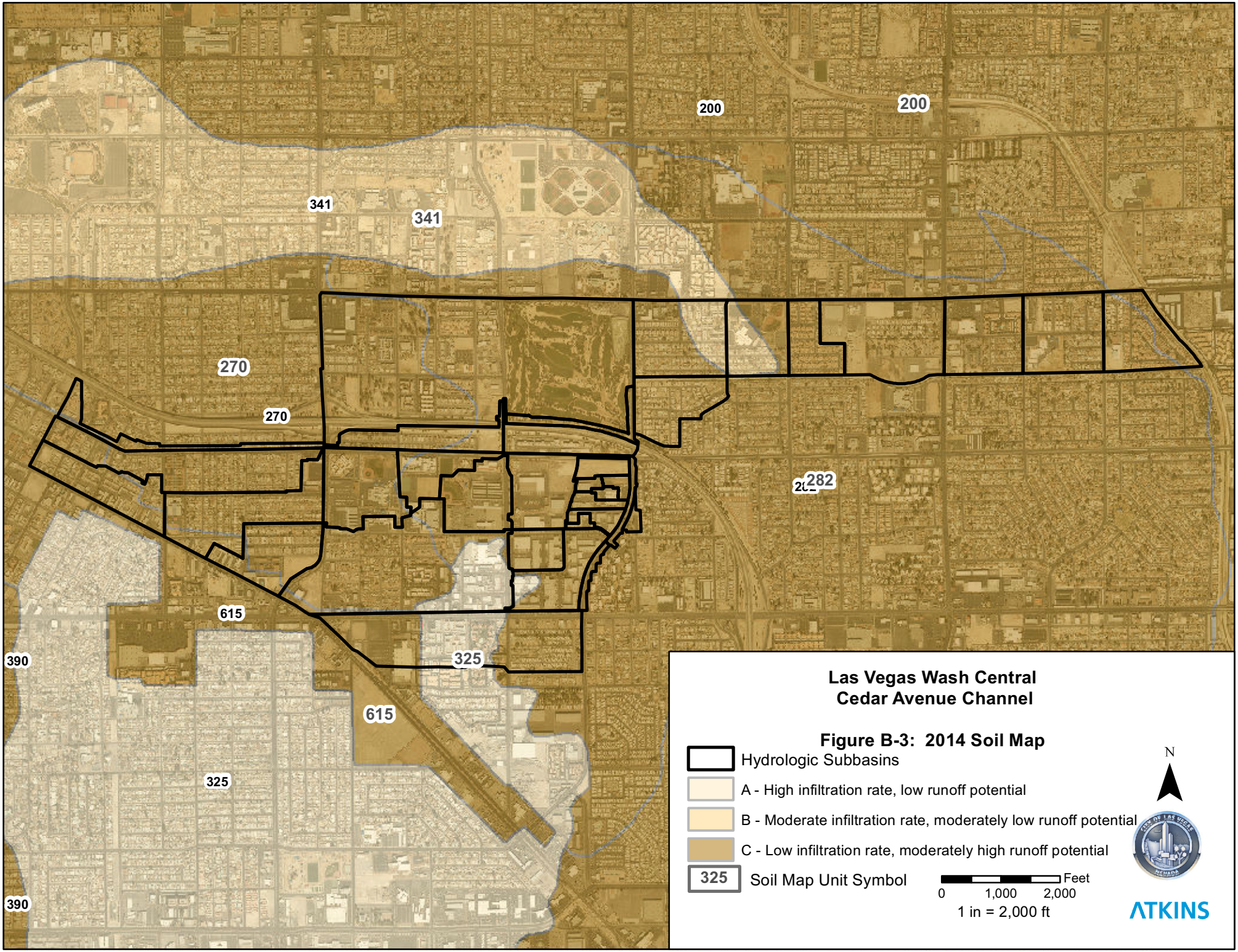
Reach ID	Length (ft)	Slope (ft/ft)	Manning's n	Shape	Bottom Width (ft)	Side Slope (H:V, X:1)
RCCA04b	1780	0.00955	0.016	TRAP	50	0
RCA04g	3500	0.0140	0.016	TRAP	50	0
RCA04d	3050	0.01148	0.016	TRAP	50	0
RCCA04e	1360	0.00368	0.016	TRAP	50	0
RCCA04	2130	0.00892	0.016	TRAP	50	0
RCA05c	750	0.00933	0.016	TRAP	50	0
RCCA05f	820	0.00732	0.013	CIRC	3	-
RCHAR	4600	0.0098	0.016	TRAP	50	0
RCCHAR	1250	0.0096	0.013	CIRC	5.5	-
RCCA05m	1580	0.00633	0.013	CIRC	5.5	-
RCCA05	1310	0.0050	0.013	TRAP	14	-
RCCA06	1545	0.0026	0.015	TRAP	10	1.5
RCCA08	1050	0.0026	0.015	TRAP	10	1.5
RCCA09	935	0.002	0.015	TRAP	12	1.5
RCCA10	1730	0.0020	0.015	TRAP	12	1.5
RCCA11	1340	0.0038	0.015	TRAP	10	1.5
RCCA12	1365	0.0037	0.015	TRAP	10	1.5
RCCA13	1680	0.002	0.015	TRAP	14	1.5

Appendix B-6

Land Use Map and Soils Map


CA03a
CA03b
CA03c
CA04a
CA04b
CA04c
CA04d
CA04e
CA04f
CA04g
CA05a
CA05b
CA05c
CA05d
CA05e
CA05f
CA05g
CA05h
CA05i
CA05j
CA05k
CA05m
CA05n
CA05p
CA05q
CA06-C
CA08
CA09
CA10
CA11
CA12
CA13
CA14
CH70-C
Bonanza Rd
Cedar Ave Channel
Elm Ave
Marlin Ave
Ash Ave
Ogden Ave
Isabelle Ave
Sunrise Ave
Builders Ave
Charleston Blvd
Maple Ave
Olive St
Ferne Dr
Lewis Ave
Sweeney Ave
Houston Dr
Clifford Ave
Poplar Ave
Pecos Rd
Spectrum Blvd
Mojave Rd
Palm St
Pearl Ave
Lamb Blvd
Boulder Hwy
Las Vegas Wash Central
Cedar Avenue Channel
Figure B-1: LANDUSE MAP
Subbasins
Undeveloped Land, Open Desert
Parks, Golf Courses
Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)
High-Density Residential, 4-8 units per acre (uses 6 units/acre)
Public Facility and Residential, 8- 12 units/acre
Very High-Density Residential, 12 units/acre or more
Commercial, Retail, Casino, High Rise Condominiums
Light Industrial
Schools
0 0.125 0.25 0.5 Miles
1 inch = 0.25 miles
N
ATKINS


200
341
270
282
325
615
Las Vegas Wash Central
Cedar Avenue Channel
Figure B-2: Soil Map
Hydrologic Subbasins
B - Moderately Low Runoff Potential
C - Moderately High Runoff Potential
325 Soil Map Unit Symbol
Feet
0 1,000 2,000
1 in = 2,000 ft
N
ATKINS


200
200
341
341
270
270
282
615
325
390
615
325
390
Las Vegas Wash Central
Cedar Avenue Channel
Figure B-3: 2014 Soil Map
Hydrologic Subbasins
A - High infiltration rate, low runoff potential
B - Moderate infiltration rate, moderately low runoff potential
C - Low infiltration rate, moderately high runoff potential
325 Soil Map Unit Symbol
Feet
0 1,000 2,000
1 in = 2,000 ft
N
ATKINS

Appendix C

Hydraulic Analysis

- Appendix C-1: WSPG Model
- Appendix C-2: HEC-RAS Model
- Appendix C-3: Channel Freeboard Analysis
- Appendix C-4: Drop Inlets

Appendix C-1

WSPG Model

```
[TITLE]



[REPORT]
COMPOSITE_ONLY

[NETWORK]
**TYPE           NAME
**-----          -------
Outlet           "Node13"
Reach            "Link12"
Reach            "Link11"
Reach            "Link10"
Reach            "Link14"
Transition       "Link9"
Reach            "Link31"
Junction         "Node32"
Reach            "Link8"
Join             "Node8"
Reach            "Link7"
Transition       "Link6"
Reach            "Link5"
Reach            "Link4"
Transition       "Link3"
Join             "Node3"
Reach            "Link2"
Reach            "Link1"
Join             "Node1"
Reach            "Link15"
WallExit         "Node16"
Reach            "Link26"
Reach            "Link18.1"
Junction         "Node18"
Reach            "Link22"
Junction         "Node23"
Reach            "Link24"
Headwork         "Node25"

**BRANCH DEFINITIONS


"Node1_Branch1"
Join             "Node1"
Reach            "Link19"
Reach            "Link28"
Junction         "Node29"
Reach            "Link27"
Headwork         "Node28"


"Node3_Branch1"
Join             "Node3"
Reach            "Link20"
Reach            "Link30"
Junction         "Node31"
Reach            "Link32"
Reach            "Link29"
Headwork         "Node30"


"Node8_Branch1"
Join             "Node8"
Reach            "Link25"
Headwork         "Node26"

[OUTLET]
**NAME               STATION    INVERT     GROUND     CHANNEL     WATER SURFACE
**                              ELEV       ELEV       ID          ELEV (opt.)
**------------       ---------  ---------- ---------- ----------  ----------
"Node13"             -3125.16   1777.39    1787       "12X6"      1781.81

[HEADWORK]
**NAME               INVERT     GROUND     CHANNEL     FLOW       WATER SURFACE
**                   ELEV       ELEV       ID                     ELEV (opt.)
**------------       ---------  ---------- ----------  ---------- ----------
"Node25"             1788.35    1794.5     "8X4"       100        0
"Node26"             1787.11    1792.5     "8X4"       186        0
"Node28"             1788.19    1793.7     "7X3"       82         0
"Node30"             1789.97    1793.5     "5X3"       55         0

[WALLENTRANCE]
**NAME               INVERT     GROUND     CHANNEL     LOSS
**                   ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------       ---------  ---------- ----------  --------------

[WALLEXIT]
**NAME               INVERT     GROUND     CHANNEL     LOSS
**                   ELEV       ELEV       ID          COEFFICIENT(opt.)
**------------       ---------  ---------- ----------  --------------
"Node16"             1787.78    1796.5     "8X4"       0

[BRIDGEENTRANCE]
**NAME               INVERT     GROUND     CHANNEL     REDUCTION
```

```
**                ELEV       ELEV       ID          FACTOR(opt.)
**--------------  ---------  ---------- ----------  --------------

[BRIDGEEXIT]
**NAME            INVERT     GROUND     CHANNEL     REDUCTION
**                ELEV       ELEV       ID          FACTOR(opt.)
**--------------  ---------  ---------- ----------  --------------

[JOIN]
**NAME            INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE
**                ELEV       ELEV       ID                                BRANCHES   ANGLE
**--------------  ---------  ---------- ----------  ---------- ---------- ---------- ----------
"Node1"           1787.61    1795       "18X5"      0          0          1
"Node1_Branch1"   1787.61                "8X4"                                     30

"Node3"           1787.47    1795.5     "18X5"      0          0          1
"Node3_Branch1"   1787.47                "8X4"                                     30

"Node8"           1786.56    1793       "18X5"      0          0          1
"Node8_Branch1"   1786.56                "8X4"                                     30


[JUNCTION]
**Name            INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n NUMBER OF  CONFLUENCE FLOW
**                ELEV       ELEV       ID                                LATERALS   ANGLE
**--------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Node18"          1787.92    1794.3     "8X4"       4          0.015      1
"Node18_Lateral1" 1787.98                "8X4"                                     0          100

"Node23"          1787.97    1794.3     "8X4"       2          0.015      1
"Node23_Lateral1" 1788.5                 "24"                                      90         19

"Node29"          1787.76    1793.7     "7X3"       4          0.015      1
"Node29_Lateral1" 1787.76                "8X4"                                     0          82

"Node31"          1787.65    1793.5     "5X3"       4          0.015      1
"Node31_Lateral1" 1787.65                "8X4"                                     0          64

"Node32"          1785.32    1793       "18X5"      10         0.015      1
"Node32_Lateral1" 1787.43                "24"                                      90         14


[TRANSITION]
**NAME            INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n
**                ELEV       ELEV       ID
**--------------  ---------  ---------- ----------  ---------- ----------
"Link3"           1787.43    1795       "18X5"      2          0.015
"Link6"           1787.18    1793       "2:8x5"     10.69      0.015
"Link9"           1785.02    1793.5     "18X5"      30         0.015

[REACH]
**NAME            INVERT     GROUND     CHANNEL     LENGTH     MANNINGS n CURVE      ANGLE      NUMBER
**                ELEV       ELEV       ID                                (opt)      POINT(opt) MANHOLES(opt)
**--------------  ---------  ---------- ----------  ---------- ---------- ---------- ---------- ----------
"Link1"           1787.58    1795       "18X5"      8.55       0.015      10         0          0
"Link2"           1787.55    1795.5     "18X5"      21         0.015      10         0          0
"Link4"           1787.42    1795       "2:8x5"     39.55      0.015      10         0          0
"Link5"           1787.27    1793       "2:8x5"     22.17      0.015      10         0          0
"Link7"           1787.14    1793       "18X5"      11.31      0.015      10         0          0
"Link8"           1786.04    1793       "18X5"      141.99     0.015      10         0          0
"Link10"          1782.54    1790       "12X6"      623.14     0.015      0          0          0
"Link11"          1780.04    1797       "12X6"      176.4      0.015      51         0          0
"Link12"          1779.34    1794       "12X6"      487.18     0.015      0          0          0
"Link14"          1783.37    1793.5     "12X6"      208.44     0.015      0          0          0
"Link15"          1787.78    1795       "18X5"      42         0.015      0          0          0
"Link18.1"        1787.9     1794       "8X4"       12.8       0.015      0          15         0
"Link19"          1787.68    1793.7     "8X4"       12.8       0.015      0          15         0
"Link20"          1787.55    1793.5     "8X4"       16.545     0.015      0          15         0
"Link22"          1787.96    1794.3     "8X4"       8          0.015      0          0          0
"Link24"          1788.35    1794.5     "8X4"       75.67      0.015      0          0          0
"Link25"          1787.11    1792.5     "8X4"       66.53      0.015      0          0          0
"Link26"          1787.84    1795       "8X4"       12.8       0.015      0          15         0
"Link27"          1788.19    1793.7     "7X3"       85.65      0.015      0          0          0
"Link28"          1787.74    1793.7     "8X4"       12.8       0.015      0          15         0
"Link29"          1789.97    1793.5     "5X3"       30.16      0.015      0          0          0
"Link30"          1787.63    1793.5     "8X4"       16.545     0.015      0          15         0
"Link31"          1785.28    1793       "18X5"      52         0.015      0          0          0
"Link32"          1788.28    1793.1     "5X3"       85.83      0.015      0          0          0

[CHANNEL]
**REGULAR TYPES 1-4
**ID      TYPE HEIGHT     WIDTH      LEFT       RIGHT      NUMBER     AVG PIER   INVERT
**                                   SLOPE      SLOPE      PIERS      WIDTH      CROSS FALL
**------  ---- ---------- ---------- ---------- ---------- ---------- ---------- ----------
"12X6"         3   6          12         0          0          0          0          0
"8X4"          3   4          8          0          0          0          0          0
"7X3"          3   3          7          0          0          0          0          0
"5X3"          3   3          5          0          0          0          0          0
"18X5"         3   5          18         0          0          0          0          0
"24"           4   2          2
"2:8x5"        3   5          18         0          0          1          2          0

**IRREGULAR TYPES 5-6
**ID       TYPE NUMBER     AVG PIER   PIER1      PIER2      PIER3      PIER4      PIER5      PIER6      PIER7      PIER8
PIER9      PIER10
```

```
**             PIERS      WIDTH      ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV       ELEV
ELEV       ELEV
**------   ---- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---------- ---
------- ----------


[POINT]
**ID          XCOORD     YCOORD
**----------- ---------- ----------
```

```
************************************
Water Surface Profile Gradient (WSPG)
XP WSPG
Engine Version 1.3         06/09/2010
XP Software        www.xpsoftware.com
************************************

INPUT FILE
************************************
X:\Projects\100039014_Cedar\Drainage\H&H\Hydraulics\WSPG\70pecentSubmittal\StormDrain_final.wsx
Computed  11/10/16  11:10:32

TITLE INFORMATION
************************************

WARNING SUMMARY
************************************
 WARNING 47: Junction Node29 has a different channel than its direct downstream element.
 WARNING 47: Junction Node31 has a different channel than its direct downstream element.
 WARNING 49: Manning's n for open flow of element Node1 not in recommended range 0.01 - 0.06.
 WARNING 49: Manning's n for open flow of element Node3 not in recommended range 0.01 - 0.06.
 WARNING 49: Manning's n for open flow of element Node8 not in recommended range 0.01 - 0.06.
 WARNING 25: Link type element Link1 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link8 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link18.1 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link22 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link28 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link30 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link31 has different invert elevation than its upstream node.
 WARNING 25: Link type element Link3 has different invert elevation than its upstream node.
 WARNING 36: D/S processing stopped in junction Node23 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node18 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node1 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node3 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node8 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node32 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node29 because critical momentum is greater than maximum momentum.
 WARNING 36: D/S processing stopped in junction Node31 because critical momentum is greater than maximum momentum.

RESULTS
************************************


============================================================
   Main Line
============================================================

 Composite Profile:

ELEMENT    TYPE       STATION    INVERT   GROUND   W.S.      DEPTH    Q        VELOC.  VELOC. ENERGY     SUPER   CRITICAL FROUDE  SLOPE    NORMAL   CROSS
NAME                             ELEV     ELEV     ELEV                         HEAD   GRADE LN   ELEV    DEPTH    NUMBER           DEPTH    SECTION
---------- ---------- ---------- -------- -------- --------  -------- -------- ------- ------ ---------- ------  -------- ------ -------  ------   ---------
###
"Node13"   Outlet     -3125.16   1777.39  1787.00  1782.128   4.738    702.00   12.35   2.37   1784.50    0.000   4.738    0.000  0.00000  0.000    Tr./Rect.closed
           "i.p."     -3097.69   1777.50  1787.11  1782.339   4.839    702.00   12.09   2.27   1784.61    0.000   4.738    0.968  0.00400  4.839    Tr./Rect.closed
"Link12"   Reach      -2637.98   1779.34  1794.00  1784.179   4.839    702.00   12.09   2.27   1786.45    0.000   4.738    0.968  0.00400  4.839    Tr./Rect.closed
           "i.p."     -2569.13   1779.61  1794.27  1784.468   4.854    702.00   12.05   2.26   1786.72    0.000   4.738    0.964  0.00397  4.854    Tr./Rect.closed
"Link11"   Reach      -2461.58   1780.04  1797.00  1784.894   4.854    702.00   12.05   2.26   1787.15    0.000   4.738    0.964  0.00397  4.854    Tr./Rect.closed
           "i.p."     -2409.46   1780.25  1797.21  1785.084   4.835    702.00   12.10   2.27   1787.36    0.000   4.738    0.970  0.00401  4.835    Tr./Rect.closed
"Link10"   Reach      -1838.44   1782.54  1790.00  1787.375   4.835    702.00   12.10   2.27   1789.65    0.000   4.738    0.970  0.00401  4.835    Tr./Rect.closed
           "i.p."     -1771.31   1782.81  1790.27  1787.656   4.848    702.00   12.07   2.26   1789.92    0.000   4.738    0.966  0.00398  4.848    Tr./Rect.closed
"Link14"   Reach      -1630.00   1783.37  1793.50  1788.218   4.848    702.00   12.07   2.26   1790.48    0.000   4.738    0.966  0.00398  4.848    Tr./Rect.closed
"Link9"    Transition -1600.00   1785.02  1793.50  1789.494   4.474    702.00   8.72    1.18   1790.67    0.000   3.615    0.726  0.05500  0.000    Tr./Rect.closed
           "i.p."     -1570.60   1785.17  1793.65  1789.432   4.265    702.00   9.14    1.30   1790.73    0.000   3.615    0.780  0.00500  3.160    Tr./Rect.closed
"Link31"   Reach      -1548.00   1785.28  1793.00  1789.365   4.085    702.00   9.55    1.42   1790.78    0.000   3.615    0.832  0.00500  3.160    Tr./Rect.closed
"Node32"   Junction   -1538.00   1785.32  1793.00  1789.637   4.317    688.00   8.85    1.22   1790.85    0.000   3.567    0.000  0.00400  0.000    Tr./Rect.closed
 HYDRAULIC JUMP  at -1495.26  of length  0.03
           "i.p."     -1511.71   1785.45  1793.13  1789.570   4.116    688.00   9.29    1.34   1790.91    0.000   3.567    0.807  0.00507  3.103    Tr./Rect.closed
```

	"i.p."	-1495.26	1785.54	1793.22	1789.512	3.975	688.00	9.61	1.44	1790.95	0.000	3.567	0.850	0.00507	3.103	Tr./Rect.closed
	"i.p."	-1495.26	1785.54	1793.22	1788.724	3.187	688.00	11.99	2.23	1790.96	0.000	3.567	1.184	0.00507	3.103	Tr./Rect.closed
	"i.p."	-1446.05	1785.79	1793.47	1789.028	3.242	688.00	11.79	2.16	1791.19	0.000	3.567	1.154	0.00507	3.103	Tr./Rect.closed
	"i.p."	-1404.52	1786.00	1793.68	1789.397	3.400	688.00	11.24	1.96	1791.36	0.000	3.567	1.074	0.00507	3.103	Tr./Rect.closed
"Link8"	Reach	-1396.01	1786.04	1793.00	1789.606	3.566	688.00	10.72	1.78	1791.39	0.000	3.567	1.000	0.00507	3.103	Tr./Rect.closed
"Node8"	Join	-1396.01	1786.56	1793.00	1790.992	4.432	502.00	6.29	0.61	1791.61	0.000	2.891	0.000	0.00000	0.000	Tr./Rect.closed
HYDRAULIC JUMP at -1386.67 of length 0.05																
	"i.p."	-1393.13	1786.71	1793.15	1790.934	4.226	502.00	6.60	0.68	1791.61	0.000	2.891	0.566	0.05128	1.198	Tr./Rect.closed
	"i.p."	-1390.55	1786.84	1793.28	1790.869	4.030	502.00	6.92	0.74	1791.61	0.000	2.891	0.608	0.05128	1.198	Tr./Rect.closed
	"i.p."	-1388.29	1786.96	1793.40	1790.798	3.842	502.00	7.26	0.82	1791.62	0.000	2.891	0.653	0.05128	1.198	Tr./Rect.closed
	"i.p."	-1386.67	1787.04	1793.48	1790.735	3.696	502.00	7.55	0.88	1791.62	0.000	2.891	0.692	0.05128	1.198	Tr./Rect.closed
	"i.p."	-1386.67	1787.04	1793.48	1789.251	2.212	502.00	12.61	2.47	1791.72	0.000	2.891	1.494	0.05128	1.198	Tr./Rect.closed
"Link7"	Reach	-1384.70	1787.14	1793.00	1789.429	2.289	502.00	12.18	2.30	1791.73	0.000	2.891	1.419	0.05128	1.198	Tr./Rect.closed
"Link6"	Transition	-1374.01	1787.18	1793.00	1790.306	3.126	502.00	10.04	1.56	1791.87	0.000	3.127	1.000	0.00374	0.000	Tr./Rect.closed
	"i.p."	-1352.36	1787.27	1793.09	1790.548	3.280	502.00	9.57	1.42	1791.97	0.000	3.127	0.931	0.00406	3.336	Tr./Rect.closed
"Link5"	Reach	-1351.84	1787.27	1793.00	1790.551	3.281	502.00	9.56	1.42	1791.97	0.000	3.127	0.930	0.00406	3.336	Tr./Rect.closed
"Link4"	Reach	-1312.29	1787.42	1795.00	1790.779	3.359	502.00	9.34	1.35	1792.13	0.000	3.127	0.898	0.00379	3.420	Tr./Rect.closed
"Link3"	Transition	-1310.29	1787.43	1795.00	1791.454	4.024	502.00	6.93	0.75	1792.20	0.000	2.891	0.609	0.00500	0.000	Tr./Rect.closed
"Node3"	Join	-1310.29	1787.47	1795.50	1791.973	4.503	383.00	4.73	0.35	1792.32	0.000	2.414	0.000	0.00000	0.000	Tr./Rect.closed
"Link2"	Reach	-1289.29	1787.55	1795.50	1791.972	4.422	383.00	4.81	0.36	1792.33	0.000	2.414	0.403	0.00381	2.316	Tr./Rect.closed
"Link1"	Reach	-1280.74	1787.58	1795.00	1791.971	4.391	383.00	4.85	0.36	1792.34	0.000	2.414	0.407	0.00351	2.379	Tr./Rect.closed
"Node1"	Join	-1280.74	1787.61	1795.00	1792.179	4.569	219.00	2.66	0.11	1792.29	0.000	1.663	0.000	0.00000	0.000	Tr./Rect.closed
"Link15"	Reach	-1238.74	1787.78	1795.00	1792.177	4.397	219.00	2.77	0.12	1792.30	0.000	1.663	0.233	0.00405	1.583	Tr./Rect.closed
"Node16"	WallExt	-1238.74	1787.78	1796.50	1792.177	4.397	219.00	6.90	0.74	1792.92	0.000	2.856	0.000	0.00000	0.000	Tr./Rect.closed
"Link26"	Reach	-1225.94	1787.84	1795.00	1792.257	4.417	219.00	6.90	0.74	1793.00	0.000	2.856	0.610	0.00469	2.867	Tr./Rect.closed
"Link18.1"	Reach	-1213.14	1787.90	1794.00	1792.336	4.436	219.00	6.90	0.74	1793.07	0.000	2.856	0.610	0.00469	2.867	Tr./Rect.closed
"Node18"	Junction	-1209.14	1787.92	1794.30	1793.078	5.158	119.00	3.75	0.22	1793.30	0.000	1.901	0.000	0.00500	0.000	Tr./Rect.closed
"Link22"	Reach	-1201.14	1787.96	1794.30	1793.086	5.126	119.00	3.75	0.22	1793.30	0.000	1.901	0.332	0.00500	1.826	Tr./Rect.closed
"Node23"	Junction	-1199.14	1787.97	1794.30	1793.216	5.246	100.00	3.15	0.15	1793.37	0.000	1.693	0.000	0.00500	0.000	Tr./Rect.closed
"Link24"	Reach	-1123.47	1788.35	1794.50	1793.268	4.918	100.00	3.15	0.15	1793.42	0.000	1.693	0.279	0.00502	1.620	Tr./Rect.closed
"Node25"	Headwrk	-1123.47	1788.35	1794.50	1793.268	4.918	100.00	3.15	0.15	1793.42	0.000	1.693	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

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Node1_Branch1
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Composite Profile:

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet/N"	Outlet	-1280.74	1787.61	1795.00	1792.090	4.480	164.00	5.17	0.41	1792.50	0.000	2.355	0.000	0.00000	0.000	Tr./Rect.closed
"Link19"	Reach	-1267.94	1787.68	1793.70	1792.135	4.455	164.00	5.17	0.41	1792.55	0.000	2.355	0.457	0.00547	2.211	Tr./Rect.closed
"Link28"	Reach	-1255.14	1787.74	1793.70	1792.179	4.439	164.00	5.17	0.41	1792.59	0.000	2.355	0.457	0.00469	2.334	Tr./Rect.closed
"Node29"	Junction	-1251.14	1787.76	1793.70	1792.554	4.794	82.00	3.95	0.24	1792.80	0.000	1.621	0.000	0.00500	0.000	Tr./Rect.closed
"Link27"	Reach	-1165.49	1788.19	1793.70	1792.684	4.494	82.00	3.95	0.24	1792.93	0.000	1.621	0.404	0.00502	1.578	Tr./Rect.closed
"Node28"	Headwrk	-1165.49	1788.19	1793.70	1792.684	4.494	82.00	3.95	0.24	1792.93	0.000	1.621	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

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Node3_Branch1
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Composite Profile:

ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet/N"	Outlet	-1310.29	1787.47	1795.50	1791.734	4.264	119.00	3.75	0.22	1791.95	0.000	1.901	0.000	0.00000	0.000	Tr./Rect.closed

"Link20"	Reach	-1293.74	1787.55	1793.50	1791.761	4.211	119.00	3.75	0.22	1791.98	0.000	1.901	0.332	0.00484	1.847	Tr./Rect.closed
"Link30"	Reach	-1277.20	1787.63	1793.50	1791.788	4.158	119.00	3.75	0.22	1792.01	0.000	1.901	0.332	0.00484	1.847	Tr./Rect.closed
"Node31"	Junction	-1273.20	1787.65	1793.50	1791.942	4.292	55.00	3.73	0.22	1792.16	0.000	1.555	0.000	0.00500	0.000	Tr./Rect.closed
"Link32"	Reach	-1187.37	1788.28	1793.10	1792.078	3.798	55.00	3.73	0.22	1792.29	0.000	1.555	0.383	0.00734	1.395	Tr./Rect.closed
	"i.p."	-1172.72	1789.10	1793.92	1792.101	3.000	55.00	3.73	0.22	1792.32	0.000	1.555	0.383	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1169.71	1789.27	1794.09	1792.082	2.813	55.00	3.91	0.24	1792.32	0.000	1.555	0.411	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1167.75	1789.38	1794.20	1792.061	2.682	55.00	4.10	0.26	1792.32	0.000	1.555	0.441	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1165.95	1789.48	1794.30	1792.037	2.557	55.00	4.30	0.29	1792.32	0.000	1.555	0.474	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1164.30	1789.57	1794.39	1792.011	2.438	55.00	4.51	0.32	1792.33	0.000	1.555	0.509	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1162.79	1789.66	1794.48	1791.982	2.325	55.00	4.73	0.35	1792.33	0.000	1.555	0.547	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1161.44	1789.73	1794.55	1791.950	2.216	55.00	4.96	0.38	1792.33	0.000	1.555	0.587	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1160.23	1789.80	1794.62	1791.914	2.113	55.00	5.21	0.42	1792.33	0.000	1.555	0.631	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1159.18	1789.86	1794.68	1791.874	2.015	55.00	5.46	0.46	1792.34	0.000	1.555	0.678	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1158.29	1789.91	1794.73	1791.831	1.921	55.00	5.73	0.51	1792.34	0.000	1.555	0.728	0.05603	0.701	Tr./Rect.closed
	"i.p."	-1157.56	1789.95	1794.77	1791.782	1.832	55.00	6.01	0.56	1792.34	0.000	1.555	0.782	0.05603	0.701	Tr./Rect.closed
"Link29"	Reach	-1157.21	1789.97	1793.50	1791.751	1.781	55.00	6.18	0.59	1792.34	0.000	1.555	0.816	0.05603	0.701	Tr./Rect.closed
"Node30"	Headwrk	-1157.21	1789.97	1793.50	1791.751	1.781	55.00	6.18	0.59	1792.34	0.000	1.555	0.000	0.00000	0.000	Tr./Rect.closed

*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

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Node8_Branch1
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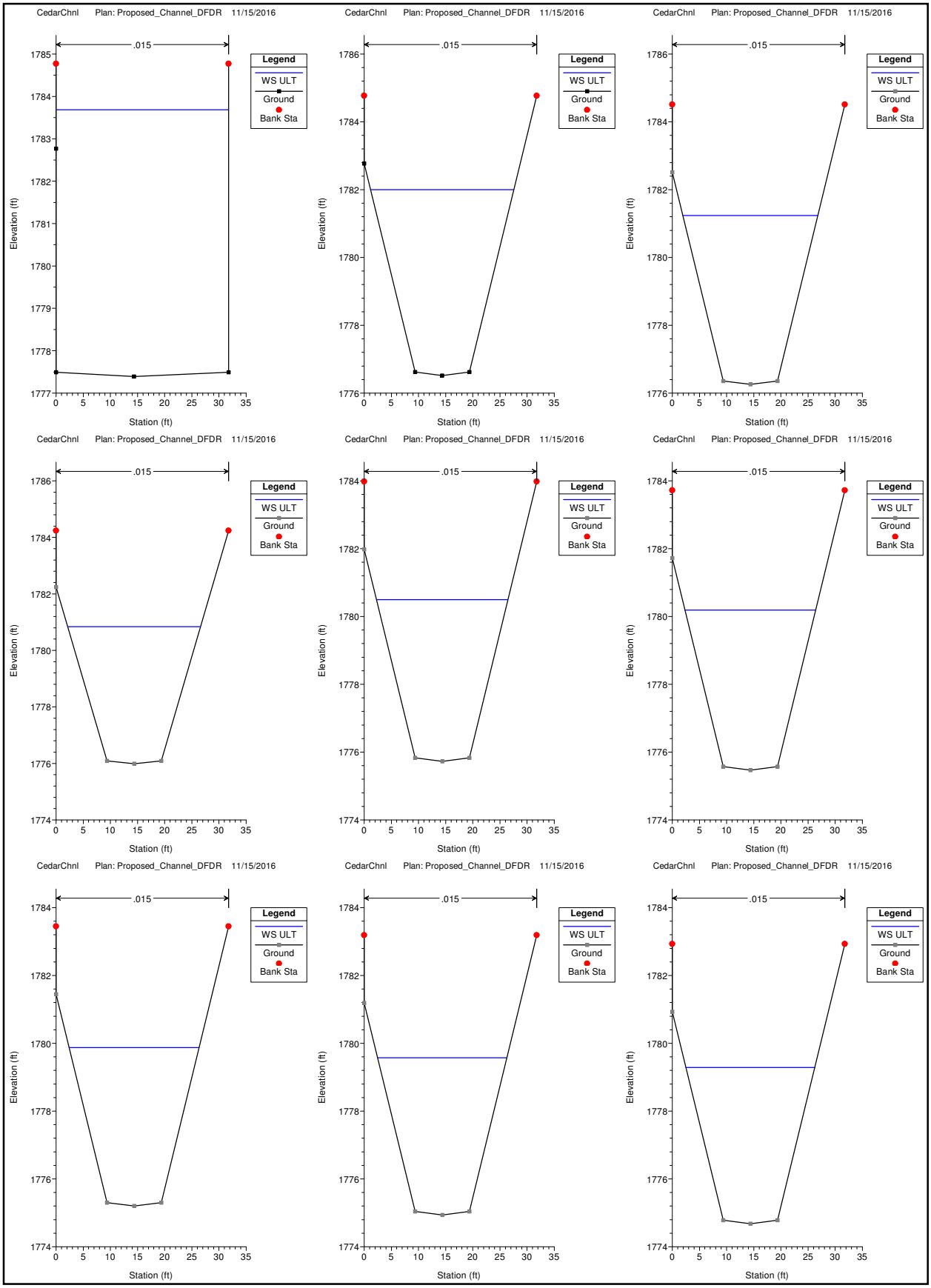
Composite Profile:

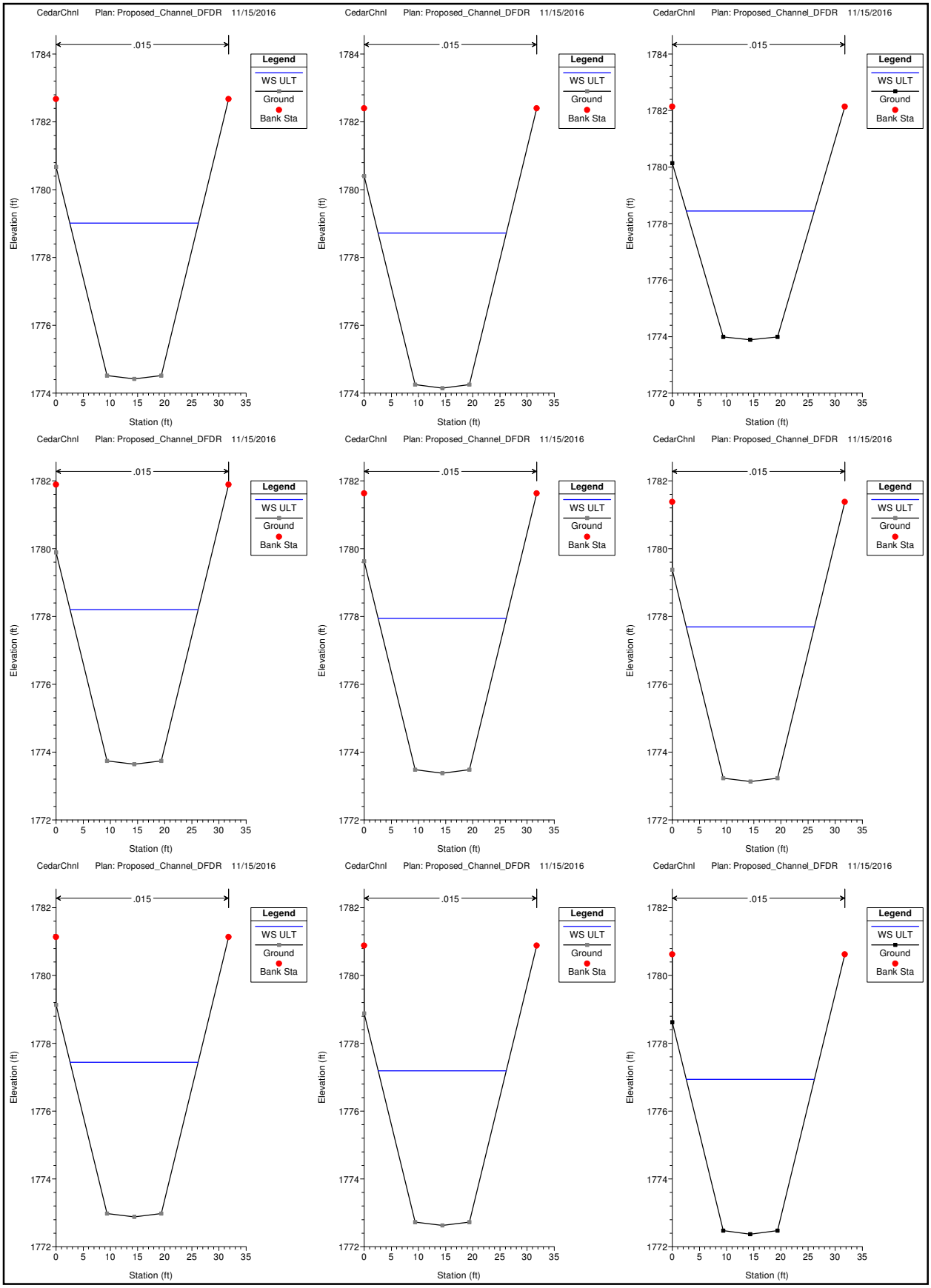
ELEMENT NAME	TYPE	STATION	INVERT ELEV	GROUND ELEV	W.S. ELEV	DEPTH	Q	VELOC.	VELOC. HEAD	ENERGY GRADE LN	SUPER ELEV	CRITICAL DEPTH	FROUDE NUMBER	SLOPE	NORMAL DEPTH	CROSS SECTION
###																
"Outlet/N"	Outlet	-1396.01	1786.56	1793.00	1790.560	4.000	186.00	5.81	0.52	1791.08	0.000	2.561	0.000	0.00000	0.000	Tr./Rect.closed
	"i.p."	-1376.38	1786.72	1793.16	1790.536	3.814	186.00	6.10	0.58	1791.11	0.000	2.561	0.550	0.00827	2.090	Tr./Rect.closed
	"i.p."	-1358.25	1786.87	1793.31	1790.508	3.636	186.00	6.39	0.63	1791.14	0.000	2.561	0.591	0.00827	2.090	Tr./Rect.closed
	"i.p."	-1341.68	1787.01	1793.45	1790.476	3.467	186.00	6.71	0.70	1791.17	0.000	2.561	0.635	0.00827	2.090	Tr./Rect.closed
"Link25"	Reach	-1329.48	1787.11	1792.50	1790.446	3.336	186.00	6.97	0.75	1791.20	0.000	2.561	0.672	0.00827	2.090	Tr./Rect.closed
"Node26"	Headwrk	-1329.48	1787.11	1792.50	1790.446	3.336	186.00	6.97	0.75	1791.20	0.000	2.561	0.000	0.00000	0.000	Tr./Rect.closed

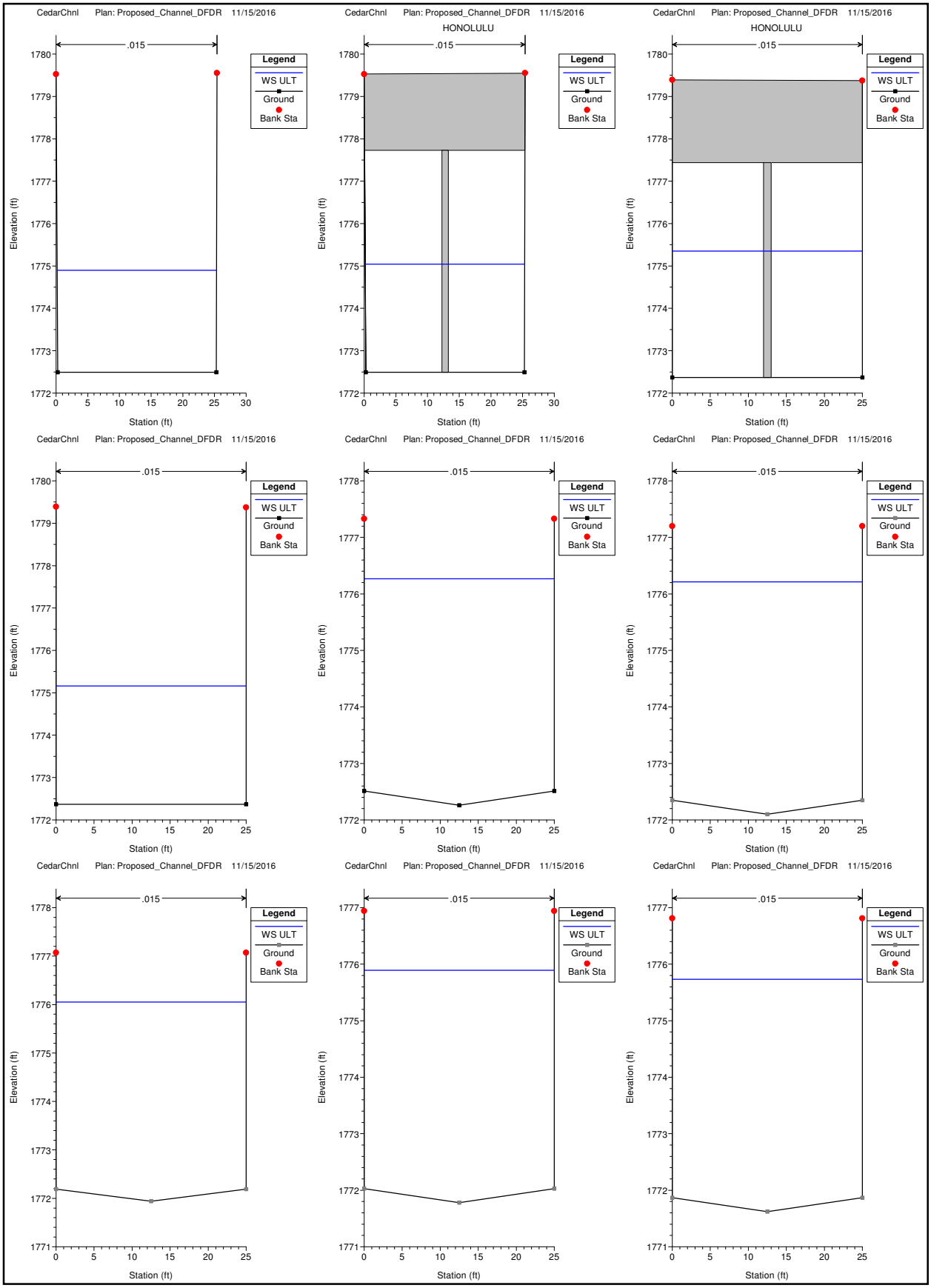
*) in the W.S.ELEV column indicates flooding, it is set whenever W.S.ELEV > GROUND ELEV
i.p. = intermediate point processing results for reaches

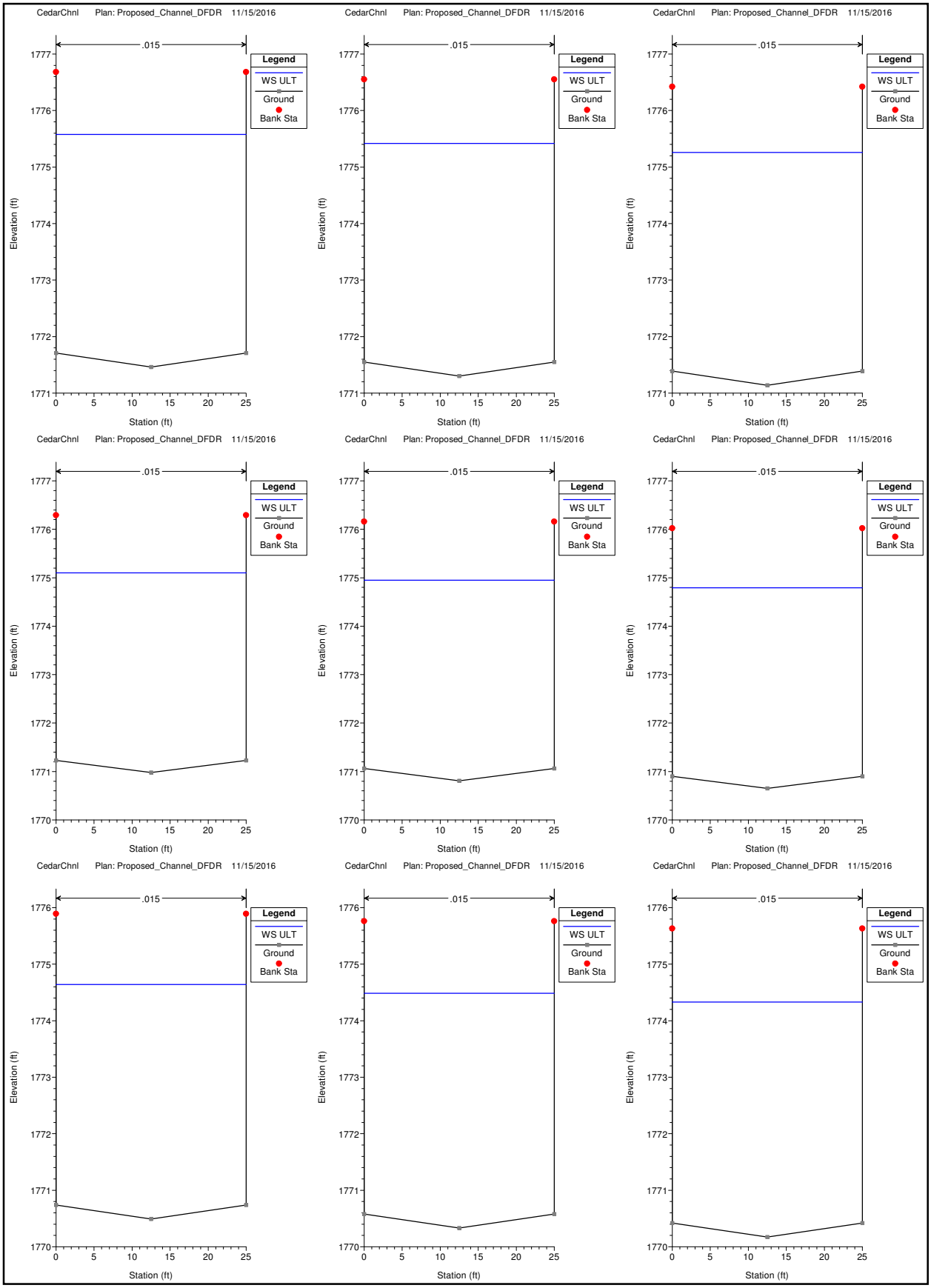
Appendix C-2

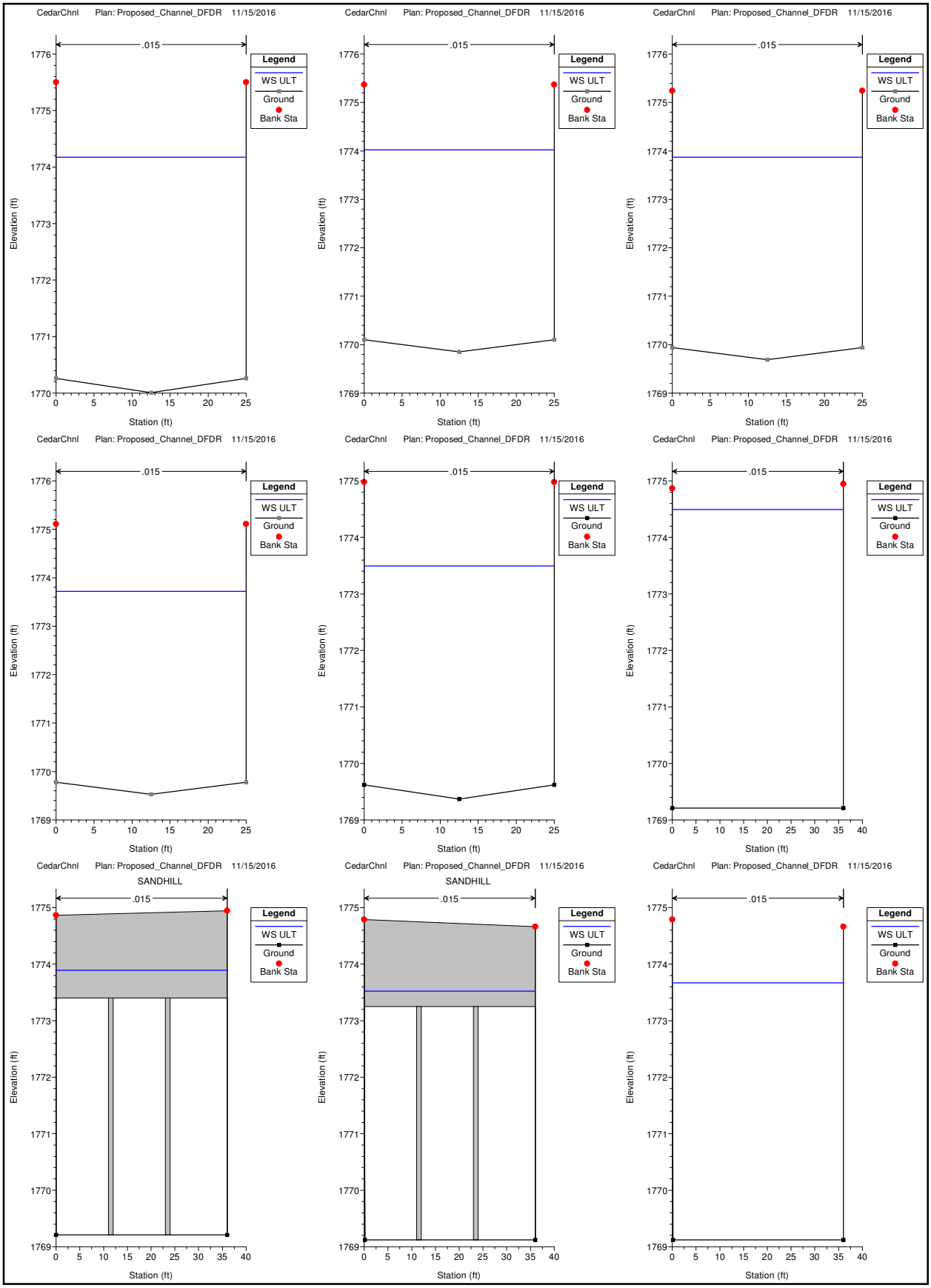
HEC-RAS Model

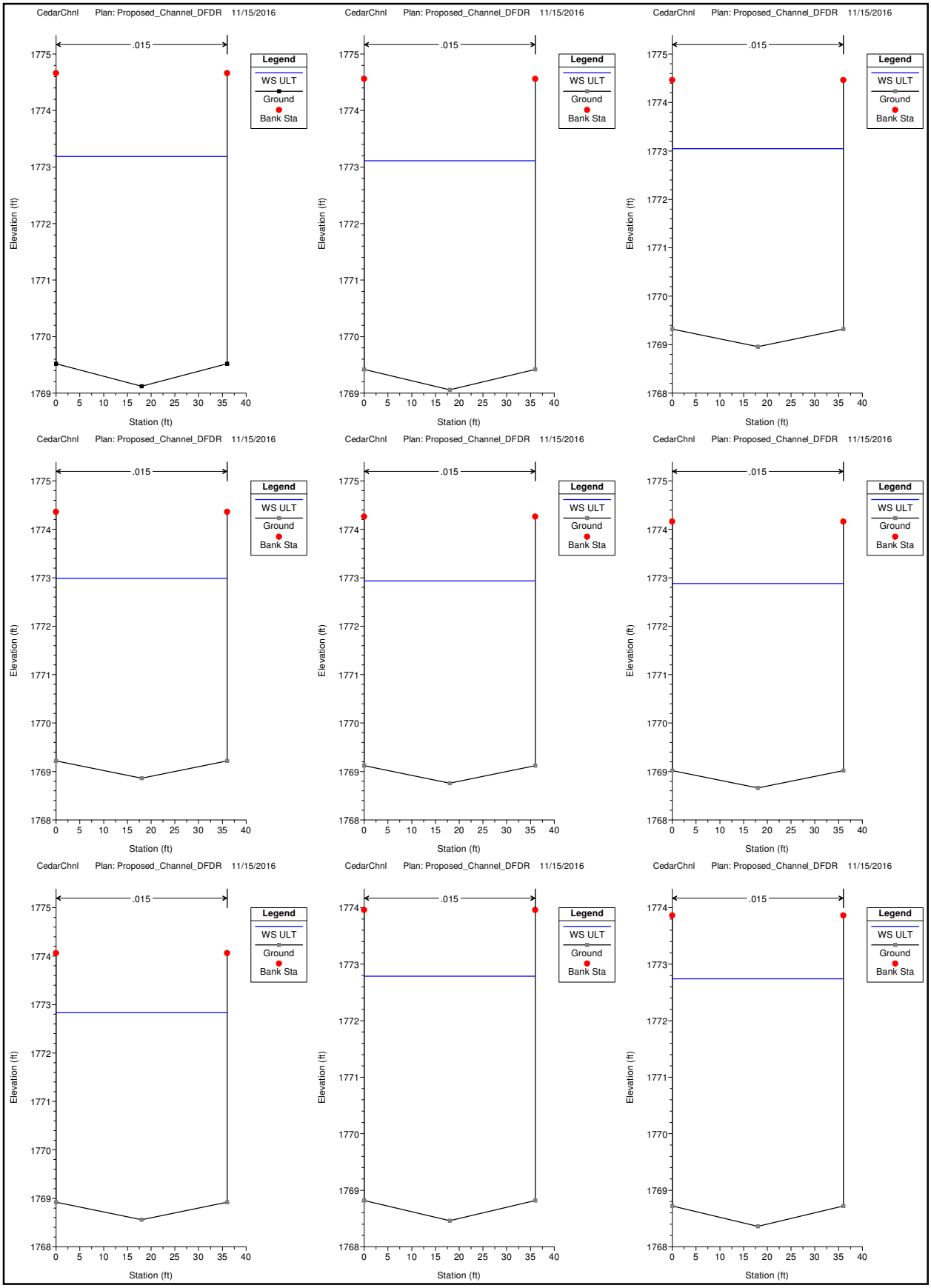

CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
.015
Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

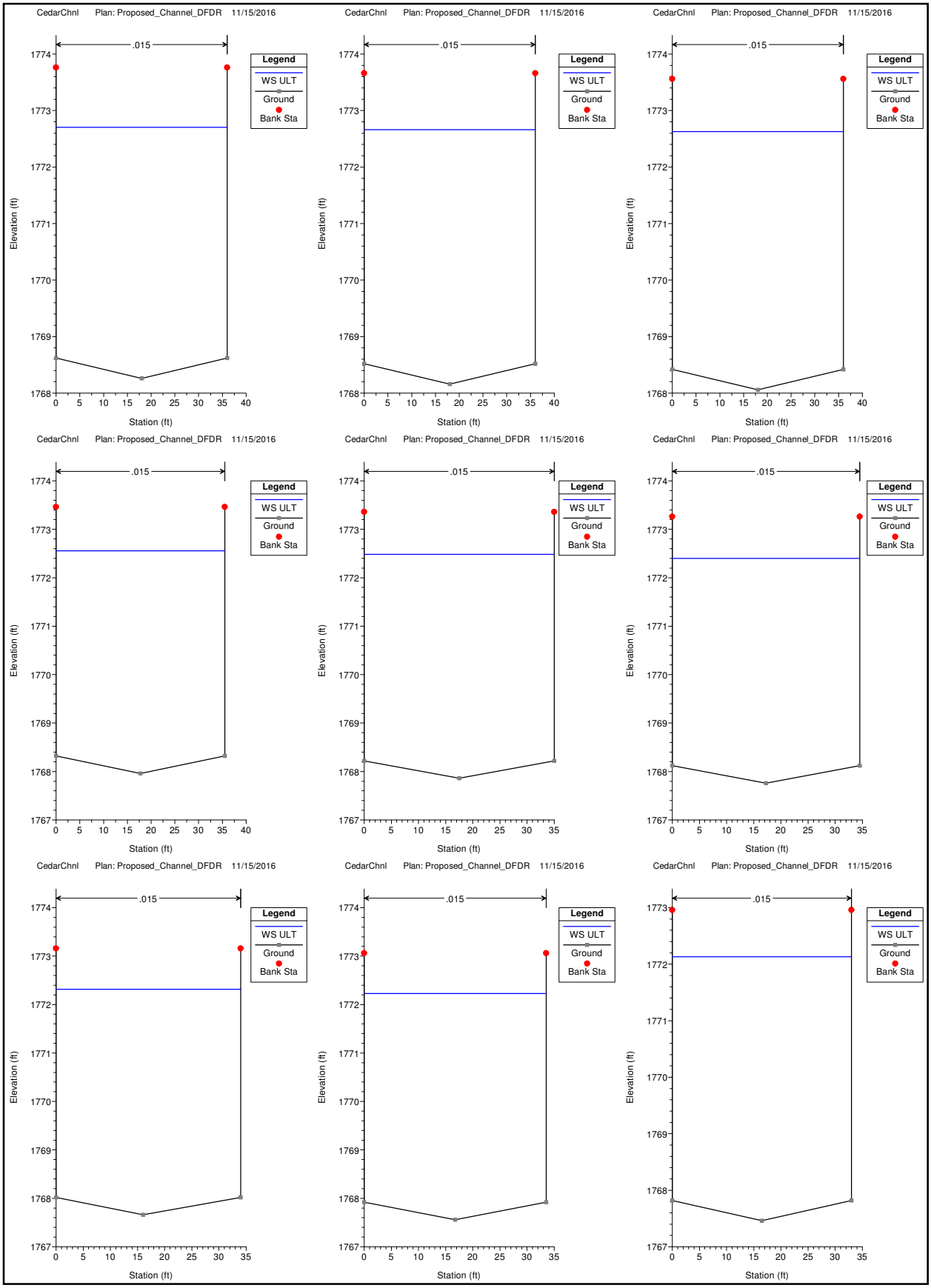

CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Legend
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Ground
Bank Sta
Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Legend
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Elevation (ft)
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Elevation (ft)
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Elevation (ft)
Station (ft)

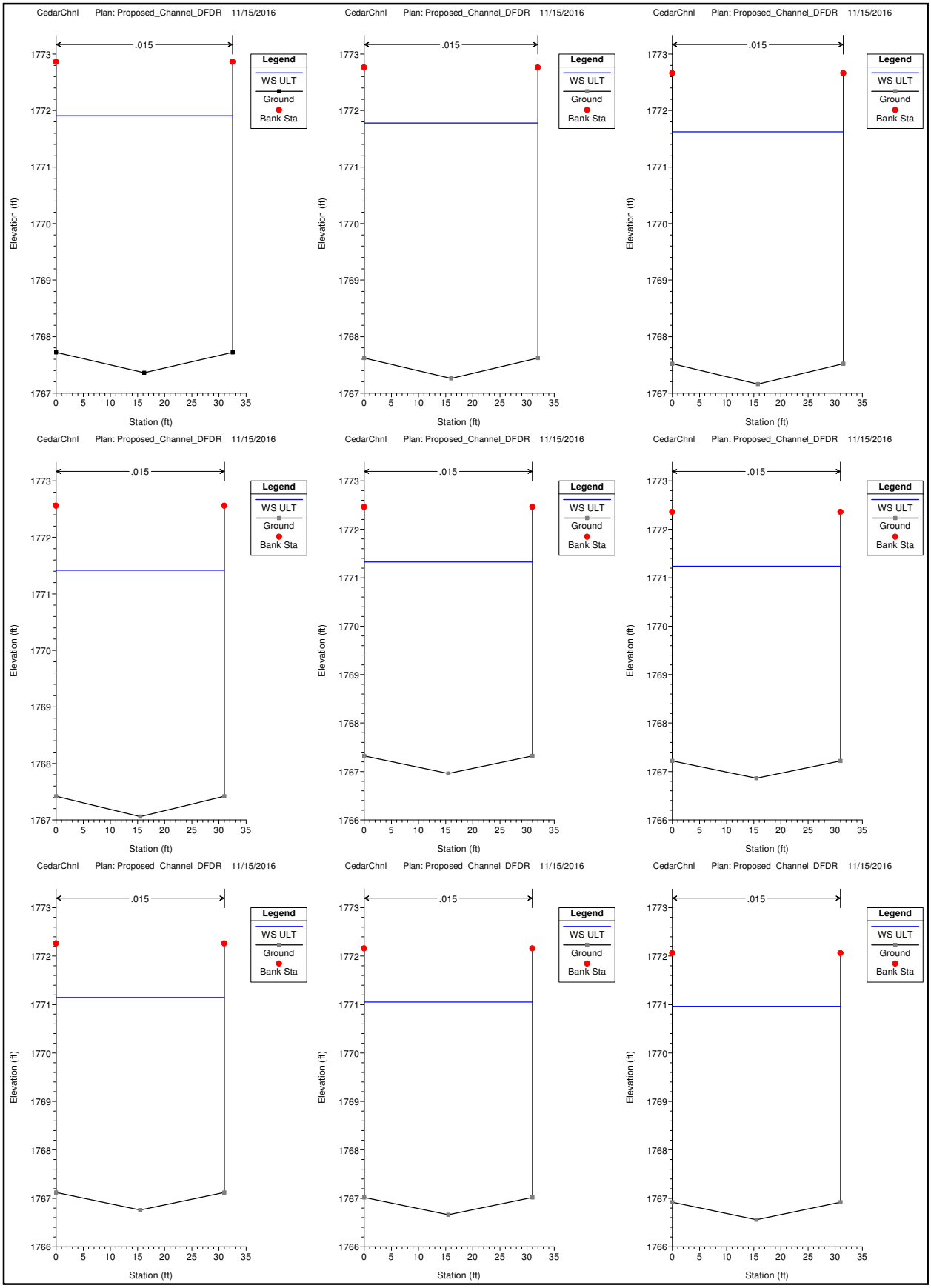

CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
HONOLULU
.015
Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

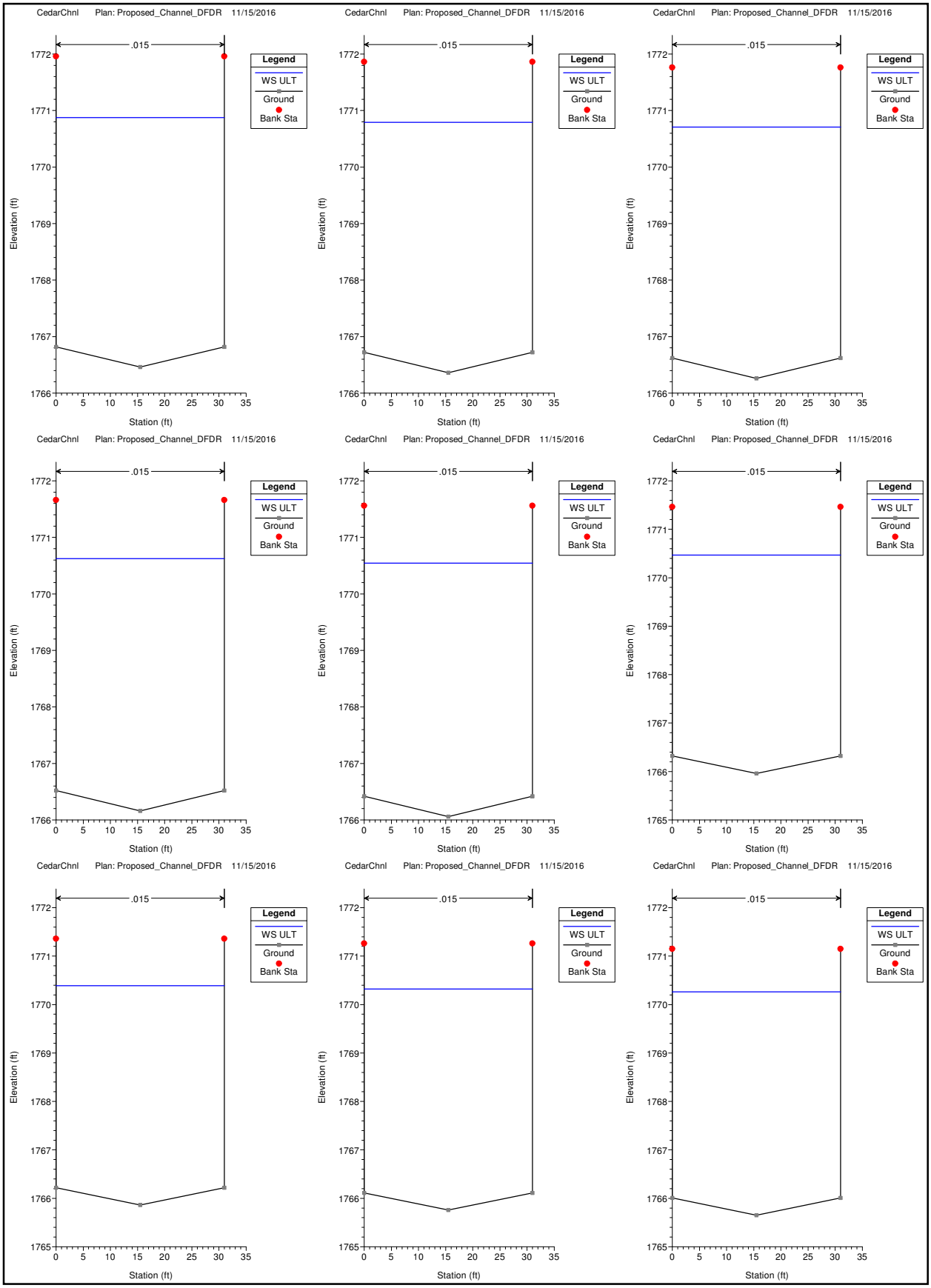

CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
.015
Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Ground
Bank Sta
Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)
CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
.015
Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)

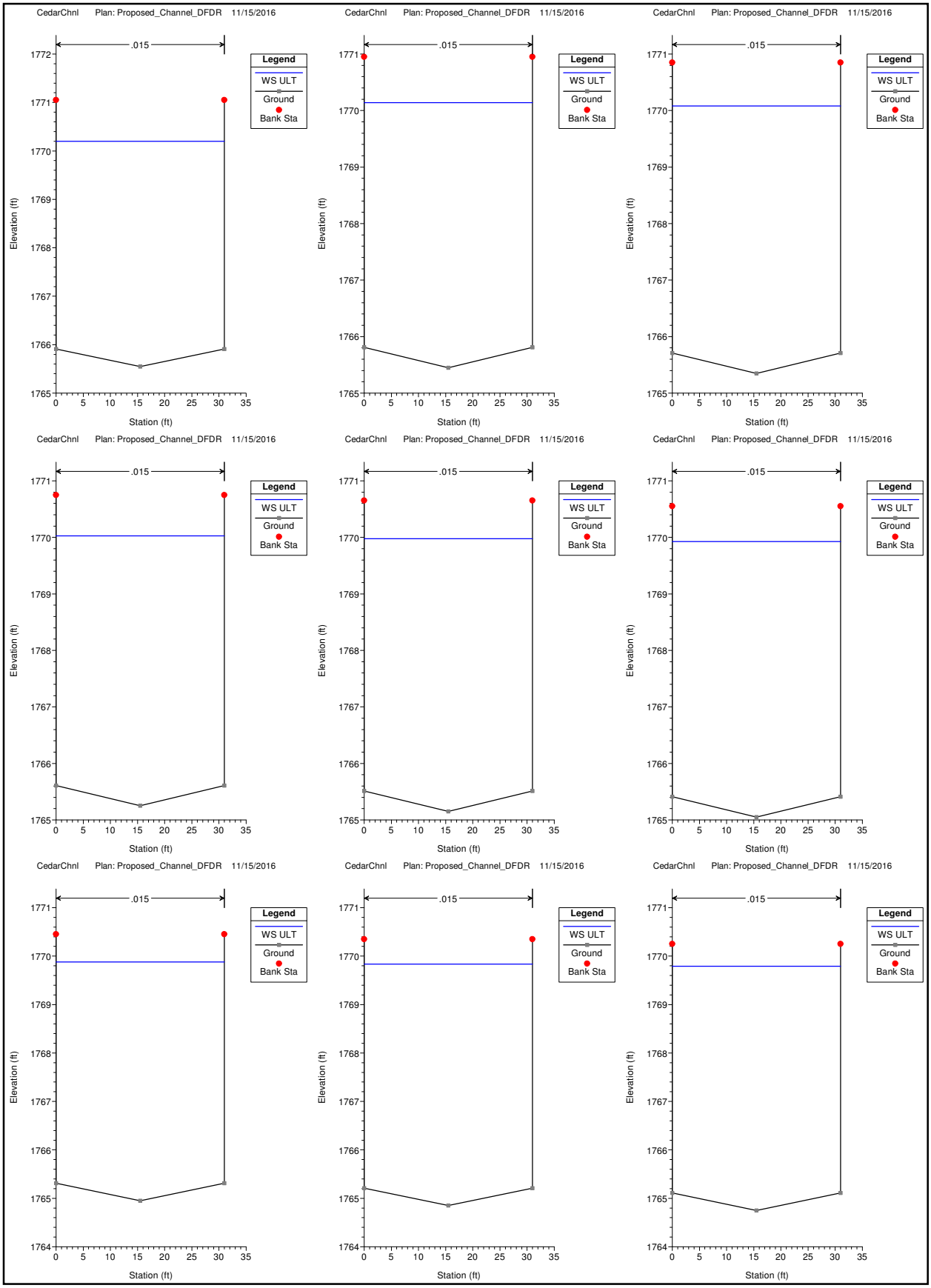

CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
.015
Legend
WS ULT
Ground
Bank Sta
Elevation (ft)
Station (ft)
SANDHILL

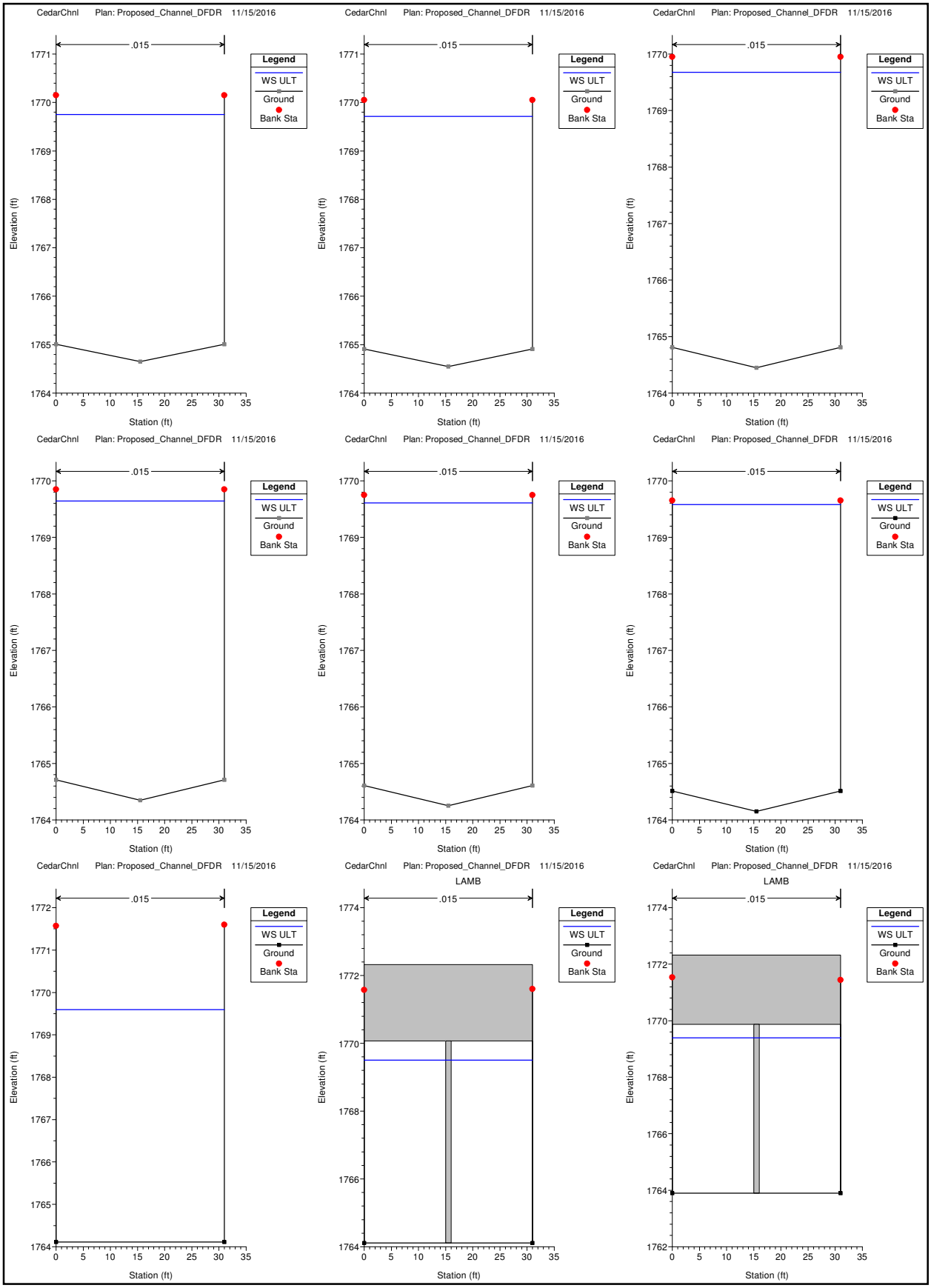

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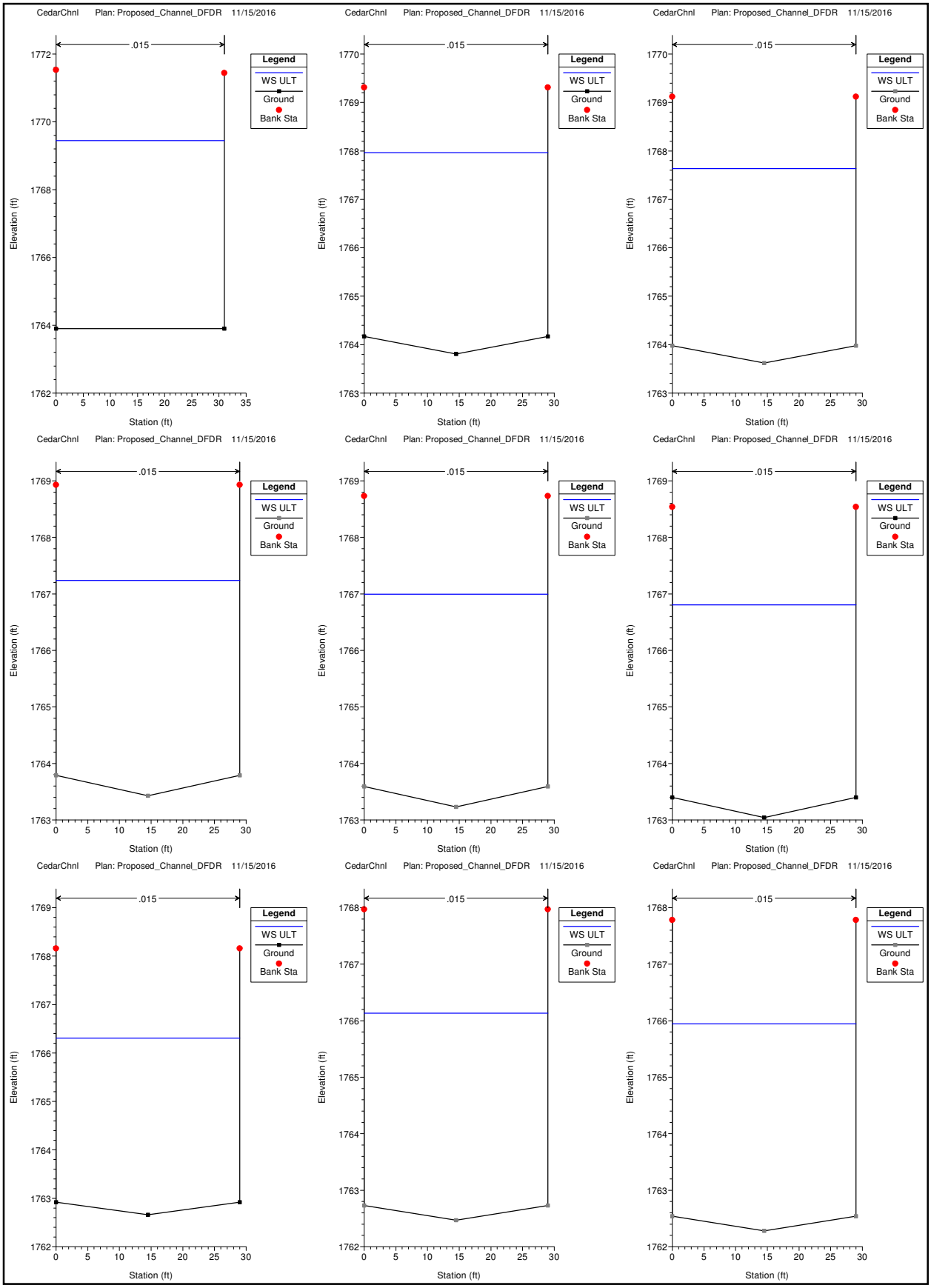

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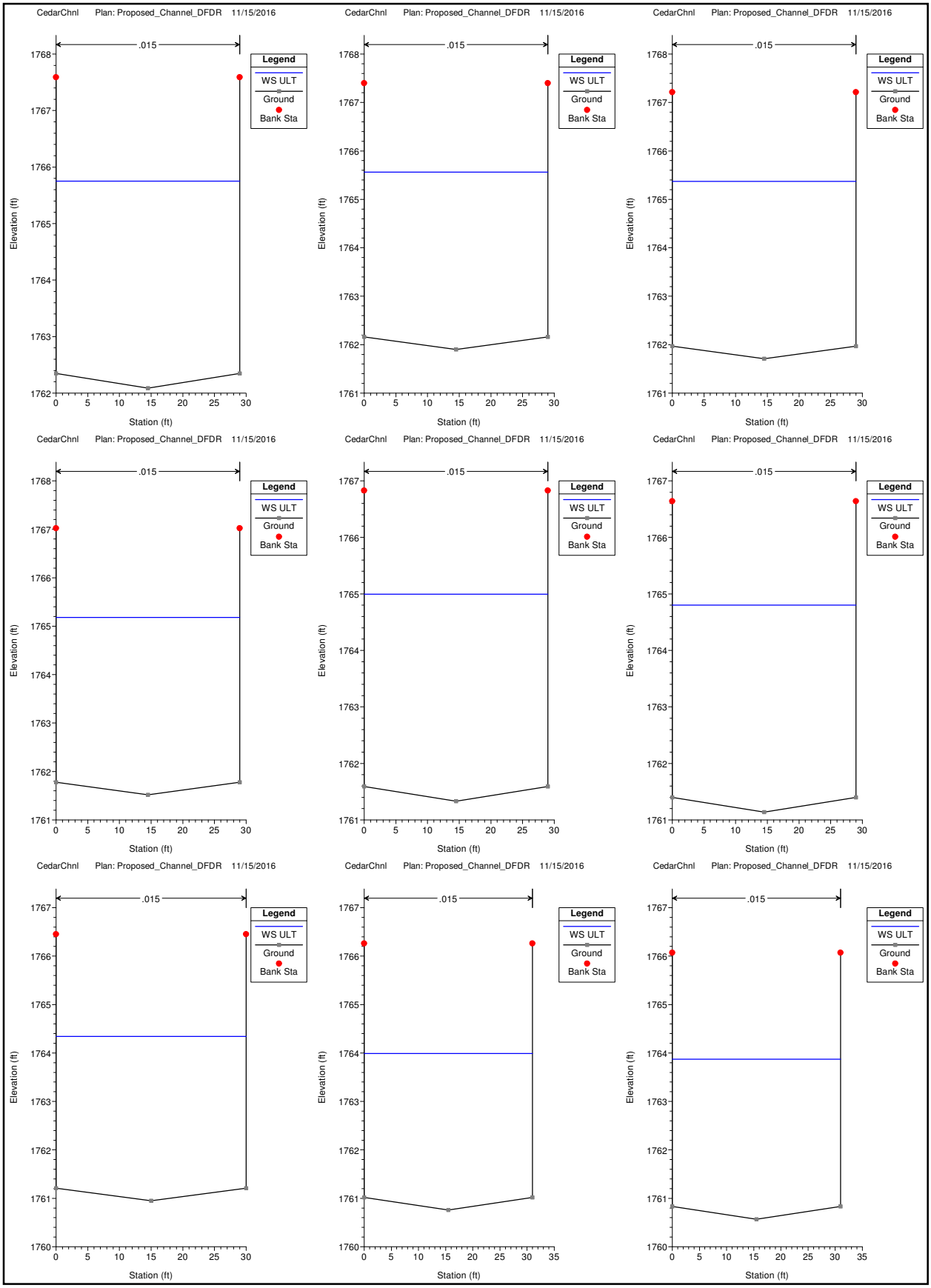

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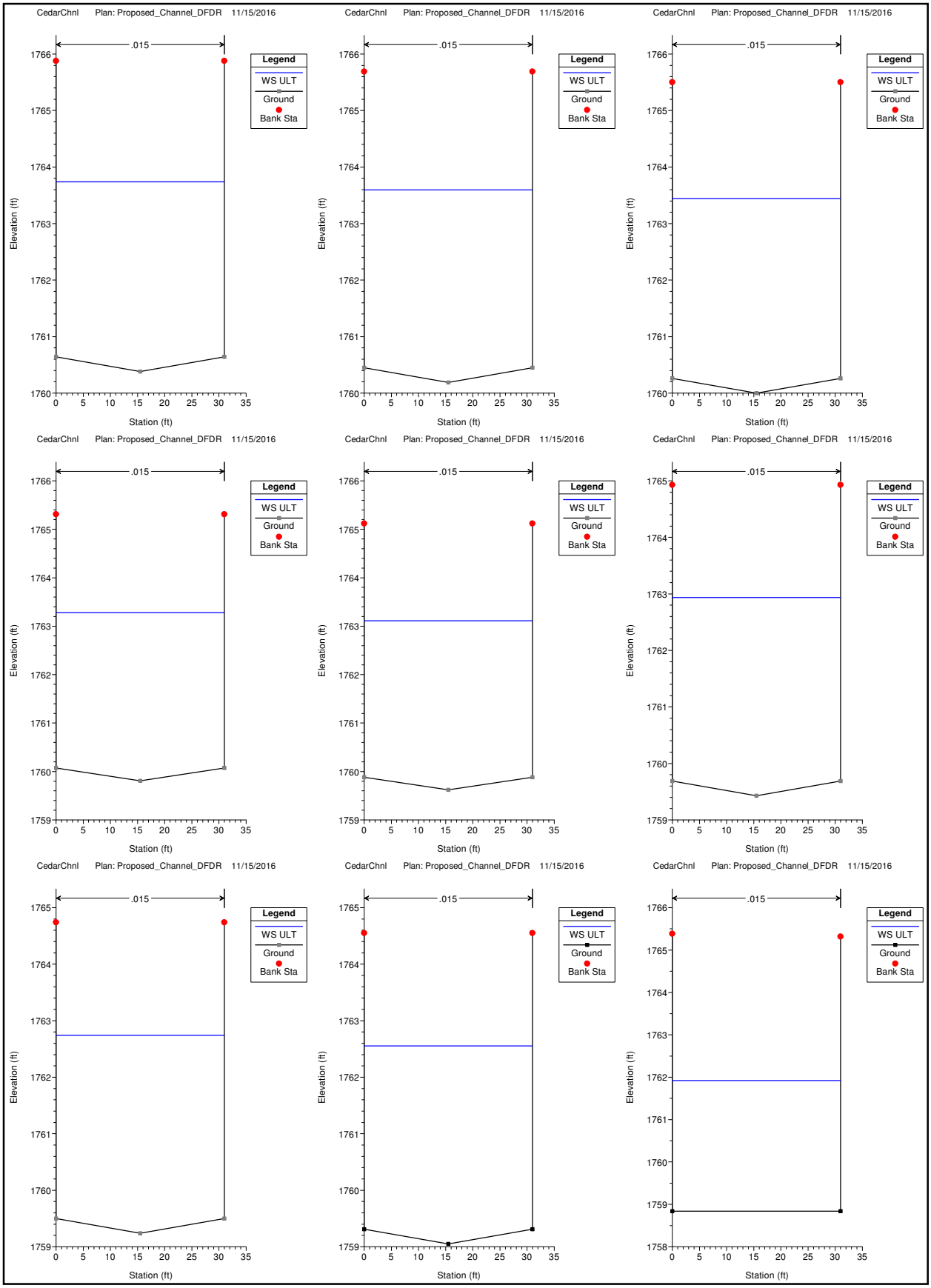

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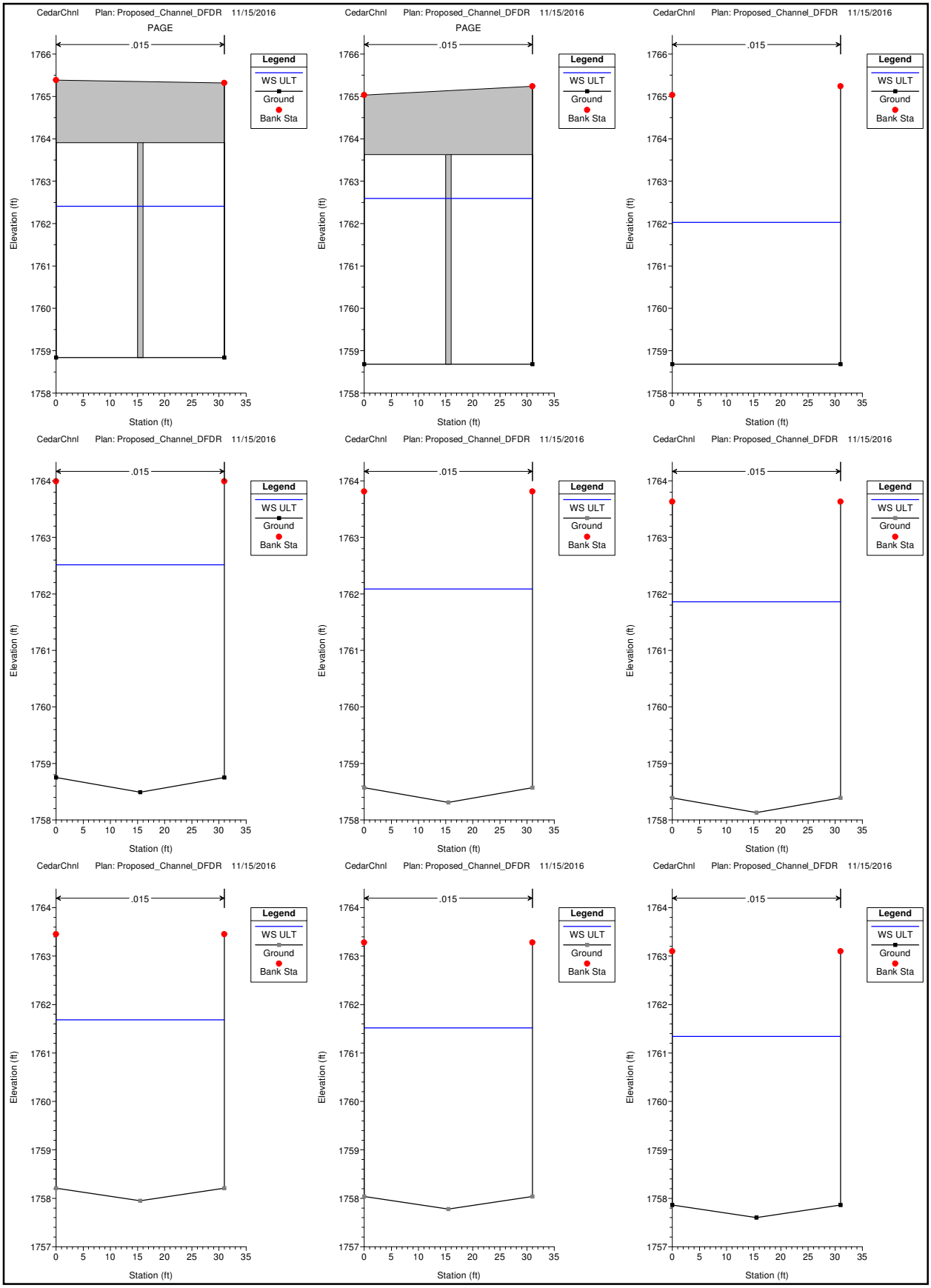

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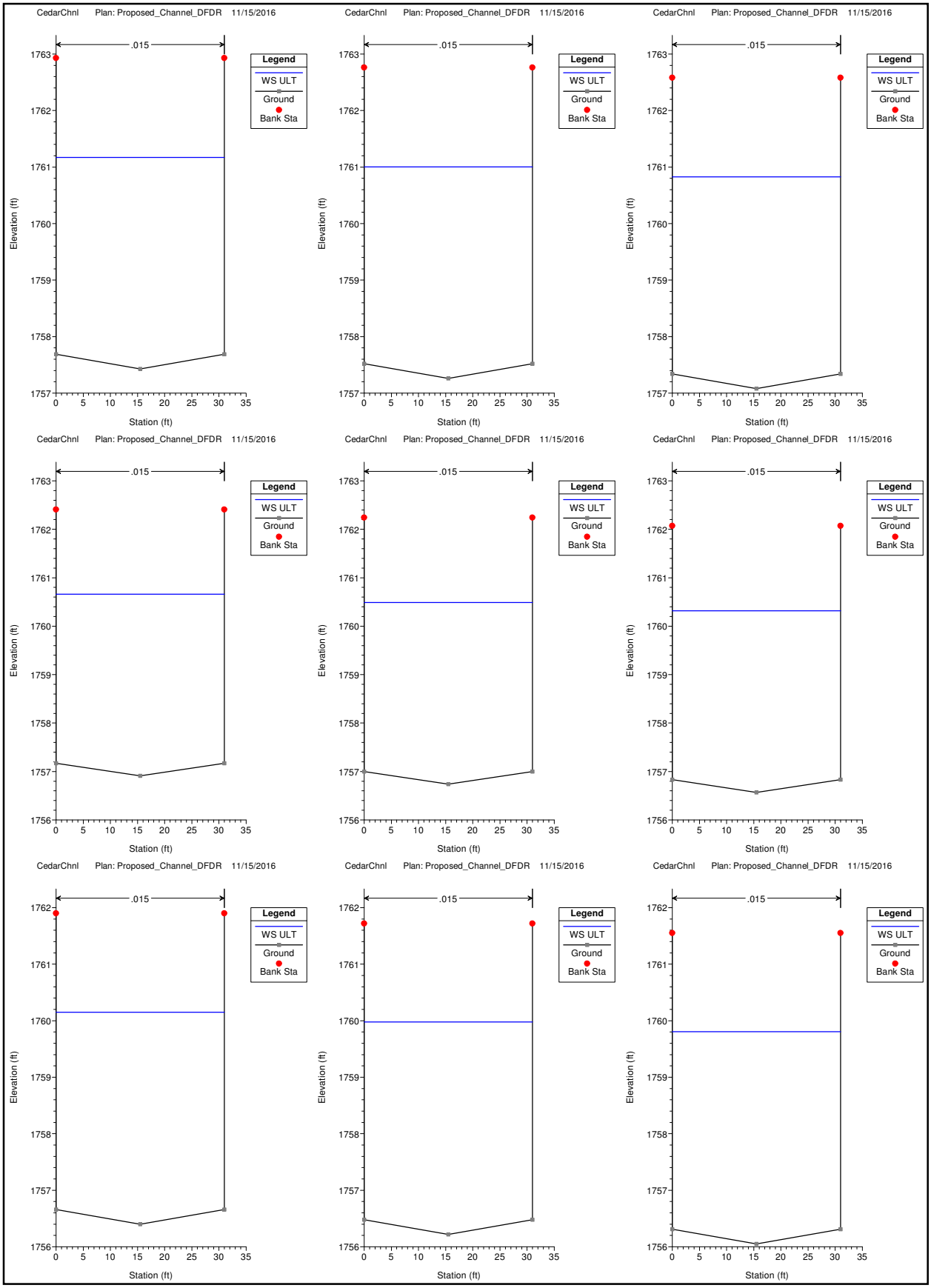

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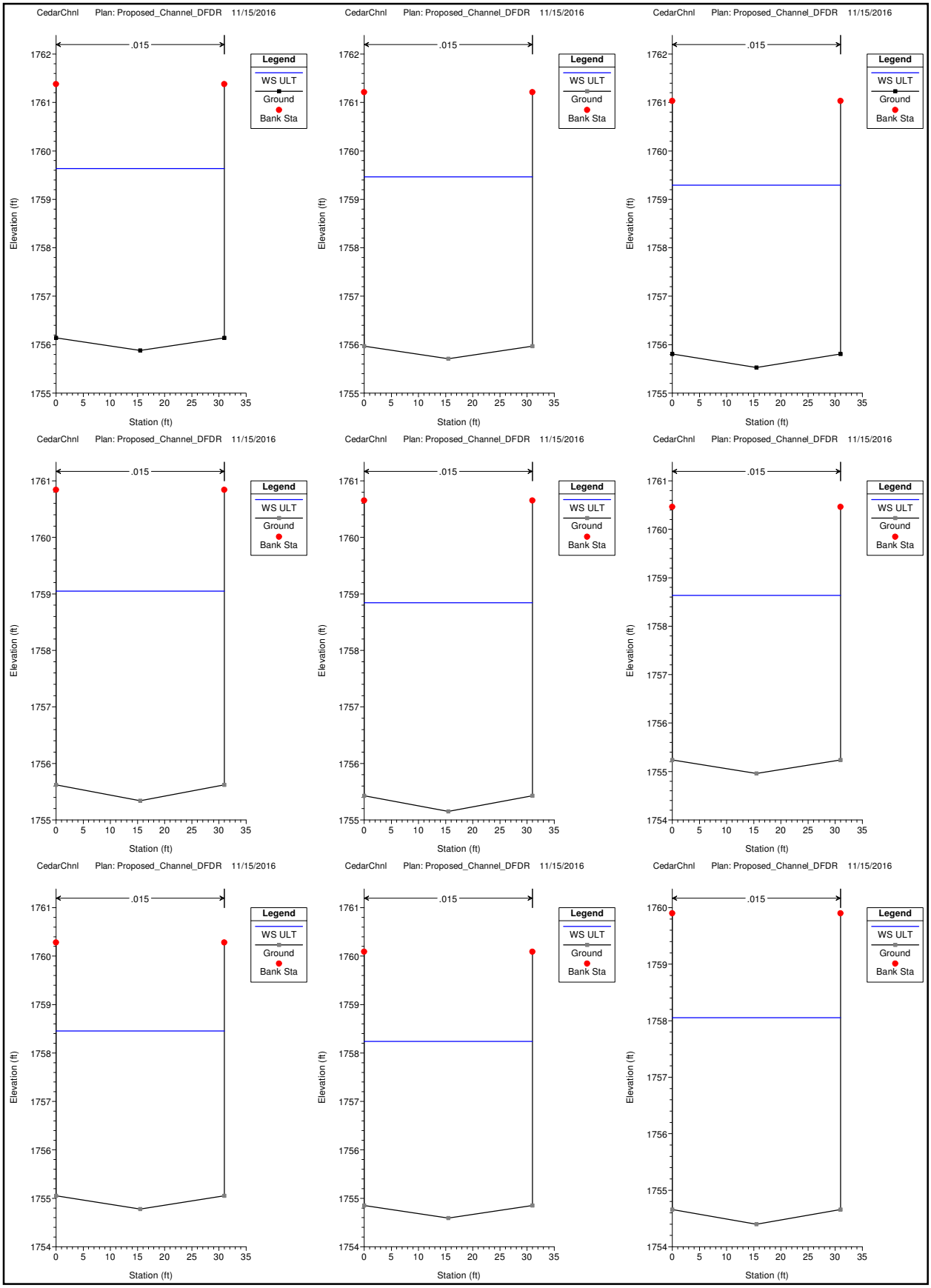

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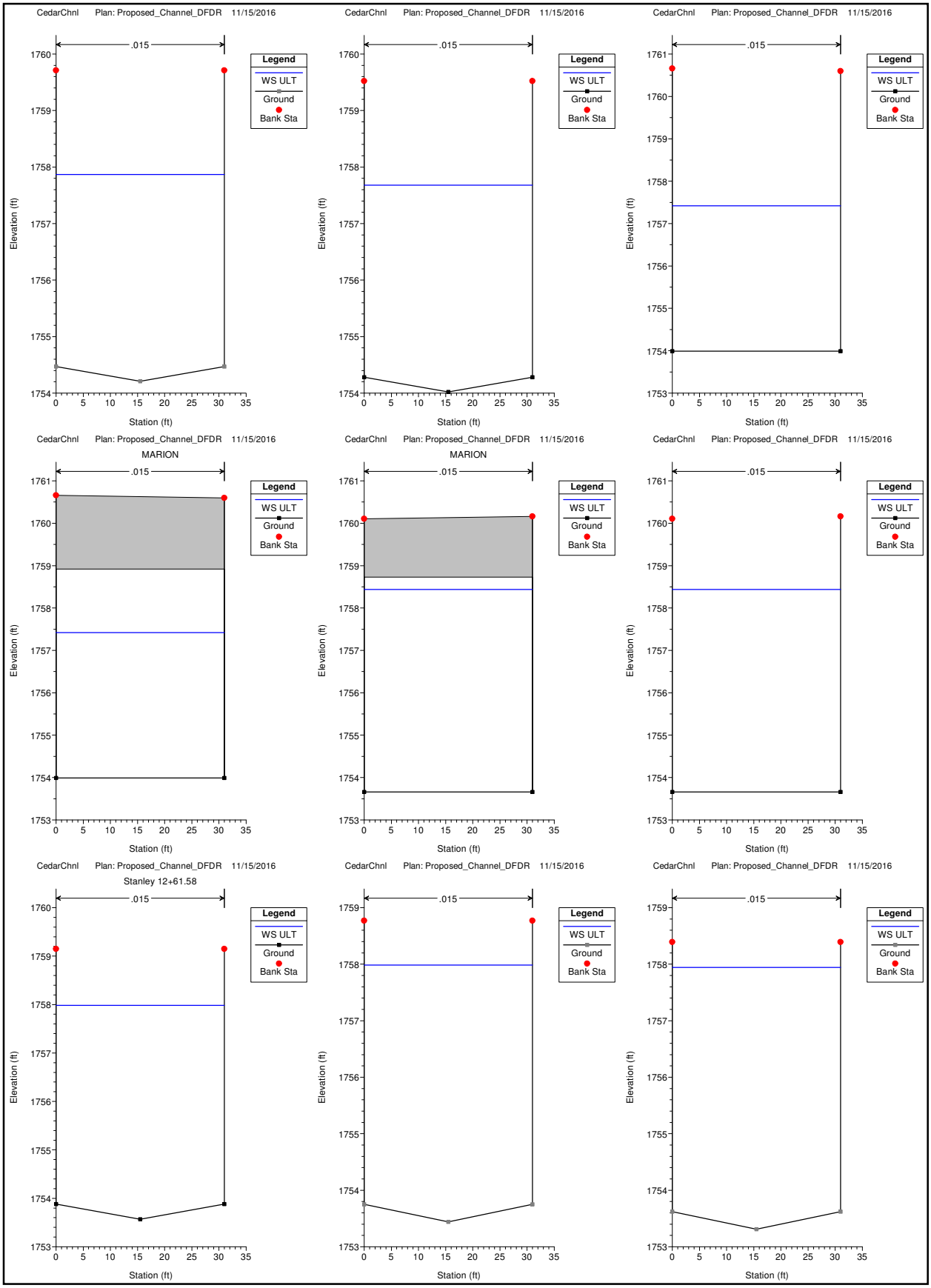

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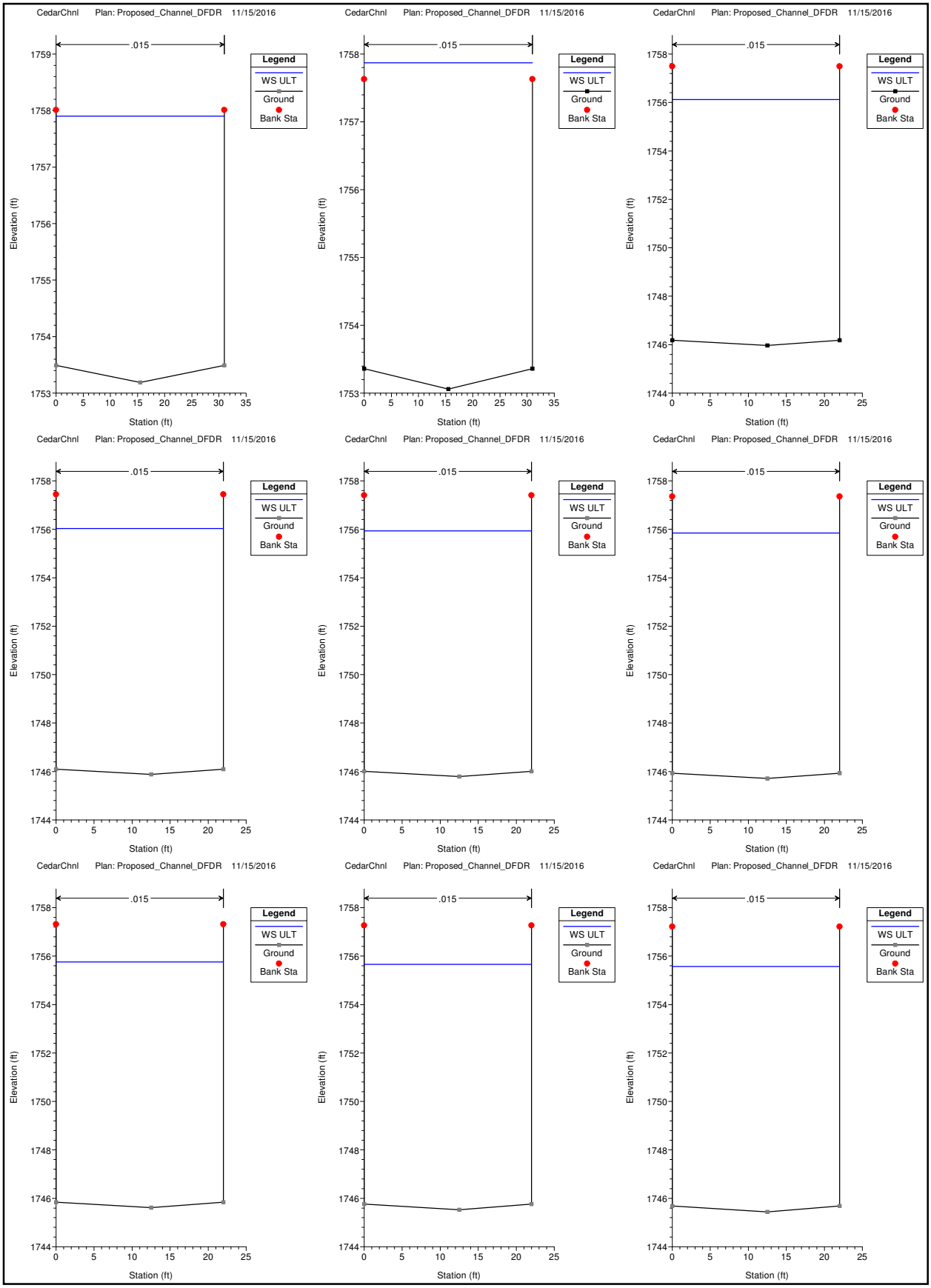

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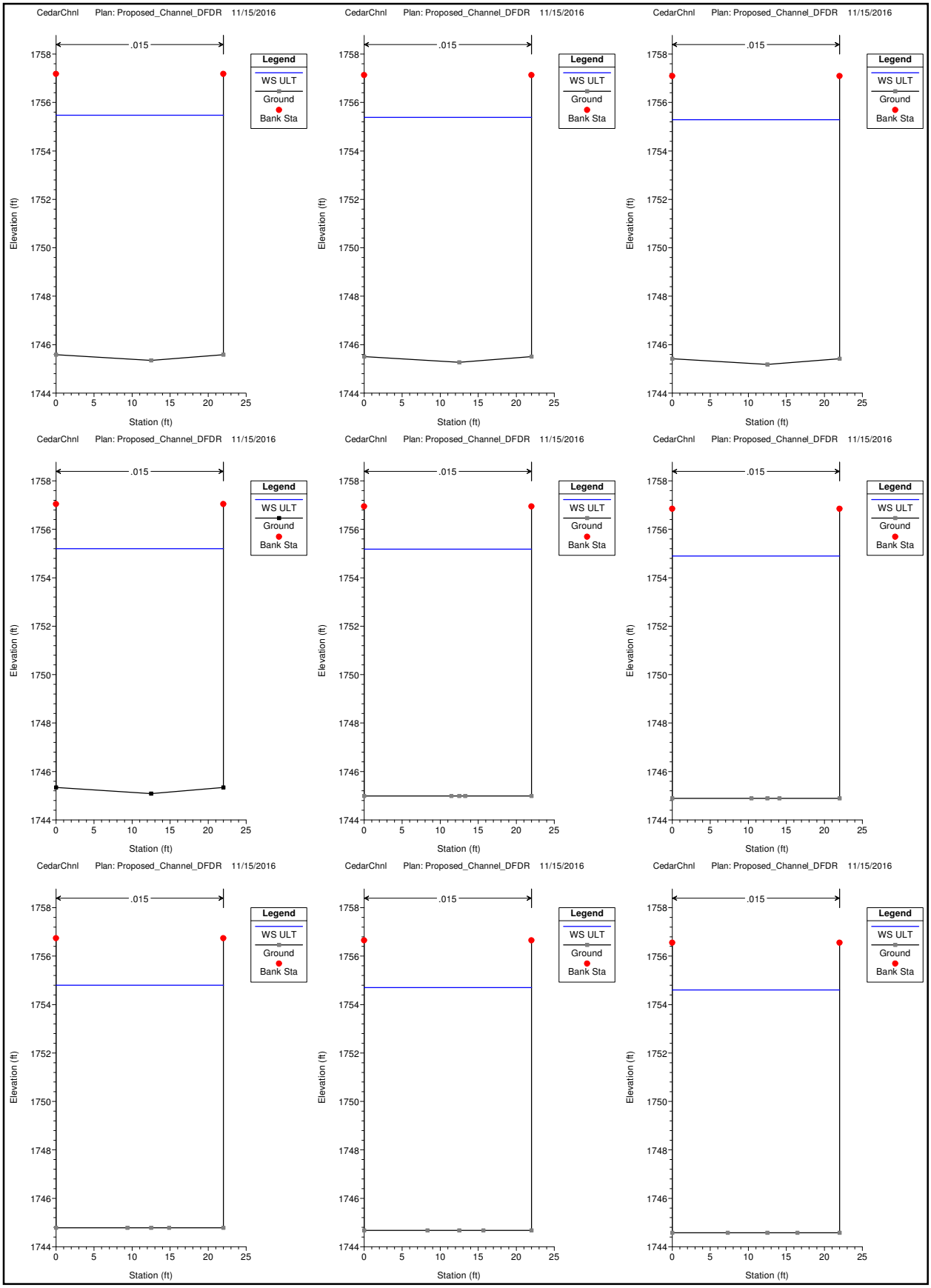

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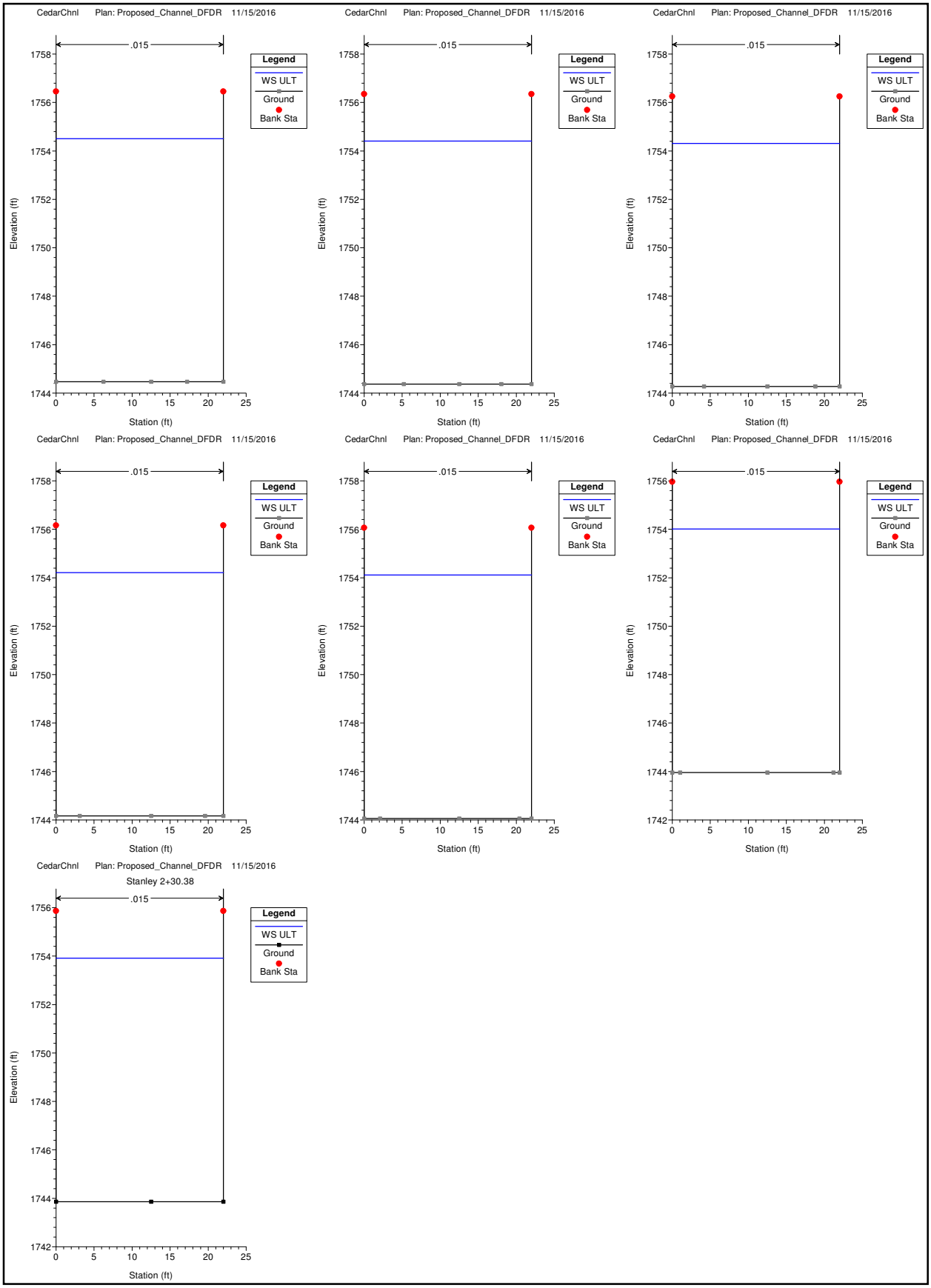

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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
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1744
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CedarChnl Plan: Proposed_Channel_DFDR 11/15/2016
Stanley 2+30.38
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Elevation (ft)
Station (ft)

Appendix C-3

Channel Freeboard Analysis

Channel Freeboard Analysis

Freeboard required is calculated by the following equation for supercritical flow regime (Equation 747 in HCDDM).

$$F_b = 1.0 + 0.025\, V\, (d)^{1/3}$$

Where F_b = Freeboard height (ft)

V = velocity (ft/s)

D = depth of flow (ft)

Freeboard required is calculated by the following equation for subcritical flow regime (Equation 741 in HCDDM).

$$F_b = 0.5 + V^2/2g$$

Where F_b = Freeboard height (ft)

V = velocity (ft/s)

g = acceleration of gravity (ft/s^2)

Super-elevation is calculated by the following equation (Equation 748 in HCDDM).

$$S_e = C\, V^2\, T_w / g\, r$$

Where S_e = super-elevation (ft)

C = 1.0 for all other Channel Section, with or without Spiral Transition Curves

V = velocity (ft/s)

T_w = Normal channel flow top width (ft)

r = channel centerline radius (ft)

g = acceleration of gravity (ft/s^2)

The maximum allowable super-elevation per HCDDM is 2 feet.

Super-elevation for subcritical flow is taken as 0.5 feet.

River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Elev w FB	TW Left	TW Right	Top of Wall (ft)		Min. Available	
30% Design Plans	EC-RAS Mod	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)		Supercritical flow	SubCritical flow	(Depth+Calc FB+super evev)				Left	Right		
3125.16	-3125.16	1085	1777.39	1783.68	1780.74	1784.15	0.000412	5.47	198.25	31.75	0.39	6.29	Sub	0.96	7.25			0.96	1784.64	1785.00	1786.90	1.32	3.22	1.32	Met
3265.93	-3265.93	1085	1776.52	1782	1782	1783.89	0.002501	11.03	98.34	26.37	1.01	5.48	Super	1.49	6.97			1.49	1783.49	1784.90	1785.10	2.90	3.10	2.90	Met
3315.10	-3315.10	1085	1776.26	1781.24	1781.76	1783.74	0.003656	12.68	85.56	24.85	1.2	4.98	Super	1.54	6.52			1.54	1782.78	1784.80	1785.00	3.56	3.76	3.56	Met
3364.30	-3364.30	1085	1775.99	1780.84	1781.49	1783.54	0.004065	13.18	82.31	24.45	1.27	4.85	Super	1.56	6.41			1.56	1782.40	1784.50	1785.00	3.66	4.16	3.66	Met
3413.50	-3413.50	1085	1775.73	1780.5	1781.23	1783.33	0.004337	13.5	80.38	24.21	1.31	4.77	Super	1.57	6.34			1.57	1782.07	1784.10	1785.80	3.60	5.30	3.60	Met
3462.70	-3462.70	1085	1775.47	1780.19	1780.97	1783.11	0.004521	13.7	79.17	24.06	1.33	4.72	Super	1.57	6.29			1.57	1781.76	1783.90	1785.70	3.71	5.51	3.71	Met
3511.90	-3511.90	1085	1775.2	1779.87	1780.7	1782.87	0.004703	13.9	78.03	23.91	1.36	4.67	Super	1.58	6.25			1.58	1781.45	1783.63	1785.43	3.76	5.56	3.76	Met
3561.10	-3561.10	1085	1774.94	1779.58	1780.44	1782.65	0.004854	14.07	77.14	23.8	1.38	4.64	Super	1.59	6.23			1.59	1781.17	1783.37	1785.17	3.79	5.59	3.79	Met
3610.30	-3610.30	1085	1774.68	1779.29	1780.18	1782.41	0.004959	14.18	76.54	23.72	1.39	4.61	Super	1.59	6.20			1.59	1780.88	1783.10	1784.90	3.81	5.61	3.81	Met
3659.50	-3659.50	1085	1774.42	1779.01	1779.92	1782.17	0.005034	14.25	76.13	23.67	1.4	4.59	Super	1.59	6.18			1.59	1780.60	1782.84	1784.64	3.83	5.63	3.83	Met
3708.70	-3708.70	1085	1774.15	1778.72	1779.65	1781.92	0.005141	14.36	75.54	23.59	1.41	4.57	Super	1.60	6.17			1.60	1780.32	1782.57	1784.37	3.85	5.65	3.85	Met
3757.94	-3757.94	1085	1773.89	1778.45	1779.39	1781.67	0.005176	14.4	75.35	23.57	1.42	4.56	Super	1.60	6.16			1.60	1780.05	1782.31	1784.11	3.86	5.66	3.86	Met
3807.80	-3807.80	1085	1773.64	1778.2	1779.14	1781.42	0.005176	14.4	75.36	23.57	1.42	4.56	Super	1.60	6.16			1.60	1779.80	1782.04	1783.84	3.84	5.64	3.84	Met
3857.60	-3857.60	1085	1773.38	1777.94	1778.88	1781.16	0.005167	14.39	75.4	23.58	1.42	4.56	Super	1.60	6.16			1.60	1779.54	1781.77	1783.57	3.83	5.63	3.83	Met
3907.50	-3907.50	1085	1773.13	1777.69	1778.63	1780.91	0.005167	14.39	75.4	23.58	1.42	4.56	Super	1.60	6.16			1.60	1779.29	1781.50	1783.30	3.81	5.61	3.81	Met
3957.30	-3957.30	1085	1772.88	1777.44	1778.38	1780.66	0.005167	14.39	75.4	23.58	1.42	4.56	Super	1.60	6.16			1.60	1779.04	1781.23	1783.03	3.79	5.59	3.79	Met
4007.10	-4007.10	1085	1772.63	1777.19	1778.13	1780.41	0.005167	14.39	75.4	23.58	1.42	4.56	Super	1.60	6.16			1.60	1778.79	1780.96	1782.76	3.77	5.57	3.77	Met
4056.98	-4056.98	1085	1772.37	1776.94	1777.87	1780.15	0.005167	14.39	75.4	23.58	1.42	4.57	Super	1.60	6.17			1.60	1778.54	1780.69	1782.49	3.75	5.55	3.75	Met
4085.50	-4085.50	1085	1772.49	1774.9	1776.37	1779.91	0.01285	17.97	60.38	25.14	2.04	2.41	Super	1.60	4.01			1.60	1776.50	1779.50	1779.50	4.60	4.60	4.60	Met
4086.95	-4086.95	Hololulu																							
4147.71	-4147.71	1085	1772.37	1775.16	1776.24	1778.92	0.008213	15.56	69.75	25	1.64	2.79	Super	1.55	4.34			1.55	1776.71	1779.40	1779.40	4.24	4.24	4.24	Met
4177.83	-4177.83	1173	1772.26	1776.27	1776.46	1778.54	0.003459	12.08	97.1	25	1.08	4.01	Super	1.48	5.49			1.48	1777.75	1779.79	1779.79	3.52	3.52	3.52	Met
4227.50	-4227.50	1173	1772.1	1776.21	1776.3	1778.36	0.003197	11.77	99.67	25	1.04	4.11	Super	1.47	5.58			1.47	1777.68	1779.57	1779.57	3.36	3.36	3.36	Met
4277.10	-4277.10	1173	1771.94	1776.05	1776.14	1778.2	0.003197	11.77	99.67	25	1.04	4.11	Super	1.47	5.58			1.47	1777.52	1779.62	1779.62	3.57	3.57	3.57	Met
4326.80	-4326.80	1173	1771.78	1775.89	1775.98	1778.04	0.003194	11.76	99.7	25	1.04	4.11	Super	1.47	5.58			1.47	1777.36	1779.46	1779.46	3.57	3.57	3.57	Met
4376.40	-4376.40	1173	1771.62	1775.73	1775.82	1777.88	0.003191	11.76	99.74	25	1.04	4.11	Super	1.47	5.58			1.47	1777.20	1779.29	1779.29	3.56	3.56	3.56	Met
4426.10	-4426.10	1173	1771.46	1775.58	1775.66	1777.72	0.003187	11.76	99.77	25	1.04	4.12	Super	1.47	5.59			1.47	1777.05	1779.13	1779.13	3.55	3.55	3.55	Met
4475.70	-4475.70	1173	1771.3	1775.42	1775.5	1777.56	0.003184	11.75	99.81	25	1.04	4.12	Super	1.47	5.59			1.47	1776.89	1778.97	1778.97	3.55	3.55	3.55	Met
4525.40	-4525.40	1173	1771.14	1775.26	1775.34	1777.4	0.003179	11.75	99.86	25	1.04	4.12	Super	1.47	5.59			1.47	1776.73	1778.81	1778.81	3.55	3.55	3.55	Met
4575.00	-4575.00	1173	1770.98	1775.1	1775.18	1777.24	0.003174	11.74	99.91	25	1.03	4.12	Super	1.47	5.59			1.47	1776.57	1778.64	1778.64	3.54	3.54	3.54	Met
4624.70	-4624.70	1173	1770.81	1774.95	1775.01	1777.07	0.003129	11.68	100.39	25	1.03	4.14	Super	1.47	5.61			1.47	1776.42	1778.48	1778.48	3.53	3.53	3.53	Met
4674.30	-4674.30	1173	1770.65	1774.79	1774.85	1776.91	0.003121	11.67	100.48	25	1.03	4.14	Super	1.47	5.61			1.47	1776.26	1778.32	1778.32	3.53	3.53	3.53	Met
4724.00	-4724.00	1173	1770.49	1774.64	1774.69	1776.75	0.003109	11.66	100.6	25	1.02	4.15	Super	1.47	5.62			1.47	1776.11	1778.16	1778.16	3.52	3.52	3.52	Met
4773.60	-4773.60	1173	1770.33	1774.48	1774.53	1776.59	0.003097	11.64	100.74	25	1.02	4.15	Super	1.47	5.62			1.47	1775.95	1777.99	1777.99	3.51	3.51	3.51	Met
4823.30	-4823.30	1173	1770.17	1774.33	1774.37	1776.43	0.003083	11.63	100.88	25	1.02	4.16	Super	1.47	5.63			1.47	1775.80	1777.83	1777.83	3.50	3.50	3.50	Met
4872.90	-4872.90	1173	1770.01	1774.18	1774.21	1776.27	0.003068	11.61	101.05	25	1.02	4.17	Super	1.47	5.64			1.47	1775.65	1777.67	1777.67	3.49	3.49	3.49	Met
4922.60	-4922.60	1173	1769.85	1774.02	1774.05	1776.11	0.003052	11.59	101.23	25	1.01	4.17	Super	1.47	5.64			1.47	1775.49	1777.51	1777.51	3.49	3.49	3.49	Met
4972.20	-4972.20	1173	1769.69	1773.87	1773.89	1775.95	0.003033	11.56	101.43	25	1.01	4.18	Super	1.47	5.65			1.47	1775.34	1777.35	1777.35	3.47	3.47	3.47	Met
5021.90	-5021.90	1173	1769.53	1773.72	1773.73	1775.79	0.003014	11.54	101.65	25	1.01	4.19	Super	1.47	5.66			1.47	1775.19	1777.18	1777.18	3.46	3.46	3.46	Met
5071.53	-5071.53	1173	1769.37	1773.49	1773.57	1775.63	0.003169	11.73	99.97	25	1.03	4.12	Super	1.47	5.59			1.47	1774.96	1777.02	1777.02	3.53	3.53	3.53	Met
5120.76	-5120.76	1173	1769.21	1774.49	1772.41	1775.08	0.000595	6.17	190.1	36	0.47	5.28	Sub	1.09	6.37			1.09	1775.58	1776.27	1776.27	1.78	1.78	1.78	Met
5122.00	-5122.00	Sandhill																							
5200.29	-5200.29	1210	1769.12	1773.67	1772.39	1774.52	0.001	7.41	163.37	35.97	0.61	4.55	Sub	1.35	5.90			1.35	1775.02	1774.74	1774.79	1.07	1.12	1.07	>1
5252.28	-5252.28	1210	1769.12	1773.19	1772.59	1774.36	0.001622	8.69	139.28	36	0.78	4.07	Sub	1.67	5.74			1.67	1774.86	1775.59	1776.13	2.40	2.94	2.40	Met
5301.00	-5301.00	1210	1769.06	1773.11	1772.5	1774.28	0.001622	8.68	139.34	36	0.78	4.05	Sub	1.67	5.72			1.67	1774.78	1775.53	1776.03	2.42	2.92	2.42	Met
5349.70	-5349.70	1210	1768.96	1773.05	1772.4	1774.2	0.001573	8.6	140.72	36	0.77	4.09	Sub	1.65	5.74			1.65	1774.70	1775.43	1775.93	2.38	2.88	2.38	Met
5398.40	-5398.40	1210	1768.86	1772.99	1772.3	1774.11	0.001523	8.51	142.2	36	0.75	4.13	Sub	1.62	5.75			1.62	1774.61	1775.34	1775.84	2.35	2.85	2.35	Met
5447.10	-5447.10	1210	1768.76	1772.94	1772.2	1774.03	0.001471	8.41	143.8	36	0.74	4.18	Sub	1.60	5.78			1.60	1774.54	1775.24	1775.74	2.30	2.80	2.30	Met
5495.80	-5495.80	1210	1768.66	1772.88	1772.1	1773.96	0.001418	8.32	145.52	36	0.73	4.22	Sub	1.57	5.79			1.57	1774.45	1775.14	1775.64	2.26	2.76	2.26	Met
5544.50	-5544.50	1210	1768.56	1772.83	1772	1773.88	0.001365	8.21	147.34	36	0.72	4.27	Sub	1.55	5.82			1.55	1774.38	1775.05	1775.55	2.22	2.72	2.22	Met
5593.30	-5593.30	1210	1768.46	1772.79	1771.9	1773.81	0.001311	8.11	149.28	36	0.7	4.33	Sub	1.52	5.85			1.52	1774.31	1774.95	1775.45	2.16	2.66	2.16	Met
5642.00	-5642.00	1210	1768.36	1772.74	1771.8	1773.74	0.001258	8	151.3	36	0.69	4.38	Sub	1.49	5.87			1.49	1774.23	1774.85	1775.35	2.11	2.61	2.11	Met
5690.70	-5690.70	1210	1768.26	1772.7	1771.7	1773.67	0.001205	7.89	153.43	36	0.67	4.44	Sub	1.47	5.91			1.47	1774.17	1774.77	1774.96	2.07	2.26	2.07	Met
5739.40	-5739.40	1210	1768.16	1772.66	1771.6	1773.6	0.001153	7.77	155.65	36	0.66	4.50	Sub	1.44	5.94			1.44	1774.10	1774.67	1774.86	2.01	2.20	2.01	Met
5788.10	-5788.10	1210	1768.06	1772.63	1771.51	1773.54	0.001102	7.66	157.96	36	0.64	4.57	Sub	1.41	5.98			1.41	1774.04	1774.58	1774.77	1.95	2.14	1.95	Met
5836.80	-5836.80	1210	1767.96	1772.56	1771.44	1773.48	0.001116	7.72	156.74	35.5	0.65	4.60	Sub	1.43	6.03			1.43	1773.99	1774.48	1774.67	1.92	2.11	1.92	Met
5885.50	-5885.50	1210	1767.86	1772.48	1771.37	1773.42	0.001132	7.79	155.41	35	0.65	4.62	Sub	1.44	6.06			1.44	1773.92	1774.38	1774.57	1.90	2.09	1.90	Met
5934.20	-5934.20	1210	1767.76	1772.4	1771.3	1773.36	0.001154	7.86	153.86	34.5	0.66	4.64	Sub	1.46	6.10			1.46	1773.86	1774.28	1774.47	1.88	2.07	1.88	Met
5982.90	-5982.90	1210	1767.66	1772.32	1771.23	1773.3	0.00118	7.95	152.18	34	0.66	4.66	Sub	1.48	6.14			1.48	1773.80	1774.19	1774.38	1.87	2.06	1.87	Met
6031.60	-6031.60	1210	1767.56	1772.23	1771.17	1773.23	0.001212	8.05	150.27	33.5	0.67	4.67	Sub	1.51	6.18			1.51	1773.74	1774.20	1773.95	1.97	1.72	1.72	Met
6080.40	-6080.40	1210	1767.46	1772.13	1771.1	1773.17	0.001249	8.16	148.24	33	0.68	4.67	Sub	1.53	6.20			1.53	1773.66	1774.11	1773.86	1.98	1.73	1.73	Met
6129.06	-6129.06	1236	1767.36	1771.91	1771.09	1773.09	0.001468	8.7	142	32.5	0.73	4.55	Sub	1.68	6.23			1.68	1773.59	1774.02	1773.80	2.11	1.89	1.89	Met
6178.80	-6178.80	1236	1767.26	1771.78	1771.02	1773.01	0.001552	8.9	138.89	32	0.75	4.52	Sub	1.73	6.25			1.73	1773.51	1773.92	1773.75	2.14	1.97	1.97	Met
6228.60	-6228.60	1236	1767.16	1771.63	1770.96	1772.93	0.001673	9.16	134.97	31.5	0.78	4.47	Sub	1.80	6.27			1.80	1773.43	1774.50	1773.70	2.87	2.07	2.07	Met
6278.30	-6278.30	1236	1767.06	1771.42	1770.9	1772.83	0.001871	9.54	129.58	31	0.82	4.36	Sub	1.91	6.27			1.91	1773.33	1774.45	1773.65	3.03	2.23	2.23	Met
6328.10	-6328.10	1236	1766.96	1771.33	1770.8	1772.74	0.00186	9.52	129.81	31	0.82	4.37	Sub	1.91	6.28			1.91	1773.24	1774.30	1773.50	2.97	2.17	2.17	Met
6377.90	-6377.90	1236	1766.86	1771.24	1770.7	1772.64	0.00185	9.5	130.06	31	0.82	4.38	Sub	1.90	6.28			1.90	1773.14	1774.15	1773.25	2.91	2.01	2.01	Met
6427.60	-6427.60	1236	1766.76	1771.14	1770.6	1772.54	0.001838	9.48	130.33	31	0.82	4.38	Sub	1.90	6.28			1.90	1773.04	1774.00	1773.40	2.86	2.26	2.26	Met
6477.40	-6477.40	1236	1766.66	1771.05	1770.5	1772.44	0.001826	9.46	130.61	31	0.81	4.39	Sub	1.89	6.28	0.18	0.50	2.39	1773.44	1774.01	1774.01	2.96	2.96	2.96	Met
6527.10	-6527.10	1236	1766.56	1770.96	1770.4	1772.35	0.001813	9.44	130.91	31	0.81	4.40	Sub	1.88	6.28	0.18	0.50	2.38	1773.34	1773.91	1773.91	2.95	2.95	2.95	Met
6576.90	-6576.90	1236	1766.46	1770.88	1770.3	1772.25	0.001795	9.41	131.35	31	0.81	4.42	Sub	1.87	6.29	0.18	0.50	2.37	1773.25	1773.81	1773.81	2.93	2.93	2.93	Met
6626.70	-6626.70	1236	1766.36	1770.79	1770.2	1772.16	0.001776	9.38	131.81	31	0.8	4.43	Sub	1.87	6.30	0.18	0.50	2.37	1773.16	1773.71	1773.71	2.92	2.92	2.92	Met
6676.40	-6676.40	1236	1766.26	1770.71	1770.1	1772.06	0.001755	9.34	132.32	31	0.8	4.45	Sub	1.85	6.30	0.17	0.50	2.35	1773.06	1773.61	1773.61	2.90	2.90	2.90	Met
6726.20	-6726.20	1236	1766.16	1770.63	1770	1771.97	0.001733	9.3	132.86	31	0.79	4.47	Sub	1.84	6.31	0.17	0.50	2.34	1772.97	1773.51	1773.51	2.88	2.88	2.88	Met
6775.90	-6775.90	1236	1766.06	1770.55	1769.9	1771.88	0.00171	9.26	133.45	31	0.79	4.49	Sub	1.83	6.32	0.17	0.50	2.33	1772.88	1773.41	1773.41	2.86	2.86	2.86	Met
6825.70	-6825.70	1236	1765.96	1770.47	1769.8	1771.79	0.001685	9.22	134.09	31	0.78	4.51	Sub	1.82	6.33	0.17	0.50	2.32	1772.79	1773.31	1773.31	2.84	2.84	2.84	Met
6875.50	-6875.50	1236	1765.86	1770.39	1769.7	1771.7	0.001656	9.16	134.88	31	0.77	4.53	Sub	1.80	6.33	0.17	0.50	2.30	1772.69	1773.21	1773.21	2.82	2.82	2.82	Met
6925.20	-6925.20	1236	1765.76	1770.32	1769.59	1771.6	0.001616	9.09	135.98	31	0.76	4.56	Sub	1.78	6.34	0.17	0.50	2.28	1772.60	1773.11	1773.11	2.79	2.79	2.79	Met
6975.00	-6975.00	1236	1765.65	1770.26	1769.49	1771.52	0.001567	9	137.34	31	0.75	4.61	Sub	1.76	6.37	0.16	0.50	2.26	1772.52	1773.01	1773.01	2.75	2.75	2.75	Met
7024.70	-7024.70	1236	1765.55	1770.2	1769.39	1771.44	0.001527	8.92	138.51	31	0.74	4.65	Sub	1.74	6.39	0.16	0.50	2.24	1772.44	1772.92	1772.92	2.72	2.72	2.72	Met
7074.50	-7074.50	1236	1765.45	1770.14	1769.29	1771.35	0.001486	8.84	139.77	31	0.73	4.69	Sub	1.71	6.40	0.16	0.50	2.21	1772.35	1772.82	1772.82	2.68	2.68	2.68	Met
7124.30	-7124.30	1236	1765.35	1770.08	1769.19	1771.27	0.001444	8.76	141.11	31	0.72	4.73	Sub	1.69	6.42	0.15	0.50	2.19	1772.27	1772.72	1772.72	2.64	2.64	2.64	Met
7174.00	-7174.00	1236	1765.25	1770.03	1769.09	1771.2	0.001401	8.67	142.53	31	0.71	4.78	Sub	1.67	6.45	0.15	0.50	2.17	1772.20	1772.62	1772.62	2.59	2.59	2.59	Met
7223.80	-7223.80	1236	1765.15	1769.98	1768.99	1771.12	0.001357	8.58	144.02	31	0.7	4.83	Sub	1.64	6.47	0.15	0.50	2.14	1772.12	1772.52	1772.52	2.54	2.54	2.54	Met

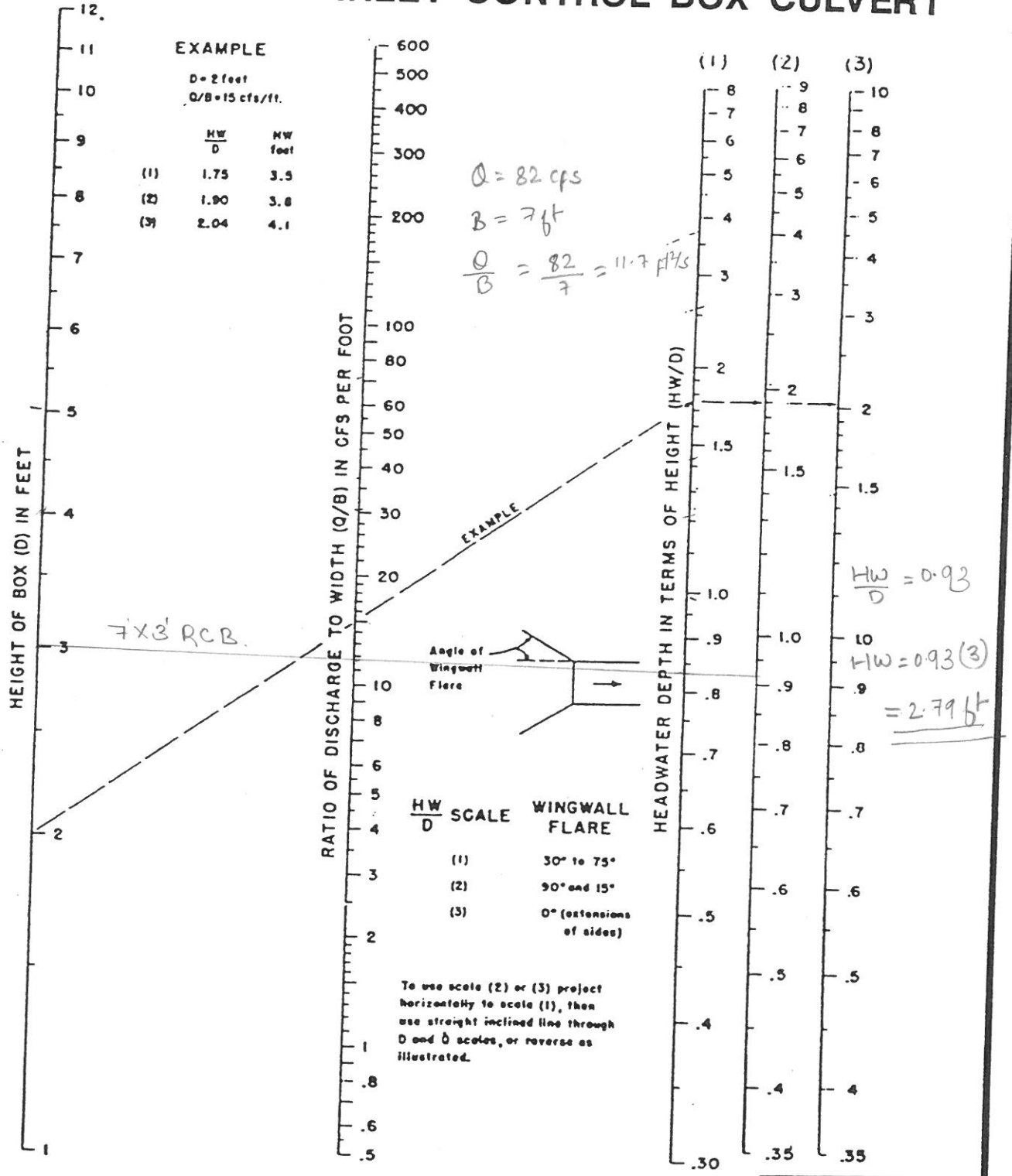
River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Elev w FB	TW Left	TW Right	Top of Wall (ft)		Min. Available	
30% Design Plans	EC-RAS Mod	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)		Supercritical flow	SubCritical flow	(Depth+Calc FB+super evev)				Left	Right		
7273.50	-7273.50	1236	1765.05	1769.93	1768.89	1771.05	0.001314	8.49	145.59	31	0.69	4.88	Sub	1.62	6.50	0.14	0.50	2.12	1772.05	1772.42	1772.42	2.49	2.49	2.49	Met
7323.30	-7323.30	1236	1764.95	1769.88	1768.79	1770.97	0.00127	8.39	147.24	31	0.68	4.93	Sub	1.59	6.52	0.14	0.50	2.09	1771.97	1772.32	1772.32	2.44	2.44	2.44	Met
7373.10	-7373.10	1236	1764.85	1769.84	1768.69	1770.9	0.001226	8.3	148.96	31	0.67	4.99	Sub	1.57	6.56	0.14	0.50	2.07	1771.91	1772.22	1772.22	2.38	2.38	2.38	Met
7422.80	-7422.80	1236	1764.75	1769.79	1768.59	1770.84	0.001183	8.2	150.75	31	0.66	5.04	Sub	1.54	6.58	0.13	0.50	2.04	1771.83	1772.12	1772.12	2.33	2.33	2.33	Met
7472.60	-7472.60	1236	1764.65	1769.75	1768.49	1770.77	0.00114	8.1	152.6	31	0.64	5.10	Sub	1.52	6.62	0.13	0.50	2.02	1771.77	1772.02	1772.02	2.27	2.27	2.27	Met
7522.30	-7522.30	1236	1764.55	1769.72	1768.39	1770.71	0.001098	8	154.52	31	0.63	5.17	Sub	1.49	6.66	0.13	0.50	1.99	1771.71	1771.92	1771.92	2.20	2.20	2.20	Met
7572.10	-7572.10	1236	1764.45	1769.68	1768.29	1770.65	0.001057	7.9	156.5	31	0.62	5.23	Sub	1.47	6.70	0.13	0.50	1.97	1771.65	1771.82	1771.82	2.14	2.14	2.14	Met
7621.90	-7621.90	1236	1764.35	1769.64	1768.19	1770.59	0.001016	7.8	158.54	31	0.61	5.29	Sub	1.44	6.73	0.12	0.50	1.94	1771.58	1771.80	1771.80	2.16	2.16	2.16	Met
7671.60	-7671.60	1236	1764.25	1769.61	1768.09	1770.53	0.000977	7.69	160.64	31	0.6	5.36	Sub	1.42	6.78	0.12	0.50	1.92	1771.53	1771.80	1771.80	2.19	2.19	2.19	Met
7721.38	-7721.38	1236	1764.15	1769.58	1767.99	1770.48	0.000939	7.59	162.78	31	0.58	5.43	Sub	1.39	6.82			1.39	1770.97	1771.52	1771.52	1.94	1.94	1.94	Met
7763.06	-7763.06	1236	1764.11	1769.6	1767.77	1770.42	0.000833	7.27	170.1	31	0.55	5.49	Sub	1.32	6.81			1.32	1770.92	1771.60	1771.60	2.00	2.00	2.00	Met
7764.27	-7764.27	Lamb																							
7865.78	-7865.78	1310	1763.9	1769.44	1767.7	1770.35	0.000907	7.62	171.87	31	0.57	5.54	Sub	1.40	6.94			1.40	1770.84	1771.48	1771.48	2.04	2.04	2.04	Met
7895.45	-7895.45	1310	1763.81	1767.96	1767.96	1769.97	0.002856	11.37	115.2	29	1.01	4.15	Super	1.46	5.61			1.46	1769.42	1770.23	1770.85	2.27	2.89	2.27	Met
7944.00	-7944.00	1310	1763.62	1767.64	1767.77	1769.79	0.003172	11.77	111.3	29	1.06	4.02	Super	1.47	5.49			1.47	1769.11	1769.90	1770.65	2.26	3.01	2.26	Met
7992.50	-7992.50	1310	1763.43	1767.24	1767.58	1769.65	0.003774	12.46	105.16	29	1.15	3.81	Super	1.49	5.30			1.49	1768.73	1769.71	1770.46	2.47	3.22	2.47	Met
8041.10	-8041.10	1310	1763.23	1766.99	1767.38	1769.46	0.003911	12.6	103.93	29	1.17	3.76	Super	1.49	5.25			1.49	1768.48	1769.52	1770.27	2.53	3.28	2.53	Met
8089.61	-8089.61	1310	1763.04	1766.81	1767.19	1769.27	0.0039	12.59	104.03	29	1.17	3.77	Super	1.49	5.26			1.49	1768.30	1769.32	1770.07	2.51	3.26	2.51	Met
8186.69	-8186.69	1310	1762.66	1766.31	1766.77	1768.87	0.004164	12.85	101.96	29	1.21	3.65	Super	1.49	5.14			1.49	1767.80	1768.93	1769.68	2.62	3.37	2.62	Met
8235.20	-8235.20	1310	1762.47	1766.13	1766.57	1768.67	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1767.62	1768.74	1769.49	2.61	3.36	2.61	Met
8283.80	-8283.80	1310	1762.28	1765.94	1766.38	1768.48	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1767.43	1768.55	1769.30	2.61	3.36	2.61	Met
8332.30	-8332.30	1310	1762.09	1765.75	1766.19	1768.29	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1767.24	1768.35	1769.10	2.60	3.35	2.60	Met
8380.90	-8380.90	1310	1761.9	1765.56	1766.01	1768.1	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1767.05	1768.16	1768.91	2.60	3.35	2.60	Met
8429.40	-8429.40	1310	1761.71	1765.37	1765.81	1767.91	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1766.86	1767.96	1768.71	2.59	3.34	2.59	Met
8477.90	-8477.90	1310	1761.52	1765.18	1765.63	1767.72	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1766.67	1767.77	1768.52	2.59	3.34	2.59	Met
8526.50	-8526.50	1310	1761.33	1764.99	1765.43	1767.53	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1766.48	1767.57	1768.32	2.58	3.33	2.58	Met
8575.00	-8575.00	1310	1761.14	1764.8	1765.25	1767.34	0.004103	12.79	102.45	29	1.2	3.66	Super	1.49	5.15			1.49	1766.29	1767.38	1768.13	2.58	3.33	2.58	Met
8623.60	-8623.60	1310	1760.95	1764.34	1764.97	1767.13	0.004863	13.39	97.85	30	1.31	3.39	Super	1.50	4.89			1.50	1765.84	1767.19	1767.94	2.85	3.60	2.85	Met
8672.10	-8672.10	1310	1760.76	1763.99	1764.69	1766.88	0.005299	13.64	96.07	31	1.37	3.23	Super	1.50	4.73			1.50	1765.49	1766.99	1767.74	3.00	3.75	3.00	Met
8720.60	-8720.60	1310	1760.57	1763.87	1764.5	1766.63	0.004918	13.31	98.4	31	1.32	3.30	Super	1.50	4.80			1.50	1765.37	1766.80	1767.55	2.93	3.68	2.93	Met
8769.20	-8769.20	1310	1760.38	1763.74	1764.31	1766.4	0.004666	13.09	100.08	31	1.28	3.36	Super	1.49	4.85			1.49	1765.23	1766.60	1767.35	2.86	3.61	2.86	Met
8817.70	-8817.70	1310	1760.19	1763.6	1764.12	1766.18	0.004465	12.9	101.51	31	1.26	3.41	Super	1.49	4.90			1.49	1765.09	1766.41	1767.16	2.81	3.56	2.81	Met
8866.30	-8866.30	1310	1760	1763.44	1763.93	1765.97	0.004311	12.76	102.67	31	1.24	3.44	Super	1.48	4.92			1.48	1764.92	1766.22	1766.97	2.78	3.53	2.78	Met
8914.80	-8914.80	1310	1759.81	1763.28	1763.74	1765.77	0.004199	12.65	103.55	31	1.22	3.47	Super	1.48	4.95			1.48	1764.76	1766.02	1766.77	2.74	3.49	2.74	Met
8963.30	-8963.30	1310	1759.62	1763.11	1763.55	1765.57	0.004122	12.58	104.17	31	1.21	3.49	Super	1.48	4.97			1.48	1764.59	1765.83	1766.58	2.72	3.47	2.72	Met
9011.90	-9011.90	1310	1759.43	1762.94	1763.36	1765.37	0.004068	12.52	104.62	31	1.2	3.51	Super	1.48	4.99			1.48	1764.42	1765.63	1766.38	2.69	3.44	2.69	Met
9060.40	-9060.40	1310	1759.24	1762.75	1763.17	1765.18	0.004068	12.52	104.61	31	1.2	3.51	Super	1.48	4.99			1.48	1764.23	1765.44	1766.19	2.69	3.44	2.69	Met
9108.95	-9108.95	1310	1759.05	1762.56	1762.98	1764.99	0.004068	12.52	104.61	31	1.2	3.51	Super	1.48	4.99			1.48	1764.04	1765.27	1766.09	2.71	3.53	2.71	Met
9139.50	-9139.50	1310	1758.84	1761.92	1762.64	1764.84	0.005446	13.72	95.51	31	1.38	3.08	Super	1.50	4.58			1.50	1763.42	1765.38	1765.38	3.46	3.46	3.46	Met
9140.49	-9140.49	Page																							
9202.94	-9202.94	1310	1758.68	1762.03	1762.48	1764.5	0.004214	12.63	103.73	31	1.22	3.35	Super	1.47	4.82			1.47	1763.50	1765.14	1765.14	3.11	3.11	3.11	Met
9232.57	-9232.57	1359	1758.49	1762.51	1762.53	1764.48	0.002818	11.26	120.7	31	1.01	4.02	Super	1.45	5.47			1.45	1763.96	1765.32	1766.82	2.81	4.31	2.81	Met
9281.50	-9281.50	1359	1758.31	1762.09	1762.35	1764.33	0.003443	12.02	113.08	31	1.11	3.78	Super	1.47	5.25			1.47	1763.56	1765.21	1766.71	3.12	4.62	3.12	Met
9330.50	-9330.50	1359	1758.13	1761.86	1762.16	1764.16	0.00359	12.18	111.56	31	1.13	3.73	Super	1.47	5.20			1.47	1763.33	1765.03	1766.53	3.17	4.67	3.17	Met
9379.40	-9379.40	1359	1757.95	1761.69	1761.97	1763.98	0.003566	12.16	111.8	31	1.13	3.74	Super	1.47	5.21			1.47	1763.16	1764.85	1766.35	3.16	4.66	3.16	Met
9428.40	-9428.40	1359	1757.78	1761.52	1761.81	1763.81	0.003566	12.16	111.8	31	1.13	3.74	Super	1.47	5.21			1.47	1762.99	1764.67	1766.17	3.15	4.65	3.15	Met
9477.32	-9477.32	1359	1757.6	1761.34	1761.62	1763.63	0.003549	12.14	111.97	31	1.13	3.74	Super	1.47	5.21			1.47	1762.81	1764.49	1765.99	3.15	4.65	3.15	Met
9526.30	-9526.30	1359	1757.43	1761.17	1761.46	1763.46	0.003549	12.14	111.98	31	1.13	3.74	Super	1.47	5.21			1.47	1762.64	1764.31	1765.81	3.14	4.64	3.14	Met
9575.20	-9575.20	1359	1757.26	1761	1761.28	1763.29	0.003549	12.14	111.97	31	1.13	3.74	Super	1.47	5.21			1.47	1762.47	1764.13	1765.63	3.13	4.63	3.13	Met
9624.20	-9624.20	1359	1757.08	1760.83	1761.11	1763.11	0.00353	12.12	112.17	31	1.12	3.75	Super	1.47	5.22			1.47	1762.30	1764.10	1765.45	3.27	4.62	3.27	Met
9673.10	-9673.10	1359	1756.91	1760.66	1760.93	1762.94	0.00353	12.12	112.17	31	1.12	3.75	Super	1.47	5.22			1.47	1762.13	1764.07	1765.27	3.41	4.61	3.41	Met
9722.10	-9722.10	1359	1756.74	1760.49	1760.77	1762.77	0.00353	12.12	112.17	31	1.12	3.75	Super	1.47	5.22			1.47	1761.96	1764.04	1765.09	3.55	4.60	3.55	Met
9771.00	-9771.00	1359	1756.57	1760.32	1760.59	1762.6	0.00353	12.12	112.17	31	1.12	3.75	Super	1.47	5.22			1.47	1761.79	1764.02	1764.92	3.70	4.60	3.70	Met
9820.00	-9820.00	1359	1756.4	1760.15	1760.43	1762.43	0.00353	12.12	112.17	31	1.12	3.75	Super	1.47	5.22			1.47	1761.62	1763.99	1764.74	3.84	4.59	3.84	Met
9868.90	-9868.90	1359	1756.22	1759.98	1760.24	1762.25	0.003509	12.09	112.39	31	1.12	3.76	Super	1.47	5.23			1.47	1761.45	1763.81	1764.56	3.83	4.58	3.83	Met
9917.90	-9917.90	1359	1756.05	1759.81	1760.08	1762.08	0.003509	12.09	112.39	31	1.12	3.76	Super	1.47	5.23			1.47	1761.28	1763.63	1764.38	3.82	4.57	3.82	Met
9966.82	-9966.82	1359	1755.88	1759.64	1759.9	1761.91	0.003509	12.09	112.39	31	1.12	3.76	Super	1.47	5.23			1.47	1761.11	1763.45	1764.20	3.81	4.56	3.81	Met
10015.00	-10015.00	1359	1755.71	1759.47	1759.74	1761.74	0.003509	12.09	112.39	31	1.12	3.76	Super	1.47	5.23			1.47	1760.94	1763.27	1764.02	3.80	4.55	3.80	Met
10064.90	-10064.90	1359	1755.53	1759.29	1759.57	1761.57	0.003513	12.1	112.33	31	1.12	3.76	Super	1.47	5.23			1.47	1760.76	1763.09	1763.84	3.80	4.55	3.80	Met
10113.00	-10113.00	1359	1755.34	1759.05	1759.37	1761.39	0.003676	12.28	110.68	31	1.15	3.71	Super	1.48	5.19			1.48	1760.53	1762.91	1763.66	3.86	4.61	3.86	Met
10162.00	-10162.00	1359	1755.15	1758.84	1759.18	1761.21	0.003732	12.34	110.14	31	1.15	3.69	Super	1.48	5.17			1.48	1760.32	1762.73	1763.48	3.89	4.64	3.89	Met
10211.00	-10211.00	1359	1754.96	1758.63	1759	1761.02	0.003794	12.4	109.56	31	1.16	3.67	Super	1.48	5.15			1.48	1760.11	1762.55	1763.30	3.92	4.67	3.92	Met
10260.00	-10260.00	1359	1754.78	1758.45	1758.81	1760.84	0.003778	12.39	109.71	31	1.16	3.67	Super	1.48	5.15			1.48	1759.93	1762.37	1763.12	3.92	4.67	3.92	Met
10309.00	-10309.00	1359	1754.59	1758.24	1758.61	1760.65	0.00384	12.45	109.15	31	1.17	3.65	Super	1.48	5.13			1.48	1759.72	1762.19	1762.94	3.95	4.70	3.95	Met
10358.00	-10358.00	1359	1754.4	1758.05	1758.43	1760.46	0.003828	12.44	109.26	31	1.17	3.65	Super	1.48	5.13			1.48	1759.53	1762.01	1762.76	3.96	4.71	3.96	Met
10407.00	-10407.00	1359	1754.21	1757.87	1758.23	1760.27	0.00382	12.43	109.33	31	1.17	3.66	Super	1.48	5.14			1.48	1759.35	1761.95	1762.70	4.08	4.83	4.08	Met
10456.30	-10456.30	1359	1754.02	1757.68	1758.05	1760.08	0.003811	12.42	109.42	31	1.17	3.66	Super	1.48	5.14			1.48	1759.16	1761.77	1762.52	4.09	4.84	4.09	Met
10485.60	-10485.60	1359	1753.99	1757.42	1757.89	1759.96	0.004209	12.79	106.26	31	1.22	3.43	Super	1.48	4.91			1.48	1758.90	1760.63	1760.63	3.21	3.21	3.21	Met
10486.10	-10486.10	Marion																							
10568.10	-10568.10	1359	1753.66	1758.44	1757.57	1759.74	0.001527	9.18	148.06	31	0.74	4.78	Sub	1.81	6.59			1.81	1760.25	1760.13	1760.13	1.69	1.69	1.69	>1
10598.40	-10598.40	1410	1753.57	1757.98	1757.73	1759.76	0.002305	10.68	132	31	0.91	4.41	Sub	2.27	6.68			2.27	1760.25	1761.51	1761.51	3.53	3.53	3.53	Met
10641.00	-10641.00	1410	1753.44	1757.98	1757.59	1759.65	0.002102	10.36	136.06	31	0.87	4.54	Sub	2.17	6.71			2.17	1760.15	1762.61	1762.61	4.63	4.63	4.63	Met
10683.00	-10683.00	1410	1753.31	1757.94	1757.46	1759.55	0.001978	10.16	138.82	31	0.85	4.63	Sub	2.10	6.73			2.10	1760.04	1762.72	1762.72	4.77	4.77	4.77	Met
10726.00	-10726.00	1410	1753.19	1757.9	1757.33	1759.45	0.00187	9.97	141.42	31	0.82	4.71	Sub	2.04	6.75			2.04	1759.94	1762.66	1762.66	4.76	4.76	4.76	Met
10768.40	-10768.40	1410	1753.06	1757.87	1757.2	1759.35	0.001755	9.76	144.43	31	0.8	4.81	Sub	1.98	6.79			1.98	1759.85	1762.77	1762.77	4.90	4.90	4.90	Met
10973.40	-10973.40	2924	1745.97	1756.12	1754.26	1758.84	0.001942	13.23	220.99	22	0.74	10.15	Sub	3.22	13.37			3.22	1759.34	1762.88	1762.88	6.76	6.76	6.76	Met
11019.00	-11019.00	2924	1745.88	1756.03	1754.17	1758.75	0.001945	13.24	220.83	22	0.74	10.15	Sub	3.22	13.37			3.22	1759.25	1763.25	1763.25	7.22	7.22	7.22	Met
11065.00	-11065.00	2924	1745.79	1755.94	1754.08	1758.66	0.001945	13.24	220.85	22	0.74	10.15	Sub	3.22	13.37			3.22	1759.16	1763.13	1763.13	7.19	7.19	7.19	Met
11111.00	-11111.00	2924	1745.71	1755.84	1754	1758.57	0.001953	13.26	220.51	22	0.74	10.13	Sub	3.23	13.36			3.23	1759.07	1762.82	1762.82	6.98	6.98	6.98	Met
11156.00	-11156.00	2924	1745.62	1755.75	1753.92	1758.48	0.001953	13.26	220.52	22	0.74	10.13	Sub	3.23	13.36			3.23	1758.98	1762.64	1762.64	6.89	6.89	6.89	Met
11202.00	-11202.00	2924	1745.53	1755.66	1753.83	1758.4	0.001956	13.27	220.35	22	0.74	10.13	Sub	3.23	13.36			3.23	1758.89	1762.46	1762.46	6.80	6.80	6.80	Met
11248.00	-11248.00	2924	1745.44	1755.57	1753.74	1758.31	0.00196	13.28	220.18	22	0.74	10.13	Sub	3.24	13.37			3.24	1758.81	1762.28	1762.28	6.71	6.71	6.71	Met
11294.00	-11294.00	2924	1745.35	1755.48	1753.65	1758.22	0.00196	13.28	220.18	22	0.74	10.13	Sub	3.24	13.37			3.24	1758.72	1762.10	1762.10	6.62	6.62	6.62	Met
11340.00	-11340.00	2924	1745.27	1755.38	1753.57	1758.13	0.001968	13.3	219.82	22	0.74	10.11	Sub	3.25	13.36			3.25	1758.63	1761.92	1761.92	6.54	6.54	6.54	Met

River Sta	River Sta	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl	DEPTH	Type of Flow	Calculated FB	Depth+ Calculated FB	Super Elevation		Required Freeboard	Elev w FB	TW Left	TW Right	Top of Wall (ft)		Min. Available	
30% Design Plans	EC-RAS Mod	(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)		(ft)		(ft)		Supercritical flow	SubCritical flow	(Depth+Calc FB+super evev)				Left	Right		
11386.00	-11386.00	2924	1745.18	1755.29	1753.48	1758.04	0.001969	13.3	219.81	22	0.74	10.11	Sub	3.25	13.36			3.25	1758.54	1761.74	1761.74	6.45	6.45	6.45	Met
11431.90	-11431.90	2924	1745.09	1755.2	1753.39	1757.95	0.001973	13.31	219.62	22	0.74	10.11	Sub	3.25	13.36			3.25	1758.45	1761.56	1761.56	6.36	6.36	6.36	Met
11481.00	-11481.00	2924	1744.99	1755.18	1753.15	1757.82	0.001881	13.04	224.18	22	0.72	10.19	Sub	3.14	13.33			3.14	1758.32	1761.38	1761.38	6.20	6.20	6.20	Met
11531.00	-11531.00	2961	1744.89	1754.9	1753.14	1757.71	0.002024	13.45	220.22	22	0.75	10.01	Sub	3.31	13.32			3.31	1758.21	1761.19	1761.19	6.29	6.29	6.29	Met
11580.00	-11580.00	2961	1744.78	1754.8	1753.03	1757.6	0.002017	13.43	220.5	22	0.75	10.02	Sub	3.30	13.32			3.30	1758.10	1761.00	1761.00	6.20	6.20	6.20	Met
11630.00	-11630.00	2961	1744.68	1754.7	1752.93	1757.5	0.002017	13.43	220.5	22	0.75	10.02	Sub	3.30	13.32			3.30	1758.00	1760.90	1760.90	6.20	6.20	6.20	Met
11679.00	-11679.00	2961	1744.58	1754.6	1752.83	1757.4	0.002017	13.43	220.5	22	0.75	10.02	Sub	3.30	13.32			3.30	1757.90	1760.80	1760.80	6.20	6.20	6.20	Met
11729.00	-11729.00	2961	1744.47	1754.51	1752.72	1757.3	0.00201	13.41	220.79	22	0.75	10.04	Sub	3.29	13.33			3.29	1757.80	1760.71	1760.71	6.20	6.20	6.20	Met
11778.00	-11778.00	2961	1744.37	1754.41	1752.62	1757.2	0.002009	13.41	220.8	22	0.75	10.04	Sub	3.29	13.33			3.29	1757.70	1760.61	1760.61	6.20	6.20	6.20	Met
11828.00	-11828.00	2961	1744.27	1754.31	1752.52	1757.1	0.002009	13.41	220.81	22	0.75	10.04	Sub	3.29	13.33			3.29	1757.60	1760.51	1760.51	6.20	6.20	6.20	Met
11878.00	-11878.00	2961	1744.17	1754.21	1752.42	1757	0.002009	13.41	220.81	22	0.75	10.04	Sub	3.29	13.33			3.29	1757.50	1760.41	1760.41	6.20	6.20	6.20	Met
11927.00	-11927.00	2961	1744.06	1754.11	1752.31	1756.9	0.002002	13.39	221.11	22	0.74	10.05	Sub	3.28	13.33			3.28	1757.39	1760.31	1760.31	6.20	6.20	6.20	Met
11977.00	-11977.00	2961	1743.96	1754.01	1752.21	1756.8	0.002001	13.39	221.14	22	0.74	10.05	Sub	3.28	13.33			3.28	1757.29	1760.21	1760.21	6.20	6.20	6.20	Met
12026.70	-12026.70	2961	1743.86	1753.91	1752.11	1756.7	0.002001	13.39	221.15	22	0.74	10.05	Sub	3.28	13.33			3.28	1757.19	1760.08	1760.08	6.17	6.17	6.17	Met

Appendix C-4

Drop Inlets Calculation

NOMOGRAPH – INLET CONTROL BOX CULVERT

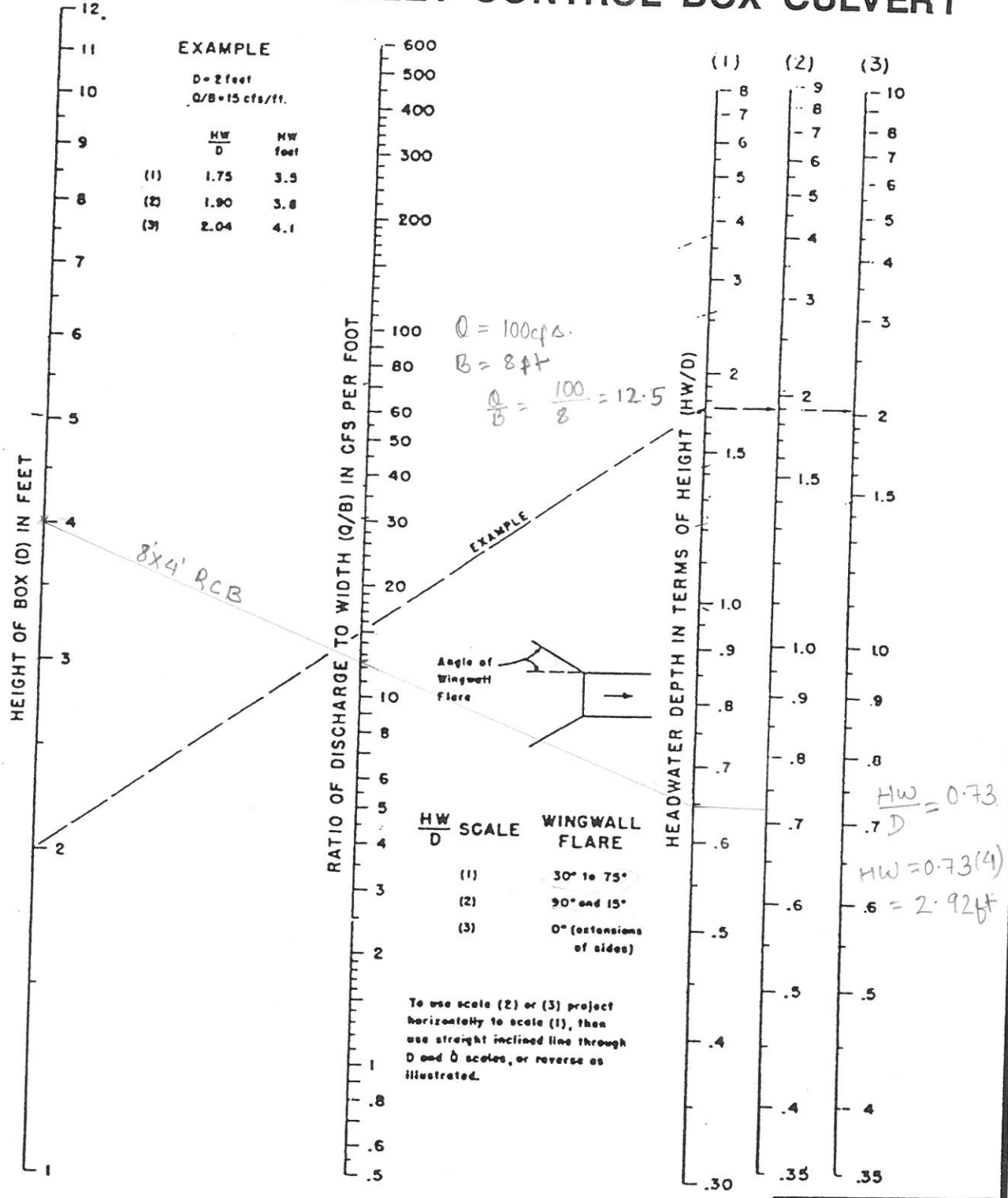


Revision	Date

Stewart Avenue Dropinlet 3 and 4

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS No.5, 1985	FIGURE 1004

NOMOGRAPH – INLET CONTROL BOX CULVERT

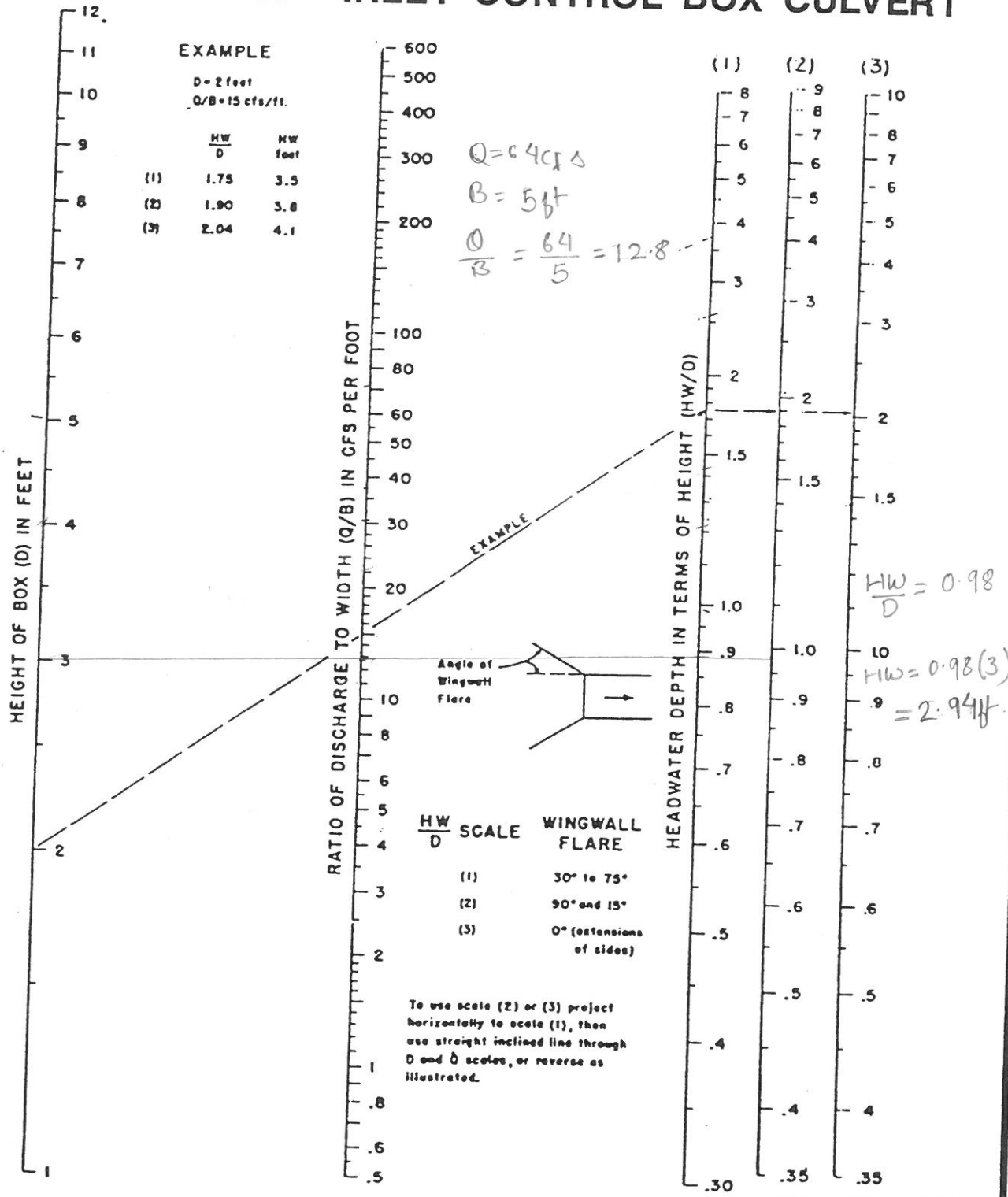


Stewart Avenue – Drop Inlets 1 and 2

Revision	Date

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS No.5, 1985	FIGURE 1004

NOMOGRAPH – INLET CONTROL BOX CULVERT



Revision	Date

Stewart Avenue Drop Inlet 5

WRC ENGINEERING	REFERENCE: USDOT, FHWA, HDS No.5, 1985	FIGURE 1004

CEDAR AVENUE CHANNEL DROP INLET SUMMARY

DI #	General Location	Type	Slope / Sump	Qstr	Q Source	Qint	Qbyp
1	South side of Stewart Ave	C: 15' Gr: 1.5' x 12.5'	1.00%	363.0	Half of (CCA05-1 minus 19 cfs in the existing 24" RCP)	100.6	262.4
2	North side of Stewart Ave	C: 15' Gr: 1.5' x 17.5'	1.00%	363.0	Half of (CCA05-1 minus 19 cfs in the existing 24" RCP)	100.6	262.4
3	South side of Stewart Ave	C: 15' Gr: 1.5' x 12.5'	1.00%	262.4	Bypass of DI #1	82.1	180.2
4	North side of Stewart Ave	C: 15' Gr: 1.5' x 12.5'	1.00%	262.4	Bypass of DI #2	82.1	180.2
5	North side of Stewart Ave	C: 15' Gr: 1.5' x 12.5'	1.00%	180.2	Bypass of DI #3	64.7	115.5

GEOTECHNICAL DATA REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

DRAFT

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 10, 2015
Project No. 303710001

April 10, 2015
Project No. 303710001

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074-7755

Subject: Geotechnical Data Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith are the data results of Ninyo & Moore's geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide our findings. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

DRAFT

Naik Banavathu, P.E.
Principal Engineer

Brad L. Olsen, PE
Principal Engineer

NB/BLO/dh

Distribution: (1) Addressee (via e-mail)

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1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment. This report presents the findings of our subsurface exploration, results of our background review and laboratory testing.

This study was performed concurrently with a hydrogeologic study, also performed by Ninyo & Moore. A report presenting the results of our hydrogeologic study will be submitted under separate cover.

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. This evaluation included preparation of a geotechnical interpretive report. Data from this report, including two exploratory borings (B-108 and B-109) that were performed along Pecos Road approximately between Stewart Avenue and Bonanza Road, were used to the extent possible for this evaluation.

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2. SCOPE OF SERVICES

The scope of our services included the following:

- Review of pertinent background data listed in the References section of this report. The data reviewed included drawings, in-house geotechnical and soils data, aerial photographs, and published soils and geologic maps and literature.
- Coordination and mobilization for subsurface exploration. Markout of existing utilities in areas of our exploratory borings was conducted through Underground Service Alert (USA).
- Drilling, logging, and sampling of 20 exploratory borings, which were advanced to depths ranging from approximately 10 to 25 feet. The borings were performed to evaluate subsurface conditions along the proposed alignment and to obtain soil samples for laboratory testing.

- Performance of laboratory tests on selected soil samples obtained from the exploratory borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts).
- Compilation and analysis of accumulated data.
- Preparation of this data report presenting results of our background review, subsurface exploration and laboratory testing.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

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4. GENERAL ALIGNMENT CONDITIONS

The proposed alignment will extend along portions of Pecos Road and existing Cedar Avenue Channel ROW. At the time of our geotechnical reconnaissance, Pecos Road extended in a north-to-south direction and was generally bordered by residential properties to the east and a golf course to the west. The existing concrete-lined trapezoidal channel extended in an east-to-west

direction and was generally bordered by residential properties to the north and south. An elementary school was located to the south of the channel near the Lamb Boulevard crossing and north of the channel near Page Street crossing. Chain-link fencing and concrete block screen walls were located on the north and south sides of the channel.

The existing channel was up to approximately 30 feet wide and up to approximately 10 feet deep. An asphalt-concrete paved trail, up to approximately 15 feet wide, was located to the north of the existing channel. The existing trail is at an elevation of approximately 1,792 feet above mean sea level (AMSL) near Pecos Road and at an elevation of approximately 1,760 feet AMSL near Las Vegas Wash. Water, several inches deep, was observed flowing in the channel bottom. The existing channel crosses under numerous streets, including Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive. At the time of our geotechnical reconnaissance, all these streets were paved with asphalt concrete and extended in a north-south direction. All these streets in the vicinity of the project alignment were fully improved with curb, gutter, and sidewalks. Honolulu Street and Page Street included one lane each way, Marion Drive and Sandhill Road included one lane each way with a turn lane, and Lamb Boulevard included three lanes each way with a two-way left turn lane

Indications of underground utilities observed in the vicinity of the alignment included gas, water, storm drain, and electric lines. Other underground utilities may be present in the vicinity of the project.

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5. GEOLOGY

Based on our field observations, subsurface exploration, and review of referenced geologic and soils data, the project alignment is underlain primarily by relatively shallow fill, which is in turn underlain by Quaternary-age alluvium (native soil). Ninyo & Moore's findings regarding the geologic setting, potential geologic hazards and problematic soils, and ground motions are provided in the following sections.

5.1. Geologic Setting

The project alignment is located in the eastern portion of Las Vegas Valley, which lies in the southwestern portion of the Great Basin, within the Basin and Range physiographic province. Las Vegas Valley is a naturally formed structural basin as a result of block faulting, a fundamental characteristic of the Basin and Range physiographic province.

Las Vegas Valley extends in a northwest-southeast direction and drains generally toward the southeast through Las Vegas Wash into Lake Mead. Bordering the alluvium-filled valley are relatively steep mountain ranges, including the Spring Mountains to the west; the Desert, Sheep, and Las Vegas ranges to the north; the McCullough Range to the south; and Sunrise Mountain, Frenchman Mountain, and River Mountains to the east.

Las Vegas Valley is underlain at depth by Proterozoic-age igneous and metamorphic basement rock, which is overlain by thick layers of Paleozoic- and Mesozoic-age sedimentary rock, and Tertiary-age volcanic rock. The lower lying areas of Las Vegas Valley generally contain relatively fine-grained alluvial, aeolian, and playa deposits. Extending outward into the valley from the bordering mountain fronts, are sloping alluvial aprons, or fans, comprised primarily of poorly sorted gravel and sand deposits with cobbles and boulders. The soils are up to approximately 5,000 feet thick in some areas of the valley.

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5.2. Potential Geologic Hazards and Problematic Soils

Ninyo & Moore's geotechnical study included an evaluation of the possible presence of geologic hazards, such as faults and ground fissures, in the project alignment area. This evaluation included visual observation of the alignment for indications of adverse geologic features and review of published geologic and soils maps and literature, and other data listed in the References section of this report. Referenced geologic data were also reviewed to evaluate seismic activity levels, and associated potential earthquake hazards, for faults in the alignment vicinity. It should be noted that the fault seismic activity levels provided in this section were obtained/interpreted primarily from United States Geological Survey (USGS, 2015b) data.

Review of referenced geologic data indicates that the nearest active fault (i.e., a fault that has experienced ground surface rupture within the past 11,000 years) to the alignment is the Black Hills fault. The Frenchman Mountain fault and the Eglington fault, which are considered potentially active (i.e., faults that have experienced ground surface rupture within the past 1.6 million years) are also located in the alignment vicinity. The distances from the alignment to these active and potentially active faults are provided in Table 1.

Review of referenced geologic data also indicates that an unnamed Las Vegas Valley fault extends through the western portion of the alignment (Figure 2). Referenced USGS data indicate that this fault is of uncertain origin and that its seismic activity level has not been established. During our geologic field reconnaissance along the project alignment, surficial indications of previous faulting were not observed. The origin of this geologic feature, and other similar features in southern Nevada, which have been previously referred to as "compaction faults." Differing proposed origins for these faults include:

- Differential consolidation or compaction over time of the thick alluvial and lakebed sediments in valley areas.
- Tectonic factors associated with faults that may extend into the basement bedrock beneath the valley sediment.
- A combination of differential consolidation and tectonic factors.

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Table 1 – Faults in Project Alignment Vicinity

Fault Name	Seismic Activity Level *	Approximate Distance From Project Alignment to Fault (miles)
Black Hills fault	Active	16
Eglington fault	Potentially Active	8
Frenchman Mountain fault	Potentially Active	3
Unnamed Las Vegas Valley fault	Not Established	Extends through alignment (see Figure 2)
*From United States Geological Survey (USGS, 2015b) data.		

Ground fissures, generally believed to be caused by erosion and differential stress resulting from regional subsidence due primarily to withdrawal of groundwater, are known to occur near faults in southern Nevada. Review of the referenced geologic data does not indicate the

presence of ground fissures along the project alignment and no ground fissures were observed during our field activities. However, it should be noted that the ground surface had been disturbed/obscured by previous development.

As part of this study, Ninyo & Moore evaluated whether the project alignment is located in a Special Geotechnical Considerations Area, as shown on the referenced Clark County Soil Guidelines Map (Clark County Building Department, 1998). This map indicates important aspects of near-surface soils and geologic features in the Las Vegas Valley. Review of the Clark County Soil Guidelines Map indicates that the portion of the project alignment between Stewart Avenue and Sandhill Road is located in a *Special Geotechnical Considerations Area - Subsidence and 2,000-Foot Compaction or Seismic Fault Buffer Zone*. This buffer zone is considered to contain 90 percent of mapped ground fissures. These potential ground fissure areas extend approximately 1,000 feet to each side of faults. The portion of the project alignment between Sandhill Road and Marion Drive is located in a *Special Geotechnical Considerations Area - Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*: This area is indicative of potentially moisture-sensitive and corrosive soils. The portion of the alignment located between Marion Drive and Las Vegas Wash is located in a *Special Geotechnical Considerations Area - Potential Drainage Areas or Recent Sediment Deposits, which may also have Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*. This area is in the vicinity of major drainages and may also contain potentially moisture-sensitive and corrosive soils.

The Clark County Expansive Soil Guidelines Map (Clark County Development Services Department, 2006) indicates general trends of near-surface soils in the Las Vegas Valley. This map shows areas of the valley where previous geotechnical studies have indicated the presence of moderately, highly, and critically expansive soils. Based on review of this map, the portion of the project alignment between Stewart Avenue and Honolulu Street is located in an area prone to moderately expansive soil and the remaining portion of the alignment is located in an area prone to highly expansive soil.

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5.3. Ground Motions

Using the referenced United States Geological Survey database (USGS, 2015a), estimated maximum considered earthquake spectral response accelerations for short (0.2 second) and long (1.0 second) periods were obtained for the project alignment, which is located at approximately 36.1699 degrees north latitude and -115.0891 degrees west longitude. Based on the referenced International Building Code (ICC, 2012) and due to a detailed seismic site class evaluation not being performed for the project, Seismic Site Class D is appropriate for the project alignment and the parameters in the following table are characteristic of the project alignment for design purposes.

Table 2 – Seismic Design Parameters

Parameters	Value		Reference (ICC, 2012)
	Short Period	Long Period	
Mapped Maximum Considered Earthquake Spectral Response Acceleration, S_S and S_1	0.495g	0.164g	Figure 1613.3.1 and referenced database (USGS, 2015a)
Site Coefficient, F_a and F_v	1.40	2.14	Table 1613.3.3
Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Class Effects, S_{MS} and S_{M1}	0.695g	0.352g	Equations 16-37 and 16-38
Design Spectral Response Acceleration, S_{DS} and S_{D1}	0.463g	0.235g	Equations 16-39 and 16-40

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6. FIELD EXPLORATION, LABORATORY TESTING, AND SUBSURFACE CONDITIONS

Ninyo & Moore's subsurface exploration along the project alignment was performed from March 5 through March 16, 2015. This exploration consisted of drilling, logging, and sampling of 20 small-diameter exploratory borings. The borings were advanced to depths ranging from approximately 10 to 25 feet with a truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The purpose of the borings was to evaluate subsurface conditions along the project alignment, as well as to collect bulk and relatively undisturbed soil samples for laboratory testing. The approximate locations of the borings along with the pertinent borings from the other study previously discussed are shown on Figure 2.

Laboratory tests were performed on representative soil samples collected from the borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts). The results of the in-place moisture content and dry density tests are provided on the boring logs in Appendix A. Ground surface elevations at boring locations surveyed by Atkins personnel are also provided on the boring logs. Descriptions of the laboratory testing procedures utilized and the other test results are presented in Appendix B and Appendix C.

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6.1. Subsurface Soils Encountered

Generalized descriptions of the subsurface soils (fill and native soil) encountered in the exploratory borings are provided in the following sections.

6.1.1. Fill

Fill material, up to approximately 1.8 feet deep, was encountered in our exploratory borings. In addition, fill material approximately 7.0 feet deep was encountered in boring B-17. The encountered fill soils were comprised primarily of medium dense to dense, silty gravel with sand. A dense, clayey sand with gravel layer was also encountered in boring B-17. Much of the fill encountered in our borings was likely associated with channel sidewall backfill and/or roadway fill material.

Asphalt concrete pavement and underlying aggregate base material was penetrated in all of our 20 borings drilled during our subsurface evaluation for the subject project. The approximate thicknesses of asphalt concrete and underlying aggregate base material encountered in these borings are summarized in the following table.

Table 3 – Existing Asphalt Concrete Pavement and Aggregate Base Thicknesses

Boring	Approximate Thickness of Asphalt Concrete (inches)	Approximate Thickness of Aggregate Base Material (inches)
B-1	9-1/8	12 to 13
B-2	2	3-1/2
B-3	2	4-1/2
B-4	2-1/2	5-1/2
B-5	1-1/2	5-1/2
B-6	1-7/8	5
B-7	2-1/2	4
B-8	2-1/2	4
B-9	2-3/4	4
B-10	2-1/2	5-1/2
B-11	3	4
B-12	2-7/8	5-1/2
B-13	2-3/4	4-1/2
B-14	2-5/8	4-3/4
B-15	2-1/2	11
B-16	2-1/2	12 to 13
B-17	2-5/8	12 to 13
B-18	3-1/2	12 to 13
B-19	3	12 to 13
B-20	3-1/4	8-1/2
B-108*	8-3/4	5
B-109*	8-1/4	7
* Boring from previous evaluation		

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6.1.2. Native Soil

Native soil was encountered beneath the noted fill and extended to the total depths of our exploratory borings. The encountered native soil consisted primarily of firm to very stiff lean clay and fat clay with varying amounts of sand and gravel. An approximately 5-foot thick layer of stiff to very stiff silt with sand was encountered at a depth of approximately 12 and 15 feet in borings B-19 and B-20, respectively.

Layers of hard to very hard, strongly cemented soil (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Caliche is a naturally occurring cemented soil with rock-like characteristics. The following describes typical properties of caliche encountered in southern Nevada.

- Generally occurs in layers a few inches to several feet thick.

- Layers typically vary significantly in thickness, degree of cementation, and hardness over relatively short distances.
- Varies in composition from primarily fine-grained material to primarily coarse-grained material.
- Moderately hard, moderately cemented caliche can generally be gouged with a knife with difficulty and broken with a few hammer blows.
- Hard and very hard, strongly cemented caliche is difficult to scratch with a knife and breaks with difficulty with repeated hammer blows.
- Impedes earthwork operations, including grading and utility line trenching. Rock excavation methods are generally needed.

Laboratory tests were performed on representative samples of native soil obtained from the exploratory borings. Results of these tests are summarized in the following table.

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Table 4 – Summary of Laboratory Test Results

Test Type	Test Results	Remarks
Atterberg Limits Liquid Limit Plastic Limit Plasticity Index	 24 to 64 16 to 32 7 to 42	Low to high plasticity
Expansion Index	41 to 140	Low to very high
Sodium Sulfate Content	0.03 to 0.70 percent	Negligible to moderate chemical heave (salt heave) potential
Sodium Content	0.03 to 0.42 percent	--
Sulfate Content	0.02 to 0.47 percent	Negligibly to severely deleterious to concrete
Total Salts (Solubility)	0.15 to 1.86 percent	Low to high solubility potential

6.2. Selected and Granular Backfill Suitability

As a part of this study, Ninyo & Moore evaluated the suitability of encountered soils for use as trench backfill material. Clark County gradation and plasticity requirements (Clark County, 2003) for Selected and Granular Backfill (USSPWC Sections 207.02.01 and 207.02.02, respectively), along with the results of gradation and Atterberg limits tests performed by Ninyo & Moore, are presented in the following table.

Table 5 – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-1 5.0-6.5	B-3 2.0-3.5	B-5 2.0-3.5	B-6 5.0-6.5	B-9 5.0-6.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	82	100	100	100
No. 16	--	25-100	100	73	100	100	100
No. 200	--	5-15	86.1	61.6	88.8	84.3	93.8
Plasticity Index	15 max	15 max.	42	34	31	23	17
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

Table 5 (continued) – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-12 5.0-6.5	B-14 5.0-6.5	B-17 5.0-6.5	B-18 10.0-11.5	B-20 15.0-16.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	100	58	99	100
No. 16	--	25-100	98	100	41	99	100
No. 200	--	5-15	95.0	96.6	19.0	82.3	81.8
Plasticity Index	15 max	15 max.	8	12	14	7	20
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

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6.3. Groundwater

Groundwater was encountered in 12 of our 20 exploratory borings. Borings B-1, B-2, B-6, and B-20 were converted to temporary monitoring wells for the hydrogeologic study. The approximate depths to groundwater levels measured in the exploratory borings are presented in the following table. Depths to groundwater are also included on the boring logs in Appendix A.

Table 6 – Measured Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Approximate Time Measured After Drilling (days)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)
B-1	1,795.4	3	12.2	1,783.2
B-2	1,791.6	4	12.7	1,778.9
B-3	1,783.9	1	8.2	1,775.7
B-4	1,781.9	1	8.4	1,773.5
B-5	1,779.6	4	6.9	1,772.7
B-6	1,778.2	4	8.4	1,769.8
B-10	1,772.5	4	13.6	1,758.9
B-16	1,764.1	4	13.6	1,750.5
B-17	1,761.7	4	15.4	1,746.3
B-18	1,762.3	1	18.4	1,743.9
B-19	1,761.7	3	18.7	1,743.0
B-20	1760.5	3	18.4	1,742.1

*Measured from top of ground surface (top of channel bank) adjacent to boring.

Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this study.

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7. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical data report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the findings presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that

our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for data purposes only. It does not provide sufficient data to prepare an accurate bid by some contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

If geotechnical conditions different from those described in this report are encountered, our office should be notified. It should be understood that the conditions along the project alignments could change with time as a result of natural processes or the activities of man along the subject alignments or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings of this report by parties other than the client is undertaken at said parties' sole risk.

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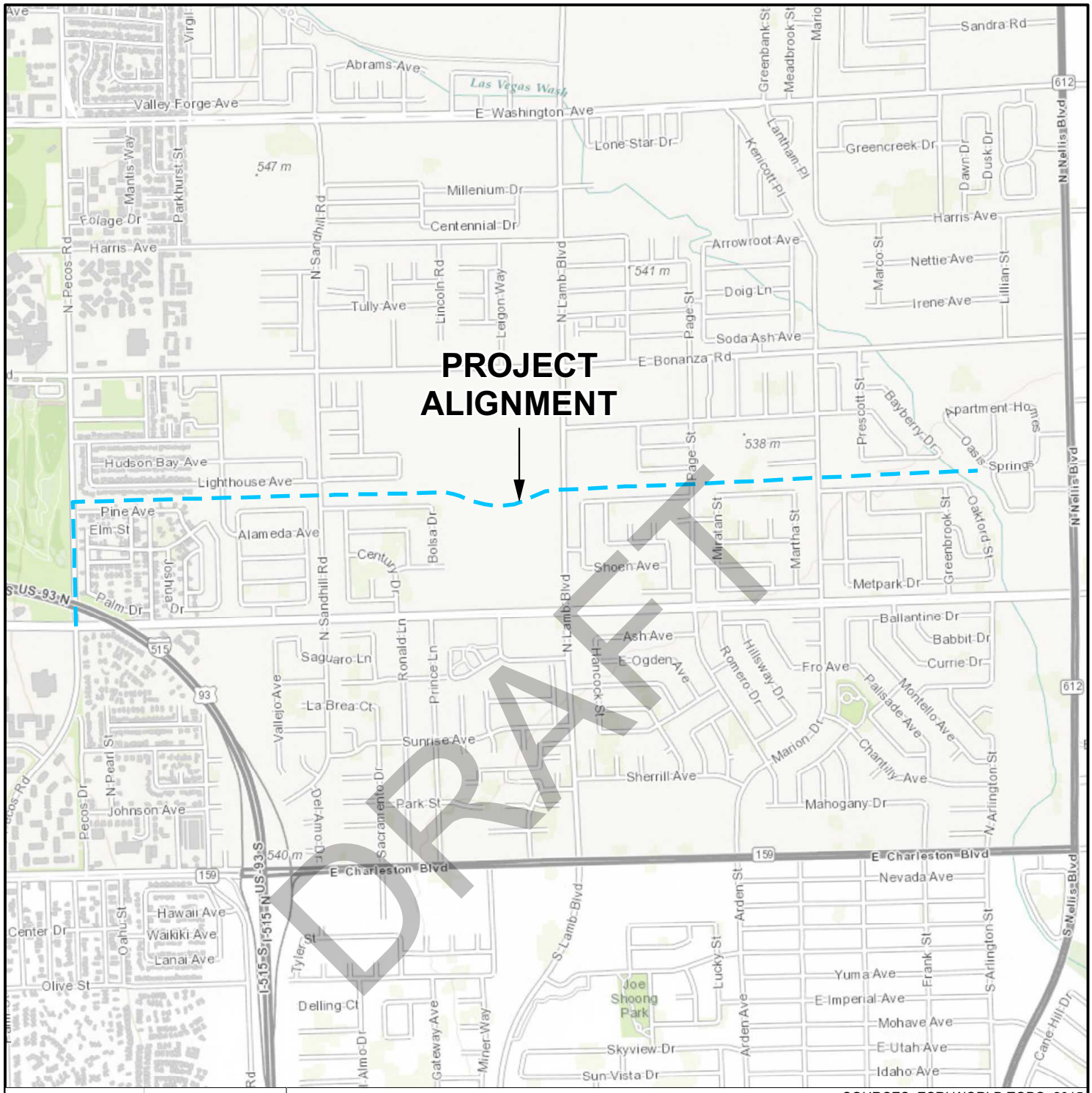
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SOURCES: ESRI WORLD TOPO, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710001_SL.mxd 4/7/2015 3:32:13 PM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2
303710001	4/15		

2_303710001_BL.mxd 4/10/2015 JDL

GEOTECHNICAL INTERPRETIVE REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

DRAFT

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 10, 2015
Project No. 303710001

April 10, 2015
Project No. 303710001

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074-7755

Subject: Geotechnical Interpretive Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith is the Geotechnical Interpretive Report, which is based on the results of Ninyo & Moore's geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide design and construction recommendations regarding geotechnical aspects of the project. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

DRAFT

Naik Banavathu, P.E.
Principal Engineer

Brad L. Olsen, PE
Principal Engineer

NB/BLO/dh

Distribution: (1) Addressee (via e-mail)

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Appendix B – Laboratory Testing
Appendix C – Chemical Test Results
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1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed a geotechnical evaluation for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purposes of our geotechnical study were to evaluate the subsurface soil conditions along the subject alignment and to provide design and construction recommendations regarding geotechnical aspects of the project. This report presents the findings of our subsurface exploration, results of our laboratory testing, conclusions regarding the subsurface soil conditions along the alignment, and geotechnical recommendations for the design and construction of this project.

This study was performed concurrently with a hydrogeologic study, also performed by Ninyo & Moore. A report presenting the results of our hydrogeologic study will be submitted under separate cover.

Ninyo & Moore is currently performing a geotechnical evaluation for the City of Las Vegas Bonanza-Mojave Reuse Pipeline project, which includes a pipeline alignment extending from the City of Las Vegas Water Pollution Control Facility to Freedom Park in Las Vegas, Nevada. This evaluation included preparation of a geotechnical interpretive report. Data from this report, including two exploratory borings (B-108 and B-109) that were performed along Pecos Road approximately between Stewart Avenue and Bonanza Road, were used to the extent possible for this evaluation.

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2. SCOPE OF SERVICES

The scope of our services included the following:

- Review of pertinent background data listed in the References section of this report. The data reviewed included drawings, in-house geotechnical and soils data, aerial photographs, and published soils and geologic maps and literature.
- Coordination and mobilization for subsurface exploration. Markout of existing utilities in areas of our exploratory borings was conducted through Underground Service Alert (USA).

- Drilling, logging, and sampling of 20 exploratory borings, which were advanced to depths ranging from approximately 10 to 25 feet. The borings were performed to evaluate subsurface conditions along the proposed alignment and to obtain soil samples for laboratory testing.

- Performance of laboratory tests on selected soil samples obtained from the exploratory borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts).

- Compilation and analysis of accumulated data.

- Preparation of this geotechnical interpretive report presenting our findings, conclusions, and recommendations regarding the subject project.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

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4. GENERAL ALIGNMENT CONDITIONS

The proposed alignment will extend along portions of Pecos Road and existing Cedar Avenue Channel ROW. At the time of our geotechnical reconnaissance, Pecos Road extended in a north-to-south direction and was generally bordered by residential properties to the east and a golf course to the west. The existing concrete-lined trapezoidal channel extended in an east-to-west direction and was generally bordered by residential properties to the north and south. An elementary school was located to the south of the channel near the Lamb Boulevard crossing and north of the channel near Page Street crossing. Chain-link fencing and concrete block screen walls were located on the north and south sides of the channel.

The existing channel was up to approximately 30 feet wide and up to approximately 10 feet deep. An asphalt-concrete paved trail, up to approximately 15 feet wide, was located to the north of the existing channel. The existing trail is at an elevation of approximately 1,792 feet above mean sea level (AMSL) near Pecos Road and at an elevation of approximately 1,760 feet AMSL near Las Vegas Wash. Water, several inches deep, was observed flowing in the channel bottom. The existing channel crosses under numerous streets, including Honolulu Street, Sandhill Road, Lamb Boulevard, Page Street, and Marion Drive. At the time of our geotechnical reconnaissance, all these streets were paved with asphalt concrete and extended in a north-south direction. All these streets in the vicinity of the project alignment were fully improved with curb, gutter, and sidewalks. Honolulu Street and Page Street included one lane each way, Marion Drive and Sandhill Road included one lane each way with a turn lane, and Lamb Boulevard included three lanes each way with a two-way left turn lane

Indications of underground utilities observed in the vicinity of the alignment included gas, water, storm drain, and electric lines. Other underground utilities may be present in the vicinity of the project.

5. GEOLOGY

Based on our field observations, subsurface exploration, and review of referenced geologic and soils data, the project alignment is underlain primarily by relatively shallow fill, which is in turn

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underlain by Quaternary-age alluvium (native soil). Ninyo & Moore's findings regarding the geologic setting, potential geologic hazards and problematic soils, and ground motions are provided in the following sections.

5.1. Geologic Setting

The project alignment is located in the eastern portion of Las Vegas Valley, which lies in the southwestern portion of the Great Basin, within the Basin and Range physiographic province. Las Vegas Valley is a naturally formed structural basin as a result of block faulting, a fundamental characteristic of the Basin and Range physiographic province.

Las Vegas Valley extends in a northwest-southeast direction and drains generally toward the southeast through Las Vegas Wash into Lake Mead. Bordering the alluvium-filled valley are relatively steep mountain ranges, including the Spring Mountains to the west; the Desert, Sheep, and Las Vegas ranges to the north; the McCullough Range to the south; and Sunrise Mountain, Frenchman Mountain, and River Mountains to the east.

Las Vegas Valley is underlain at depth by Proterozoic-age igneous and metamorphic basement rock, which is overlain by thick layers of Paleozoic- and Mesozoic-age sedimentary rock, and Tertiary-age volcanic rock. The lower lying areas of Las Vegas Valley generally contain relatively fine-grained alluvial, aeolian, and playa deposits. Extending outward into the valley from the bordering mountain fronts, are sloping alluvial aprons, or fans, comprised primarily of poorly sorted gravel and sand deposits with cobbles and boulders. The soils are up to approximately 5,000 feet thick in some areas of the valley.

5.2. Potential Geologic Hazards and Problematic Soils

Ninyo & Moore's geotechnical study included an evaluation of the possible presence of geologic hazards, such as faults and ground fissures, in the project alignment area. This evaluation included visual observation of the alignment for indications of adverse geologic features and review of published geologic and soils maps and literature, and other data listed in the References section of this report. Referenced geologic data were also reviewed to evaluate seismic activity levels, and

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associated potential earthquake hazards, for faults in the alignment vicinity. It should be noted that the fault seismic activity levels provided in this section were obtained/interpreted primarily from United States Geological Survey (USGS, 2015b) data.

Review of referenced geologic data indicates that the nearest active fault (i.e., a fault that has experienced ground surface rupture within the past 11,000 years) to the alignment is the Black Hills fault. The Frenchman Mountain fault and the Eglington fault, which are considered potentially active (i.e., faults that have experienced ground surface rupture within the past 1.6 million years) are also located in the alignment vicinity. The distances from the alignment to these active and potentially active faults are provided in Table 1.

Review of referenced geologic data also indicates that an unnamed Las Vegas Valley fault extends through the western portion of the alignment (Figure 2). Referenced USGS data indicate that this fault is of uncertain origin and that its seismic activity level has not been established. During our geologic field reconnaissance along the project alignment, surficial indications of previous faulting were not observed. The origin of this geologic feature, and other similar features in southern Nevada, which have been previously referred to as "compaction faults." Differing proposed origins for these faults include:

- Differential consolidation or compaction over time of the thick alluvial and lakebed sediments in valley areas.
- Tectonic factors associated with faults that may extend into the basement bedrock beneath the valley sediment.
- A combination of differential consolidation and tectonic factors.

Table 1 – Faults in Project Alignment Vicinity

Fault Name	Seismic Activity Level *	Approximate Distance From Project Alignment to Fault (miles)
Black Hills fault	Active	16
Eglington fault	Potentially Active	8
Frenchman Mountain fault	Potentially Active	3
Unnamed Las Vegas Valley fault	Not Established	Extends through alignment (see Figure 2)
*From United States Geological Survey (USGS, 2015b) data.		

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Ground fissures, generally believed to be caused by erosion and differential stress resulting from regional subsidence due primarily to withdrawal of groundwater, are known to occur near faults in southern Nevada. Review of the referenced geologic data does not indicate the presence of ground fissures along the project alignment and no ground fissures were observed during our field activities. However, it should be noted that the ground surface had been disturbed/obscured by previous development.

As part of this study, Ninyo & Moore evaluated whether the project alignment is located in a Special Geotechnical Considerations Area, as shown on the referenced Clark County Soil Guidelines Map (Clark County Building Department, 1998). This map indicates important aspects of near-surface soils and geologic features in the Las Vegas Valley. Review of the Clark County Soil Guidelines Map indicates that the portion of the project alignment between Stewart Avenue and Sandhill Road is located in a *Special Geotechnical Considerations Area - Subsidence and 2,000-Foot Compaction or Seismic Fault Buffer Zone*. This buffer zone is considered to contain 90 percent of mapped ground fissures. These potential ground fissure areas extend approximately 1,000 feet to each side of faults. The portion of the project alignment between Sandhill Road and Marion Drive is located in a *Special Geotechnical Considerations Area - Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*: This area is indicative of potentially moisture-sensitive and corrosive soils. The portion of the alignment located between Marion Drive and Las Vegas Wash is located in a *Special Geotechnical Considerations Area - Potential Drainage Areas or Recent Sediment Deposits, which may also have Solubility, Clay Swell, Corrosion, Gypsum Salt, Expansive or Hydro-collapsible Potential*. This area is in the vicinity of major drainages and may also contain potentially moisture-sensitive and corrosive soils.

The Clark County Expansive Soil Guidelines Map (Clark County Development Services Department, 2006) indicates general trends of near-surface soils in the Las Vegas Valley. This map shows areas of the valley where previous geotechnical studies have indicated the presence of moderately, highly, and critically expansive soils. Based on review of this map, the portion of the project alignment between Stewart Avenue and Honolulu Street is located

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in an area prone to moderately expansive soil and the remaining portion of the alignment is located in an area prone to highly expansive soil.

5.3. Ground Motions

Using the referenced United States Geological Survey database (USGS, 2015a), estimated maximum considered earthquake spectral response accelerations for short (0.2 second) and long (1.0 second) periods were obtained for the project alignment, which is located at approximately 36.1699 degrees north latitude and -115.0891 degrees west longitude. Based on the referenced International Building Code (ICC, 2012) and due to a detailed seismic site class evaluation not being performed for the project, Seismic Site Class D is appropriate for the project alignment and the parameters in the following table are characteristic of the project alignment for design purposes.

Table 2 – Seismic Design Parameters

Parameters	Value		Reference (ICC, 2012)
	Short Period	Long Period	
Mapped Maximum Considered Earthquake Spectral Response Acceleration, S_S and S_1	0.495g	0.164g	Figure 1613.3.1 and referenced database (USGS, 2015a)
Site Coefficient, F_a and F_v	1.40	2.14	Table 1613.3.3
Maximum Considered Earthquake Spectral Response Acceleration Adjusted for Site Class Effects, S_{MS} and S_{M1}	0.695g	0.352g	Equations 16-37 and 16-38
Design Spectral Response Acceleration, S_{DS} and S_{D1}	0.463g	0.235g	Equations 16-39 and 16-40

6. FIELD EXPLORATION, LABORATORY TESTING, AND SUBSURFACE CONDITIONS

Ninyo & Moore's subsurface exploration along the project alignment was performed from March 5 through March 16, 2015. This exploration consisted of drilling, logging, and sampling of 20 small-diameter exploratory borings. The borings were advanced to depths ranging from approximately 10 to 25 feet with a truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The purpose of the borings was to evaluate subsurface conditions

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along the project alignment, as well as to collect bulk and relatively undisturbed soil samples for laboratory testing. The approximate locations of the borings along with the pertinent borings from the other study previously discussed are shown on Figure 2.

Laboratory tests were performed on representative soil samples collected from the borings to evaluate physical and engineering properties of the soils, including in-place moisture content and dry density, gradation, plasticity, expansivity, sodium content, sulfate content, sodium sulfate content, and solubility potential (total salts). The results of the in-place moisture content and dry density tests are provided on the boring logs in Appendix A. Ground surface elevations at boring locations surveyed by Atkins personnel are also provided on the boring logs. Descriptions of the laboratory testing procedures utilized and the other test results are presented in Appendix B and Appendix C.

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6.1. Subsurface Soils Encountered

Generalized descriptions of the subsurface soils (fill and native soil) encountered in the exploratory borings are provided in the following sections.

6.1.1. Fill

Fill material, up to approximately 1.8 feet deep, was encountered in our exploratory borings. In addition, fill material approximately 7.0 feet deep was encountered in boring B-17. The encountered fill soils were comprised primarily of medium dense to dense, silty gravel with sand. A dense, clayey sand with gravel layer was also encountered in boring B-17. Much of the fill encountered in our borings was likely associated with channel sidewall backfill and/or roadway fill material.

Asphalt concrete pavement and underlying aggregate base material was penetrated in all of our 20 borings drilled during our subsurface evaluation for the subject project. The approximate thicknesses of asphalt concrete and underlying aggregate base material encountered in these borings are summarized in the following table.

Table 3 – Existing Asphalt Concrete Pavement and Aggregate Base Thicknesses

Boring	Approximate Thickness of Asphalt Concrete (inches)	Approximate Thickness of Aggregate Base Material (inches)
B-1	9-1/8	12 to 13
B-2	2	3-1/2
B-3	2	4-1/2
B-4	2-1/2	5-1/2
B-5	1-1/2	5-1/2
B-6	1-7/8	5
B-7	2-1/2	4
B-8	2-1/2	4
B-9	2-3/4	4
B-10	2-1/2	5-1/2
B-11	3	4
B-12	2-7/8	5-1/2
B-13	2-3/4	4-1/2
B-14	2-5/8	4-3/4
B-15	2-1/2	11
B-16	2-1/2	12 to 13
B-17	2-5/8	12 to 13
B-18	3-1/2	12 to 13
B-19	3	12 to 13
B-20	3-1/4	8-1/2
B-108*	8-3/4	5
B-109*	8-1/4	7
* Boring from previous evaluation		

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6.1.2. Native Soil

Native soil was encountered beneath the noted fill and extended to the total depths of our exploratory borings. The encountered native soil consisted primarily of firm to very stiff lean clay and fat clay with varying amounts of sand and gravel. An approximately 5-foot thick layer of stiff to very stiff silt with sand was encountered at a depth of approximately 12 and 15 feet in borings B-19 and B-20, respectively.

Layers of hard to very hard, strongly cemented soil (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Caliche is a naturally occurring cemented soil with rock-like characteristics. The following describes typical properties of caliche encountered in southern Nevada.

- Generally occurs in layers a few inches to several feet thick.

- Layers typically vary significantly in thickness, degree of cementation, and hardness over relatively short distances.
- Varies in composition from primarily fine-grained material to primarily coarse-grained material.
- Moderately hard, moderately cemented caliche can generally be gouged with a knife with difficulty and broken with a few hammer blows.
- Hard and very hard, strongly cemented caliche is difficult to scratch with a knife and breaks with difficulty with repeated hammer blows.
- Impedes earthwork operations, including grading and utility line trenching. Rock excavation methods are generally needed.

Laboratory tests were performed on representative samples of native soil obtained from the exploratory borings. Results of these tests are summarized in the following table.

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Table 4 – Summary of Laboratory Test Results

Test Type	Test Results	Remarks
Atterberg Limits Liquid Limit Plastic Limit Plasticity Index	 24 to 64 16 to 32 7 to 42	Low to high plasticity
Expansion Index	41 to 140	Low to very high
Sodium Sulfate Content	0.03 to 0.70 percent	Negligible to moderate chemical heave (salt heave) potential
Sodium Content	0.03 to 0.42 percent	--
Sulfate Content	0.02 to 0.47 percent	Negligibly to severely deleterious to concrete
Total Salts (Solubility)	0.15 to 1.86 percent	Low to high solubility potential

6.2. Selected and Granular Backfill Suitability

As a part of this study, Ninyo & Moore evaluated the suitability of encountered soils for use as trench backfill material. Clark County gradation and plasticity requirements (Clark County, 2003) for Selected and Granular Backfill (USSPWC Sections 207.02.01 and 207.02.02, respectively), along with the results of gradation and Atterberg limits tests performed by Ninyo & Moore, are presented in the following table.

Table 5 – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-1 5.0-6.5	B-3 2.0-3.5	B-5 2.0-3.5	B-6 5.0-6.5	B-9 5.0-6.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	82	100	100	100
No. 16	--	25-100	100	73	100	100	100
No. 200	--	5-15	86.1	61.6	88.8	84.3	93.8
Plasticity Index	15 max	15 max.	42	34	31	23	17
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

Table 5 (continued) – Selected and Granular Backfill Suitability

Sieve Size	Specified Percent of Weight Passing *		Percent of Weight Passing				
	Selected Backfill	Granular Backfill	B-12 5.0-6.5	B-14 5.0-6.5	B-17 5.0-6.5	B-18 10.0-11.5	B-20 15.0-16.5
3-inch	80-100	100	100	100	100	100	100
No. 4	35-100	35-100	100	100	58	99	100
No. 16	--	25-100	98	100	41	99	100
No. 200	--	5-15	95.0	96.6	19.0	82.3	81.8
Plasticity Index	15 max	15 max.	8	12	14	7	20
Meets Selected Backfill Requirements?			No	No	No	No	No
Meets Granular Backfill Requirements?			No	No	No	No	No
* USSPWC requirements							

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6.3. Groundwater

Groundwater was encountered in 12 of our 20 exploratory borings. Borings B-1, B-2, B-6, and B-20 were converted to temporary monitoring wells for the hydrogeologic study. The approximate depths to groundwater levels measured in the exploratory borings are presented in the following table. Depths to groundwater are also included on the boring logs in Appendix A.

Table 6 – Measured Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Approximate Time Measured After Drilling (days)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)
B-1	1,795.4	3	12.2	1,783.2
B-2	1,791.6	4	12.7	1,778.9
B-3	1,783.9	1	8.2	1,775.7
B-4	1,781.9	1	8.4	1,773.5
B-5	1,779.6	4	6.9	1,772.7
B-6	1,778.2	4	8.4	1,769.8
B-10	1,772.5	4	13.6	1,758.9
B-16	1,764.1	4	13.6	1,750.5
B-17	1,761.7	4	15.4	1,746.3
B-18	1,762.3	1	18.4	1,743.9
B-19	1,761.7	3	18.7	1,743.0
B-20	1760.5	3	18.4	1,742.1

*Measured from top of ground surface (top of channel bank) adjacent to boring.

Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this study.

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7. FINDINGS AND CONCLUSIONS

Based on the findings of this study, there are no known geotechnical or geologic conditions that would preclude construction of the proposed project, provided the recommendations presented herein are implemented and appropriate construction practices are followed. Geotechnical design and construction considerations for the proposed project include the following:

- Based on the results of our field and laboratory evaluation, it is our opinion that proposed improvements may be founded on medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils).

- Groundwater was measured at relatively shallow depths in our borings. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Therefore, potentially unstable and pumping subgrade conditions should be anticipated in excavation bottoms.

- Based on the results of our subsurface evaluation, we anticipate that groundwater will be encountered at or above the invert elevation along the project alignment. Accordingly, dewatering utilizing sump pumps, well points, and/or other appropriate dewatering methods will likely be needed to facilitate construction operations. During dewatering, existing structures within the limits of the resulting drawdown may be at risk of experiencing settlement. Therefore, existing structures should be monitored for possible movement associated with the dewatering operations.

- Fill material was encountered to a depth of up to approximately 1.8 feet in the exploratory borings. In addition, approximately 7 feet of fill encountered was encountered in boring B-17. This fill material is likely associated with channel sidewall backfill material. Contractors for this project should anticipate that fill will be encountered during excavation operations. The full depth of any undocumented fill material, and any loose, disturbed, or otherwise unsuitable soil should be removed from beneath proposed improvement areas and replaced with structural fill and/or appropriate backfill.

- The findings of our study indicate that some of the native soils encountered in our exploratory borings should generally be suitable for use as structural fill and backfill material for the project. However, our laboratory test results indicated that some of the on-site soils have very high expansion potential and a high solubility potential. These soils will not be suitable for use as structural fill and backfill. Additional soil sampling and laboratory testing should be performed during earthwork operations to evaluate whether on-site soils meet recommendations provided in this report for use as structural fill/backfill.

- Chemical test results performed on selected soil samples from the exploratory borings indicate that some of the on-site soils should be considered severely deleterious to concrete.

- Review of referenced geologic data indicates that a previously mapped fault traverses the western portion of the alignment (Figure 2). Published geologic data does not provide an activity level for this fault. During our field activities, surficial indications of previous faulting were not observed. A qualified geologist/geotechnical consultant should be present during trenching and excavation operations in the area of the mapped fault to assess subsurface conditions and provide recommendations as needed.

- Water, several inches deep, was observed flowing in the channel bottom. In addition, flash flooding is known to occur in Las Vegas Valley. Accordingly, the contractor for this project should be aware of the potential for adverse affects of flash flooding on construction activities and take adequate precautions.

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- Layers of hard to very hard, strongly cemented soils (caliche) were not encountered in our exploratory borings performed along the project alignment. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Due to its variable nature, caliche may be encountered in areas between and beyond our boring locations during earthwork operations. Grading activities and excavations may be impeded due to the presence of cemented soils. Rock excavation techniques should be anticipated during grading and excavation operations.

- As indicated in the referenced International Building Code, the seismic parameters provided in Table 2 are characteristic of the alignment and may be considered where appropriate in the design of structures.

8. RECOMMENDATIONS

We anticipate that the Clark County Regional Flood Control District, Hydrological Criteria and Drainage Design Manual (CCRFCD, 1999) will be used in design of the proposed channel improvements for this project. The following sections provide geotechnical recommendations for design and construction of proposed project improvements.

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8.1. Construction Dewatering

Groundwater was encountered in 12 of our 20 exploratory borings. The depths below the existing ground surface of the measured groundwater levels are provided on Table 6. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Accordingly, dewatering of excavations should be anticipated during earthwork operations. The purpose of dewatering is to improve excavation wall and bottom stability, as well as subgrade stability, and to allow installation of subsurface improvements and compaction of structural fill, trench backfill, and RCB and channel bottoms. Dewatering measures may include installation of well points, deep wells, and other devices. Disposal of groundwater should be performed in accordance with guidelines of the Nevada Division of Environmental Protection (NDEP).

Existing structures within the limits of groundwater drawdown resulting from dewatering may be at risk of experiencing settlement. The amount of settlement, if it occurs, will depend primarily on the amount and duration of the dewatering and subsurface soil conditions.

Consideration should be given to monitoring nearby structures for possible movement and associated damage during dewatering operations. If significant movement/damage occurs, dewatering operations should be temporarily suspended and the project's geotechnical consultant/owner's representative should be informed. Recommendations for mitigating settlement and associated distress should be provided by the geotechnical consultant/owner's representative.

8.2. Earthwork

Specifications for construction materials to be used and construction practices to be followed when excavating and backfilling trenches within paved and unpaved ROW are provided in the referenced USSPWC. The following subsections provide additional earthwork recommendations for the project including RCB and channel excavation, subgrade stabilization, mapped fault considerations, structural fill and backfill, import soils, and stability of temporary excavations.

8.2.1. RCB and Channel Excavation

Prior to excavation, the existing concrete for the trapezoidal channel side slopes should be removed and any ground surface along the proposed channel excavation areas should be cleared of any surface and subsurface obstructions, debris, organics (including vegetation), and other deleterious material. Materials generated from clearing operations should be removed from the project area and disposed of at a legal landfill.

Fill material, including existing channel sidewall backfill material was encountered to a depth of up to approximately 7 feet in the exploratory borings. Contractors for this project should anticipate that fill will be encountered during excavation operations, particularly below or behind existing channel side slopes. The full depth of any undocumented fill material, and any loose, disturbed, or otherwise unsuitable soil should be removed from beneath proposed improvement areas and replaced with structural fill and/or appropriate backfill.

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The proposed channel and RCB excavations for the proposed project should extend to the full depth and width, as specified in the project plans, or to a greater depth or width where needed, as evaluated in the field by the project's geotechnical consultant. Excavations should be deep enough to provide an approximately 8-inch thick layer of aggregate base beneath concrete channel and RCB bottoms. Excavations should be wide enough to provide an adequate work zone and trenching for the proposed structures should provide a 12-inch or more clearance on either side of the RCB for structural fill material placement and compaction. The 12-inch side clearance should be the clear distance between the RCB and shoring system where present.

Care should be taken not to overexcavate trench/channel bottoms. In the event that overexcavation occurs, the overexcavated area should be backfilled with Type II Aggregate Base compacted to 90 percent relative compaction, as evaluated by ASTM D 1557 or Controlled Low-Strength Material (CLSM) as described in the referenced USSPWC Section 208.02.07. Excavated bottoms should be cleaned of loose material generated by the excavation process. If the exposed surficial soils at the base of the excavations are loose, soft, or disturbed by excavation operations, these soils should be scarified to a depth of approximately 6 inches, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557. When the bottom of the excavation contains rocks larger than 6 inches nominal diameter, protruding above the bottom of the excavation, these protrusions should be removed and the area leveled prior to the compaction of the subgrade and placement of structural fill materials.

Consideration should be given to existing buried pipeline utilities running parallel to the planned excavation. Trench excavations within two pipe diameters of existing pipelines and extending below the springline of, and running parallel to, existing pipeline utilities may need to be supported by properly designed trench shoring and bracing to prevent damage to existing pipeline facilities.

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Layers of hard to very hard, strongly cemented soils (caliche) were not encountered in our exploratory borings. However, moderately hard, moderately cemented soils were encountered at the bottom of borings B-19 and B-20 at a depth of approximately 26 feet. Due to the highly variable nature of caliche, this rock-like cemented soil may be encountered along the project alignment in areas between and beyond our exploratory boring locations. If caliche is encountered, rock excavation techniques, such as use of heavy-duty ripping equipment, heavy-duty backhoe, headache ball, hoe-ram, rock bits, etc., should be anticipated during earthwork operations. The contractor should be aware of the potential for (and take adequate precautions to reduce the potential for) vibrational damage to adjacent or nearby structures, and take appropriate precautions, when using heavy impact equipment during removal of caliche.

Some shrinkage should be anticipated when on-site soils are excavated, processed, and compacted. For planning purposes, an estimated shrinkage factor of approximately 25 percent may be used for native soils.

8.2.2. Subgrade Stabilization

As previously indicated, groundwater was measured at relatively shallow depths in some of our exploratory borings. In addition, moist subgrade conditions were also encountered in our exploratory borings at relatively shallow depths. Accordingly, pumping subgrade should be anticipated during excavation and earthwork operations. Subgrade stabilization will be needed where pumping subgrade conditions are encountered.

Stabilization methods should be provided by the grading contractor, as needed, and may include the use of a geogrid, such as Tensar TX160, or a woven geotextile fabric, such as Mirafi 600X, placed on unstable subgrade and overlain by 12 inches of crushed rock in accordance with Section 704.03.06 of Uniform Standard Specifications for Public Works Construction (USSPWC) or Type II Aggregate Base (USSPWC 704.03.04). Pushing oversized angular rock, up to approximately 6 inches in nominal diameter, into

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exposed unstable subgrade soils may also be an appropriate stabilization alternative. The volume of rock needed will vary based upon factors including the moisture content of the native soil, soil type, depth to groundwater, and total affected area. Placement of angular rock should continue until the area exhibits a relatively non-yielding behavior as observed or tested by the geotechnical consultant.

If conditions (e.g. excavations extending below groundwater) are observed that indicate additional stabilization efforts may be needed, a combination of overexcavation, rock fill, and geogrid placement should be considered. Dewatering and use of relatively light or tracked equipment may also be needed. The geotechnical consultant/engineer during construction should evaluate proposed subgrade stabilization methods prior to their implementation.

8.2.3. Mapped Fault Considerations

As previously mentioned, a mapped fault transects the western portion of the project alignment. The approximate location of this fault is shown on Figure 2. Review of referenced USGS data does not provide an activity level for this fault. Published geologic data and our professional experience in the project area indicate that previous subsurface evaluation, such as fault trenching, has not been performed to confirm the fault's location, activity level, or whether it is in the mapped location. During excavation operations for this project, indications of faulting, such as off-set or deformation of soil layers, may or may not be observed. Ninyo & Moore recommends that a qualified geologist/geotechnical consultant be present during trenching/excavation operations in the area of the mapped fault to assess subsurface conditions and provide recommendations for fault mitigation as needed.

If indications of faulting, or associated potential instability, are encountered, mitigation measures may include vertical overexcavation of the trench, placement of geofabric and gravel, or a layer of geogrid across the fault prior to placement of structural fill.

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8.2.4. Structural Fill and Backfill

Structural fill soils should not contain organic matter, debris, other deleterious matter, or rocks or hard chunks larger than approximately 3 inches nominal diameter. These soils should have a low solubility potential of 1.0 percent or less, as evaluated by Technical Guideline TG-19-2007 (Clark County Development Services Department, 2007), and a very low to low expansion potential (EI less than 50, as evaluated by ASTM D 4829).

Soils used as structural fill or backfill should be moisture-conditioned to approximately optimum moisture content and placed and compacted in uniform horizontal lifts to a relative compaction of 90 percent, as evaluated by ASTM D 1557. The optimal lift thickness of fill will depend on the type of soil and compaction equipment used, but should generally not exceed approximately 8 inches in loose thickness. Placement and compaction of structural fill should be performed in accordance with the referenced USSPWC (Clark County, 2003).

Earthwork operations should be observed and compaction of structural fill materials should be tested by the project's geotechnical consultant. Typically, one field test should be performed per lift for each approximately 500 cubic yards of fill placement in structural areas. Additional field tests may also be performed in structural and non-structural areas at the discretion of the geotechnical consultant.

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8.2.5. Import Soils

Import soil for backfill or structural fill should consist of coarse-grained material (50 percent or more retained on the No. 200 sieve), with a low solubility potential of 1.0 percent or less, as evaluated by Technical Guideline TG-19-2007 (Clark County Development Services Department, 2007), a low sulfate content (less than 0.1 percent), and a very low to low expansion potential (EI less than 50, as evaluated by ASTM D 4829). Import soil should not contain organic matter, debris, other deleterious matter, or rocks or hard chunks larger than approximately 3 inches nominal diameter. We further recommend that proposed import material be evaluated by the project's

geotechnical consultant at the borrow source for its suitability prior to importation to the project site. Import soil should be moisture-conditioned and placed and compacted in accordance with the recommendations set forth in the previous section.

8.2.6. Stability of Temporary Excavations

Temporary excavations should be performed in accordance with the requirements and recommendations of the referenced Occupational Safety and Health Administration's Construction Industry Regulations (OSHA, 2005). Excavations deeper than 5 feet should be appropriately shored or laid back at a slope no steeper than 1:1 (horizontal to vertical) per OSHA recommendations. On-site safety of personnel is the responsibility of the contractor. Worker protection, such as trench boxes, may be needed for protection against rolling or falling particles.

Excavations for the proposed RCB and channel are anticipated to be up to approximately 15 feet deep. Spoils from excavations, heavy construction equipment, and other surcharge loads should not be placed above the excavations within a 1:1 (horizontal to vertical) plane extending up and back from the base of the excavation. In addition, surface drainage should be channeled away from the top edge of excavations and traffic should be routed as far away from the excavation as practicable during construction.

As an alternative to laying back the sides of the excavations, temporary excavations may be rigidly braced. Temporary earth retaining systems will be subjected to lateral loads resulting from earth pressures. As a guideline, lateral earth pressures presented in this report may be used in the design of internally braced excavation shoring for temporary excavations. A structural engineer experienced in retaining systems for temporary excavations should be consulted by the contractor during the design of the shoring system. The project's geotechnical engineer should review the design plans for a temporary retaining system prior to its implementation.

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8.3. Vertical Loads and RCB Foundations

For calculation of overburden loads, Type II Aggregate Base and trench backfill soils, when placed and compacted as specified, may be assumed to have a unit weight of approximately 130 pounds per cubic foot (pcf). This value is based on soils being compacted to a relative compaction of 90 percent of the maximum dry density, as evaluated by ASTM D 1557. We have assumed that CLSM used as pipe zone and trench backfill material will have a unit weight of approximately 120 pcf.

The base of RCB sections should be founded on 8 inches or more of Type II Aggregate Base overlying medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils). The Type II Aggregate Base should be in conformance with referenced USSPWC Subsection 704.03.04, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557. An allowable bearing pressure of 2,000 pounds per square foot (psf) may be used for RCB/structure foundations. The allowable bearing capacity, which was developed considering a factor of safety of 2.5, may be increased by one-third for short duration loads, such as seismic.

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8.4. Concrete-Lined Channel Invert Slabs and Sidewalls

We recommend that concrete channel walls, invert slabs-on-grade and access ramps be founded on 8 inches or more of Type II Aggregate Base overlying medium dense to very dense and/or stiff to very stiff native soils or on a zone of adequately placed and compacted structural fill (reworked native or import soils). The Type II Aggregate Base should be in conformance with referenced USSPWC Subsection 704.03.04, moisture-conditioned to approximately optimum moisture content, and compacted to 90 percent relative compaction, as evaluated by ASTM D 1557.

We recommend that the concrete channel lining be provided with construction joints in accordance with Section 705.7.1.3 of the Clark County Regional Flood Control District, Hydrological Criteria and Drainage Design Manual (CCRFCD, 1999). For continuously reinforced concrete channel construction, we recommend that longitudinal and transverse

cutoff walls be constructed in accordance with Section 705.7.1.12 of the CCRFCD design manual. Slab reinforcement should be in accordance with Section 705.7.1.6 of the CCRFCD design manual. Additional reinforcement and control joint recommendations may be provided by a qualified structural engineer. Recommendations regarding concrete utilized for construction of the proposed channel are provided in Section 8.7.

In order to drain accumulated water below invert slabs, we recommend that 3-inch diameter weep holes be installed in the channel bottom approximately 1 foot upstream of transverse cutoff walls and at the approximate midpoint between cutoff walls. These weep holes should be protected against clogging by installation of 1 square-foot of non-woven geotextile fabric such as Trevira 1135 (or approved equivalent) between weep holes and underlying aggregate base.

In order to reduce the potential for build-up of hydrostatic pressures and to drain possible accumulated water behind concrete channel sidewalls, 3-inch diameter weep holes should be installed in the channel sidewalls at a spacing of approximately 10 feet on-center and approximately 3 inches from the channel bottom. Drainage measures should also include the placement of free-draining granular backfill over weep hole areas encased in a non-woven filter fabric such as Trevira 1135 (or approved equivalent).

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8.5. Lateral Earth Pressures

Below grade walls that are not restrained from movement at the top and having level backfill behind the wall may be designed using an "active" lateral earth pressure as indicated on Figure 3. Restrained subsurface walls having a horizontal ground surface behind the wall, may be designed using an "at-rest" lateral earth pressure as indicated on Figure 4. These lateral earth pressure values assume compaction within about 5 feet of the wall will be accomplished with relatively light compaction equipment and that very low to low expansive backfill will be placed behind the wall. These values also assume that below grade walls will have a height of approximately 15 feet or less.

We understand that dynamic lateral earth pressures induced from a seismic event may be considered in the design of subsurface structures along the alignment. Ninyo & Moore has evaluated the "active" and "at-rest" seismic earth pressure coefficient based on the Mononobe-Okabe equation for an active driving wedge. Based on our calculations, Ninyo & Moore recommends that below grade walls, which are not restrained from movement at the top, be designed using an additional inverted triangular "active" equivalent fluid unit weight as indicated on Figure 3, where appropriate. Subsurface walls, which are restrained from movement at the top, be designed using an additional inverted triangular "at-rest" equivalent fluid unit weight as indicated on Figure 4.

Below grade walls should also be designed to resist an "active" and "at-rest" surcharge pressure as shown on Figure 3 and Figure 4. The value for "q" represents the pressure induced by adjacent light loads, uniform slab, or traffic loads plus any adjacent footing loads.

Measures should be taken so that hydrostatic pressure does not build up behind retaining walls. Drainage measures, as indicated on Figure 5, should include free-draining granular backfill material and perforated drain pipes, or weepholes lined with polyvinyl chloride (PVC) pipe. Drain pipes should outlet away from structures and retaining walls should be waterproofed in accordance with the recommendations of a qualified civil engineer or architect.

For passive resistance to lateral loads, we recommend that a passive lateral earth pressure of 300 psf/ft above groundwater and 130 psf/ft below groundwater be used up to a value of 2,000 psf. This value assumes that the ground surface is horizontal for a distance of 10 feet, or three times the height generating the passive pressure, whichever is more. We recommend that the upper 12 inches of soil not protected by pavement or a concrete slab be neglected when calculating passive resistance. For frictional resistance to lateral loads, we recommend that a coefficient of friction of 0.53 be used between soil and soil contacts and/or between soil and cast-against-grade concrete contacts. A coefficient of friction of 0.35 may be used between soil and formed concrete contacts. Passive and frictional resistances may be used in combination, provided the passive resistance does not exceed one-half of the total allowable resistance.

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8.6. Pavement Replacement

Pavement patching in trench areas for this project should be performed in accordance with the USSPWC (Clark County, 2003), which provides specifications for thickness of pavement and underlying aggregate base/CLSM depending on the width of the roadway ROW. The existing asphalt concrete pavement thickness measured in our exploratory borings is provided in Section 6.1.

In areas of pavement removal and patching, pavement saw-cuts should be linear and vertical. The pavement should be saw-cut a few inches beyond the soil excavation as shown on Drawing No. 503AF of the referenced Uniform Standard Drawings for Public Works Construction (Clark County, 2001). Saw-cuts should be adequately cleaned and then coated with an appropriate tack-coat prior to placement of new pavement.

8.7. Concrete and Corrosion Considerations

The corrosion potential of on-site soils to concrete was evaluated in the laboratory using representative samples obtained from the exploratory borings. Laboratory testing was performed to assess the effects of sulfate content on concrete. Results of these tests are presented in Appendix C. Recommendations regarding concrete to be utilized in construction of proposed improvements and for buried metal pipes are provided in the following sections.

8.7.1. Concrete

Chemical tests performed on selected samples of on-site soils indicated sulfate contents ranging from 0.02 to 0.47 percent by weight. Based on review of the referenced International Building Code (ICC, 2012) and American Concrete Institute manual (ACI, 2005), the tested soil is considered negligibly to severely deleterious to concrete. Accordingly, we recommend that concrete in contact with on-site soils, along with subsurface walls up to 12 inches above finished grade, contain Type V cement and have a design compressive strength of 4,500 pounds per square inch (psi). In accordance with Section 501 of the referenced USSPWC, concrete in contact with on-site soils should

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have a water-cement ratio of 0.45 by weight. In addition, it is recommended that reinforcing bars in cast-against-grade concrete be covered by approximately 3 inches or more of concrete. Concrete should be placed with an approximate 4-inch slump and good densification procedures should be used during placement to reduce the potential for honeycombing. Concrete samples should be obtained, as indicated by ACI manual Section 318 (ACI, 2005), and the slump should be tested at the site by the project's geotechnical consultant. Structural concrete should be placed in accordance with American Concrete Institute (ACI, 2005) and project specifications.

8.7.2. Buried Metal Pipes

Ninyo & Moore recommends that corrosion reduction methods be implemented for this project for buried metal pipes. These corrosion reduction methods may include utilization of protective coatings, pipe sleeving, and/or appropriate cathodic protection as recommended by a qualified corrosion engineer. Where permitted by jurisdictional building codes, the use of plastic pipes for buried utilities should also be considered.

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9. PLAN REVIEW

The recommendations presented in this report are based on preliminary design information for the proposed project, as provided by Atkins personnel, and on the findings of our geotechnical evaluation. When finished, project plans and specifications should be reviewed by the geotechnical consultant prior to submitting the plans and specifications for bid. Additional field exploration and laboratory testing may be needed upon review of the project design plans.

10. PRE-CONSTRUCTION MEETING

We recommend that a pre-construction meeting be held. The owner or the owner's representative, the civil engineer, the geotechnical consultant, and the contractor should be in attendance to discuss the plans and the project.

11. OBSERVATION AND TESTING

A qualified geotechnical consultant should perform appropriate observation and testing services during earthwork and construction operations. These services should include observation of removal of soft, loose, or otherwise unsuitable soils, evaluation of subgrade conditions where soil removals are performed, and performance of observation and testing services during placement and compaction of structural fill and backfill soils. The geotechnical consultant should also perform observation and testing services during placement of concrete, mortar, grout, asphalt concrete, and steel reinforcement.

12. LIMITATIONS

The field evaluation, laboratory testing, and geotechnical analyses presented in this geotechnical report have been conducted in general accordance with current practice and the standard of care exercised by geotechnical consultants performing similar tasks in the project area. No warranty, expressed or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be encountered during construction. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface evaluation will be performed upon request. Please also note that our evaluation was limited to assessment of the geotechnical aspects of the project, and did not include evaluation of structural issues, environmental concerns, or the presence of hazardous materials.

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This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document.

This report is intended for design purposes only. It does not provide sufficient data to prepare an accurate bid by contractors. It is suggested that the bidders and their geotechnical consultant perform an independent evaluation of the subsurface conditions in the project areas. The independent

evaluations may include, but not be limited to, review of other geotechnical reports prepared for the adjacent areas, site reconnaissance, and additional exploration and laboratory testing.

Our conclusions, recommendations, and opinions are based on an analysis of the observed site conditions. If geotechnical conditions different from those described in this report are encountered, our office should be notified and additional recommendations, if warranted, will be provided upon request. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control.

This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

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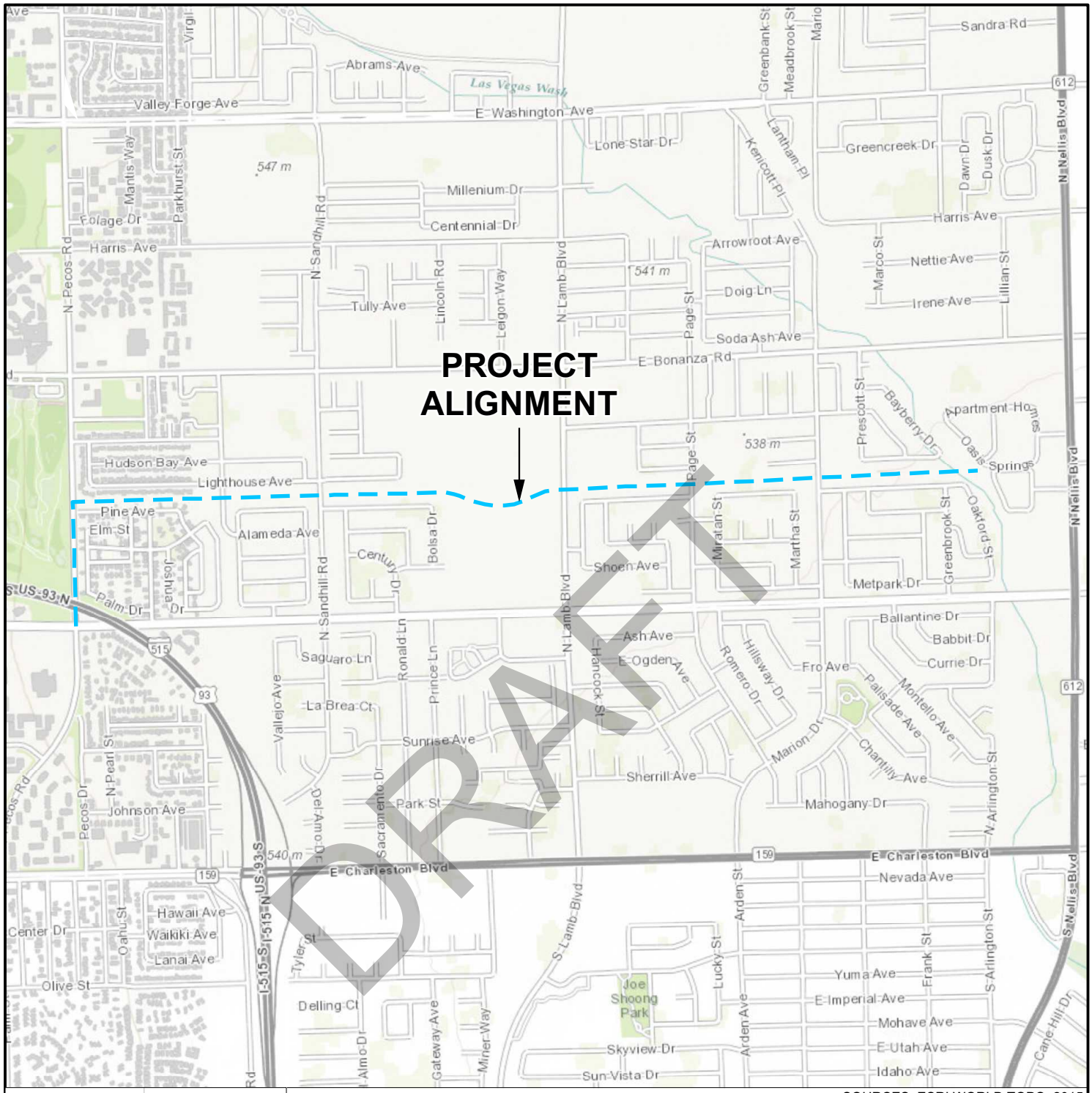
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SOURCES: ESRI WORLD TOPO, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710001_SL.mxd 4/7/2015 3:32:13 PM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

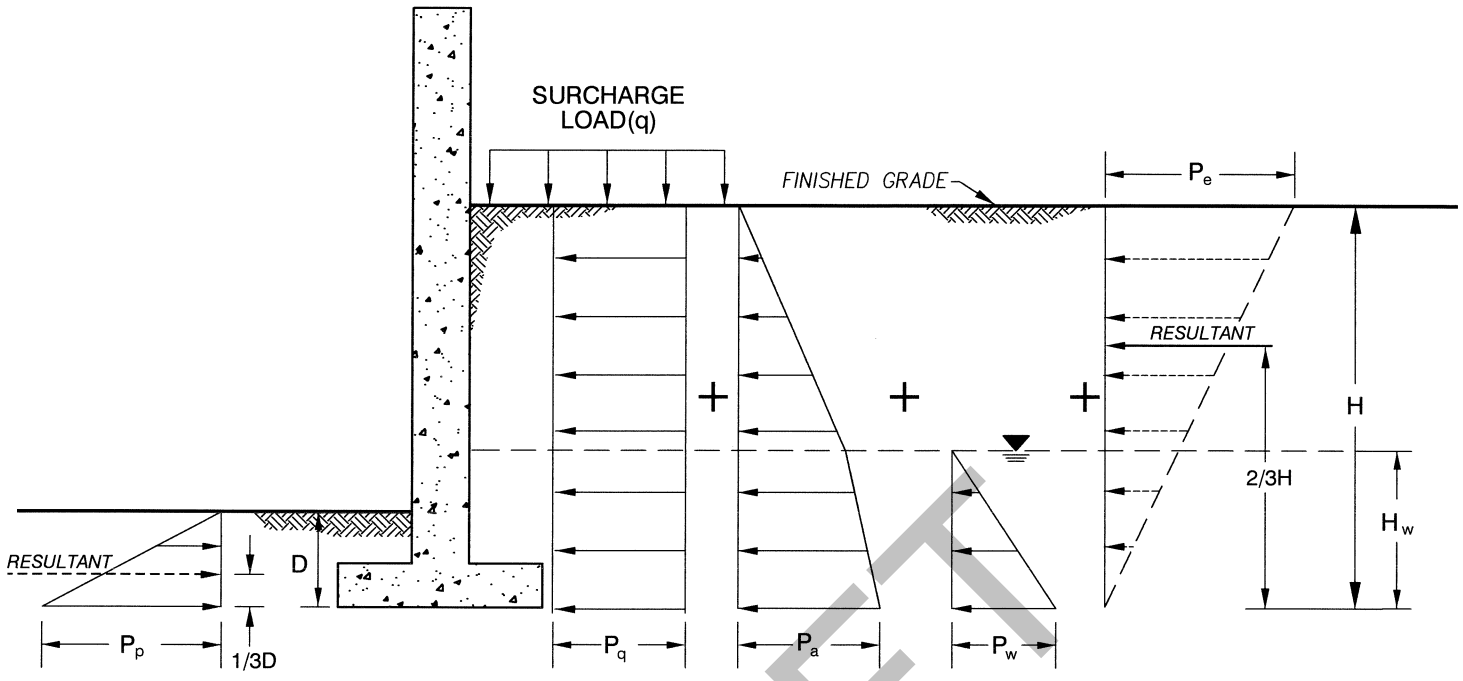
NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore		BORING LOCATIONS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2
303710001	4/15		

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DRAFT

NOTES:

1. ASSUMES NON-EXPANSIVE BACKFILL MATERIALS
2. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON AN EFFECTIVE PEAK GROUND ACCELERATOR OF 0.20g
3. H, H_w, AND D ARE IN FEET

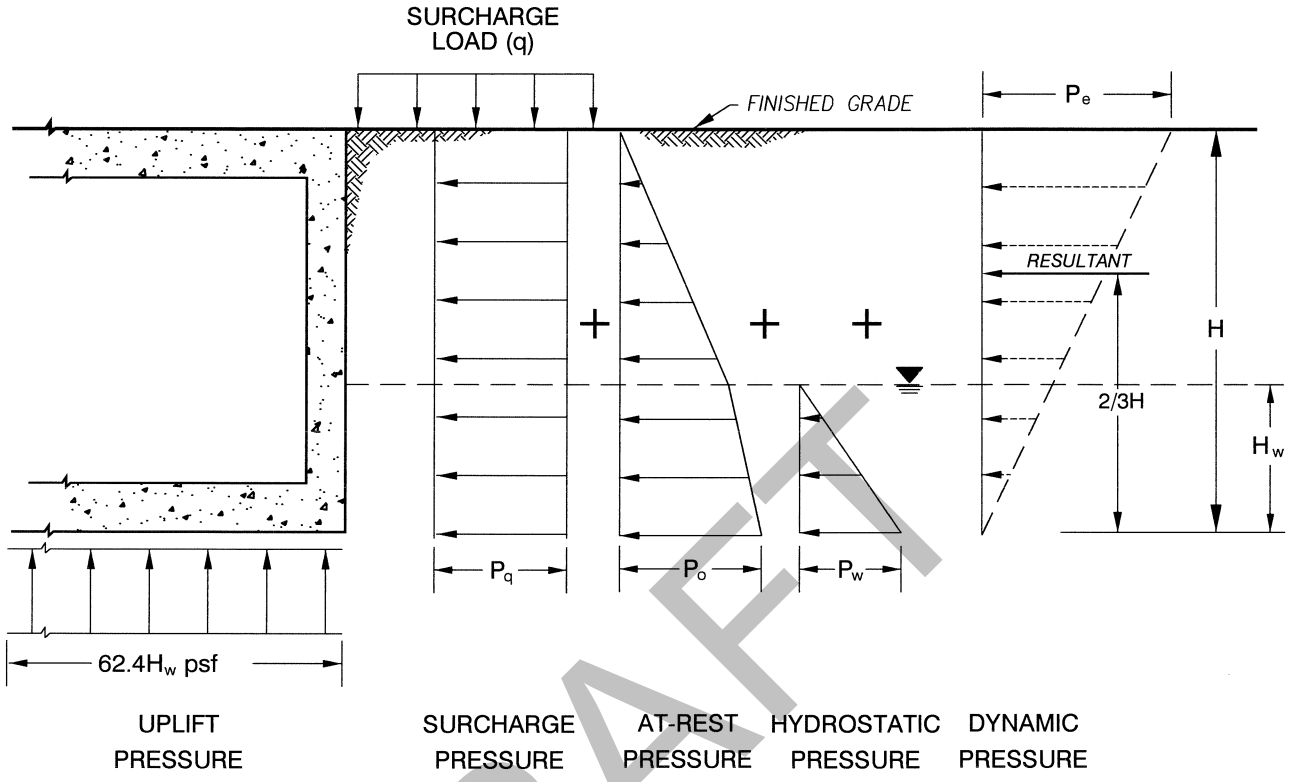
RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

Lateral Earth Pressure	Equivalent Fluid Pressure (psf/ft)	
	Level Backfill with Granular Soils	Below Groundwater
P_p	300D	130D
P_q	0.36q	0.36q
P_a	43H	$43(H-H_w)+21H_w$
P_w	--	$62.4H_w$
Resultant	Force per unit of wall	
P_e	8H	8H

NOT TO SCALE

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Ninyo & Moore	LATERAL EARTH PRESSURES FOR YIELDING RETAINING WALLS	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	3



DRAFT

NOTES:

1. ASSUMES NON-EXPANSIVE BACKFILL MATERIALS
2. DYNAMIC LATERAL EARTH PRESSURE IS BASED ON AN EFFECTIVE PEAK GROUND ACCELERATOR OF 0.20g
3. H, H_w, AND D ARE IN FEET

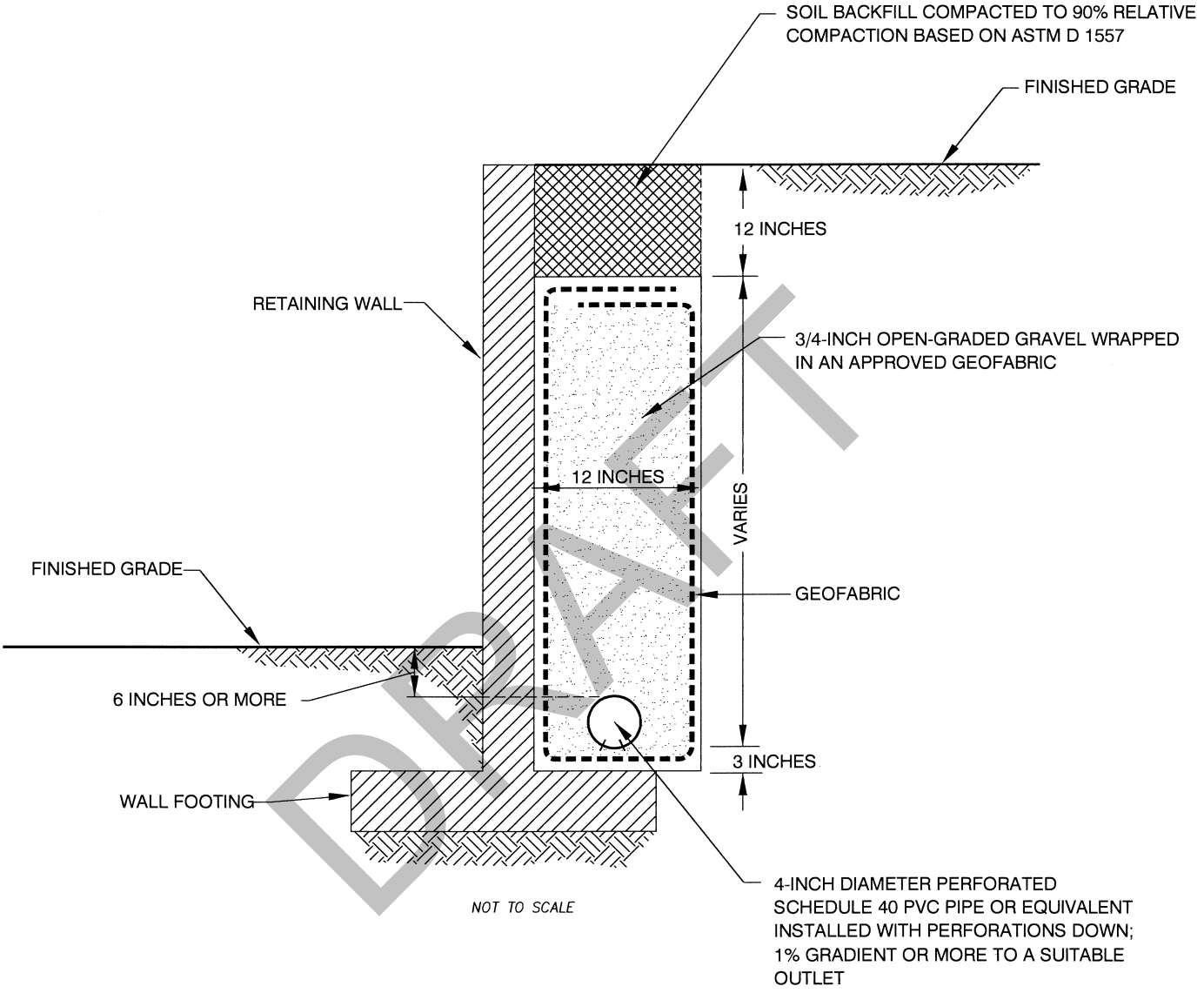
RECOMMENDED GEOTECHNICAL DESIGN PARAMETERS

Lateral Earth Pressure	Equivalent Fluid Pressure (psf/ft)	
	Level Backfill with Granular Soils	Below Groundwater
P_p	300D	130D
P_q	0.53q	0.53q
P_o	64H	$64(H-H_w)+31H_w$
P_w	--	$62.4H_w$
Resultant	Force per unit of wall	
P_e	18H	18H

NOT TO SCALE

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Ninyo & Moore		LATERAL EARTH PRESSURES FOR RESTRAINED RETAINING WALLS	FIGURE
PROJECT NO.	DATE	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	4
303710001	4/15		



DRAFT

NOTES: AS AN ALTERNATIVE, AN APPROVED GEOCOMPOSITE DRAIN SYSTEM MAY BE USED.

AS AN ALTERNATIVE TO USE OF 4" DIAMETER PVC BACKDRAINAGE PIPES, WEEP HOLES CAN BE CORED THROUGH THE WALL AND LINED WITH PVC PIPE. WEEP HOLES SHOULD BE 3" DIAMETER AND PLACED APPROXIMATELY 3" ABOVE THE LOWEST ADJACENT FINISHED GRADE AT APPROXIMATELY 10' ON-CENTER.

Ninyo & Moore	RETAINING WALL DRAINAGE DETAIL	FIGURE
PROJECT NO. 303710001 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	5

Apr 08, 2015 - 6:26pm
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Ninyo & Moore
Geotechnical and Environmental Sciences Consultants

HYDROGEOLOGIC AQUIFER TESTING REPORT
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL FACILITY
LAS VEGAS, NEVADA

PREPARED FOR:
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

PREPARED BY:
Ninyo & Moore
Geotechnical and Environmental Sciences Consultants
6700 Paradise Road, Suite E
Las Vegas, Nevada 89119

April 15, 2015
Project No. 303710002

April 15, 2015
Project No. 303710002

Mr. Harshal Desai
Atkins
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074

Subject: Hydrogeologic Aquifer Testing Report
Las Vegas Wash Central Cedar Avenue Channel Facility
Las Vegas, Nevada

Dear Mr. Desai:

Transmitted herewith are the results of Ninyo & Moore's hydrogeologic aquifer testing for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility in Las Vegas, Nevada. The purpose of this testing was to estimate the hydrogeologic conditions present along the project alignment which will be utilized in preparation of a National Pollutant Discharge Elimination System (NPDES) discharge permit application for proposed dewatering associated with the project. We appreciate the opportunity to be of service to you on this project.

Respectfully submitted,
NINYO & MOORE

Courtney J. Brooks, CEM
Senior Hydrogeologist

Robert M. Troisi, CEM
Managing Principal
Environmental Sciences Division

CB/NB/RMT/dh

Distribution: (1) Addressee (via e-mail)

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Appendix C – Hydrogeologic Aquifer Test Analyses and Modeling

1. INTRODUCTION

In accordance with your request, Ninyo & Moore has performed preliminary hydrogeologic testing for the proposed Las Vegas Wash Central Cedar Avenue Channel Facility project in Las Vegas, Nevada. The approximate location of the alignment is indicated on Figure 1. The purpose of this testing was to estimate the hydrogeologic conditions present along the project alignment which will be utilized in preparation of a National Pollutant Discharge Elimination System (NPDES) discharge permit application for proposed dewatering associated with the project. This report presents the methodologies, findings, opinions, conclusions, and recommendations regarding the hydrogeologic conditions along the project alignment.

This study was performed concurrently with a geotechnical evaluation, also performed by Ninyo & Moore. A report presenting the results of the geotechnical evaluation (Ninyo & Moore, 2015) was submitted under separate cover.

2. SCOPE OF SERVICES

In accordance with our approved scope of work, Ninyo & Moore performed the following tasks.

- Coordinated the installation and development of four temporary groundwater monitoring wells collocated in geotechnical borings B-1, B-2, B-6, and B-20 advanced along the project alignment.
- Collected groundwater samples from temporary monitoring wells to measure groundwater quality. The water samples were submitted to an NDEP-certified analytical laboratory in accordance with chain-of-custody procedures.
- The groundwater samples were analyzed for the following NDEP Profile I parameters and General *DeMinimis* groundwater discharge application Category 4 parameters, as well as perchlorate and fecal coliform bacteria.
- Multiple falling head and rising head tests were performed in the temporary monitoring wells to estimate the aquifer conditions at each location. The aquifer test data was analyzed to estimate the hydraulic conductivity values in the vicinity of the proposed excavations.
- Hydrogeologic data derived from this study was utilized to create multiple finite difference groundwater models, which simulated various well configurations and pumping scenarios to estimate the expected pumping rates capable of dewatering the excavations to target levels.

- The hydrogeologic data and groundwater model output from this study may be utilized to prepare an NDEP NPDES discharge permit application for the proposed dewatering program.

3. PROJECT DESCRIPTION

Based on our conversations with Atkins personnel, we understand that the project will include design and construction/installation of new flood control structures, including reinforced concrete box (RCB) and a concrete lined rectangular channel. The project will include approximately 1,400 linear feet of 14-foot by 6-foot RCB extending north along Pecos Road from Stewart Avenue to a wash channel right-of-way (ROW) where it will then turn and extend east within the wash ROW another 400 feet to its confluence with the existing concrete-lined trapezoidal channel. From this point, the alignment will extend east approximately 9,000 linear feet to its terminus at Las Vegas Wash. The project will include converting the existing trapezoidal channel to a rectangular channel by removing the current side slopes. The existing trapezoidal channel is approximately 7 to 10 feet deep. The project will also include improvements under the street crossings at Lamb Boulevard and Marion Drive. It is anticipated that the RCB's in Pecos Road will have approximately 2 to 12 feet of cover and will be installed by cut-and-cover methods. It is anticipated that the invert depths of the improved channel will be similar to the current invert depths except at the downstream end of the channel (from 400 feet upstream of Marion Drive to the Las Vegas Wash).

4. FINDINGS

Ninyo & Moore performed hydrogeologic testing to obtain information to prepare a General *DeMinimus* groundwater discharge permit application for submittal to the NDEP. Our findings are summarized in the sections below.

4.1. Monitoring Well Installation

Beginning on March 6, 2015, Ninyo & Moore observed the installation of four temporary groundwater monitoring wells collocated in geotechnical borings B-1, B-2, B-6 and B-20. The monitoring well boring depths ranged from approximately 15 to 25 feet below existing

grade with truck-mounted Mobile B-57 and CME-75 drill rigs utilizing 8-inch diameter hollow-stem augers and a track-mounted CME-55 drill rig utilizing 8-inch diameter hollow-stem augers. The temporary groundwater monitoring wells consist of 2-inch diameter, 0.02-inch factory-machine slotted screens flush-threaded to 2-inch diameter schedule 40 polyvinyl chloride blank casing to the existing grade. Clean silica sand filter material was placed in the annulus around the perforated section of each casing. Upon completion, Ninyo & Moore staff utilized a submersible development pump with clean, dedicated tubing to remove the fine materials from the well casings and filter packs. The temporary monitoring wells were abandoned upon completion of testing. The approximate locations of the temporary monitoring wells are shown on Figure 2.

It is anticipated that the target of dewatering will be to lower the groundwater level to approximately 3 feet below the estimated maximum design depth of the planned channel excavations. Based on preliminary design specifications and our conversations with Atkins personnel, it is our understanding that the channel invert elevations along the alignment will range from approximately 1,745.5 feet above mean sea level (AMSL) near B-20 to 1,780 feet AMSL near B-1.

Subsurface geotechnical and hydrologic conditions observed as part of Ninyo & Moore's geotechnical study (Ninyo & Moore, 2015), which was submitted under separate cover, were reviewed as part of this study.

4.2. Groundwater

Groundwater was encountered in 12 of 20 exploratory borings advanced as part of Ninyo & Moore's geotechnical evaluation for the subject project. Ninyo & Moore's groundwater measurements reflect conditions at the time of our subsurface exploration and do not preclude local and/or seasonal fluctuations in groundwater levels. These fluctuations may be due to variations in ground surface topography, subsurface geologic conditions, rainfall, surface water seepage through expansion joints in the existing channel, and other factors. Evaluation of factors associated with groundwater fluctuations was beyond the scope of this

study. Table 1 summarizes the groundwater and invert elevations observed in our borings performed as part of Ninyo & Moore's geotechnical evaluation for the subject project.

4.3. Groundwater Sampling and Analysis

Following development and purging, the temporary monitoring well was sampled utilizing clean disposable polyethylene bailers. The groundwater samples were placed in clean, laboratory-supplied containers and labeled according to the sample location, date, analysis requested, and the name of the person collecting the sample. The samples were stored in an insulated cooler, preserved on ice, and delivered under chain-of-custody protocol to an NDEP-certified laboratory for water quality analysis. The groundwater samples were analyzed for NDEP Profile I and General DeMinimis groundwater discharge Category 4 parameters, as well as for fecal coliform bacteria and perchlorate by EPA Method 331.

Tables 2 through Table 4 summarize the sample analytical results for the parameters. The analyte concentrations are printed in bold for samples that are reported above the NDEP Profile 1 and/or Category 4 recommended discharge limits. These include Sulfate and Total Dissolved Solids (TDS) in B-1, B-2, B-6 and B-20, and Chloride in B-1 and B-20. Copies of the complete laboratory report and chain-of-custody record are presented in Appendix B.

4.4. Hydrogeologic Aquifer Testing

Multiple hydraulic displacement (slug) tests were performed in the temporary monitoring well to estimate aquifer characteristics in the vicinity of the proposed excavations. The procedure involved the sudden introduction of a mechanical slug into (falling head), or the sudden removal of the mechanical slug from (rising head) the well casing. These actions caused the groundwater level to rise or fall, respectively. The water level displacement and subsequent rate of recovery was recorded and later analyzed utilizing the hydrogeologic software, Aqtesolv™, to estimate the hydraulic conditions of the aquifer in the vicinity of the monitoring well. The data analysis included the Hvorslev method (1951) and the Bouwer and Rice method (1976 and 1989), two comparable techniques for estimating the hydraulic

conductivity (K) from slug displacement test data (rising and falling head) in unconfined aquifers.

The displacement test analyses for the temporary monitoring wells, which are summarized in Appendix C, ranged from 0.8 feet per day (ft/d) to 33.2 ft/d. Data for the full hydrogeologic analysis is presented in Appendix C.

It is our understanding that the target dewatering depth for the channel excavations is approximately 3 feet below the deepest expected invert depth along the alignment.

4.4.1. Assumptions

It is assumed that no more than 500 linear feet of excavation will be open at one time during construction operations. It is expected that groundwater discharged from the dewatering systems will be pumped to one or more settling tanks, as necessary, prior to discharge to the same wash down gradient from the dewatering operations.

4.4.2. Finite Modeling

The hydraulic conductivity values were incorporated into numerical, finite difference, groundwater models to simulate the expected water level changes caused by various pumping scenarios under the modeled conditions.

The groundwater model processing platform, Groundwater Vistas, was utilized to create groundwater simulations utilizing the Modflow method (2007). Computerized finite difference groundwater models were set out on a grid with uniform 10 feet row and column spacings. The models assume that homogeneous and isotropic aquifer conditions exist horizontally across the grid similar to those ascertained from lithologic drill log and aquifer tests obtained from the temporary monitoring wells. The models' general head boundaries create a slight west to east trending water table gradient, mimicking the regional gradient across that portion of the Las Vegas Valley. The models were run until steady-state groundwater conditions were achieved. Multiple simulations

were performed with varying numbers and configurations of wells to estimate the desired water-table changes.

Groundwater was measured in our geotechnical borings at elevations ranging from approximately 1,742.1 to 1,783.2 feet AMSL, which is approximately 3.6 to 5.8 feet above the anticipated target dewatering depths in the western portion of the alignment. As the water in the lined channel could possibly be feeding the shallow alluvial aquifer due to seepage via expansion joints, depth to groundwater may decrease with closer proximity to the existing channel base, thereby increasing the potential need for additional dewatering during construction of the proposed channel improvements. However, this study cannot confirm this assumption. . In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, it is not likely to require dewatering of more than 3 feet. Ninyo & Moore prepared three groundwater models to simulate the effect of 6 dewatering wells set at 100-foot intervals along a 500-foot transect near B-1, B-6, and B-20 which simulate 500-linear foot cut and fill trenches.

The simulated wells in each model were assumed to be 10 inches in diameter and screened to 10 feet below the target dewatering elevations. The wells were programmed to pump at a constant rate for the duration of each simulation until steady state conditions were achieved.

Based on the hydrogeologic conditions and assumptions described above, the model simulations were performed utilizing the highest estimated hydraulic conductivity values for each end of the proposed excavation (near Pecos Road and near Las Vegas Wash). Based on our hydrogeologic analysis, a combined flow rate ranging from approximately 6 gallons per minute (gpm) to 18 gpm could be expected to lower the water table approximately 5 to 6 feet within an adjacent 500 linear foot trench in the western portion of the alignment. In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, a flow rate of approximately 120 gpm could be expected to lower the water

table approximately 3 feet within an adjacent 500 linear foot trench. These combined flow rates would be less than the 250 gpm threshold limit for a *DeMinimis* discharge permit.

Due to the very limited number of field tests relative to the length of the proposed alignment, the predicted dewatering flow rates should be treated as estimates only and not considered a dewatering design plan. Aquifer conditions may vary across the approximately 10,400 linear feet alignment where hydrogeologic testing was not performed. The hydrogeologic aquifer testing and analyses and modeling are summarized in Appendix C.

5. SUMMARY

A summary of our findings are presented as follows:

- Groundwater was measured in our geotechnical borings at elevations ranging from approximately 1,742.1 to 1,783.2 feet AMSL, which is approximately 3.6 to 5.8 feet above the anticipated target dewatering depths along the western portion of the project alignment. Ninyo & Moore recommends that the client apply for a *DeMinimis* discharge permit.

- As the water in the existing lined channel could possibly be feeding the shallow alluvial aquifer in the area, depth to groundwater may decrease with closer proximity to the channel base, thereby increasing the potential need for additional dewatering during construction of proposed channel improvements.

- Based on our hydrogeologic analysis, a combined flow rate ranging from approximately 6 gpm to 18 gpm could be expected to lower the water table approximately 5 to 6 feet within an adjacent 500 linear foot trench in the western portion of the alignment. In the event that groundwater is encountered during construction of the proposed channel improvements in the eastern portion of the alignment, a flow rate of approximately 120 gpm could be expected to lower the water table approximately 3 feet within an adjacent 500 linear foot trench. These flow rates would be less than the 250 gpm threshold limit for a *DeMinimis* discharge permit. Due to the relatively tight hydraulic conditions measured during this study, a modeled interval of 100-feet between wells was modeled instead of the typical 50-feet interval. If field conditions are found to require a more robust pumping operation, additional wells set at a shorter interval may be necessary.

- Based upon a review of the laboratory results for the groundwater samples collected from the temporary monitoring wells B-1, B-2, B-6 and B-20, the following parameters reported

concentrations above the NDEP recommended discharge limits: Sulfate and Total Dissolved Solids (TDS) in B-1, B-2, B-6 and B-20, and Chloride in B-1 and B-20. Treatment of the discharge waters would not likely be required for a *DeMinimis* permit.

6. OPERATIONAL MONITORING RESPONSIBILITIES

Ninyo & Moore recommends that the following bulleted list of issues be considered prior to commencing with the proposed dewatering operation:

- The NDEP General *DeMinimis* discharge permits, when approved, will be issued to the owner, along with a list of limitations and a compliance reporting schedule. Ninyo & Moore recommends that the owner require the dewatering contractor to fully comply with permit conditions, and be responsible for any violations and penalties incurred due to non-compliance.

- Based on the results of this study, to adequately dewater the proposed excavations as planned, the discharge rate is not likely to exceed the 250 gpm limit for a NDEP *DeMinimis* discharge permit for each outfall.

- During the planned construction, the operation of the dewatering wells should be closely monitored to ensure that all compliance monitoring and testing are performed, as will be required by the NDEP General *DeMinimis* groundwater discharge permit.

- Existing structures within the limits of groundwater drawdown resulting from dewatering may be at risk of experiencing settlement. The amount of settlement, if it occurs, would depend primarily on the depth and duration of the dewatering, as well as subsurface soil conditions. It is recommended that survey points be installed and monitored to evaluate potential settlement of nearby structures and that a photographic survey of the adjacent structures be conducted to monitor evidence of distress prior to the beginning of dewatering operations. If significant movement/damage occurs, dewatering operations should be temporarily suspended and the project's geotechnical consultant/owner's representative should be informed. Recommendations for mitigating settlement and associated distress should be provided by the geotechnical consultant/owner's representative.

- There is a potential for hydrogeologic conditions to be encountered that might require additional dewatering wells, deeper dewatering wells, and/or increased groundwater pumping and increased discharge rates to achieve the dewatering goal for the planned excavations. If an increased discharge rate is required, the NDEP might require from 6 to 9 months for issuing a new permanent NPDES permit for an increased discharge rate for this project.

7. LIMITATIONS

The dewatering discharge estimates provided in this report have been estimated from limited hydrogeologic testing performed at one location. The estimates presented in this report should be used for initial planning purposes and completion of the discharge permit only. The estimates are not presented, nor should they be construed, as a dewatering design plan.

The environmental and hydrological services described in this report have been conducted in general accordance with current regulatory guidelines and the standard of care exercised by consultants performing similar work in the project area. No other warranty, expressed or implied, is made regarding the professional opinions presented in this report. Please note that this study is based on a limited scope of work, and it did not include an extensive evaluation of geotechnical conditions or potential geologic hazards.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Ninyo & Moore should be contacted if the reader requires any additional information or has questions regarding the content, interpretations presented, or completeness of this document.

The findings, opinions, and conclusions are based on an analysis of the observed site conditions and the referenced literature. It should be understood that the conditions of a site could change with time as a result of natural processes or the activities of man at the subject site or nearby sites. In addition, changes to the applicable laws, regulations, codes, and standards of practice may occur due to government action or the broadening of knowledge. The findings of this report may, therefore, be invalidated over time, in part or in whole, by changes over which Ninyo & Moore has no control. Ninyo & Moore cannot warrant or guarantee that not finding indicators of any particular hazardous material means that this particular hazardous material or any other hazardous materials do not exist in the groundwater below the site. Additional research, including additional chemical and hydrological testing, can reduce the uncertainty, but no techniques now commonly employed can eliminate the uncertainty altogether.

8. NEVADA CERTIFIED ENVIRONMENTAL MANAGER

In accordance with the Nevada Revised Statutes 459.500, Section 1, a holder of a certificate who is responsible for a service requiring certification shall ensure that each document relating to the service includes the following language:

> *I, Robert M. Troisi, hereby certify that I am responsible for the services described in this document and for the preparation of this document. The services described in this document have been provided in a manner consistent with the current standards of the profession and to the best of my knowledge comply with all applicable federal, state, and local statutes, regulations, and ordinances.*

Robert M. Troisi, CEM
Certified Environmental Manager
No. 1247
Expires: January 15, 2017

4/15/15
Date

9. REFERENCES

Bouwer, Herman and R.C. Rice, 1976, A Slug Test for determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, v. 12, pp 423-428.

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Ninyo & Moore, 2015, Geotechnical Interpretive Report, Las Vegas Wash Central Cedar Avenue Channel Facility, Las Vegas, Nevada: dated April 10.

Ninyo & Moore, proprietary in-house data.

TABLES

Table 1 –Groundwater Levels

Boring	Approximate Boring Elevation (feet-amsl)	Invert Elevation (feet-amsl)	Approximate Depth to Groundwater (feet)*	Approximate Groundwater Elevation (feet-amsl)	Dewatering Target Depth below Static Groundwater (feet)
B-1	1795.4	1,780.4	12.2	1,783.2	5.8
B-2	1791.6	1,776.6	12.7	1,778.9	5.3
B-3	1783.9	1,773.9	8.2	1,775.7	4.8
B-4	1781.9	1,771.9	8.4	1,773.5	4.6
B-5	1779.6	1,771.6	6.9	1,772.7	4.1
B-6	1778.2	1,769.2	8.4	1,769.8	3.6
B-10	1772.5	1,764.5	13.6	1,758.9	0
B-16	1764.1	1,755.1	13.6	1,750.5	0
B-17	1761.7	1,752.7	15.4	1,746.3	0
B-18	1762.3	1,748.3	18.4	1,743.9	0
B-19	1761.7	1,748.7	18.7	1,743.0	0
B-20	1760.5	1,745.5	18.4	1,742.1	0

*Measured from top of ground surface adjacent to borings.

Table 2 - Groundwater Analytical Results - Metals							
Analyte						Groundwater Standards	
	B-1	B-2	B-6	B-20	Reporting Limit	Federal	RSL
	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)	(mg/l)
Alluminum	3.2	0.12	<0.25	<0.25	0.25		
Antimony	<.0005	<.0005	<.0005	<.0005	0.0005	0.006	0.015
Arsenic	0.0064	0.0047	0.0058	0.0019	0.0001	0.010	0.000045
Barium	0.12	0.012	0.0057	<0.001	0.0010	2	2.6
Beryllium	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.004	0.073
Boron	2.2	0.4	0.78	1.7	0.05		7.3
Cadmium	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.005	0.018
Calcium	310	140	230	260	0.5		
Chromium	0.0047	0.0011	0.0012	<0.001	0.0010	0.1	55
Copper	<0.001	<0.001	<0.001	<0.001	0.0010	1.3	1.5
Iron	1.3	<0.5	<0.5	<0.0005	0.0005	0.30	26
Lead	<0.005	<0.001	<0.001	<0.001	0.001	0.015	
Manganese	0.039	<0.0005	<0.0005	0.0068	0.0005	0.05	0.88
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	0.0002	0.002	0.011
Magnesium	370	200	290	410	0.1		
Molybdenum	0.005	0.012	0.0022	0.094	0.0005		0.18
Nickel	0.0019	<0.001	<0.001	<0.001	0.0010		0.73
Potassium	61	19	39	50	5		
Selenium	0.0068	0.0021	0.0075	0.024	0.001	0.05	0.18
Silver	<0.0005	<0.0005	<0.0005	<0.0005	0.0005	0.1	0.18
Sodium	320	110	220	390	25		
Thallium	<0.0025	<0.0005	<0.0005	<0.0005	0.0005	0.002	0.0024
Zinc	<0.01	<0.01	<0.01	<0.01	0.010	5	11
Chloride	**480**	94	240	**390**	50	250	
Fluoride	1.3	0.96	1.4	2.4	0.5	4	2.20
Nitrogen, Nitrite (as N)	<0.5	<0.5	<0.5	<0.5	0.5	1	1
Nitrogen, Nitrate (as N)	4.5	1	4.4	6.3	0.5	10	10
Sulfate	**2400**	**880**	**1400**	**2200**	200	250	
Sulfur	820	370	630	920	50		
Hardness, Calcium (As $CaCO_3$)	780	340	580	650	0.5		
Hardness, Total	2300	1200	1800	2300	1		
pH (pH units)	7.6	7.6	7.6	7.4			
Suspended Solids (Residue-Non Filterable)	260	21	15	19	10		
Total Disolved Solids (Residue, Filterable)	**4400**	**1700**	**2700**	**4200**	33	500	
Phosphorus, Total	0.047	<0.02	<0.02	0.048	0.020		
Alkalinity, Bicarbonate (As $CaCO_3$)	440	230	240	290	5		
Alkalinity, Carbonate (As $CaCO_3$)	<5	<5	<5	<5	5		
Alkalinity, Hydroxide (As $CaCO_3$)	<5	<5	<5	<5	5		
Alkalinity, Total (As $CaCO_3$)	440	230	240	290	5		
Bio.Oxygen Demand (BOD) - field measurement	2.31	6.24	6.12	0.96			

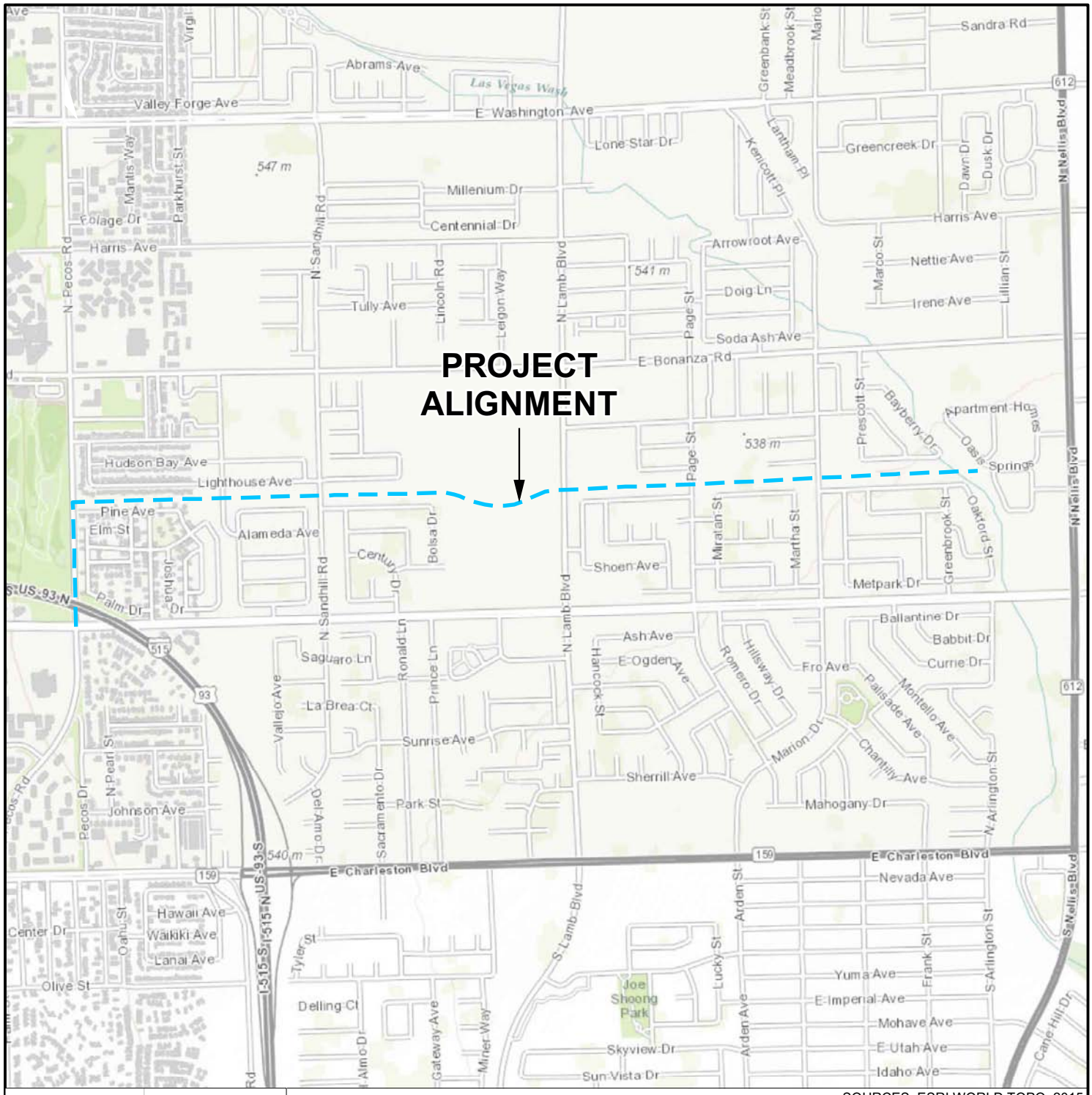
Notes:
RSL - Regional Screening Level

Table 3 - Groundwater Analytical Results - Organics and Biological							
Analyte						Groundwater Standards	
	B-1 (µg/L)	B-2 (µg/L)	B-6 (µg/L)	B-20 (µg/L)	Reporting Limit (µg/L)	Federal (µg/L)	MCL (µg/L)
Benzene	<0.50	<0.50	<0.50	<0.50	0.50	0.39	5.0
Ethylbenzene	<0.50	<0.50	<0.50	<0.50	0.50	1.3	700
m,p-Xylene	<1.0	<1.0	<1.0	<1.0	1.0	190	
Methylene chloride	<2.0	<2.0	<2.0	<2.0	2.0	9.9	5.0
MTBE	<0.50	<0.50	<0.50	<0.50	0.50	12	
o-Xylene	<0.50	<0.50	<0.50	<0.50	0.50	190	
Xylenes, Total	<1.5	<1.5	<1.5	<1.5	1.50		
Tetrachloroethene	<0.50	<0.50	<0.50	<0.50	0.50		
Toluene	<0.50	<0.50	<0.50	<0.50	0.50	860.00	1,000
Trichloroethene	<0.50	<0.50	<0.50	<0.50	0.50		

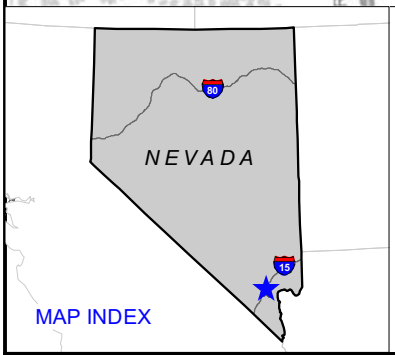
Table 4 - Organochlorine Pesticides and Herbicides							
Analyte						Groundwater Standards	
	B-1	B-2	B-6	B-20	Reporting Limit	Federal	MCL
	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)
4,4'-DDD (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.027	
4,4'-DDE (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.2	
4,4'-DDT (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.2	
Aldrin (1)	<0.027	<0.027	<0.027	<0.027	0.027	0.004	
alpha-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
alpha-Chlordane (1)	<0.027	<0.027	<0.027	<0.027	0.027		
beta-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Chlordane (1)	<0.27	<0.27	<0.27	<0.27	0.27	0.19	2.0
delta-BHD (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Dieldrin (1)	<0.053	<0.053	<0.053	<0.053	0.053	0.0015	
Endosulfan I (1)	<0.027	<0.027	<0.027	<0.027	0.027	78	
Endosulfan II (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endosulfane sulfate (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endrin (1)	<0.053	<0.053	<0.053	<0.053	0.053	1.7	2.0
Endrin aldehyde (1)	<0.053	<0.053	<0.053	<0.053	0.053		
Endrin ketone (1)	<0.053	<0.053	<0.053	<0.053	0.053		
gamma-BHC (1)	<0.027	<0.027	<0.027	<0.027	0.027		
gamma-Chlordane (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Heptachlor (1)	<0.027	<0.027	<0.027	<0.027	0.027	0.0018	0.4
Heptachlor epoxide (1)	<0.027	<0.027	<0.027	<0.027	0.027		
Methoxychlor (1)	<0.27	<0.27	<0.27	<0.27	0.27	27	40
Toxaphene (1)	<2.7	<2.7	<2.7	<2.7	2.7	0.013	3.0
Azinphos-methyl	<2.0	<2.0	<2.0	<2.0	2		
Bulstar (Sulfprofos)	<1.0	<1.0	<1.0	<1.0	1		
Chloropyrifos	<1.0	<1.0	<1.0	<1.0	1	6.200	
Coumaphos	<2.0	<2.0	<2.0	<2.0	2		
Demeton-O & S	<1.0	<1.0	<1.0	<1.0	1		
Diazinon	<1.0	<1.0	<1.0	<1.0	1	7.900	
Dichlorvos	<1.0	<1.0	<1.0	<1.0	1	0.230	
Disulfoton	<1.0	<1.0	<1.0	<1.0	1	0.380	
Ethoprop	<1.0	<1.0	<1.0	<1.0	1		
Fensulfothion	<1.0	<1.0	<1.0	<1.0	1		
Fenthion	<1.0	<1.0	<1.0	<1.0	1		
Malathion	<1.0	<1.0	<1.0	<1.0	1	300.000	
Merphos	<1.0	<1.0	<1.0	<1.0	1		
Methyl parathion	<1.0	<1.0	<1.0	<1.0	1	3.400	
Mevinphos	<2.0	<2.0	<2.0	<2.0	2		
Naled	<2.0	<2.0	<2.0	<2.0	2	31.000	
Phorate	<1.0	<1.0	<1.0	<1.0	1	2.300	
Ronnel	<1.0	<1.0	<1.0	<1.0	1	300.000	
Tetrachlor0vinphos	<1.0	<1.0	<1.0	<1.0	1		
Tokuthion	<1.0	<1.0	<1.0	<1.0	1		
Trichloronate	<1.0	<1.0	<1.0	<1.0	1		

Notes:
(1) - EPA Method 8081A
MCL - Maximum Contaminant Level

FIGURES



SOURCES: ESRI WORLD TOPO, 2015



N

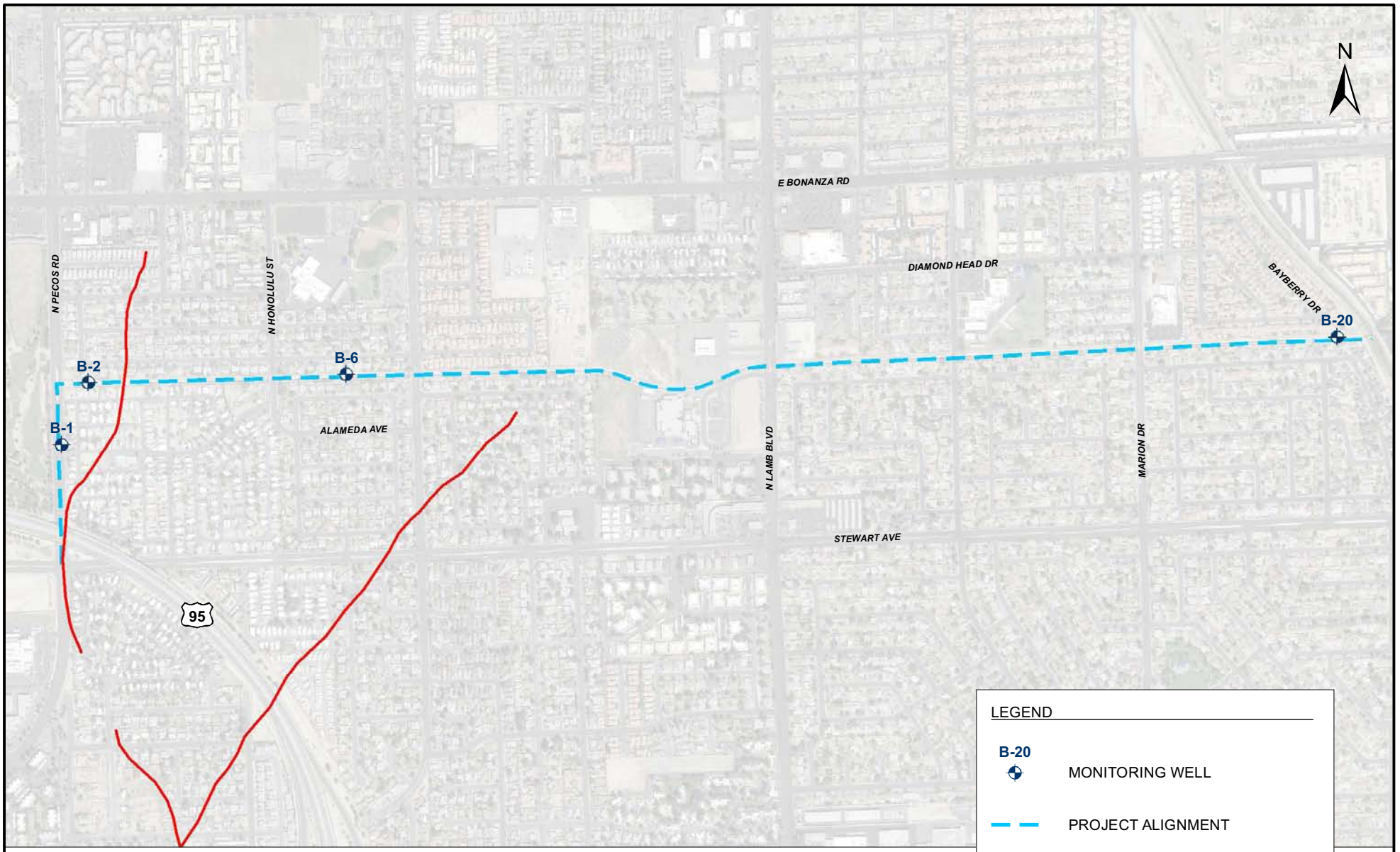
SCALE IN FEET

0 1,500 3,000

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE

Ninyo & Moore	ALIGNMENT LOCATION	FIGURE
PROJECT NO. 303710002 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	1

1_303710002_SL.mxd 4/14/2015 10:25:03 AM JDL



SOURCE: DEPOLO, C.M. AND BELL, J.W., 2000, MAP OF FAULTS AND EARTH FISSURES IN THE LAS VEGAS AREA (NEVADA BUREAU OF MINES AND GEOLOGY); GOOGLE EARTH, 2015

NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

SCALE IN FEET

0 1,000 2,000

Ninyo & Moore	MONITORING WELL LOCATIONS	FIGURE
PROJECT NO. 303710002 / DATE 4/15	LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL FACILITY LAS VEGAS, NEVADA	2

2_303710002_BL.mxd 4/14/2015 JDL

COUNTY RECORDER'S NOTE

ANY SUBSEQUENT CHANGES TO THIS MAP SHOULD BE EXAMINED AND MAY BE DETERMINED BY REFERENCE TO THE COUNTY RECORDER'S CUMULATIVE MAP INDEX NRS 278.5695

RECORD OF SURVEY FOR

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

LOCATED IN SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.

NEVADA COORDINATE REFERENCE SYSTEM BASIS OF BEARING AND DATUM STATEMENT

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWICH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS2011) EPOCH 20010.00.

TRANSVERSE MERCATOR PROJECTION

STANDARD PARALLEL & GRID ORIGIN:	36°15'00"N
CENTRAL MERIDIAN:	114°58'00"W
FALSE NORTHING:	200,000m 656,166.6667 FEET(US)
FALSE EASTING:	100,000m 328,083.3333 FEET(US)
STANDARD PARALLEL SCALE:	1.0001 (EXACT)

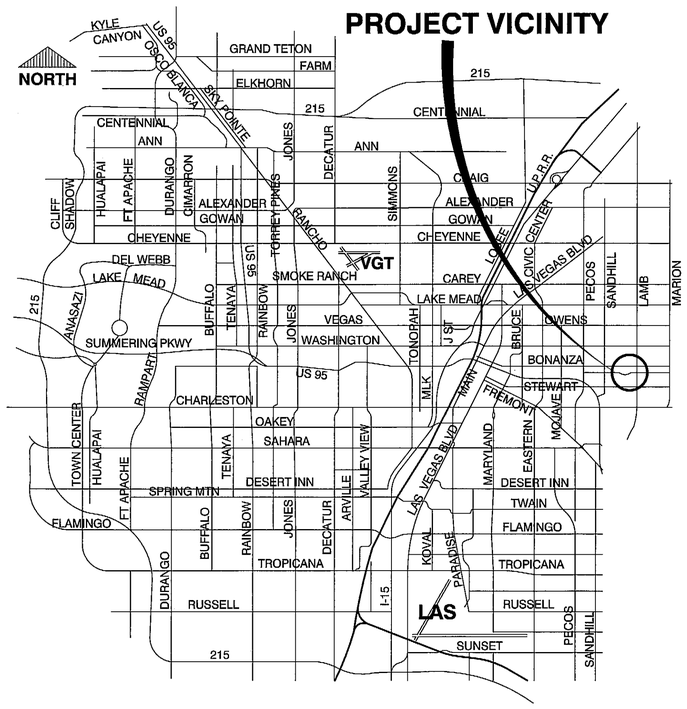
NOTE:

BEARINGS AND DISTANCES SHOWN HEREON ARE BASED ON THE "RESULTANT COORDINATES" TABLE. "RESULTANT COORDINATES" REPRESENT THE MATHEMATICAL LOCATION OF THE MONUMENTS BASED ON BEST FIT LINES OR ARCS AS DETERMINED BY A COMBINATION OF "COLLECTED COORDINATES" AND RECORD INFORMATION.

"COLLECTED COORDINATES ARE POSITIONS OF MONUMENTS AS LOCATED DURING THE FIELD SURVEY FOR THE PROJECT AS DETERMINED BY GPS AND CONVENTIONAL SURVEY METHODS.

NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NAD83 (COR2011) EPOCH 2010.00

COLLECTED COORDINATE TABLE					RESULTANT COORDINATE	
POINT NO.	DESCRIPTION	ELEVATION	NORTHING	EASTING	NORTHING	EASTING
151	RM-48.03	1790.72	628377.60	290028.12	628377.60	290028.12
152	RM-63.54	1790.07	628288.32	290092.31	628288.32	290092.31
219	1 1/2 IN. ALCAP, ILLEGIBLE	1774.82	628322.92	294499.56	628322.92	294499.56
255	1 1/2 IN. ALCAP, ILLEGIBLE	1786.60	628331.75	290824.12	628331.75	290824.12
256	RM-72.66, NO PLS	1783.14	628267.17	291906.20	628267.17	291906.20
257	RM-68.67, NO PLS	1783.33	628281.96	291818.51	628281.96	291818.51
258	RM-70.11, NO PLS	1783.41	628388.42	291831.02	628388.42	291831.02
259	RM-72.38, NO PLS	1783.08	628390.85	291906.33	628390.85	291906.33
261	2 1/2 IN. BRASS CAP, PLS 6015	1771.61	628374.20	295847.70	628374.20	295847.70
262	2 1/2 IN. BRASS CAP IN WELL, PLS 9390	1766.73	628425.51	297195.89	628425.51	297195.89
263	NAIL/TAG-PLS 1863	1766.80	628455.42	297979.16	628455.35	297979.16
265	2 IN. BRASS CAP, PLS 5835	1762.14	628528.31	299894.54	628528.31	299894.54
269	1 1/2 IN. ALCAP, ILLEGIBLE	1758.19	625729.89	295858.63	625729.91	295858.63
270	1 1/2 IN. ALCAP, PLS 4046	1757.66	625733.59	296114.21	625733.56	296114.21
271	2 IN. ALCAP, PLS 12469	1755.31	625749.10	297202.07	625749.10	297202.07
272	RM-57.86, PLS 8488	1758.11	625804.35	297932.59	625804.35	297932.59
273	RM-59.06, PLS 8488	1758.05	625805.33	298007.16	625805.33	298007.16
274	RM-67.95, PLS 8488	1757.90	625715.53	298021.07	625715.53	298021.07
275	RM-71.19, PLS 8488	1757.95	625714.15	297914.95	625714.15	297914.95
276	RM-71.19, PLS 8488	1755.28	625768.98	298558.81	625768.03	298558.82
277	1 1/2 IN. ALCAP, ILLEGIBLE	1752.69	625774.54	299022.99	625774.50	299022.99
278	2 IN. BRASS CAP IN WELL, PLS 7635	1750.09	625786.95	299915.24	625786.95	299915.24
279	2 IN. BRASS CAP, PLS 7635	1755.46	627157.59	299904.91	627157.59	299904.89
280	1 1/2 IN. ALCAP, PLS 7635	1758.68	627843.06	299899.72	627843.06	299899.71
281	2 IN. BRASS CAP IN WELL, PLS 10598	1753.82	623035.03	294563.73	623035.03	294563.73
283	3 1/2 IN. NDOT BRASS CAP	1758.33	624336.57	294520.83	624336.57	294520.83
284	2 IN. BRASS CAP IN WELL, PLS 10598	1765.15	623013.82	291922.81	623013.82	291922.81
300	RM-70.41/66.39, PLS 8421	1776.41	627209.83	291913.25	627209.83	291913.25
301	RM-61.83/56.82, PLS 8421	1775.25	627097.49	291914.45	627097.49	291914.45
302	RM-57.82, PLS 8421	1774.26	627099.85	291847.49	627099.85	291847.49
303	RM-55.81, PLS 8421	1775.70	627193.49	291846.54	627193.49	291846.54
306	1 1/2 IN. ALCAP, ILLEGIBLE	1766.40	627713.10	295845.45	627713.10	295845.45
307	1 1/2 IN. VTN ALCAP, ILLEGIBLE	1760.06	626924.69	297199.51	626924.69	297199.36
309	2 1/2 IN. VTN BRASS CAP, RLS 4046	1761.25	627249.65	297198.59	627249.65	297198.61
310	2 IN. CLV ALCAP, NOT STAMPED	1756.06	625924.51	297201.59	625924.51	297201.67
311	2 1/2 IN. VTN BRASS CAP, RLS 4046	1757.17	626175.59	297201.07	626175.59	297201.09
312	1 1/2 IN. ALCAP, PLS 9105	1763.27	627756.29	297197.52	627756.28	297197.44
313	1 1/2 IN. VTN ALCAP, ILLEGIBLE	1766.66	628263.32	297196.33	628263.32	297196.27
515	2 IN. BRASS CAP, NO PLS	1796.30	626995.41	289247.24	626995.41	289247.24
516	3.5 IN. ALCAP, ILLEGIBLE	1792.74	625655.14	289249.74	625655.14	289249.74
538	RM-91.17	1795.78	628415.90	289288.34	628415.90	289288.34
539	RM-80.68	1796.49	628402.10	289198.92	628402.10	289198.92
540	RM-83.97	1797.03	628293.80	289172.27	628293.80	289172.27
587	PK & BRASS TAG, ??? 6204	1782.96	627622.11	290831.28	627622.11	290831.28



VICINITY MAP
N.T.S.

SURVEYOR'S CERTIFICATE

I, ERIC CHRISTIANSON, A PROFESSIONAL LAND SURVEYOR LICENSED IN THE STATE OF NEVADA, CERTIFY THAT:

1. THIS PLAT REPRESENTS THE RESULTS OF A SURVEY CONDUCTED UNDER MY DIRECT SUPERVISION AT THE INSTANCE OF THE CITY OF LAS VEGAS
2. THE LANDS SURVEYED LIE WITHIN SECTIONS 31 AND 32 TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA AND THE SURVEY WAS COMPLETED ON MARCH 20, 2015.
3. THIS PLAT COMPLIES WITH THE APPLICABLE STATE STATUTES AND ANY LOCAL ORDINANCES IN EFFECT ON THE DATE THAT THE GOVERNING BODY GAVE ITS FINAL APPROVAL.
4. THE MONUMENTS DEPICTED ON THE PLAT ARE OF THE CHARACTER SHOWN, OCCUPY THE POSITIONS INDICATED AND ARE OF SUFFICIENT NUMBER AND DURABILITY.

ERIC CHRISTIANSON
PROFESSIONAL LAND SURVEYOR
STATE OF NEVADA
NEVADA LICENSE No. 8895

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTIANSON
Exp. 12-31-16
No. 8895

8/14/15

BENCHMARK:

CITY OF LAS VEGAS BENCHMARK:
1LV02 32N6

RIVET & PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO.

NAVD 1988 DATUM
ELEVATION = 536.414 METERS
1759.89 FEET

CLV GRID PROJ. NO. 49866

SHEET 1 OF 3

RECORD OF SURVEY

PORTIONS OF SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

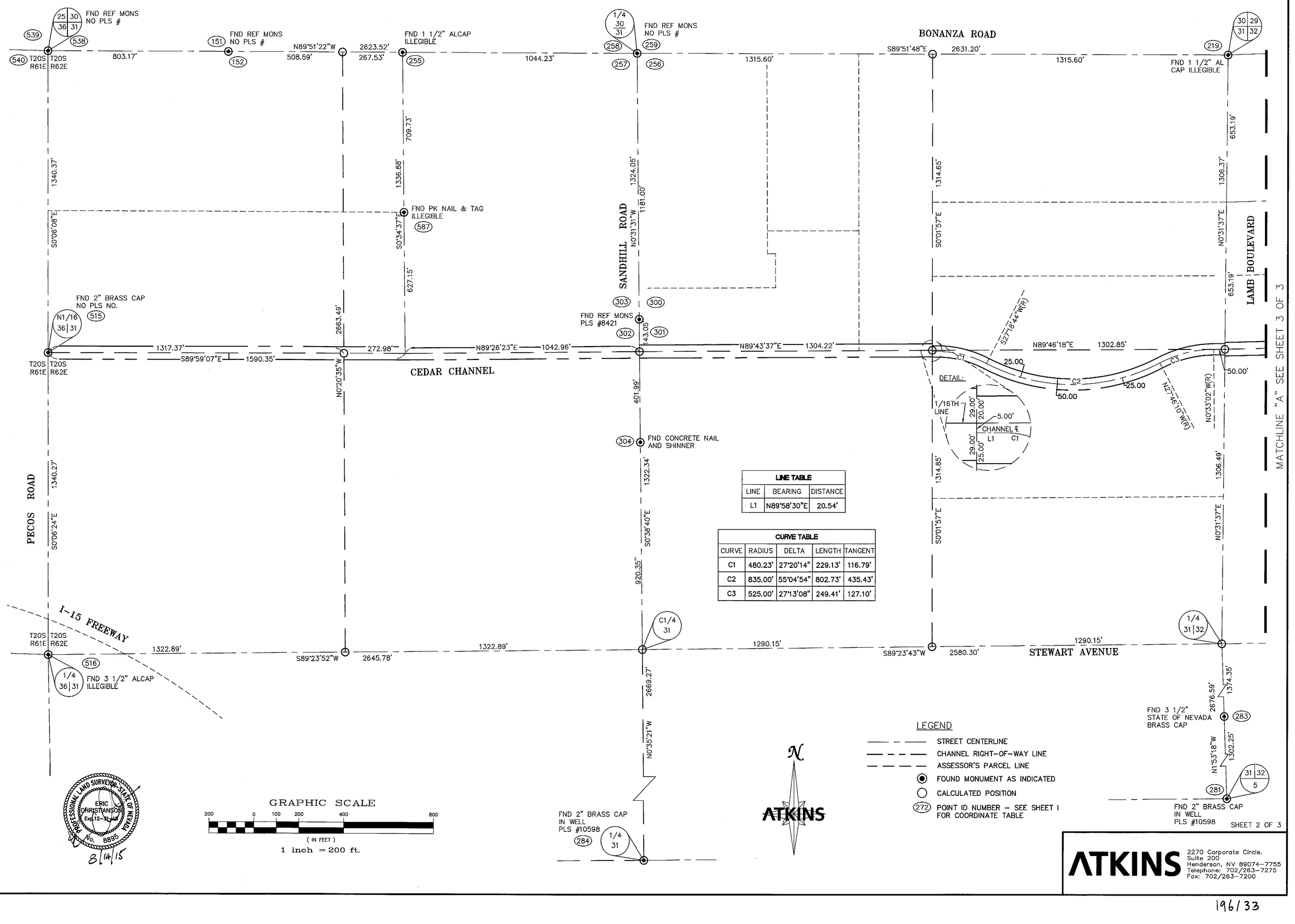
ATKINS
2270 Corporate Circle.
Suite 200
Henderson, NV 89074-7755
Telephone: 702/263-7275
Fax: 702/263-7200

No. 1619
Filed at the request of Atkins North America, Inc.
Date 08/14/15 *Time* 15:06
File 196 *Page* 33
of SURVEYS
Official Records Book No. 20150814
Clark County, Nevada Records
DEBBIE CONWAY, Recorder
Fee 44— *Deputy* GlorD

RECORD OF SURVEY FOR

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

LOCATED IN SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.



LINE TABLE		
LINE	BEARING	DISTANCE
L1	N89°58'30"E	20.54'

CURVE TABLE				
CURVE	RADIUS	DELTA	LENGTH	TANGENT
C1	480.23'	27°20'14"	229.13'	116.79'
C2	835.00'	55°04'54"	802.73'	435.43'
C3	525.00'	27°13'08"	249.41'	127.10'

LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED
- CALCULATED POSITION
- (272) POINT ID NUMBER – SEE SHEET 1 FOR COORDINATE TABLE

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTIANSON
Exp. 12-31-16
No. 8895
8/14/15

GRAPHIC SCALE

200 0 100 200 400 800
(IN FEET)
1 inch = 200 ft.

N

ATKINS

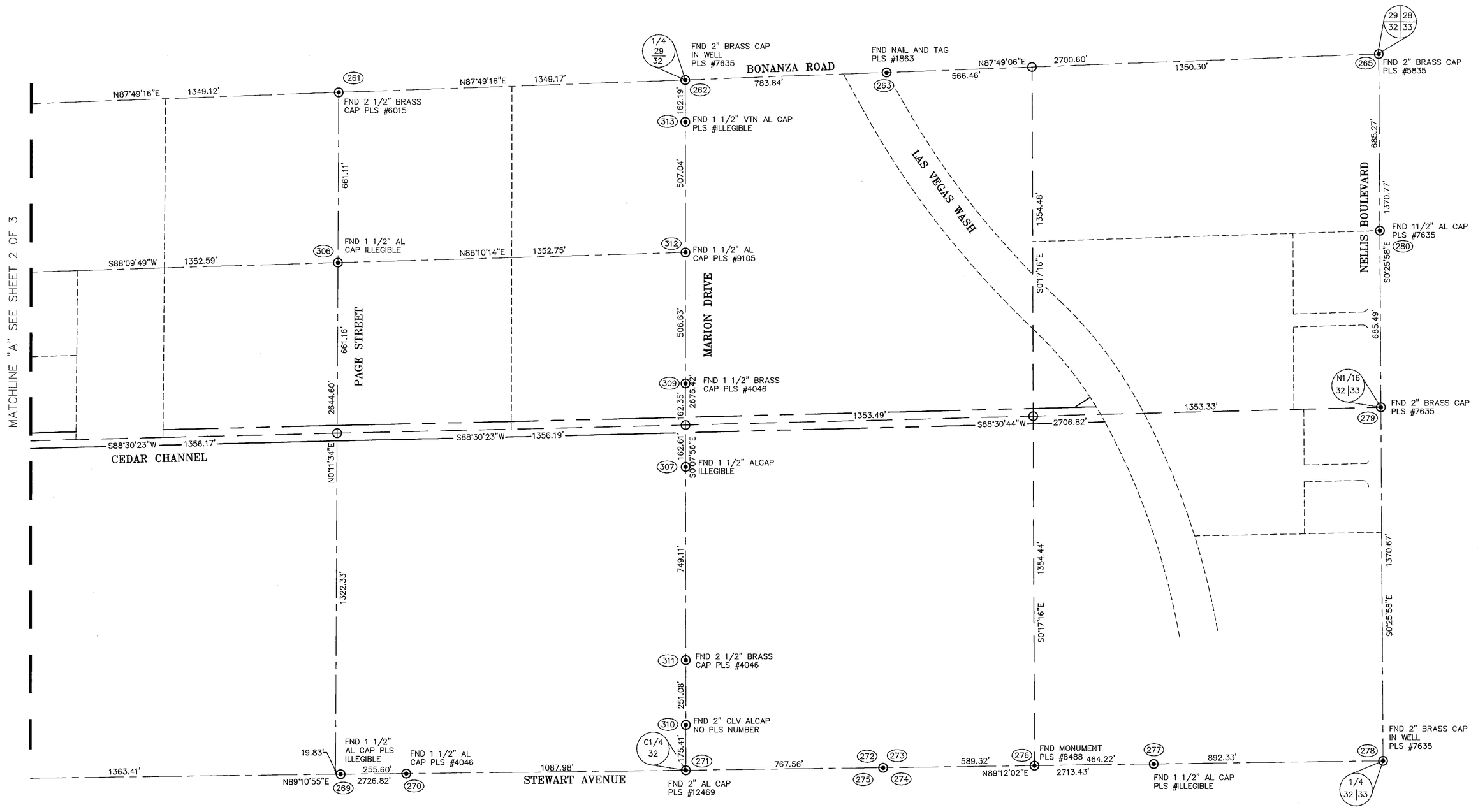
ATKINS
2270 Corporate Circle.
Suite 200
Henderson, NV 89074-7755
Telephone: 702/263-7275
Fax: 702/263-7200

196/33

RECORD OF SURVEY FOR

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

LOCATED IN SECTIONS 31 AND 32, TOWNSHIP 20 SOUTH, RANGE 62 EAST, M.D.M., CITY OF LAS VEGAS, CLARK COUNTY, NEVADA.



PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTIANSON
Exp.12-31-16
No. 8895
8/14/15

ATKINS

N

GRAPHIC SCALE

200 0 100 200 400 800

(IN FEET)

1 inch = 200 ft.

LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED
- CALCULATED POSITION
- (272) POINT ID NUMBER – SEE SHEET 1 FOR COORDINATE TABLE

SHEET 3 OF 3

ATKINS
2270 Corporate Circle.
Suite 200
Henderson, NV 89074-7755
Telephone: 702/263-7275
Fax: 702/263-7200

196/33

Appendix F

Utility Conflict Schedule And Test Holes

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - MAINLINE

PROJECT: Las Vegas Wash Central Cedar Avenue Channel PREPARED BY: KRM DATE: 11/18/2016

PROJECT NO.: 100039014 CHECKED BY: DATE:

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA		SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
SD01	13+06.72	0'				UGP	1791.73	1791.06		TH#11	2 -8'X5' RCB	1793.07	1786.74	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+19.86	0'				1-1/4" STREETLIGHT	1791.97	1791.80		TYPICAL DEPTH	2-8'X5' RCB	1793.07	1786.74	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+21.18	0'				2" ITS	1791.89	1791.64		TH#13	2-8'X5' RCB	1793.02	1786.68	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+44.17	0'				10" HP STL GAS	1789.01	1788.18		TH#14 & TH#15	2-8'X5' RCB	1792.96	1786.63	0.83	0.83		0.00'	YES	RELOCATE
SD01	13+21.18	0'				2" ITS	1790.18	1790.02		TYPICAL DEPTH	2-8'X5' RCB	1793.07	1786.74	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+52.19	0'				2" ITS	1790.21	1790.04		TYPICAL DEPTH	2-8'X5' RCB	1793.07	1786.74	0.5	0.5		0.00'	YES	RELOCATE
SD01	13+59.55	0'				36" RCP SS	1785.83	1782.83		TH#16 & TH#18	2-8'X5' RCB	1792.86	1786.53	0.5	0.5		0.49'	NO	PROTECT-IN-PLACE
SD01	13+73.21		TO	14+16.42		72" RCP SD W/ CONC CAP					18'X5' RCB					0'		YES	REMOVE EX 72" RCP SD
SD01	15+38.16	0'				24" STORM DRAIN	1789.68	1787.18		MH DIPS	18'X5' RCB	1791.41	1784.24					YES	CONNECT TO SD
SD01	15+88.70	0'				2" ITS	1790.44	1790.27		TYPICAL DEPTH	18'X5' RCB	1790.16	1783.99	0.5	0.5		0.11'	NO	RELOCATE
SD01	17+74.07		TO	19+00.00		72" RCP STORM DRAIN					12'X6' RCB					0'		YES	REMOVE EX 72" RCP SD
SD01	18+50.10					UGP	1790.46	1790.13		TYPICAL DEPTH	12'X6' RCB	1789.49	1781.49	0.5	0.5		1.96'	NO	PROTECT-IN-PLACE
SD02	19+00.00		TO	27+00.00		72" RCP STORM DRAIN					12'X6' RCB					0'		YES	REMOVE EX 72" RCP SD
SD02	25+65.78	0'				1-1/4" STREETLIGHT	1793.92	1793.75		TYPICAL DEPTH	12'X6' RCB	1786.63	1778.63	0.5	0.5		7.12'	NO	PROTECT-IN-PLACE
SD03	27+00.00		TO	31+25.16		72" RCP STORM DRAIN					12'X6' RCB					0'		YES	REMOVE EX 72" RCP SD
SD04	42+05.00	33.0' LT	TO	43+16.00	33.0' LT	1-1/4" STLT					ACCESS RAMP					6.5'		NO	PROTECT-IN-PLACE
SD05	52+00.00	32.9' LT	TO	54+50.00	30.3' LT	1-1/4" STLT					36' CHANNEL					11.45'		NO	PROTECT-IN PLACE
SD06	59+65.75	23.2' LT	TO	62+00.00	22.3' LT	4" UGP					CHANNEL TRANSITION					5.0'		NO	PROTECT-IN-PLACE
SD07	62+00.00	22.3' LT	TO	68+00.00	20.6' LT	4" UGP					31' CHANNEL					4.0'		NO	PROTECT-IN-PLACE
SD08	68+00.00	20.6' LT	TO	75+00.00	22.1' LT	4" UGP					31' CHANNEL					3.7'		NO	PROTECT-IN-PLACE
SD09	75+00.00	22.1' LT	TO	77+46.07	25.9' LT	4" UGP					31' CHANNEL					4.3'		NO	PROTECT-IN-PLACE
SD09	77+83.50	16.5' RT	TO	77+83.71	16.48' LT	12" VCP SS	1763.00	1762.00			DUAL 15'X6' RCB	1771.00	1763.00			10'		YES	RELOCATE MH AND REPROFILE SS
SD09	78+15.17	16.5' RT	TO	78+15.42	16.5' LT	36" STL WATER	1774.59	1758.55		TH#33,34,35	DUAL 15'X6' RCB	1771.00	1763.00			10'		YES	RELOCATE
SD09	79+53.73	30.0' LT	TO	80+51.59	29.3' LT	4" UGP					ACCESS RAMP					0.9'		YES	RELOCATE
SD11	92+58.58	33.2' LT	TO	93+60.55	29.5' LT	4" UGP					ACCESS RAMP					1'		YES	RELOCATE
SD14	118+77.65	0'				6" & 8" PVC SEWER					25' CHANNEL		1744.46						RELOCATED BY OTHERS

DEPARTMENT OF PUBLIC WORKS - DESIGN ENGINEERING DIVISION

UTILITY CONFLICT SCHEDULE - LATERALS

PROJECT: Las Vegas Wash Central Cedar Channel PREPARED BY: KRM DATE: 11/18/2016

PROJECT NO.: 100039014 CHECKED BY: DATE:

SHEET	LOCATION					UTILITY	ELEVATION		SOURCE OF INFO		IMPROVEMENT	ELEVATION		REQ. CLEARANCE		PLANS CLEARANCE		CONFLICT?	
NO.	STA	OFFSET	TO	STA		SIZE AND TYPE	TOP	BOTTOM	POTHOLE	OTHER	SIZE AND TYPE	TOP	BOTTOM	TOP	BOTTOM	H	V	YES OR NO	RESOLUTION
LATERAL 01																			
LAT-01	10+07.12	4.4' LT				18" ACP WATER	1786.62	1785.12		TH#29	8'X4' RCB SD	1792.99	1787.65	1.5	1.5		1.03'	YES	RELOCATE WATERLINE DUE TO HORIZONTAL CLEARNACE FROM DI
LAT-01	10+11.25	6.0' LT				4" HP STL GAS	1790.22	1789.89		TH#2	8'X4' RCB SD	1792.96	1787.63	0.83	0.83			YES	RELOCATE
LAT-01	10+27.18					PROPOSED 21" SS (BY OTHERS)	1785.60	1783.68		PER CADD FILES	8'X4' RCB SD	1792.88	1787.55	0.83	0.83			NO	PROTECT-IN-PLACE
LAT-01	10+48.71	4.0' LT				STREETLIGHT CONDUIT	1792.90	1792.65		TH#6	8'X4' RCB SD	1792.78	1787.44	0.5	0.5			YES	RELOCATE
LAT-01	10+49.71	4.0' LT				TRAFFIC SIGNAL/ITS CONDUIT	1792.90	1792.65		TH#6	8'X4' RCB SD	1792.78	1787.44	0.5	0.5			YES	RELOCATE
LAT-01	10+68.80					18" PVC BOMO FM	1785.05	1783.49		PER CADD FILES	8'X4' RCB SD	1792.97	1787.34	0.5	0.5		2.29'	NO	PROTECT-IN-PLACE
LAT-01	10+79.52					8" VCP SS	1787.53	1786.81		MH DIPS	8'X4' RCB SD	1792.99	1787.65	0.5	0.5			YES	TO BE REMOVED BY OTHERS
LAT-01	10+80.89					24" RCP SD	1790.80	1788.30		MH DIPS	8'X4' RCB SD	1792.63	1787.29						CONNECT TO RCB SD
LATERAL 02																			
LAT-02	10+04.82					18" ACP WATER	1785.45	1783.95		BOMO TH*	7'X3' RCB SD	1791.83	1787.50	1.5	1.5		2.05'	NO	RELOCATE WATERLINE DUE TO HORIZONTAL CLEARNACE FROM DI
LAT-02	10+11.54	1.3' LT				4" HP STL GAS	1789.22	1788.89		TH#3	7'X3' RCB SD	1791.80	1787.46	0.83	0.83			YES	RELOCATE
LAT-02	10+25.69					PROPOSED 21" SS (BY OTHERS)	1785.60	1783.60		PER CADD FILES	7'X3' RCB SD	1791.73	1787.39	0.5	0.5		1.80'	NO	PROTECT-IN-PLACE
LAT-02	10+48.45	1.8' RT				STREETLIGHT CONDUIT	1792.50	1792.25		TH#7	7'X3' RCB SD	1791.61	1787.28	0.5	0.5		0.64'	NO	PROTECT-IN-PLACE
LAT-02	10+48.45	1.8' RT				TRAFFIC SIGNAL CONDUIT	1792.50	1792.25		TH#7	7'X3' RCB SD	1791.61	1787.28	0.5	0.5		0.64	NO	PROTECT-IN-PLACE
LAT-02	10+68.78					18" PVC BOMO FM	1784.97	1783.40		PER CADD FILES	7'X3' RCB SD	1791.51	1787.18	0.5	0.5		2.21'	NO	PROTECT-IN-PLACE
LAT-02	10+79.63					8" VCP SS	1787.17	1786.49		MH DIPS	7'X3' RCB SD	1791.46	1787.12	0.5	0.5		0.12'	YES	TO BE REMOVED BY OTHERS
LATERAL 03																			
LAT-03	10+04.83					18" ACP WATER	1785.19	1783.69		BOMO TH*	5X3' RCB SD	1791.56	1787.56	1.5	1.5		2.20'	NO	RELOCATE WATERLINE DUE TO HORIZONTAL CLEARNACE FROM DI
LAT-03	10+11.65	3.5' LT				4" HP STL GAS	1786.82	1786.48		TH#5	5X3' RCB SD	1791.53	1787.53	0.83	0.83		0.00'	YES	RELOCATE
LAT-03	10+24.19					PROPOSED 21" SS (BY OTHERS)	1785.60	1783.53		PER CADD FILES	5X3' RCB SD	1791.46	1787.46	0.5	0.5		1.87'	NO	PROTECT-IN-PLACE
LAT-03	10+47.40					STREETLIGHT CONDUIT	1791.94	1791.69		TYPICAL DEPTH	5X3' RCB SD	1791.35	1787.35	0.5	0.5		0.34'	YES	RELOCATE
LAT-03	10+47.40					TRAFFIC SIGNAL CONDUIT	1791.94	1791.69		TYPICAL DEPTH	5X3' RCB SD	1791.35	1787.35	0.5	0.5		0.34	YES	RELOCATE
LAT-03	10+68.81					18" PVC BOMO FM	1784.90	1783.33		PER CADD FILES	5X3' RCB SD	1791.24	1787.24	0.5	0.5		2.34'	NO	PROTECT-IN-PLACE
LAT-03	10+79.75					8" VCP SS	1786.85	1786.19		MH DIPS	5X3' RCB SD	1791.18	1787.18	0.5	0.5		0.33'	YES	TO BE REMOVED BY OTHERS
LATERAL 04																			
LAT-04	10+00.00	0.0'	TO	10+61.93	6.3' LT	DUAL 48" RCP SD					8'X4' RCB SD							YES	REMOVE EX SD
LAT-04	10+32.43					2" ITS	1790.25	1790.08		TYPICAL DEPTH	8'X4' RCB SD	1791.61	1786.28					YES	RELOCATE
LAT-04	10+34.00					2" ITS	1790.25	1790.08		TYPICAL DEPTH	8'X4' RCB SD	1791.61	1786.27					YES	RELOCATE

Las Vegas Wash Central
Cedar Avenue Channel

Test Hole Summary Table

TH NO.	UTILITY			DEPTH TO TOP	DEPTH TO BOTTOM	TOP ELEV.	STATION	OFFSET
	TYPE	MATERIAL	DIA. (IN)	(FT)	(FT)			
TH1	GAS	STL	4	3.60	N/A	1790.67	11+02.19	92.55' RT
TH2	GAS	STL	4	3.99	N/A	1790.22	11+17.90	95.64' RT
TH3	GAS	STL	4	4.42	N/A	1789.22	12+41.45	109.28' RT
TH4	UGP	PVC	(4)-6"	5.20	N/A	1788.54	12+64.50	135.99' RT
TH5	GAS	STL	4	6.48	N/A	1786.82	12+65.90	110.32' RT
TH6	UGP	PVC	(1)-1", (1)-2"	2.37	N/A	1792.90	11+45.75	70.52' RT
TH7	UGP	PVC	(1)-1", (1)-2"	2.21	N/A	1792.50	12+44.45	72.37' RT
TH8	UGP	PVC	(1)-1", (1)-2"	2.38	N/A	1791.94	12+66.42	74.56' RT
TH9	UGP	PVC	8	3.55	N/A	1791.00	12+51.76	19.63' RT
TH10	UGP	PVC	8	4.08	N/A	1790.89	12+80.46	16.53' RT
TH11	UGP	PVC	8	3.74	N/A	1791.73	13+06.72	0.98' LT
TH12	FO	PVC	(1)-1", (1)-2"	2.46	N/A	1791.53	13+21.18	2.71' RT
TH13	FO	PVC	3	2.15	N/A	1791.89	13+21.40	1.41' LT
TH14	HP GAS	STL	10	4.37	N/A	1789.08	13+34.74	10.28' RT
TH15	HP GAS	STL	10	4.56	N/A	1788.94	13+51.90	7.67' LT
TH16	SS	RCP	36	7.48	N/A	1785.82	13+47.60	11.79' RT
TH17	UGP	PVC	3	2.16	N/A	1791.45	13+52.43	14.44' LT
TH18	SS	RCP	36	7.60	N/A	1785.84	13+68.56	8.89' LT
TH20	UGP	PVC	4	4.31	N/A	1790.46	18+50.10	1.35' RT
TH21	UGP	PVC	1.25	2.69	N/A	1777.17	42+52.29	34.05' LT
TH22	UGP	PVC	1.25	2.37	N/A	1773.66	53+03.99	33.74' LT
TH23	UGP	PVC	4	3.32	N/A	1770.72	60+41.63	26.48' LT
TH24	UGP	PVC	(1)-4", (1)-1.25"	3.68	N/A	1769.03	66+96.88	20.62' LT
TH25	UGP	PVC	(1)-4", (1)-1.25"	3.86	N/A	1767.36	74+04.60	20.66' LT
TH26	UGP	PVC	(1)-4", (1)-1.25"	3.91	N/A	1766.95	79+96.64	32.35' LT
TH27	UGP	PVC	(1)-4", (1)-1.25"	2.99	N/A	1762.09	92+95.93	34.47' LT
TH29	WATER	STL	18	7.50	N/A	1794.12	11+16.06	99.65' RT
TH31	UGP	PVC	(1)-1", (3)-2"	1.95	N/A	1791.11	12+87.19	106.85' RT
TH32	HP GAS	STL	10	5.71	N/A	1787.20	12+96.49	115.02' RT
TH34	WATER	STL	36	10.75	N/A	1761.55	78+15.52	9.10' LT
TH35	WATER	STL	36	6.71	N/A	1765.62	78+15.55	22.81' LT

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-1	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

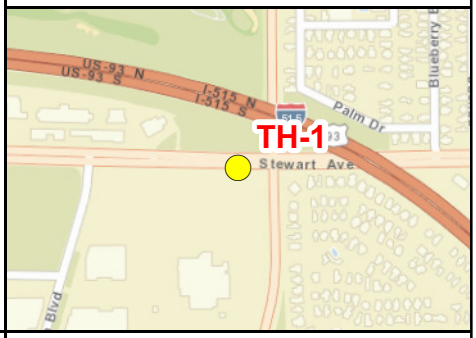
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nails
Depth to Top:	3.60	**Top Ref. Level:**	9.04	**Hand Meas. Top:**	3.65
Depth to Bottom:	3.93	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1790.673	**Mkr. Ref. Level:**	5.44	**Ref. Elevation:**	1794.273
Bottom Elevation:	1790.340	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 3.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	104.50
B	Power Pole	79.50
C	Street Light	46.50

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-2	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

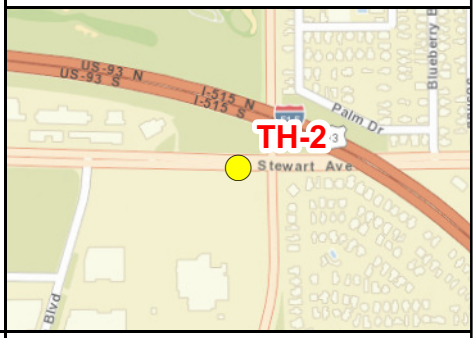
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nails
Depth to Top:	3.99	**Top Ref. Level:**	9.44	**Hand Meas. Top:**	4.00
Depth to Bottom:	4.32	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1790.221	**Mkr. Ref. Level:**	5..45	**Ref. Elevation:**	1794.211
Bottom Elevation:	1789.888	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 12.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	91.00
B	Power Pole	69.00
C	Street Light	40.80

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-3	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

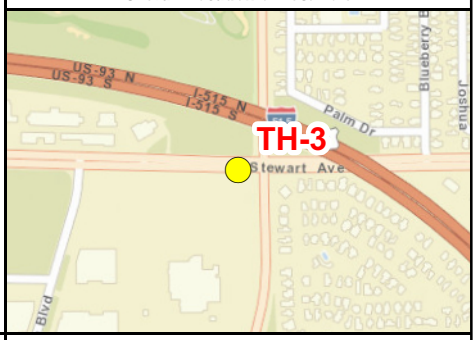
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	8 Inches	**Marker Type:**	Saw Cut
Depth to Top:	4.42	**Top Ref. Level:**	9.72	**Hand Meas. Top:**	4.40
Depth to Bottom:	4.75	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1789.221	**Mkr. Ref. Level:**	5.30	**Ref. Elevation:**	1793.641
Bottom Elevation:	1788.888	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 12.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	98.70
B	Traffic Signal	92.50
C	Power Pole	31.50

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-4	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

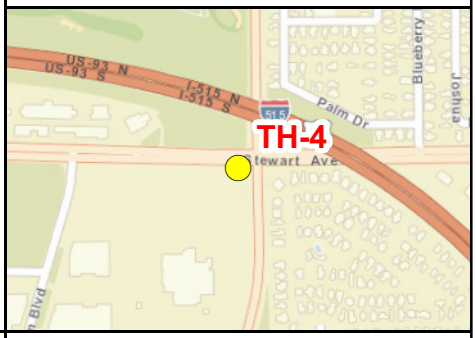
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	(4) 6 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Natural	**Thickness:**	N/A	**Marker Type:**	5/8 rebar & cap
Depth to Top:	5.20	**Top Ref. Level:**	9.73	**Hand Meas. Top:**	5.15
Depth to Bottom:	7.2	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1788.536	**Mkr. Ref. Level:**	4.53	**Ref. Elevation:**	1793.736
Bottom Elevation:	1786.536	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 13.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	107.00
B	Traffic Signal	47.70
C	Power Pole	11.50

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-5	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

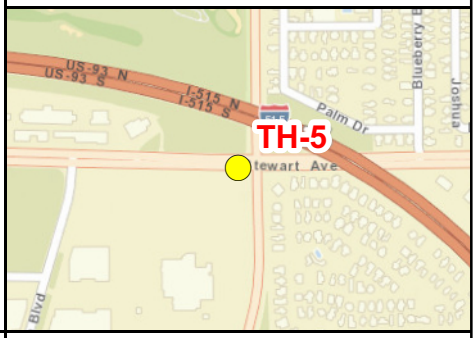
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Gas	**Utility Size:**	4 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Slurry
Surface Type:	Concrete	**Thickness:**	8 Inches	**Marker Type:**	Saw Cut
Depth to Top:	6.48	**Top Ref. Level:**	12.02	**Hand Meas. Top:**	6.55
Depth to Bottom:	6.81	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1786.817	**Mkr. Ref. Level:**	5.54	**Ref. Elevation:**	1793.297
Bottom Elevation:	1786.484	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 11.7

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	84.00
B	Traffic Signal	64.00
C	Power Pole	22.50

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-6	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

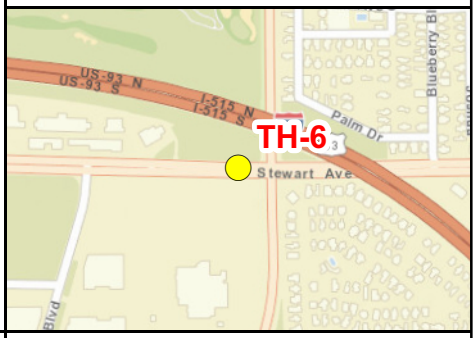
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	(1) 1 Inch (1) 2 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	14 Inches	**Marker Type:**	Saw Cut
Depth to Top:	2.37	**Top Ref. Level:**	5.10	**Hand Meas. Top:**	2.40
Depth to Bottom:	2.62	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1792.895	**Mkr. Ref. Level:**	2.73	**Ref. Elevation:**	1795.265
Bottom Elevation:	1792.645	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 38.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	55.70
B	Traffic Signal	109.00
C	Traffic Signal	143.00

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-7	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

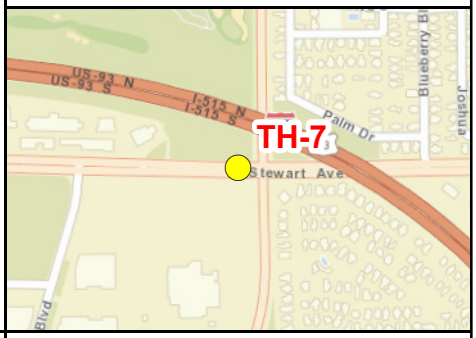
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	(1) 1 Inch (1) 2 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	14 Inches	**Marker Type:**	Saw Cut
Depth to Top:	2.21	**Top Ref. Level:**	6.00	**Hand Meas. Top:**	2.25
Depth to Bottom:	2.46	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1792.503	**Mkr. Ref. Level:**	3.79	**Ref. Elevation:**	1794.713
Bottom Elevation:	1792.253	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 38.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	51.00
B	Traffic Signal	68.70
C	Traffic Signal	113.30

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-8	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

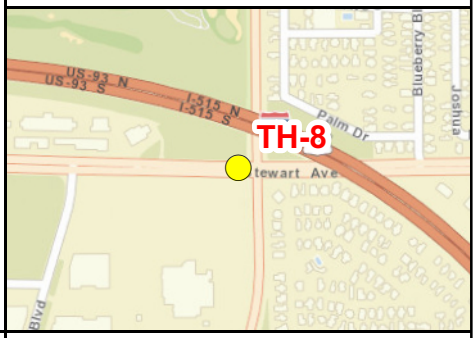
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	(1) 1 Inch (1) 2 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	14 Inches	**Marker Type:**	Saw Cut
Depth to Top:	2.38	**Top Ref. Level:**	6.92	**Hand Meas. Top:**	2.30
Depth to Bottom:	2.63	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.939	**Mkr. Ref. Level:**	4.54	**Ref. Elevation:**	1794.319
Bottom Elevation:	1791.689	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 39.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	66.50
B	Traffic Signal	51.00
C	Traffic Signal	93.50

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-9	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/13/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

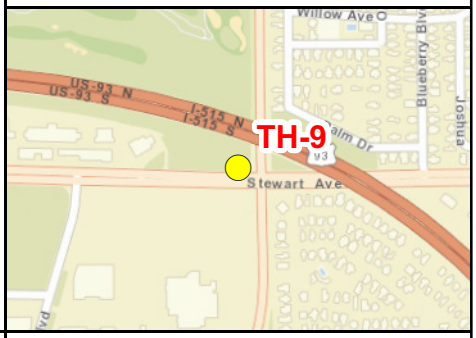
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	8 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Natural	**Thickness:**	N/A	**Marker Type:**	5/8 rebar & cap
Depth to Top:	3.55	**Top Ref. Level:**	7.70	**Hand Meas. Top:**	3.50
Depth to Bottom:	4.22	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.001	**Mkr. Ref. Level:**	4.15	**Ref. Elevation:**	1794.551
Bottom Elevation:	1790.334	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 14.8

N

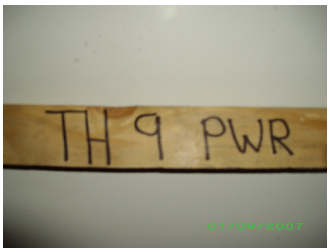
Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	MSD Lid	12.80
B	MSD Lid	26.20
C	Traffic Signal	45.00

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-10	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/13/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

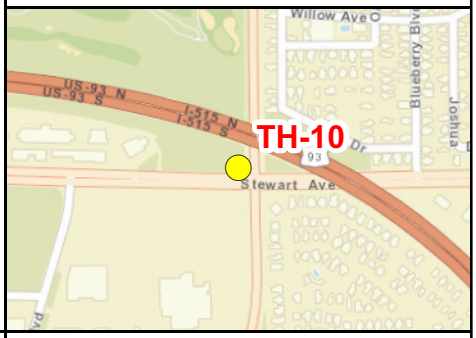
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	8 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Natural	**Thickness:**	N/A	**Marker Type:**	5/8 rebar & cap
Depth to Top:	4.08	**Top Ref. Level:**	7.86	**Hand Meas. Top:**	4.10
Depth to Bottom:	4.75	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1790.892	**Mkr. Ref. Level:**	3.78	**Ref. Elevation:**	1794.972
Bottom Elevation:	1790.225	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 22.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	MSD Lid	41.00
B	MSD Lid	20.00
C	Traffic Signal	19.40

General Notes About This Test Hole

Off set facing East Looks like pipe is smashed

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-11	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/13/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

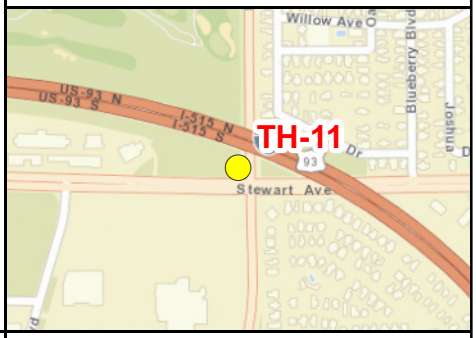
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Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	8 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Natural	**Thickness:**	N/A	**Marker Type:**	5/8 rebar & cap
Depth to Top:	3.74	**Top Ref. Level:**	8.16	**Hand Meas. Top:**	3.80
Depth to Bottom:	4.41	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.729	**Mkr. Ref. Level:**	4.42	**Ref. Elevation:**	1795.469
Bottom Elevation:	1791.062	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 18.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	MSD Lid	73.00
B	MSD Lid	52.00
C	Traffic Signal	42.00

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-12	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

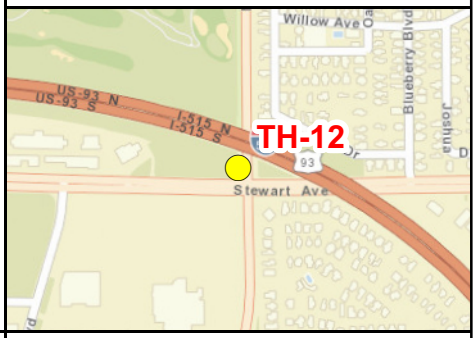
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	F/O	**Utility Size:**	(1) 1 Inch (1) 2 Inches	**Utility Material:**	PVC
Utility Company:	N/A	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	Saw Cut
Depth to Top:	2.46	**Top Ref. Level:**	7.60	**Hand Meas. Top:**	2.45
Depth to Bottom:	2.71	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.528	**Mkr. Ref. Level:**	5.14	**Ref. Elevation:**	1793.988
Bottom Elevation:	1791.278	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 4.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	43.00
B	Traffic Signal	54.00
C	Traffic Signal	48.50

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-13	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

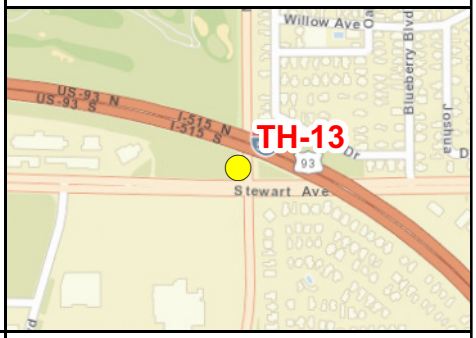
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	F/O	**Utility Size:**	3 Inches	**Utility Material:**	PVC
Utility Company:	N/A	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	Saw Cut
Depth to Top:	2.15	**Top Ref. Level:**	7.25	**Hand Meas. Top:**	2.10
Depth to Bottom:	2.4	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.891	**Mkr. Ref. Level:**	5.10	**Ref. Elevation:**	1794.041
Bottom Elevation:	1791.641	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 6.2

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	35.20
B	Traffic Signal	57.50
C	Traffic Signal	102.00

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-14	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

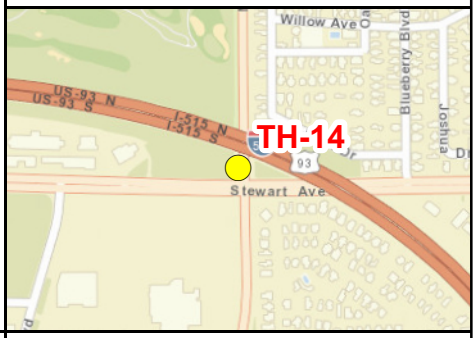
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	HP Gas	**Utility Size:**	10 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	10 Inches	**Marker Type:**	Saw Cut
Depth to Top:	4.37	**Top Ref. Level:**	9.92	**Hand Meas. Top:**	4.35
Depth to Bottom:	5.20	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1789.083	**Mkr. Ref. Level:**	5.55	**Ref. Elevation:**	1793.453
Bottom Elevation:	1788.250	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 12.3

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Light Pole	41.00
B	Traffic Signal	62.60
C	Traffic Signal	83.70

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-15	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

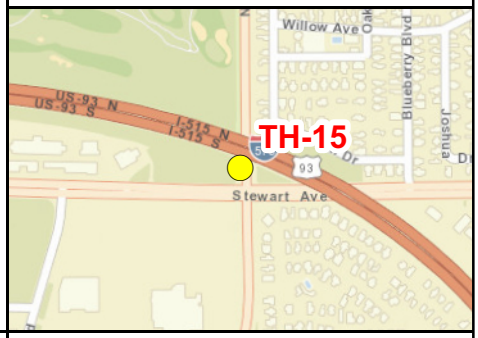
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	HP Gas	**Utility Size:**	10 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	8 Inches	**Marker Type:**	Saw Cut
Depth to Top:	4.56	**Top Ref. Level:**	10.10	**Hand Meas. Top:**	4.55
Depth to Bottom:	5.39	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1788.938	**Mkr. Ref. Level:**	5.54	**Ref. Elevation:**	1793.498
Bottom Elevation:	1788.105	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 12.3

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	21.80
B	Traffic Signal	94.80
C	Traffic Signal	86.00

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-16	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

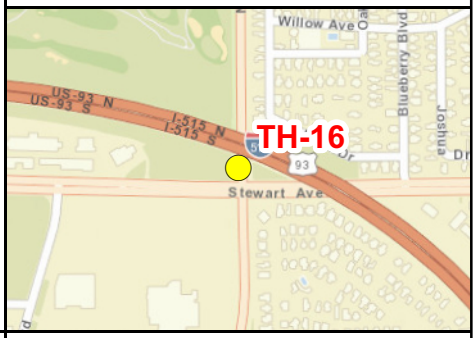
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Sewer	**Utility Size:**	36 Inches	**Utility Material:**	RCP
Utility Company:	Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	14 Inches	**Marker Type:**	Saw Cut
Depth to Top:	7.48	**Top Ref. Level:**	12.82	**Hand Meas. Top:**	7.50
Depth to Bottom:	10.48	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1785.816	**Mkr. Ref. Level:**	5.34	**Ref. Elevation:**	1793.296
Bottom Elevation:	1782.816	**Mkr. Offset From:**	Edge of concrete	**Marker Offset (ft):**	RT 24.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A		
B		
C		

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-17	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/22/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

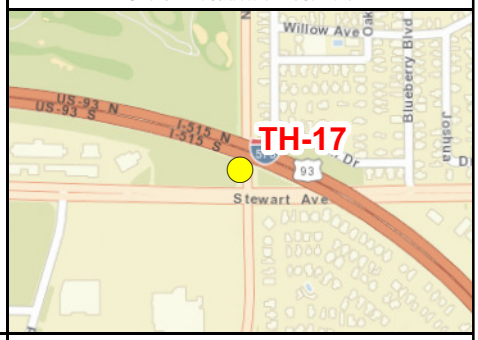
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	3 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	12 Inches	**Marker Type:**	Saw Cut
Depth to Top:	2.16	**Top Ref. Level:**	7.85	**Hand Meas. Top:**	2.20
Depth to Bottom:	2.41	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.449	**Mkr. Ref. Level:**	5.69	**Ref. Elevation:**	1793.609
Bottom Elevation:	1791.199	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 8.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	16.50
B	Storm Drain Lid	33.50
C	Traffic Signal	13.50

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-18	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

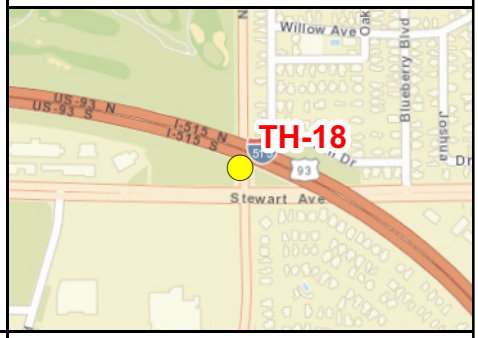
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Sewer	**Utility Size:**	36 Inches	**Utility Material:**	RCP
Utility Company:	Las Vegas	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	14 Inches	**Marker Type:**	Saw Cut
Depth to Top:	7.60	**Top Ref. Level:**	12.63	**Hand Meas. Top:**	7.55
Depth to Bottom:	10.6	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1785.836	**Mkr. Ref. Level:**	5.03	**Ref. Elevation:**	1793.436
Bottom Elevation:	1782.836	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 23.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	31.00
B	Traffic Signal	104.00
C	Traffic Signal	94.50

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-19	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/20/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

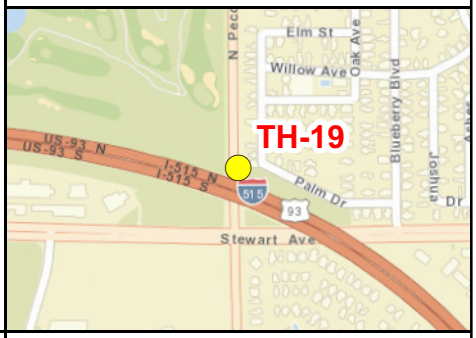
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	F/O	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	F.A.S.T.	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	12 Inches	**Marker Type:**	Test hole
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	N/A
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1793.313
Bottom Elevation:	N/A	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 20.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	108.50
B	Traffic Signal	36.50
C	SDI	55.00

General Notes About This Test Hole

1' of water, water at 8.80 hand measure hit hard pack, could not go any more off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-20	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/15/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

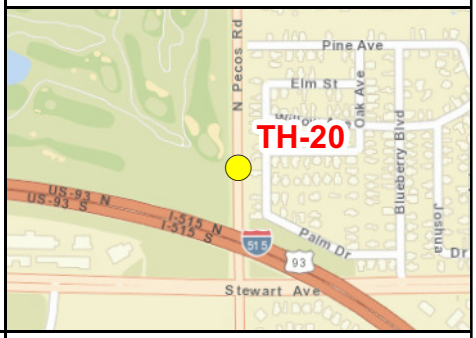
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	4 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nails
Depth to Top:	4.31	**Top Ref. Level:**	9.45	**Hand Meas. Top:**	4.30
Depth to Bottom:	4.64	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1790.46	**Mkr. Ref. Level:**	5.14	**Ref. Elevation:**	1794.770
Bottom Elevation:	1790.127	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	Rt 44.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, Mapmyindia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	81.60
B	Storm Drain Lid	45.40
C	Sewer Lid	83.00

General Notes About This Test Hole

Off set facing North, hit sewer line, hand measure is 5.60

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-21	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

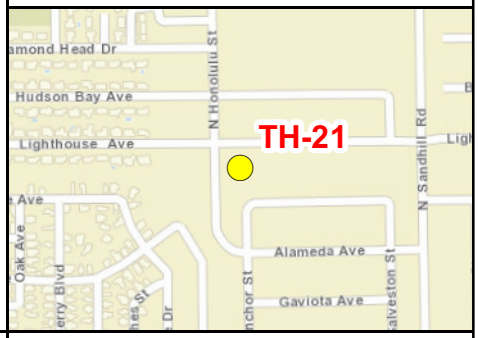
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

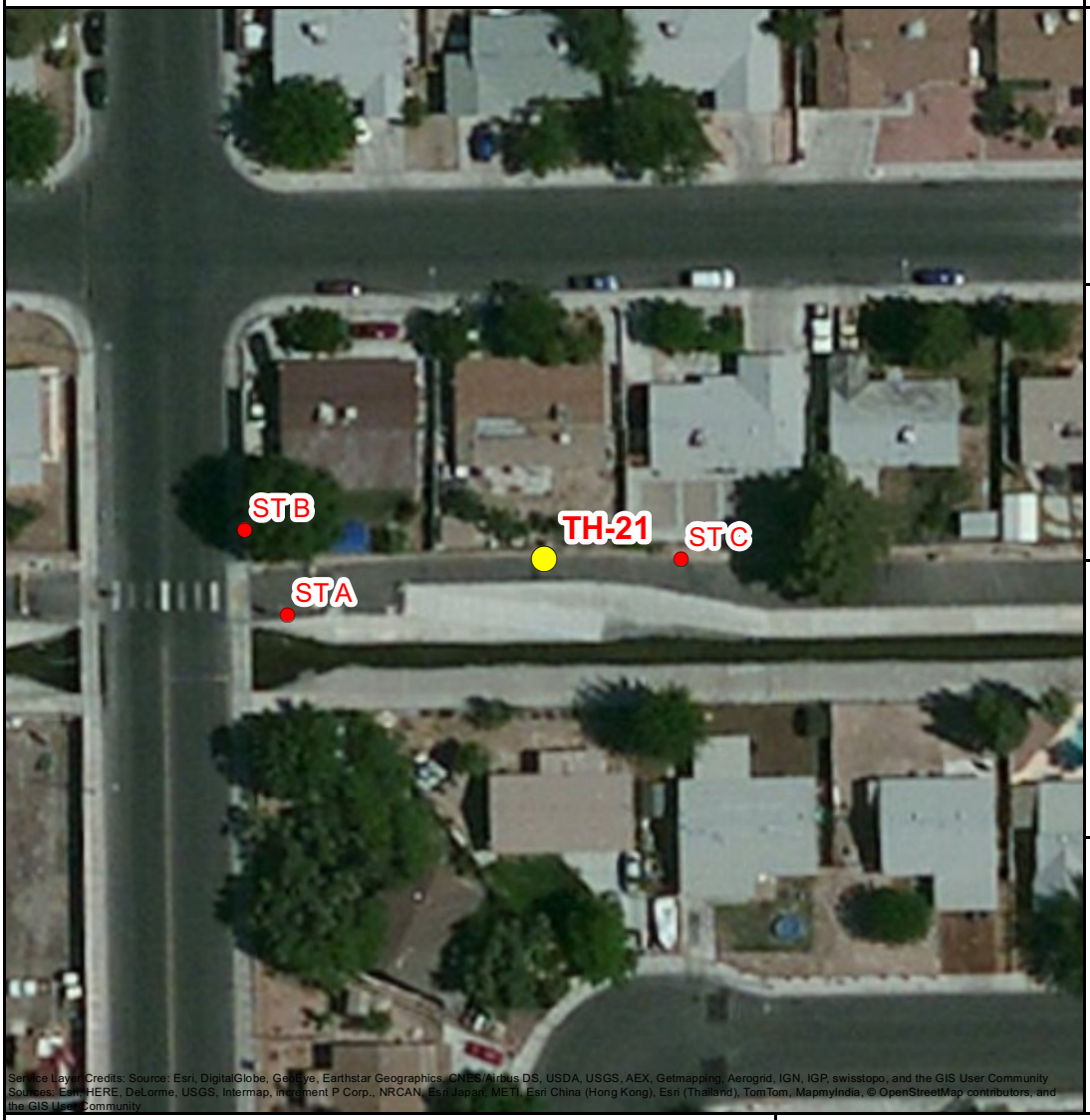
Utility Type:	Power	**Utility Size:**	1.25 inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nails
Depth to Top:	2.69	**Top Ref. Level:**	7.78	**Hand Meas. Top:**	2.70
Depth to Bottom:	2.79	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1777.167	**Mkr. Ref. Level:**	5.09	**Ref. Elevation:**	1779.857
Bottom Elevation:	1777.063	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 2.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	92.00
B	Street Light	112.50
C	SDI	50.00

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-22	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

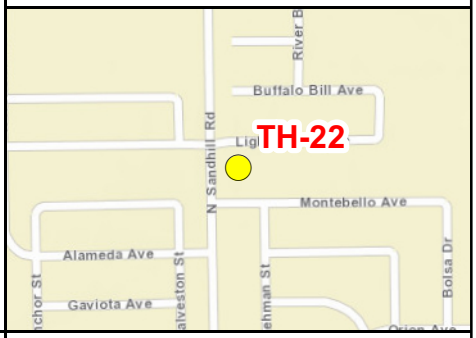
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	1.25 inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nails
Depth to Top:	2.37	**Top Ref. Level:**	7.47	**Hand Meas. Top:**	2.45
Depth to Bottom:	2.47	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1773.655	**Mkr. Ref. Level:**	5.10	**Ref. Elevation:**	1776.025
Bottom Elevation:	1773.551	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 1.8

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	54.00
B	Street Light	69.50
C		

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-23	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

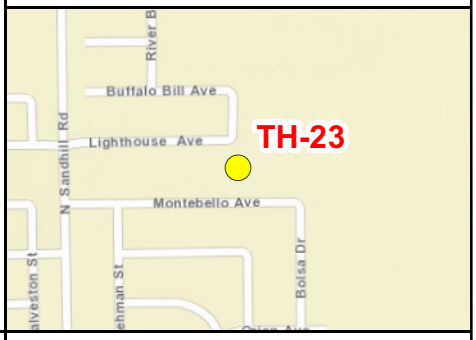
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Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	4 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	4 Inches	**Marker Type:**	PK Nails
Depth to Top:	3.32	**Top Ref. Level:**	8.39	**Hand Meas. Top:**	3.35
Depth to Bottom:	3.65	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1770.724	**Mkr. Ref. Level:**	5.07	**Ref. Elevation:**	1774.044
Bottom Elevation:	1770.391	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT .01

N

Overall Location of Test Hole



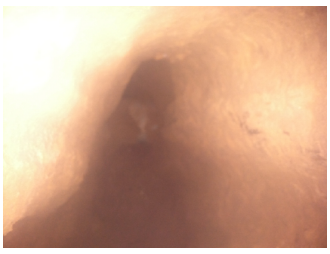
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	69.70
B	Street Light	13.50
C		

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-24	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

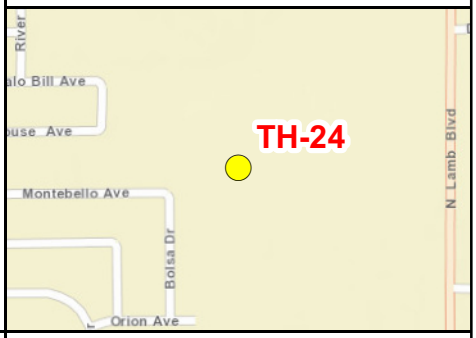
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	4 inches 1.25 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	5 Inches	**Marker Type:**	Saw Cut
Depth to Top:	3.68	**Top Ref. Level:**	8.74	**Hand Meas. Top:**	3.70
Depth to Bottom:	4.12	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1769.029	**Mkr. Ref. Level:**	5.06	**Ref. Elevation:**	1772.709
Bottom Elevation:	1768.592	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 2.3

N

Overall Location of Test Hole



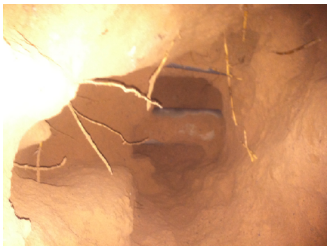
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	75.50
B	Street Light	5.50
C	Street Light	88.00

General Notes About This Test Hole

Edge of Concrete, 1.25 is 2.85 hand measure

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-25	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

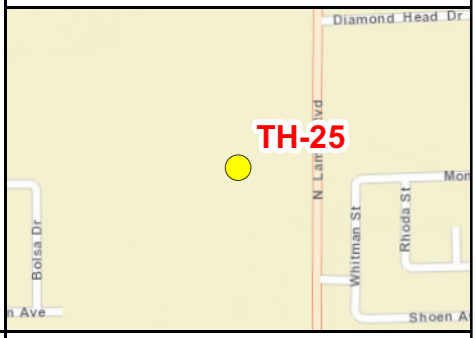
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	4 inches 1.25 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nails
Depth to Top:	3.86	**Top Ref. Level:**	8.99	**Hand Meas. Top:**	3.90
Depth to Bottom:	4.30	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1767.359	**Mkr. Ref. Level:**	5.13	**Ref. Elevation:**	1771.219
Bottom Elevation:	1766.922	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 3.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	36.00
B	Street Light	45.00
C		

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-26	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

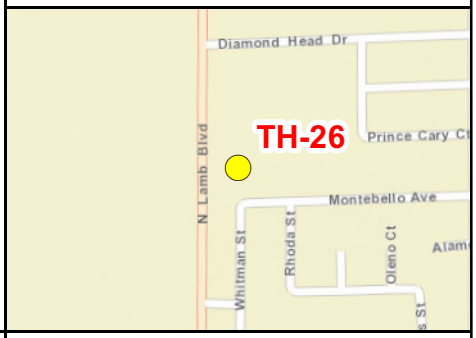
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Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	4 inches 1.25 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	4 Inches	**Marker Type:**	PK Nails
Depth to Top:	3.91	**Top Ref. Level:**	9.13	**Hand Meas. Top:**	3.90
Depth to Bottom:	4.35	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1766.948	**Mkr. Ref. Level:**	5.22	**Ref. Elevation:**	1770.858
Bottom Elevation:	1766.511	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT.01

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	90.00
B	Street Light	8.00
C	Street Light	74.00

General Notes About This Test Hole

Off set facing East 1.25 is 2.90 hand measure

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-27	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/12/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	4 inches 1.25 Inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	5 Inches	**Marker Type:**	PK Nails
Depth to Top:	2.99	**Top Ref. Level:**	8.19	**Hand Meas. Top:**	3.00
Depth to Bottom:	3.43	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1762.094	**Mkr. Ref. Level:**	5.20	**Ref. Elevation:**	1765.084
Bottom Elevation:	1761.657	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 1.8

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



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Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	52.80
B	Street Light	26.00
C		

General Notes About This Test Hole

Off set facing East 1.25 is 2.20 hand measure

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-28	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

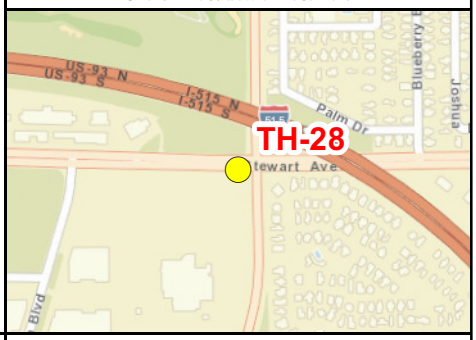
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	Las Vegas Water Department	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	8 Inches	**Marker Type:**	Concrete
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	N/A
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1793.224
Bottom Elevation:	N/A	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 5.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	91.50
B	Traffic Signal	56.00
C	Power Pole	16.50

General Notes About This Test Hole

Off set facing east hit water at 6.0, dug to 7.50 dry hole

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-29	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

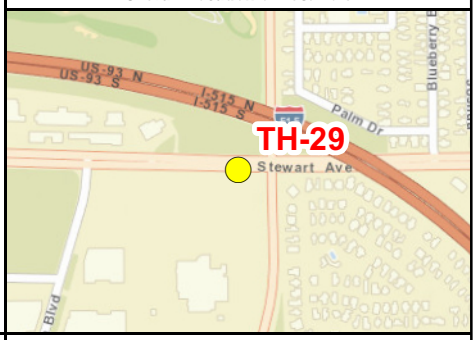
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Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	18 Inches	**Utility Material:**	Steel
Utility Company:	Las Vegas Water Department	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nails
Depth to Top:	7.50	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	7.50
Depth to Bottom:	9.00	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1794.115	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1794.115
Bottom Elevation:	1792.615	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 7.8

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Power Pole	95.00
B	Power Pole	68.00
C	Street Light	45.50

General Notes About This Test Hole

Off set facing East, hit water table, full of water

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-30	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/20/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

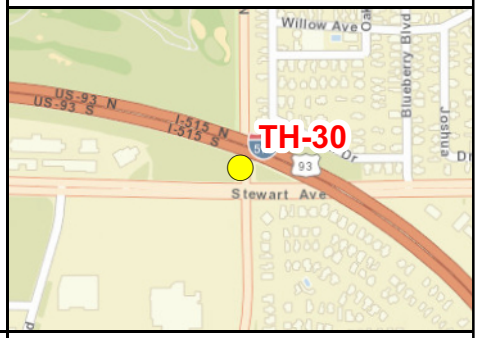
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

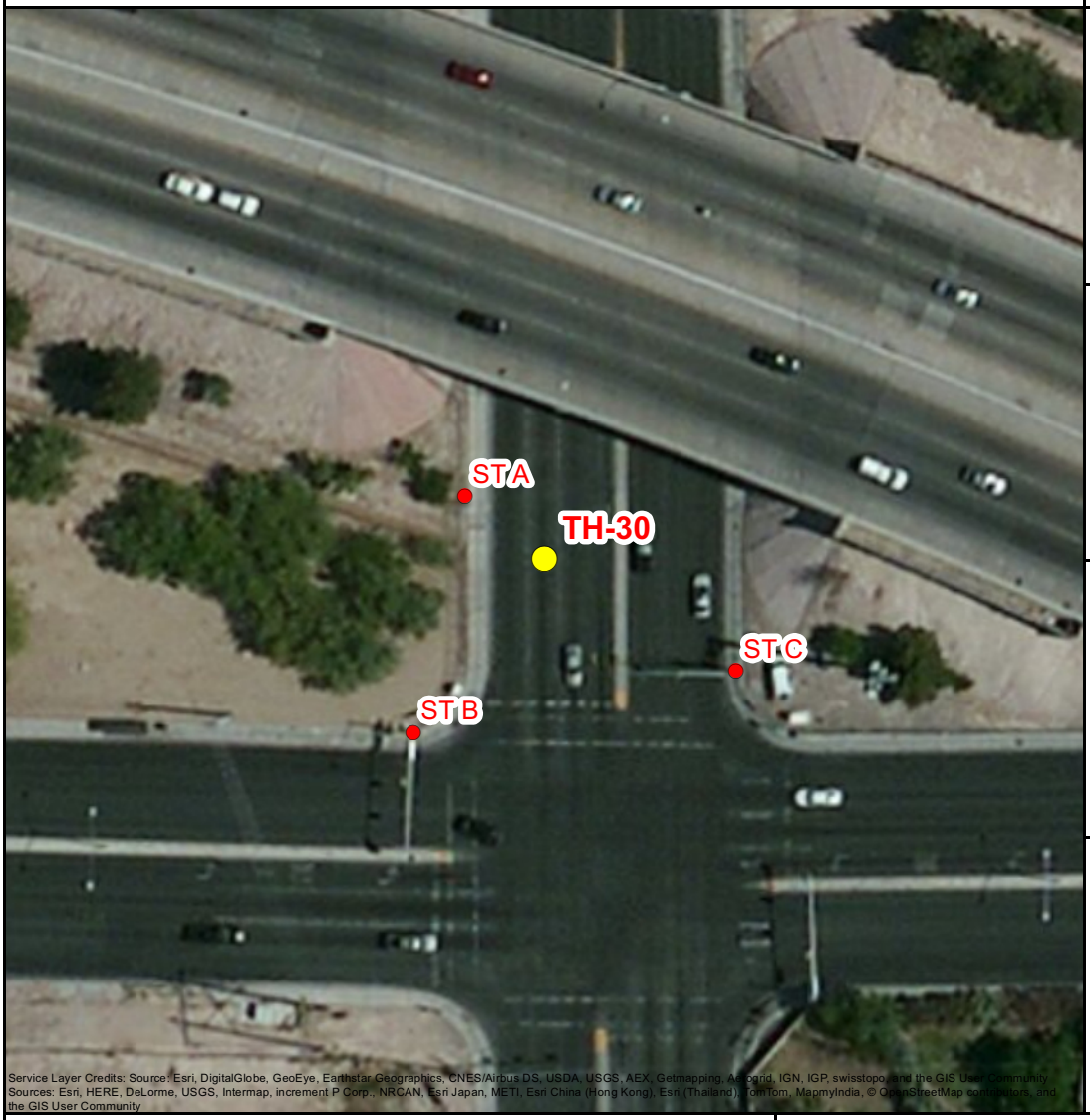
Utility Type:	F/O	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	F.A.S.T.	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	12 Inches	**Marker Type:**	Test hole
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	N/A
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1793.435
Bottom Elevation:	N/A	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	RT 17.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	31.50
B	Traffic Signal	78.00
C	Traffic Signal	85.00

General Notes About This Test Hole

Hit storm drain 2.80, off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-30A	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/20/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

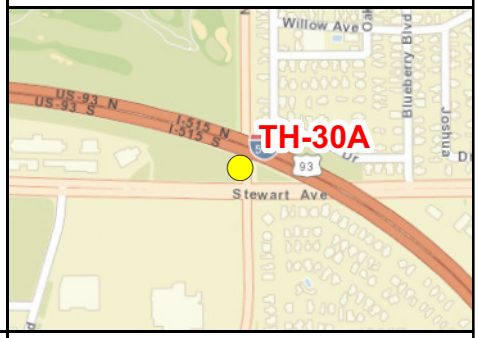
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	F/O	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	F.A.S.T.	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	12 Inches	**Marker Type:**	Test hole
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	N/A
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1793.498
Bottom Elevation:	N/A	**Mkr. Offset From:**	Edge of concrete	**Marker Offset (ft):**	RT 12.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Street Light	26.50
B	Traffic Signal	77.00
C	Traffic Signal	90.00

General Notes About This Test Hole

Off set facing North, 11.28 hit hard pack, water at 7.0 hand measure

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-31	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/20/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

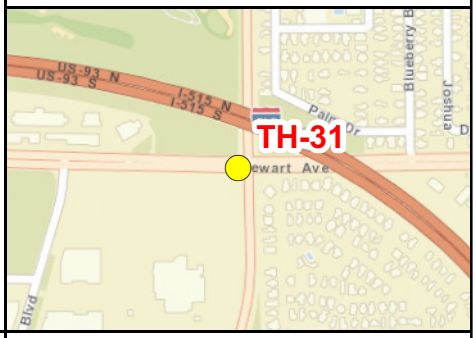
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Power	**Utility Size:**	(1) 1 inch (3) 2 inches	**Utility Material:**	PVC
Utility Company:	NV Energy	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	12 Inches	**Marker Type:**	Saw Cut
Depth to Top:	1.95	**Top Ref. Level:**	7.08	**Hand Meas. Top:**	1.90
Depth to Bottom:	2.53	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1791.108	**Mkr. Ref. Level:**	5.13	**Ref. Elevation:**	1793.058
Bottom Elevation:	1790.525	**Mkr. Offset From:**	Edge of concrete	**Marker Offset (ft):**	LT 33.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	73.50
B	Traffic Signal	55.00
C	Sewer Lid	34.00

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-32	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/20/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

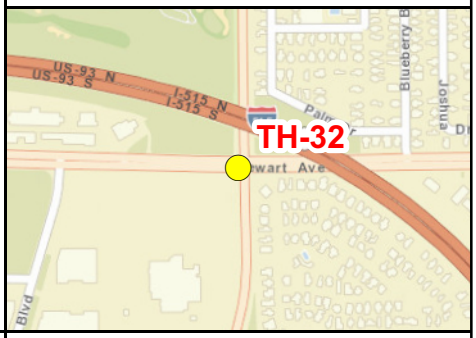
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	HP Gas	**Utility Size:**	10 Inches	**Utility Material:**	Steel
Utility Company:	South West	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Concrete	**Thickness:**	12 Inches	**Marker Type:**	Saw Cut
Depth to Top:	5.71	**Top Ref. Level:**	10.95	**Hand Meas. Top:**	5.75
Depth to Bottom:	6.54	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1787.198	**Mkr. Ref. Level:**	5.24	**Ref. Elevation:**	1792.908
Bottom Elevation:	1786.365	**Mkr. Offset From:**	Edge of concrete	**Marker Offset (ft):**	LT 38.0

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	81.50
B	Traffic Signal	57.00
C	Sewer Lid	13.00

General Notes About This Test Hole

Off set facing East

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-33	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

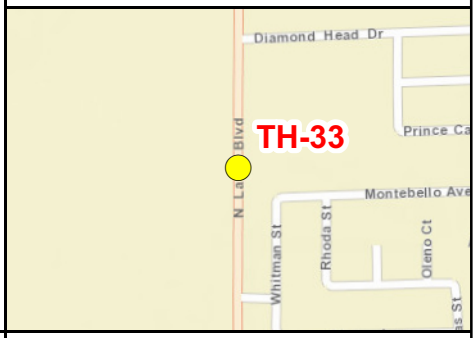
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	N/A	**Utility Material:**	N/A
Utility Company:	Las Vegas Water Department	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	Asphalt
Depth to Top:	N/A	**Top Ref. Level:**	N/A	**Hand Meas. Top:**	N/A
Depth to Bottom:	N/A	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	N/A	**Mkr. Ref. Level:**	N/A	**Ref. Elevation:**	1772.227
Bottom Elevation:	N/A	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 42.0

N

Overall Location of Test Hole



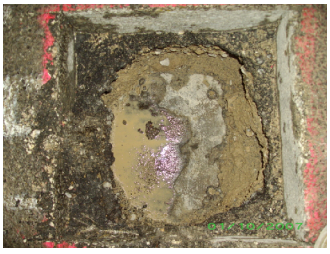
TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	65.00
B	Traffic Signal	55.00
C	Street Light	56.00

General Notes About This Test Hole

Hit box culvert, concrete 1.50 hand measure, off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-34	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

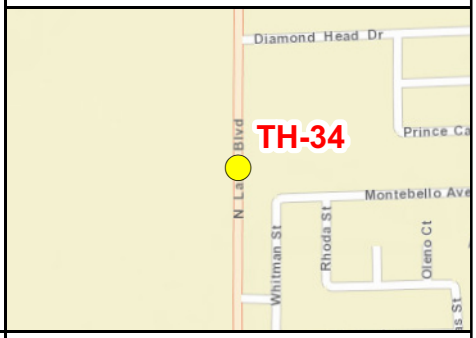
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	36 Inches	**Utility Material:**	Steel
Utility Company:	Las Vegas Water Department	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nails
Depth to Top:	10.75	**Top Ref. Level:**	15.72	**Hand Meas. Top:**	10.75
Depth to Bottom:	13.75	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1761.548	**Mkr. Ref. Level:**	4.97	**Ref. Elevation:**	1772.298
Bottom Elevation:	1758.548	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 42.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	68.40
B	Traffic Signal	54.50
C	Street Light	55.00

General Notes About This Test Hole

Off set facing North

Test Hole Summary Sheet

HORROCKS ENGINEERS

TH #:	TH-35	**Completed By:**	Jeremy Tangren
Utility ID #:		**QA/QC By:**	Shawn Conlin
Date:	10/14/2015	**HE Project #:**	LV-824-1510
Project City:	Clark	**Client Project #:**	
Project County:	Las Vegas	**Sheet:**	

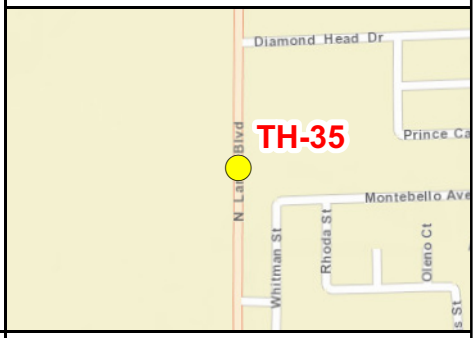
1349 Galleria Drive, Suite 110
Henderson, NV 89014
Phone: 702-966-4063

Test Hole Data

Utility Type:	Water	**Utility Size:**	36 Inches	**Utility Material:**	Steel
Utility Company:	Las Vegas Water Department	**English/Metric:**	English	**Soil Conditions:**	Dirt
Surface Type:	Asphalt	**Thickness:**	8 Inches	**Marker Type:**	PK Nails
Depth to Top:	6.71	**Top Ref. Level:**	11.84	**Hand Meas. Top:**	6.75
Depth to Bottom:	9.71	**Bot. Ref. Level:**	N/A	**Hand Meas. Bot:**	N/A
Top Elevation:	1765.623	**Mkr. Ref. Level:**	5.13	**Ref. Elevation:**	1772.333
Bottom Elevation:	1762.623	**Mkr. Offset From:**	Edge of oil	**Marker Offset (ft):**	LT 42.5

N

Overall Location of Test Hole



TEST HOLE LOCATION PLAN



TEST HOLE PICTURES



Picture #1



Picture #2

Picture #3

Picture #4

Swing Ties - 3 per Test Hole

Swing Tie	Structure Pulled From	Distance (ft)
A	Traffic Signal	76.50
B	Traffic Signal	50.00
C	Light Pole	50.60

General Notes About This Test Hole

Off set facing North

DEPARTMENT OF PUBLIC WORKS

MAYOR
CAROLYN G. GOODMAN

CITY COUNCIL
STAVROS S. ANTHONY (Mayor Pro-Tem)
LOIS TARKANIAN
STEVEN D. ROSS
RICKI Y. BARLOW
BOB COFFIN
BOB BEERS

CITY MANAGER
ELIZABETH N. FRETWELL

DIRECTOR OF PUBLIC WORKS
DAVID N. BOWERS, P.E., P.T.O.E.

CITY ENGINEER
ALLEN E. PAVELKA, P.E.

FUNDED BY
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

30% SUBMITTAL

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

RECOMMENDED BY

CLV CITY ENGINEER — DATE

CLV PROJECT MANAGER — DATE

CLV CITY TRAFFIC ENGINEER — DATE

CLV CONSTRUCTION MANAGER — DATE

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT — DATE

REGIONAL TRANSPORTATION COMMISSION OF SOUTHERN NEVADA — DATE

SOUTHWEST GAS CORPORATION — DATE

CENTRAL TELEPHONE COMPANY d/b/a CENTURYLINK — DATE

THE AFFIXED CENTURYLINK NEVADA APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFLICT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION STANDARD REGULATIONS.

COX COMMUNICATIONS LAS VEGAS, INC. — DATE

NV ENERGY – DISTRIBUTION — DATE

NV ENERGY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NV ENERGY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSIONS RULES AND REGULATIONS.

NV ENERGY - TRANSMISSION — DATE

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# XXXXX
SHEETS: CV, GN, ...

THE SIGNATURE ABOVE ACKNOWLEDGES THAT THE UTILITY COMPANY REPRESENTATIVE HAS REVIEWED THE PLANS, AND THAT TO THE BEST OF HIS OR HER KNOWLEDGE THE UTILITY LINES ARE SHOWN IN THE CORRECT LOCATIONS AND ARE THE CORRECT SIZES. WHILE SUCH DATA HAS BEEN COLLECTED WITH REASONABLE CARE, THERE IS NO EXPRESSED OR IMPLIED GUARANTEE THAT THE LOCATIONS ARE EXACT. THE CONTRACTOR SHALL BEAR THE RESPONSIBILITY OF OBTAINING THE ACTUAL FIELD LOCATIONS.

THE SIGNATURE ABOVE FURTHER ACKNOWLEDGES THAT THE UTILITY COMPANY DOES NOT ANTICIPATE CONSTRUCTION OR MAINTENANCE IN THE PROJECT AREA FOR FIVE (5) YEARS IN CONFORMANCE WITH THE CLV NO-CUT POLICY.

NO.	DATE	SHEET	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX-XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015		DRAWN BY: MM	
SUBMITTAL STAGE: 30% - PRELIMINARY		CHECKED BY: HBD	

TITLE: LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET: COVER SHEET

PROFESSIONAL ENGINEER-STATE OF NEVADA
HARSHBIR BHATIA
DATE OF EXPIRATION 12-31-16
CIVIL
No. 17468
NOT FOR CONSTRUCTION

SHEET
CV
1 OF 31
DRAWING NO.
XXX-XXXX

C:\Temp\AcPublish_4992\H49866-CV01 16-18-15 02:34pm

CITY OF LAS VEGAS GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", LATEST ISSUE THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST REVISED EDITION THE "SUMMERLIN IMPROVEMENT STANDARDS" FOR WORK IN THE SUMMERLIN AREA AND OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY THE UNIFORM BUILDING CODE AND ALL LOCAL CITY CODES AND ORDINANCES APPLICABLE, EXCEPT AS NOTED ON THIS SHEET AS "DEVIATIONS FROM STANDARDS".

2. THE EXISTENCE AND LOCATION OF ANY OVERHEAD OR UNDERGROUND UTILITY LINES, PIPES, OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A RESEARCH OF THE AVAILABLE RECORDS. EXISTING UTILITIES AS SHOWN FROM CLV PLANS LIBRARY ARE APPROXIMATE AND FOR RECORD PURPOSES. EXISTING UTILITIES ARE LOCATED ON PLANS ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. EXISTING UTILITY SERVICE LATERALS MAY NOT BE SHOWN ON THE PLANS. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL UNDERGROUND AND OVERHEAD INTERFERENCE WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COST AND LIABILITY IN CONNECTION THEREWITH.

3. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING UTILITY LINES, STRUCTURES AND STREET IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTORS OPERATIONS SHALL BE REPAIRED OR REPLACED SATISFACTORY TO THE CITY ENGINEER OR OWNING UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.

4. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS, ANY REVISIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE CITY ENGINEER.

5. TYPE V CEMENT SHALL BE USED IN ALL OFF-SITE CONCRETE WORK. CONCRETE TO BE 3000 P.S.I. MINIMUM 28 DAYS. MIX DESIGN TO BE APPROVED BY THE QUALITY CONTROL DIVISION, PRIOR TO THE USE ON THE PROJECT.

6. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION.

7. EXPANSION JOINTS REQUIRED, MAXIMUM EVERY 300 IN EXTRUDED-TYPE CURB.

8. AC PAVEMENT TO BE 1/2" ABOVE LIP OF ALL GUTTERS AFTER COMPACTION, EXCEPT AT SIDEWALK RAMPS.

9. CURB AND GUTTER WITH A GRADE OF LESS THAN FOUR-TENTHS OF ONE PERCENT SHALL BE WATER-TESTED AS SOON AS POSSIBLE AFTER CONSTRUCTION. ANY CURB AND GUTTER FOUND TO BE UNACCEPTABLE TO THE CITY SHALL BE REMOVED AND REPLACED PER USD 216.

10. SIDEWALK RAMPS SHALL BE CONSTRUCTED IN EACH QUADRANT OF AN INTERSECTION PER USD 235, CASE I. EXACT LOCATION OF RAMPS MAY BE ADJUSTED IN THE FIELD BY A CITY PROJECT REPRESENTATIVE.

11. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND EGRESS TO NEW CONSTRUCTION. THE EXTENT OF TRANSITIONS TO BE AS SHOWN ON PLANS, OR AS DESIGNATED IN THE FIELD BY CITY PROJECT REPRESENTATIVE.

12. EXACT LOCATION OF ALL SAWCUT LINES MAY BE DETERMINED IN THE FIELD BY A CITY PROJECT REPRESENTATIVE IF LOCATION ON PLANS IS NOT CLEARLY SHOWN, OR EXISTING PAVEMENT CONDITION REQUIRES RELOCATIONS.

13. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED, AND SHALL BE DONE ONLY BY A NEVADA PROFESSIONAL LAND SURVEYOR IN ACCORDANCE WITH THE UNIFORM STANDARD DRAWINGS - CLARK COUNTY AREA. A RECORD-OF-SURVEY FOR REPLACEMENT OF PERMANENT SURVEY MONUMENTS SHALL BE SUBMITTED TO THE CITY ENGINEER FOR APPROVAL PRIOR TO RECORDING. THE RECORD-OF-SURVEY SHALL BE PREPARED IN ACCORDANCE WITH NEVADA REVISED STATUTES 625.350.

14. UTILITY COMPANY METER BOXES, MANHOLE LIDS, VALVE COVERS, ETC., SHALL BE LOCATED OUT OF DRIVEWAYS, DRIVEWAY APRONS, FLOWLINES, AND CROSS GUTTERS UNLESS WRITTEN APPROVAL IS GRANTED BY THE AFFECTED UTILITY COMPANY AND THE CITY ENGINEER.

15. ALL WALLS, NEW OR EXISTING, ARE ONLY SHOWN ON CIVIL PLANS FOR THE PURPOSE OF REVIEWING GRADING RELATIONSHIPS FLOOD CONTROL AND SIGHT DISTANCE AT INTERSECTIONS. NEW WALLS REQUIRE A SEPARATE PERMIT AND INSPECTION BY THE CLV BUILDING DEPARTMENT.

16. ASPHALT MIX DESIGN MUST BE SUBMITTED AND APPROVED BY THE CITY ENGINEER PRIOR TO THE PLACEMENT OF ASPHALT WITHIN CITY RIGHTS OF WAY.

17. CONTRACTOR SHALL ADJUST ALL NEW AND EXISTING INLETS, VALVE BOXES, MANHOLE RIMS, SEWER CLEANOUTS, ETC. TO FINISH GRADE AS APPLICABLE WHETHER OR NOT THEY ARE SHOWN ON THE PLANS.

18. MATERIALS, HANDLING AND PLACEMENT OF PORTLAND CEMENT CONCRETE SHALL BE IN ACCORDANCE WITH APPLICABLE SECTIONS OF NDOT AND CLARK COUNTY AREA SPECIFICATIONS (AS APPLICABLE) AND THE PLANS AND DETAILS SHOWN HEREON.

19. WHEN INSTALLING UNDERGROUND FACILITIES THAT REQUIRE UNDERGROUND LOCATING DEVICES SUCH AS MARKER BALLS, LOCATING RIBBON, ETC, THE CONTRACTOR SHALL PROVIDE WRITTEN DOCUMENTATION TO THE ENGINEER CERTIFYING THAT ALL DEVICES HAVE BEEN PLACED AND VERIFIED TO BE IN GOOD WORKING CONDITION PRIOR TO THE CONSTRUCTION OF ANY ROAD BASE.

20. SANITARY SEWER AND STORM DRAIN FINAL LOCATION INFORMATION SHALL BE PROVIDED TO THE ENGINEER PRIOR TO PROJECT ACCEPTANCE. THE INFORMATION SHALL INCLUDE THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MANHOLES, STORM DRAIN MANHOLES, STORM DRAIN LATERALS AT THE CONNECTION TO THE STORM DRAIN MAIN AND AT THE CONNECTION TO A DROP INLET, AND THE CONNECTION OF SEWER SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXITS THE PUBLIC RIGHT-OF-WAY. THE LOCATION SHALL BE DESCRIBED BY COORDINATES WHICH SHALL BE BASED ON THE OFFICIAL HORIZONTAL AND VERTICAL CONTROL NETWORKS OF THE CITY OF LAS VEGAS. FINAL LOCATION INFORMATION MUST BE SEALED AND CERTIFIED BY A NEVADA PROFESSIONAL LAND SURVEYOR TO HAVE POSITIONAL CERTAINTIES OF ± 0.09 METERS (± 0.3 FEET) HORIZONTALLY AND VERTICALLY. A SEPARATE ELECTRONIC COMMA DELIMITED FILE FOR THE SANITARY SEWER AND STORM DRAIN COORDINATES SHALL ALSO ACCOMPANY THE SANITARY SEWER AND STORM DRAIN FINAL LOCATION INFORMATION.

21. CCTV VIDEO INSPECTION IS REQUIRED FOR ALL SEWER AND STORM DRAINS. THE CCTV VIDEO INSPECTIONS NEED TO BE PERFORMED PER THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS LATEST ADDITION.

22. A SEPARATE BORING PERMIT IS REQUIRED FOR ALL BORING ACTIVITIES.

REVISED JANUARY 23, 2014 (CPM VERSION)

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ABBREVIATIONS

	AT
AC	ASPHALTIC CONCRETE
ACP	ASBESTOS CEMENT PIPE
AEP	AUTHORIZATION TO ENTER PROPERTY
APPROX.	APPROXIMATE
B/C, BC	BACK OF CURB
BCR	BACK OF CURB RADIUS
BM	BENCHMARK
BOT	BOTTOM
B.R.	BACK OF RAMP
$\mathbb{Q}$, CL	CENTERLINE
CATV	CABLE T.V.
CIPP	CURED-IN-PLACE PIPE
CLV	CITY OF LAS VEGAS
CONC.	CONCRETE
COND.	CONDUCTOR
CLSM	CONTROLLED LOW STRENGTH MATERIAL
C G	CURB AND GUTTER
D/W	DRIVEWAY
DWG.	DRAWING
ECR	END OF CURB RETURN (AT B/C)
ELEC.	ELECTRIC
EOP, EP	EDGE OF PAVEMENT
ELEV.	ELEVATION
EXIST., EX.	EXISTING
EXOH	EXISTING OVERHEAD UTILITY
FD	FOUND
FL	FLOWLINE
FG	FINISHED GRADE
FH	FIRE HYDRANT
FT.	FOOT/FEET
FC	FACE OF CURB
G	GAS
GV	GAS VALVE
GW	GUY WIRE
INT.	INTERSECTION
IRR	IRRIGATION
L	LENGTH
LF	LINEAL FOOT, LINEAR FEET
LT	LEFT
MH	MANHOLE
MLCP	MULTI-LAYER COMPOSITE PIPE
NTS	NOT TO SCALE
NVE	NV ENERGY
OHP	OVERHEAD POWER LINE
PC	POINT OF CURVE
P.I.P.	PROTECT IN PLACE
PP	POWER POLE
PT	POINT OF TANGENCY
PRC	POINT OF REVERSE CURVE
PB	PULLBOX
R, PL	PROPERTY LINE
R	RADIUS
RT	RIGHT
R/W, R.O.W.	RIGHT OF WAY
SCCP	STEEL CYLINDER CONCRETE PIPE
SD	STORM DRAIN
SF	SQUARE FOOT
SS	SANITARY SEWER
STA.	STATION
STD	STANDARD
SY	SQUARE YARD
S/W	SIDEWALK
T	TELEPHONE LINE
TC	TOP OF CURB
TEL	TELEPHONE
TRANS.	TRANSITION
T.R.C.	TOP OF RAMP CURB
TS	TRAFFIC SIGNAL
TYP.	TYPICAL
USD	UNIFORM STD DRAWING
USS	UNIFORM STD SPECIFICATIONS
W	WATER LINE
WC	WHEEL CHAIR
WM	WATER METER
WV	WATER VALVE
W/	WITH
△	INCLUDED DELTA ANGLE

RTC NOTES

1. THE CONTRACTOR SHALL NOT BE ALLOWED TO CLOSE MORE THAN ONE CONSECUTIVE BUS STOP ON THE SAME SIDE OF THE STREET. TEMPORARY CLOSURES SHALL BE PWD (PERSONS WITH DISABILITY) ACCESSIBLE BEFORE ANY BUS STOP CAN BE CLOSED. THE CONTRACTOR SHALL NOTIFY CARL SCARBROUGH AT (702) 676-1608 OR ERIC TRAASDAHL AT (702) 676-1633, AT LEAST SEVEN WORKING DAYS IN ADVANCE.

2. THE CONTRACTOR SHALL SUBMIT A BUS STOP CLOSURES SCHEDULE WITH THE TRAFFIC CONTROL PLAN. THE BUS STOP CLOSURE SCHEDULE SHALL IDENTIFY SPECIFIC DURATIONS AND TIMES OF THE DAY FOR ALL PROPOSED BUS STOP CLOSURES. BUS STOP CLOSURES ARE NOT TO EXCEED TWO CONSECUTIVE STOPS AT ONE TIME, OR MORE THAN 1,000 FEET AT A TIME. PERSONS WITH DISABILITIES SHALL HAVE ACCESS TO BUS STOPS. THE CONTRACTOR SHALL PROVIDE A 100 FOOT LONG BY 10 FEET WIDE GRAVELED TURN OUT AT TEMPORARY BUS STOPS.

REVISED FEBRUARY 14, 2013

BASIS OF BEARINGS

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983 SAID MERIDIAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
RIVET PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION 536.414 METERS
1759.89 FEET

CITY OF LAS VEGAS GRADING NOTES

1. IN THE EVENT THAT ANY UNFORESEEN CONDITIONS NOT COVERED BY THESE NOTES ARE ENCOUNTERED DURING GRADING OPERATIONS, THE OWNER/ENGINEER SHALL BE IMMEDIATELY NOTIFIED FOR DIRECTION.

2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM ALL NECESSARY CUTS AND FILLS WITHIN THE LIMITS OF THIS PROJECT AND THE RELATED OFF-SITE WORK, SO AS TO GENERATE THE DESIRED SUBGRADE, FINISH GRADES AND SLOPES SHOWN.

3. CONTRACTOR SHALL TAKE FULL RESPONSIBILITY FOR ALL EXCAVATION. ADEQUATE SHORING SHALL BE DESIGNED AND PROVIDED BY THE CONTRACTOR TO PREVENT UNDERMINING OF ANY ADJACENT FEATURES OR FACILITIES AND/OR CAVING OF THE EXCAVATION.

4. THE GRADING CONTRACTOR IS RESPONSIBLE TO COORDINATE WITH THE OWNER TO PROVIDE FOR THE REQUIREMENTS OF THE PROJECT STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND ASSOCIATED PERMIT.

5. CONTRACTOR SHALL GRADE TO THE LINES AND ELEVATIONS SHOWN ON THE PLANS WITHIN THE FOLLOWING HORIZONTAL AND VERTICAL TOLERANCES AND DEGREES OF COMPACTION, IN THE AREAS INDICATED:

	HORIZONTAL	VERTICAL
A. PAVEMENT AREA SUBGRADE	0.1'±	+0.0 TO -0.1
B. ENGINEERED FILL	0.5'±	+0.1 TO -0.1

COMPACTION TESTING WILL BE PERFORMED BY THE OWNER OR HIS REPRESENTATIVE. COMPACTION SHALL COMPLY WITH THE REQUIREMENTS OF THE ENGINEER.

6. ALL CUT AND FILL SLOPES SHALL BE PROTECTED UNTIL EFFECTIVE EROSION CONTROL HAS BEEN ESTABLISHED.

7. THE USE OF POTABLE WATER WITHOUT A SPECIAL PERMIT FOR BUILDING OR CONSTRUCTION PURPOSES INCLUDING CONSOLIDATION OF BACKFILL OR DUST CONTROL IS PROHIBITED. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FOR CONSTRUCTION WATER.

8. THE CONTRACTOR SHALL MAINTAIN THE STREETS, SIDEWALKS AND ALL OTHER PUBLIC RIGHT- OF-WAY IN A CLEAN, SAFE AND USABLE CONDITION. ALL SPILLS OF SOIL, ROCK OR CONSTRUCTION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE PUBLICLY OWNED PROPERTY DURING CONSTRUCTION AND UPON COMPLETION OF THE PROJECT. ALL ADJACENT PROPERTY, PRIVATE OR PUBLIC SHALL BE MAINTAINED IN A CLEAN, SAFE AND USABLE CONDITION.

9. IN THE EVENT THAT ANY TEMPORARY CONSTRUCTION ITEM IS REQUIRED THAT IS NOT SHOWN ON THESE DRAWINGS, SUCH ITEM SHALL BE PROVIDED, AS DIRECTED BY THE CITY ENGINEER, AT NO EXPENSE TO THE CITY OF LAS VEGAS. TEMPORARY CONSTRUCTION INCLUDES DITCHES, BERMS, ROAD SIGNS AND BARRICADES, ETC.

REVISED JULY 2008 (CPM VERSION)

CITY OF LAS VEGAS TRAFFIC NOTES

1. ALL CONSTRUCTION SIGNING, BARRICADING, AND TRAFFIC DELINEATION SHALL CONFORM TO THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES", LATEST EDITION.

2. THE STREET SIGN CONTRACTOR SHALL OBTAIN STREET NAMES AND BLOCK NUMBERING FROM THE PLANNING DEPARTMENT PRIOR TO CONSTRUCTION.

3. BEFORE ANY WORK IS STARTED IN THE RIGHT-OF-WAY, THE CONTRACTOR SHALL INSTALL ALL ADVANCE WARNING SIGNS FOR THE CONSTRUCTION ZONE. THE CONTRACTOR SHALL INSTALL TEMPORARY STOP SIGNS AT ALL NEW STREET ENCROACHMENTS INTO EXISTING CITY STREETS WHERE WARRANTED IMMEDIATELY AFTER FIRST GRADING WORK IS ACCOMPLISHED, AND SHALL MAINTAIN SAID SIGNS UNTIL PERMANENT SIGNS ARE INSTALLED.

4. WHEN A DESIGNATED "SUGGESTED ROUTE TO SCHOOL" IS ENCROACHED UPON BY A CONSTRUCTION WORK ZONE AND PUBLIC WORKS STAFF IDENTIFIES A NEED FOR STUDENTS TO BE ASSISTED IN THE SAFE CROSSING THROUGH THAT WORK ZONE, THE CONTRACTOR SHALL BE REQUIRED TO PROVIDE A QUALIFIED "CROSSING GUARD". THE GUARD SHALL BE PRESENT FOR THE FULL DURATION OF TIME THAT CHILDREN ARE LIKELY TO BE PRESENT.

5. IF THE IMPROVEMENTS NECESSITATE THE OBLITERATION, TEMPORARY OBSTRUCTION, TEMPORARY REMOVAL OR RELOCATION OF ANY EXISTING TRAFFIC PAVEMENT MARKING, SUCH PAVEMENT MARKING SHALL BE RESTORED OR REPLACED WITH LIKE MATERIALS TO THE SATISFACTION OF THE CITY TRAFFIC ENGINEER.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND INSTALLING ALL PERMANENT SIGNS SHOWN ON THE PLANS. ALL NEW TRAFFIC SIGNS SHALL UTILIZE TYPE XI RETROREFLECTIVE SHEETING IN ACCORDANCE WITH CCAUSS 627 AND 716 AND SHALL HAVE AN ANTI-GRAFFITI PROTECTIVE OVERLAY FILM THAT IS A MATCHING COMPONENT TO, AND OF THE SAME MANUFACTURER AS THE RETROREFLECTIVE SHEETING TO WHICH IT IS APPLIED. STREET NAME SIGNS SHALL CONFORM IN THEIR ENTIRETY TO CURRENT CITY STANDARDS. ALL OTHER SIGNS SHALL BE STANDARD SIZE UNLESS OTHERWISE SPECIFIED ON THE PLANS. ALL SIGN POSTS SHALL BE INSTALLED IN ACCORDANCE WITH THE CURRENT CITY STANDARDS.

7. WHEN A PROPOSED STREET LIGHT STANDARD IS LOCATED WITHIN FIVE (5) FEET OF ANY PROPOSED SIGN SHOWN ON THE PLANS TO BE MOUNTED ON A SIGNPOST, THE SIGN SHALL BE MOUNTED ON THE STREET LIGHT STANDARD AND THE SIGNPOST SHALL BE ELIMINATED.

8. ALL PERMANENT TRAFFIC CONTROL DEVICES CALLED FOR HEREON SHALL BE IN PLACE AND IN FINAL POSITION PRIOR TO ALLOWING ANY PUBLIC TRAFFIC ONTO THE PORTIONS OF THE ROAD(S) BEING IMPROVED HERE UNDER, REGARDLESS OF THE STATUS OF COMPLETION OF PAVING OR OTHER OFF-SITE IMPROVEMENTS CALLED FOR BY THESE PLANS.

9. STREET SIGNS AND STOP SIGNS SHALL BE INSTALLED PER CITY STANDARD SPECIFICATIONS FOR PLACEMENT OF STREET NAME SIGNS.

10. THE CONTRACTOR SHALL PROVIDE ALL NECESSARY TRAFFIC CONTROL DEVICES AND FLAGGERS TO INSURE THE SAFETY OF THE PUBLIC IN OR AROUND THE WORK AREA. THE CONTRACTOR SHALL HAVE A CERTIFIED ATSSA TRAFFIC CONTROL TECHNICIAN OR IMSA WORK ZONE SAFETY SPECIALIST SET UP, MAINTAIN AND/OR REMOVE ALL TRAFFIC CONTROL DEVICES IN THE CITY OF LAS VEGAS RIGHT OF WAY.

11. WORK IN PUBLIC STREETS, ONCE BEGUN, SHALL BE EXPEDITED TO COMPLETION SO AS TO PROVIDE MINIMUM INCONVENIENCE TO ADJACENT PROPERTY OWNERS AND TO THE TRAVELING PUBLIC.

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING RTC TRANSIT IF THE CONSTRUCTION INTERRUPTS OR RELOCATES A BUS STOP OR HAS AN ADVERSE EFFECT ON BUS SERVICE ON THAT STREET TO ARRANGE FOR TEMPORARY RELOCATION OF STOP.

13. GUARDS SHALL BE OBTAINED BY CONTACTING THE METROPOLITAN POLICE DEPARTMENT SPECIAL EVENTS UNIT (PHONE # 828-3442) WHO WILL PROVIDE OFFICERS PROPERLY TRAINED IN TRAFFIC CONTROL. FEES FOR THE USE OF THESE OFFICERS SHALL BE SET BY METRO AND WILL BE PAID BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE FOR ALL ARRANGEMENTS WITH METRO.

14. ANY WORK WITHIN 300 OF A SIGNALIZED INTERSECTION WILL BE NIGHT WORK, UNLESS DIRECTED BY THE CITY OF LAS VEGAS TRAFFIC ENGINEER.

15. THE CONTRACTOR SHALL CONTACT THE TRAFFIC ENGINEERING DIVISION (TRANSPORTATION SECTION) THROUGH THE PROJECTS OFFSITE INSPECTOR PRIOR TO INITIATING PAVING TO RECEIVE DIRECTION FOR ANY PERMANENT OR TEMPORARY MODIFICATIONS TO THE APPROVED DRAWINGS REGARDING FINAL PAVEMENT TRANSITIONS, MARKINGS AND SIGNING THAT ARE REQUIRED TO MATCH ADJACENT ROADWAY SEGMENTS. THE CONTRACTOR SHALL PROVIDE A DRAWING FOR APPROVAL BY THE TRAFFIC ENGINEERING DIVISION DEPICTING ANY ADJUSTMENTS TO THE FINAL PAVEMENT MARKINGS AND SIGNAGE, WHICH MAY INCLUDE OMITTING, ADDING OR MODIFYING PAVEMENT MARKINGS AND TRAFFIC CONTROL SIGNS SUCH THAT ADEQUATE TRANSITIONS AND LANE TERMINATIONS BETWEEN ADJACENT ROADWAY SEGMENTS ARE CONSTRUCTED.

REVISED JULY 13, 2013

CITY OF LAS VEGAS SEWER NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS AND THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA, AS AMENDED. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO BE AWARE OF THE CONTENTS OF THE ABOVE SPECIFICATIONS.

2. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO PERFORM CONSTRUCTION AS PER PLANS. ANY ADDITIONS, DELETIONS, OR CHANGES SHALL FIRST MEET WITH THE APPROVAL OF THE CITY PLANNING ENGINEER.

3. CHISEL "S" OR "G" IN CURBS WHERE SEWER OR GAS LATERALS PASS UNDER THE CURB.

4. POLYVINYL (PVC) SEWER PIPE SHALL MEET ASTM D-3034 SDR 35 SPECIFICATIONS, INSTALLED WITH SAND BEDDING AND BACKFILL OF TYPE II AGGREGATE BASE.

5. ALL MANHOLES PAVED IN STREETS EIGHTY (80) FOOT R/W AND LARGER SHALL HAVE CONCRETE COLLARS. STREETS LESS THAN EIGHTY (80) FOOT R/W WILL REQUIRE RETROFIT IF PAVING DOES NOT CONFORM TO CITY STANDARDS AT THE MANHOLE.

6. TEE SADDLES SHALL BE USED TO CONNECT SEWER LATERALS TO EXISTING MAIN LINES UP TO TWELVE INCH (12") DIAMETER. CONNECTIONS TO FIFTEEN INCH (15") OR LARGER MAINS SHALL REQUIRE SPECIAL PROCEDURES. IN LINE "Y" S SHALL BE USED ON LINES TWELVE INCHES (12") OR ABOVE.

7. WATER MAINS SHALL BE PROTECTED IN ACCORDANCE WITH LVVWD STANDARDS WHENEVER A SEWER MAIN CROSSES OVER A WATER MAIN OR THE SEWER IS LESS THAN EIGHTEEN INCH (18") UNDER A WATER MAIN.

8. ALL CONTRACTORS INSTALLING SEWER MAINS THAT WILL BE UNDER THE JURISDICTION OF THE CITY OF LAS VEGAS MUST BE STATE OF NEVADA CLASS "A" CONTRACTORS.

9. THE CITY OF LAS VEGAS WILL NOT ACCEPT ANY SEWER MAINS WHICH HAVE A VERTICAL DEFLECTION OF MORE THAN ONE TENTH (0.1) OF A FOOT FROM THE APPROVED CONSTRUCTION PLANS AT ANY LOCATION. SEWER MAINS FOUND TO EXCEED THIS TOLERANCE WILL HAVE TO BE REPAIRED OR REMOVED OR REPLACED TO THE SATISFACTION OF THE CITY PLANNING ENGINEER PRIOR TO ACCEPTANCE BY THE CITY OF LAS VEGAS.

10. INSTALLATION OF CURVED SEWERS REQUIRES THE USE OF C-900 PVC PIPE WHICH ALLOWS FOR PIPE DEFLECTION AT THE JOINTS.

REVISED JANUARY 2008

LVVWD STANDARD NOTES

LVVWD PROJECT # XXXXX

1. NO WORK SHALL BEGIN UNTIL THE WATER PLANS HAVE BEEN APPROVED FOR CONSTRUCTION BY THE LVVWD. FOLLOWING WATER PLAN APPROVAL, NOTICE SHALL BE GIVEN TO THE LVVWD COMMUNICATION SUPPORT CENTER (258-7171) TWO (2) WORKING DAYS PRIOR TO THE START OF CONSTRUCTION. FOR FUTURE INSPECTIONS, NOTICE MUST BE GIVEN BY 2:00 P.M. THE BUSINESS DAY PRIOR TO THE REQUESTED LVVWD INSPECTION. WHEN REQUESTING INSPECTIONS, PLEASE REFER TO THE PROJECT# IDENTIFIED ABOVE.

2. ALL WORK SHALL CONFORM TO LVVWD STANDARD PLATES, DRAWINGS, AND SPECIFICATIONS, AND TO THE 2010 EDITION OF THE UNIFORM DESIGN AND CONSTRUCTION STANDARDS FOR POTABLE WATER SYSTEMS (UDACS). THE LATEST EDITION OF UDACS SHALL SUPERSEDE ANY CONFLICTS CONTAINED IN THE APPROVED DRAWINGS AND/OR SPECIFICATIONS.

3. ALL WORK, EXCEPT AS MODIFIED BY THESE PLANS OR BY NOTE 2 ABOVE, SHALL BE DONE IN ACCORDANCE WITH THE MOST RECENT DRAFT OR EDITION OF THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFFSITE IMPROVEMENT, CLARK COUNTY AREA.

4. A SINGLE PIPE MATERIAL SHALL BE USED THROUGHOUT THE PROJECT UNLESS OTHERWISE APPROVED BY THE LVVWD.

5. ALL SERVICE LATERALS TWO (2) INCHES IN DIAMETER AND SMALLER SHALL BE TYPE K COPPER TUBING WITH LVVWD APPROVED SERVICE SADDLES.

6. ALL WATER METER BOXES SHALL BE LOCATED OUTSIDE OF DRIVEWAY AREAS.

7. ALL VALVES SHALL BE LOCATED OUTSIDE OF DRIVEWAYS, VALLEY AND CURB GUTTERS.

8. ALL WATER AND STORM DRAIN OR SANITARY SEWER CROSSINGS SHALL CONFORM TO SECTION 2.22 OF THE 2010 EDITION OF THE UDACS.

9. ALL WATER FACILITIES SHALL BE FILLED, DISINFECTED, PRESSURE TESTED, FLUSHED, FILLED AND AN ACCEPTABLE WATER SAMPLE OBTAINED, PRIOR TO CONNECTION TO THE LVVWD DISTRIBUTION SYSTEM.

10. THE CONTRACTOR MUST OBTAIN ALL METERS TWO (2) INCHES AND SMALLER FROM LVVWD CENTRAL STORES. TELEPHONE 258-3152 OR 258-3802, TWO (2) WORKING DAYS PRIOR TO METER PICKUP.

11. ANY INTERRUPTION OF SERVICE MUST BE PERFORMED IN ACCORDANCE WITH UDACS SECTION 3.14.01, AND APPROVED BY THE LVVWD INSPECTION DIVISION PRIOR TO SHUTDOWN. PROPER WRITTEN NOTIFICATION MUST BE GIVEN TO ALL AFFECTED CUSTOMERS.

12. ALL WATER FACILITY CONSTRUCTION MATERIALS USED MUST BE AS LISTED ON THE LVVWD PRE-APPROVED MATERIALS AND MANUFACTURERS LISTING FOR NEW FACILITIES, LATEST REVISION, OR SPECIFICALLY APPROVED ON THESE PLANS.

13. TELEPHONE "CALL BEFORE YOU DIG" AT "811" OR 1-800-227-2600

14. THE INSTALLATION OF LAS VEGAS VALLEY WATER DISTRICT (LVVWD) MUNICIPAL WATER FACILITIES WITHIN ALL STREETS IS ASSUMED TO BE IN COMPLIANCE WITH THE UNIFORM STANDARDS, INCLUDING THE PLACEMENT OF ASPHALT PAVING STREET SURFACES. ANY REPAIR WORK DONE BY THE LVVWD TO THE MUNICIPAL FACILITIES WILL INCLUDE THE PLACEMENT OF ANY APPROPRIATELY SIZED ASPHALT REPAIR PATCH ON THE STREET SURFACE.

ANY DECORATIVE PAVING SURFACE WITHIN THE STREET IS THE RESPONSIBILITY OF THE OWNERS ASSOCIATION, OR THE INDIVIDUAL PROPERTY OWNERS IF NO OWNERS ASSOCIATION IS IN EXISTENCE, OR THE AGENCY HAVING JURISDICTION. DECORATIVE SURFACE MATERIALS PLACED WITHIN THE TEN FOOT EASEMENT ABUTTING A PUBLIC OR PRIVATE STREET, IF DISTURBED BY THE LVVWD DURING THE REPAIR OR OPERATION OF ITS FACILITIES, WILL BE REPLACED BY LVVWD WITH AN APPROPRIATELY SIZED PLAIN FINISH CONCRETE PATCH. THE LVVWD WILL NOT RESTORE, AND WILL NOT BE RESPONSIBLE FOR THE RESTORATION OF, ANY DECORATIVE PAVING SURFACE WITHIN THE STREET. THE LVVWD WILL NOT ATTEMPT TO MATCH COLOR OR FINISH OF ANY ADJACENT MATERIALS.

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# XXXXX

CITY OF LAS VEGAS STREET LIGHT NOTES

1. ALL STREET LIGHTING INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE STREET LIGHTING PLANS, THE "UNIFORM STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA", LATEST REVISION, AND THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA", LATEST REVISION.

2. NO DEVIATION OF STREET LIGHT, PULL BOX, CONDUITS (ETC.) LOCATIONS SHALL BE PERMITTED WITHOUT WRITTEN APPROVAL OF THE TRAFFIC AND CITY ENGINEER. ANY DEVIATION FROM THE PLAN LOCATION WILL REQUIRE COMPLIANCE WITH SECTION 623 OF THE SPECIFICATIONS.

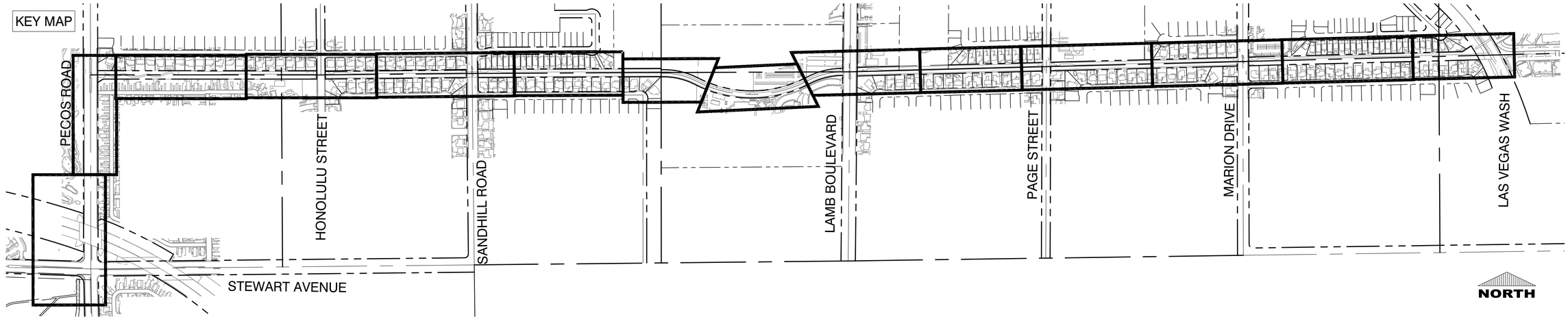
3. ALL EXISTING STREET LIGHTING SHALL REMAIN OPERATIONAL DURING CONSTRUCTION.

4. ALL EMPTY CONDUIT SHALL HAVE PULL STRINGS AND A #8 AWG TRACER WIRE INSTALLED PER SECTION 623 G.02.01 OF THE SPECIFICATIONS PRIOR TO BACKFILLING AND FINAL INSPECTION.

5. ANY STRUCTURE SUCH AS BLOCK WALLS, CHAIN LINK FENCES, RETAINING WALLS, ETC., SHALL LEAVE A MINIMUM CLEARANCE IN COMPLIANCE WITH USD NO. 320A WHEN POLE IS INSTALLED BEHIND SIDEWALK, AND SHALL AT NO TIME COMPLETELY ENCLOSE THE STREET LIGHTING POLE.

6. AS-BUILT DRAWINGS SHALL BE SUPPLIED TO THE TRAFFIC ENGINEERING DIVISION PRIOR TO ANY PRE-FINAL INSPECTION. THE AS-BUILT DRAWING NEEDS TO BE STAMPED AS-BUILT AND SIGNED BY THE PREPARER.

7. SERVICE POINTS SHALL BE COORDINAT



CITY OF LAS VEGAS FIRE AND RESCUE NOTES

1. ALL WORK SHALL BE DONE IN STRICT ACCORDANCE WITH THE LAS VEGAS FIRE AND RESCUE ADOPTED FIRE CODE ORDINANCE #6124 FOR HYDRANT SPECIFICATIONS AND HYDRANT INSTALLATION SPECIFICATIONS.
2. AUTHORIZED FIRE HYDRANTS ARE AS FOLLOWS:
   - KENNEDY - GUARDIAN MODELS K81A AND K81D
   - MUELLER - SUPER CENTURION 250, MODEL A-423
   - CLOW - MEDALLION MODEL F-2546LVD
   - TROY VALVE - PATRIOT MODEL PT8100N, NEVADA HYDRANT
   - U.S.PIPE - METROFLOW/M-03
3. A PERMIT IS REQUIRED FROM LAS VEGAS FIRE AND RESCUE FOR THE INSTALLATION OF ON-SITE WATER LINES AND FIRE HYDRANTS. THE PERMIT AND CONTRACTORS MATERIAL TEST CERTIFICATE FOR UNDERGROUND PIPING FORM SHALL BE OBTAINED FROM THE FIRE PROTECTION ENGINEER BEFORE COMMENCEMENT OF WORK. IFC § 105.7.11
4. ON ANY RESIDENTIAL OR COMMERCIAL INSTALLATIONS, FIRE HYDRANTS SHALL BE INSTALLED AND FIRE APPARATUS ACCESS ROADS SHALL BE MAINTAINED BEFORE COMMENCEMENT OF ANY COMBUSTIBLE CONSTRUCTION. ALL FIRE HYDRANTS SHALL BE IN GOOD WORKING ORDER AND SHALL BE CAPABLE OF DELIVERING THE REQUIRED FIRE FLOW. IFC § 1412.
5. TO IDENTIFY THE FIRE HYDRANT LOCATIONS, THE CONTRACTOR SHALL PLACE A BLUE REFLECTIVE MARKER AT THE CENTER LINE OF THE STREET ADJACENT TO THE FIRE HYDRANTS. IFC § 507.5.7.3
6. ALL UNDERGROUND INSPECTIONS, PRESSURE AND FLUSH VERIFICATIONS OF ALL FIRE HYDRANTS AND FIRE LINES, SHALL BE CONDUCTED BEFORE COVERING THE LINES. CENTER LOADING IS ACCEPTABLE FOR THE HYDRO TESTS WITH PRIOR FIRE PREVENTION APPROVAL
7. ALL ON-SITE UNDERGROUND WATER MAINS AND MATERIALS SHALL BE U.L. LISTED, A.W.W.A APPROVED AND SHALL BE RATED FOR THE APPROPRIATE WORKING PRESSURE. IFC § 507.2.1, NFPA 24
8. PAINTING OF CURBS, FIRE HYDRANTS, PADS, PROTECTION OF FIRE HYDRANTS FROM PHYSICAL DAMAGE, AND ALL OTHER WORK NECESSARY PER PLANS SHALL BE COMPLETED BEFORE APPROVAL BY LAS VEGAS FIRE AND RESCUE, FIRE PREVENTION DIVISION. IFC § 507; 507.5.7
9. PRIVATE HYDRANTS SHALL BE PAINTED RED. IFC § 507.5.7.1
10. PREVENTION DIVISION TO VERIFY AVAILABILITY OF THE REQUIRED FIRE FLOW. IFC § 507; 507.1
11. FIRE HYDRANT SPACING SHALL BE AS FOLLOWS: IFC § C102
    - RESIDENTIAL - 500 FT UNSPRINKLERED/600 FT SPRINKLERED.
    - COMMERCIAL - 300 FT UNSPRINKLERED/400 FT SPRINKLERED.
12. WHERE THE WATER MAINS ARE EXTENDED ALONG STREETS OR NEW STREETS ARE INSTALLED WHERE FIRE HYDRANTS ARE NOT NEEDED FOR PROTECTION OF THE STRUCTURES, FIRE HYDRANTS SHALL BE INSTALLED AT A MAXIMUM OF 1000 FT SPACING, TO PROVIDE FOR TRANSPORTATION HAZARDS. WHERE STREETS ARE PROVIDED WITH MEDIAN DIVIDERS OR HAVE FOUR (4) OR MORE TRAFFIC LANES AND HAVE A TRAFFIC COUNT OF MORE THAN 30,000 PER DAY, HYDRANTS ARE REQUIRED ON EACH SIDE OF THE STREET SPACED AT 500 FT ON AN ALTERNATING BASIS. IFC § C102.14
13. NO FIRE HYDRANTS SHALL BE LOCATED WITHIN THE RADIUS OF A CUL-DE-SAC OR WITHIN 20 FT OF THE PERIMETER OF THE RADIUS OF THE CUL-DE-SAC.
14. NO FIRE HYDRANTS SHALL BE LOCATED WITHIN 6 FT OF ANY CURB RETURN, DRIVEWAY, POWER POLE, STREETLIGHT OR ANY OTHER OBSTRUCTION. IFC § C102.12
15. A MAXIMUM DISTANCE FROM A FIRE HYDRANT TO A ONE-TWO FAMILY DWELLING SHALL NOT EXCEED 300 FT, AS MEASURED BY AN APPROVED ROUTE. IFC § 102.4
16. THE MAXIMUM DISTANCE FROM A FIRE HYDRANT TO A FIRE DEPARTMENT CONNECTION (FDC) SHALL NOT EXCEED 100 FT, AS MEASURED BY AN APPROVED ROUTE. IFC § C102.7
17. THE MAXIMUM DISTANCE FROM A HYDRANT TO THE END OF A DEAD-END STREET SHALL NOT EXCEED 200 FT. IFC § C102.6
18. TWO (2) SOURCES OF SUPPLY ARE REQUIRED WHENEVER THERE IS 4 OR MORE FIRE HYDRANTS/SPRINKLER LEAD-INS ARE INSTALLED ON A SINGLE SYSTEM. SECTIONAL CONTROL VALVES SHALL BE INSTALLED SO THAT NO MORE THAN 2 FIRE HYDRANTS CAN BE OUT OF SERVICE DUE TO A BREAK IN A WATER MAIN. IFC § C104.1
19. ALL FIRE APPARATUS ACCESS ROADS SHALL BE PAVED TO PROVIDE ALL-WEATHER DRIVING CAPABILITIES, AND SHALL BE DESIGNED AND MAINTAINED TO SUPPORT THE IMPOSED LOADS OF THE FIRE APPARATUS. IFC § 503.2.3
20. THE GRADIENT FOR THE FIRE APPARATUS ACCESS ROADS SHALL NOT EXCEED 12% . ANGLES OF APPROACH AND ANGLES OF DEPARTURE SHALL NOT EXCEED 6% FOR 25 FT PRIOR TO OR AFTER THE GRADE CHANGE. ADJACENT TO THE STRUCTURES GRADIENT SHALL NOT EXCEED 6%. IFC § 503.2.7; 503.2.8
21. THE TURNING RADIUS OF THE FIRE APPARATUS ACCESS ROADS SHALL BE NO LESS THAN 52 FT OUTSIDE AND 28 FT INSIDE TURNING RADIUS. IFC § 503.2.4
22. VERTICAL CLEARANCE OF ALL FIRE APPARATUS ACCESS ROADS SHALL NOT BE LESS THAN 13FT 6 INS. IFC § 503.2.1.1
23. FIRE DEPARTMENT ACCESS ROADS IN ALL RESIDENTIAL DEVELOPMENTS (EXCEPT APARTMENT BUILDINGS) SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF NOT LESS THAN 36 FT FLOW LINE TO FLOW LINE (THIS WIDTH MAY BE REDUCED TO 24 FT IF ALL BUILDINGS FRONTING THE STREET ARE SPRINKLERED) FOR MAIN RESIDENTIAL STREETS, WITH PARKING PERMITTED ON BOTH SIDES OF THE STREET. PRIVATE DRIVE AISLES, DRIVEWAYS, ETC. SHALL BE ALLOWED TO BE REDUCED TO A MINIMUM WIDTH OF 24 FT FLOW LINE TO FLOW LINE WHEN SERVING NO MORE THE 6 RESIDENTS, AND WHEN ON STREET PARKING IS DISALLOWED. IFC § 503.2.1; 503.2.11
24. ALL FIRE APPARATUS ACCESS ROADS IN COMMERCIAL DEVELOPMENTS AND APARTMENT COMPLEXES SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF NOT LESS THAN 24 FT (FLOW LINE TO FLOW LINE), PROVIDED NO PARKING IS ALLOWED ON EITHER SIDE/32 FT (FLOW LINE TO FLOW LINE), WITH PARALLEL PARKING ON ONE SIDE. AND 36 FT (FLOW LINE TO FLOW LINE), IF PARALLEL PARKING IS ALLOWED ON BOTH SIDES. THESE WIDTHS MAY BE REDUCED TO 24 FT IF SPRINKLERED. IFC § 503.2.1.1
25. A FIRE APPARATUS ACCESS ROAD SHALL BE REQUIRED WHEN ANY PORTION OF AN EXTERIOR WALL OF THE FIRST STORY IS LOCATED MORE THAN 150 FT FROM A FIRE DEPARTMENT VEHICLE ACCESS. THIS DISTANCE COULD BE INCREASED TO 250 FT IF THE BUILDING IS SPRINKLERED. IFC § 503.1.1; 503.11
26. APPROVED SECONDARY FIRE APPARATUS ACCESS SHALL BE PROVIDED FOR 100 OR MORE DWELLING UNITS, ROAD(S) WITH DEAD-ENDS OR WITH A SINGLE POINT OF ACCESS IN EXCESS OF 600 FT, AND FOR ALL COMMERCIAL, INDUSTRIAL, AND MULTI-FAMILY RESIDENTIAL DEVELOPMENTS. IFC § 503.1.2
27. ALL DEAD-END FIRE APPARATUS ROADS AND/OR FIRE LANES, PUBLIC OR PRIVATE, IN EXCESS OF 150 FT IN LENGTH SHALL BE PROVIDED WITH AN APPROVED TURN AROUND HAVING A MINIMUM DIAMETER OF 81 FT. IFC § 503.2.5
28. ALL FIRE APPARATUS ACCESS ROADS SHALL BE MARKED BY PLACING APPROVED SIGNS AT THE START OF THE DESIGNATED FIRE LANE, ONE SIGN AT THE END OF THE FIRE LANE AND WITH SIGNS AT INTERVALS OF 100 FT ALONG THE DESIGNATED FIRE LANES. SIGNS TO BE PLACED ON BOTH SIDES OF AN ACCESS ROADWAY IF NEEDED TO PREVENT PARKING ON EITHER SIDE. SIGNS TO BE INSTALLED NO HIGHER THAN 10 FT OR LESS THAN 6 FT FROM THE ROADWAY LEVEL. THE CURB ALONG OR ON THE PAVEMENT OR CEMENT (IF NO CURB IS PROVIDED) SHALL BE PAINTED WITH A RED WEATHER RESISTANT PAINT IN ADDITION TO THE SIGNS. IFC § 503.3
29. ELECTRICALLY CONTROLLED ACCESS GATES SHALL BE PROVIDED WITH AN APPROVED EMERGENCY VEHICLE DETECTOR/RECEIVER SYSTEM. SAID SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE CITY OF LAS VEGAS GUIDELINES FOR AUTOMATIC EMERGENCY VEHICLE ACCESS GATES. IFC § 503.6

REVISED FEBRUARY 1, 2011

SHEET INDEX

SHEET NUMBER	DRAWING NUMBER	SHEET LINE 1	SHEET LINE 2
1	CV	COVER SHEET	
2	GN01	GENERAL NOTES, LEGEND, VICINTIY	MAP & ABBREVITATIONS
3	GN02	GENERAL NOTES & SHEET INDEX	
4	SC01	SURVEY CONTROL PLAN	
5	SC02	SURVEY CONTROL PLAN	
6	HC01	HORIZONAL CONTROL PLAN	
7	HC02	HORIZONAL CONTROL PLAN	POINT, LINE & CURVE TABLES
8	SU01	EXISTING UTILITIES LOCATION PLAN	"SD01" 10+00 TO "SD01" 19+00
9	SU02	EXISTING UTILITIES LOCATION PLAN	"SD01" 19+00 TO "SD01" 36+00
10	SU03	EXISTING UTILITIES LOCATION PLAN	"SD01" 36+00 TO "SD01" 54+50
11	SU04	EXISTING UTILITIES LOCATION PLAN	"SD01" 54+50 TO "SD01" 66+00
12	SU05	EXISTING UTILITIES LOCATION PLAN	"SD01" 66+00 TO "SD01" 83+00
13	SU06	EXISTING UTILITIES LOCATION PLAN	"SD01" 83+00 TO "SD01" 99+00
14	SU07	EXISTING UTILITIES LOCATION PLAN	"SD01" 99+00 TO "SD01" 117+00
15	SU08	EXISTING UTILITIES LOCATION PLAN	"SD01" 117+00 TO "SD01" 123+00
16	SD01	STORM DRAIN PLAN AND PROFILE	
17	SD02	STORM DRAIN PLAN AND PROFILE	
18	SD03	STORM DRAIN PLAN AND PROFILE	"SD01" 27+00 TO "SD01" 36+00
19	SD04	STORM DRAIN PLAN AND PROFILE	"SD01" 36+00 TO "SD01" 45+00
20	SD05	STORM DRAIN PLAN AND PROFILE	"SD01" 45+00 TO "SD01" 54+50
21	SD06	STORM DRAIN PLAN AND PROFILE	"SD01" 54+50 TO "SD01" 62+00
22	SD07	STORM DRAIN PLAN AND PROFILE	"SD01" 62+00 TO "SD01" 68+00
23	SD08	STORM DRAIN PLAN AND PROFILE	"SD01" 68+00 TO "SD01" 75+00
24	SD09	STORM DRAIN PLAN AND PROFILE	"SD01" 75+00 TO "SD01" 83+00
25	SD10	STORM DRAIN PLAN AND PROFILE	"SD01" 83+00 TO "SD01" 90+00
26	SD11	STORM DRAIN PLAN AND PROFILE	"SD01" 90+00 TO "SD01" 99+00
27	SD12	STORM DRAIN PLAN AND PROFILE	"SD01" 99+00 TO "SD01" 108+00
28	SD13	STORM DRAIN PLAN AND PROFILE	"SD01" 108+00 TO "SD01" 117+00
29	SD14	STORM DRAIN PLAN AND PROFILE	"SD01" 117+00 TO "SD01" 123+00
30	TY01	CHANNEL TYPICAL SECTIONS	
31	TY02	CHANNEL TYPICAL SECTIONS	

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

REVISIONS

NO.	DATE

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866 | BID# XX-XXXX
DATE: 6/19/2015 | DESIGNED BY: SMB | DRAWN BY: MM | CHECKED BY: HBD
SUBMITTAL STAGE: 30% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
GENERAL NOTES & SHEET INDEX

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER - STATE OF NEVADA
STEVEN BELLMO
EXP. 6-30-16
CIVIL
No. 19040

SHEET
GN02
3 OF 31
DRAWING NO.
XXX-XXXX

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BASIS OF BEARING

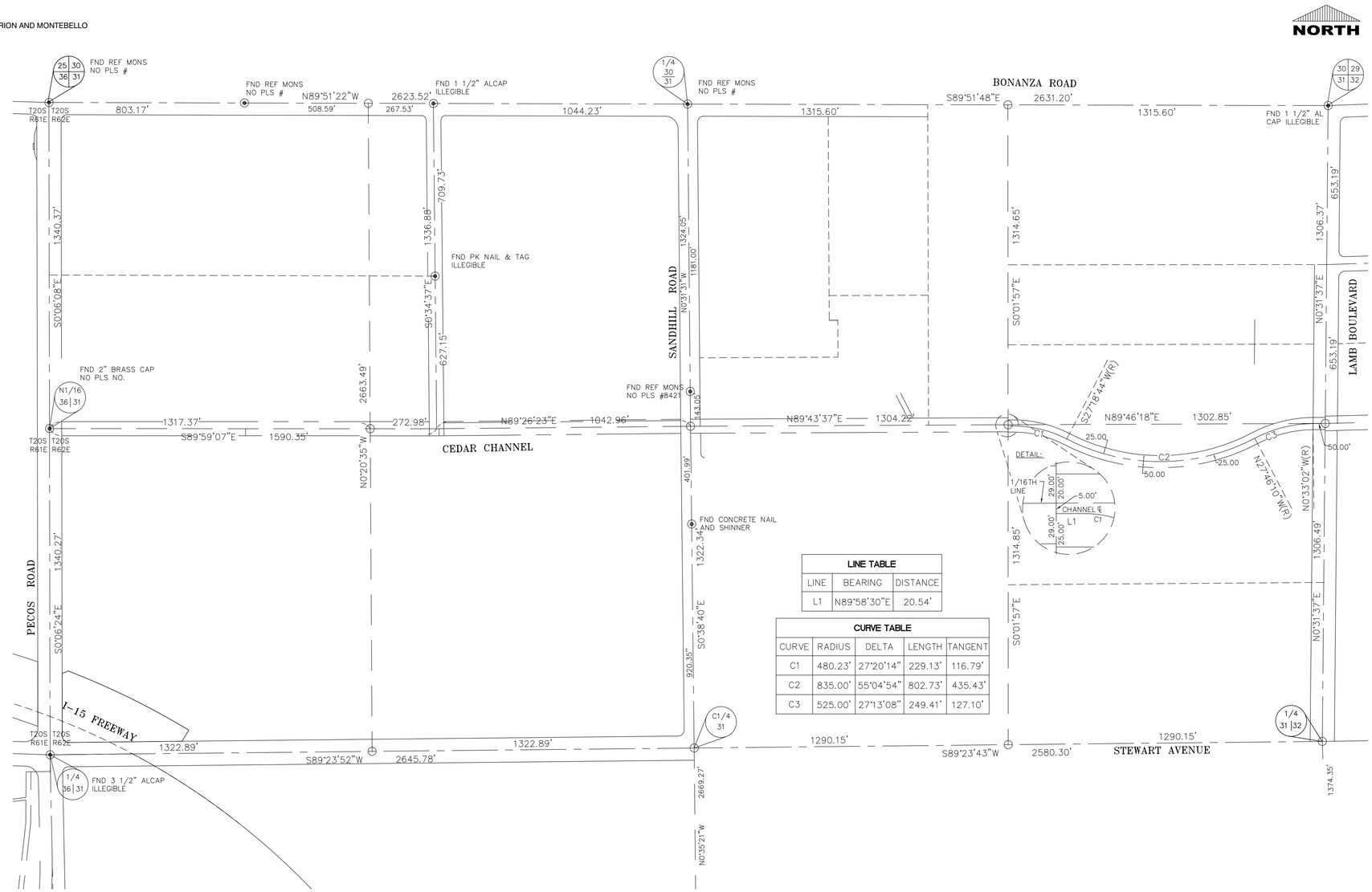
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983. SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
RIVET IN PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION = 536.414 METERS
= 1759.89 FEET

HORIZONTAL CONTROL PLANS ARE BASED ON RECORD OF SURVEY AS RECORDED BY ATKINS FILE XXX, PAGE XX.



LINE TABLE

LINE	BEARING	DISTANCE
L1	N89°58'30"E	20.54'

CURVE TABLE

CURVE	RADIUS	DELTA	LENGTH	TANGENT
C1	480.23'	27°20'14"	229.13'	116.79'
C2	835.00'	55°04'54"	802.73'	435.43'
C3	525.00'	27°13'08"	249.41'	127.10'

LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED

GRAPHIC SCALE
250 0 125 250 500
(IN FEET)

NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866 | BID# XX.XXXX | DESIGNED BY: TH | DRAWN BY: MM | CHECKED BY: EC

DATE: 6/19/2015

SUBMITTAL STAGE:
30% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
SURVEY CONTROL PLAN

PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTENSON
Exp 12-31-16
No. 8895
NOT FOR CONSTRUCTION

SHEET
SC01
OF 31

DRAWING NO.
XXX-XXXX

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BASIS OF BEARING

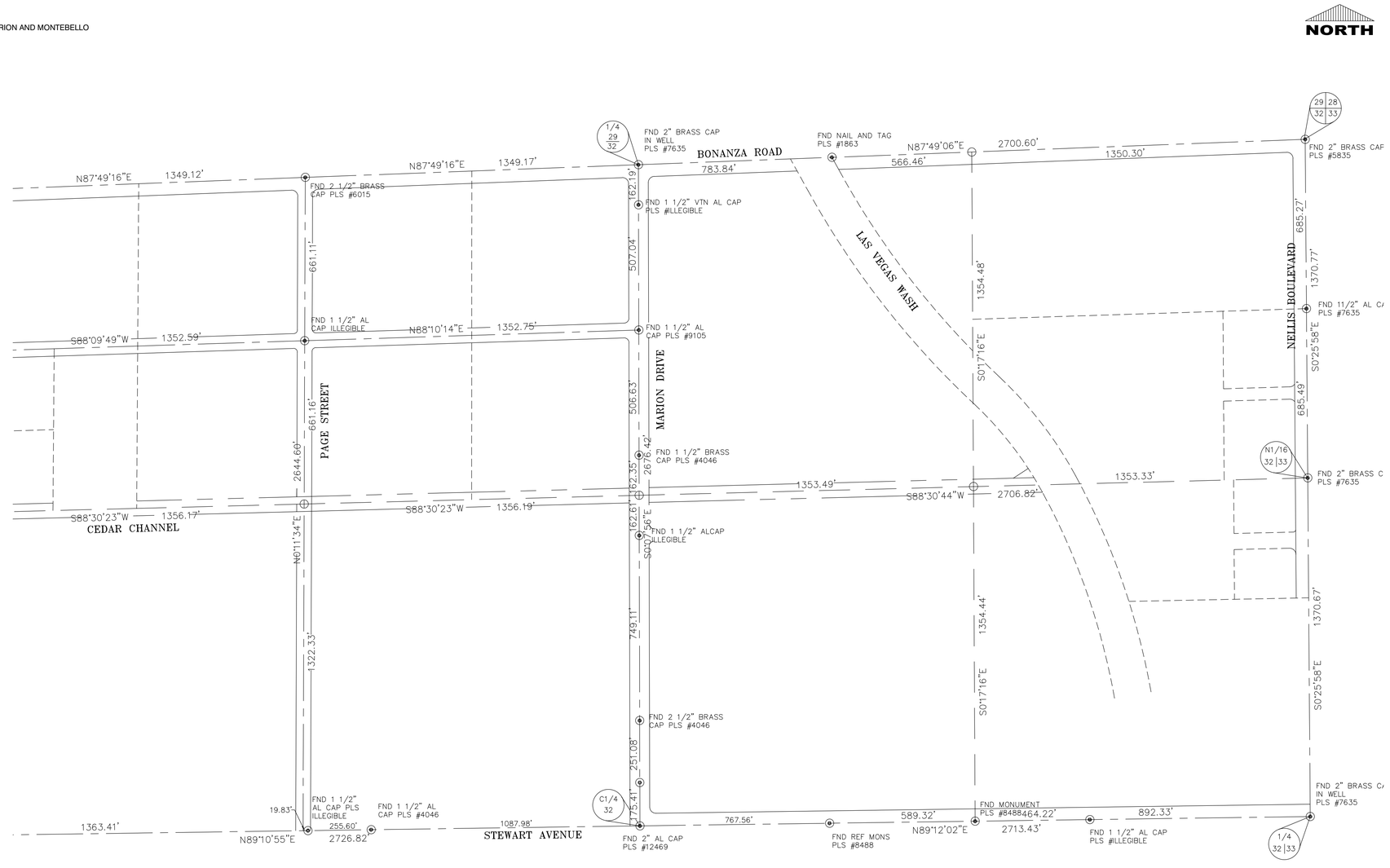
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983□SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMAR□

CITY OF LAS VEGAS BENCHMARK
RIVET □ PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION □ 536.414 METERS
□ 1759.89 FEET

HORIZONTAL CONTROL PLANS ARE BASED ON RECORD OF SURVEY AS RECORDED BY ATKINS FILE XXX, PAGE XX.



LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED

GRAPHIC SCALE
250 0 125 250 500
(IN FEET)

NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

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CITY OF LAS VEGAS

H# H49866
DATE: 6/19/2015
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DESIGNED BY: TH
DRAWN BY: MM
CHECKED BY: EC
SUBMITTAL STAGE:
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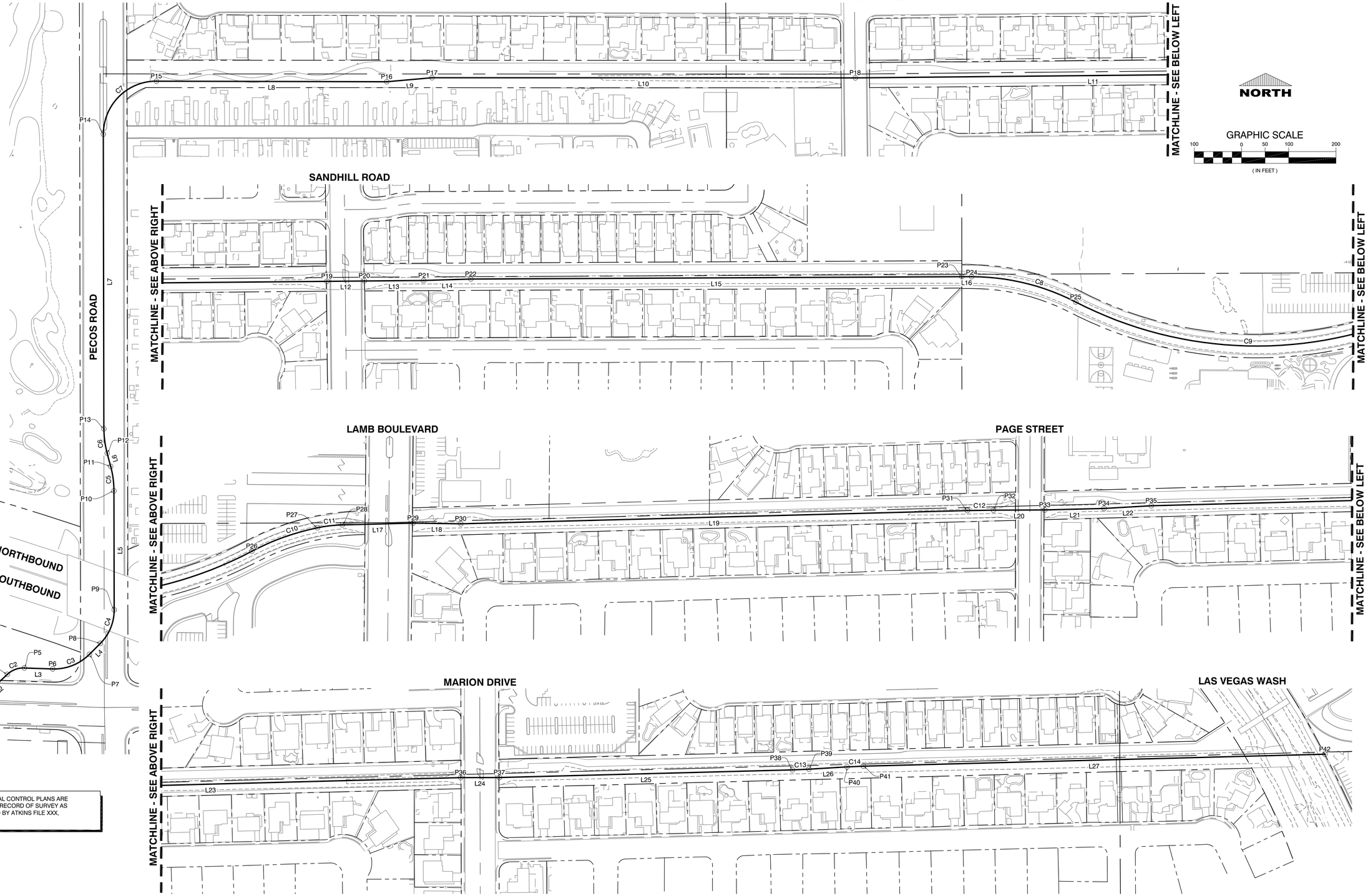
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
SURVEY CONTROL PLAN

NOT FOR CONSTRUCTION
PROFESSIONAL LAND SURVEYOR
ERIC CHRISTIANSON
EXP 12-31-16
No. 8895
STATE OF NEVADA

SHEET
SC02
□ OF 31
DRAWING NO.
XXX-XXXX

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HORIZONTAL CONTROL PLANS ARE BASED ON RECORD OF SURVEY AS RECORDED BY ATKINS FILE XXX, PAGE XX.

BASIS OF BEARING

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983□SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMAR□

CITY OF LAS VEGAS BENCHMARK
RIVET □ PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION □ 536.414 METERS
□ 1759.89 FEET

SEE SHEET HC02 FOR POINT□LINE□AND CURVE TABLES

NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID# XX-XXXX
H# H49866
DESIGNED BY: SMB
DATE: 6/19/2015
DRAWN BY: MM
SUBMITTAL STAGE:
30% - PRELIMINARY
CHECKED BY: HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
HORI□ONAL CONTROL PLAN

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN BELKNAP
EXP. 12-31-16
CIVIL
No. 19040
NOT FOR CONSTRUCTION

SHEET
HC01
□ OF 31
DRAWING NO
XXX-XXXX

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POINT TABLE				
NO.	NORTHING	EASTING	STATION	DESCRIPTION
P1	625652.1445	288913.2784	10+00.00	BP
P2	625651.8172	288923.2731	10+10.00	PC
P3	625678.7768	288994.9044	10+88.54	PT
P4	625725.2440	289044.5177	11+56.52	PC
P5	625738.7238	289080.3334	11+95.79	PT
P6	625736.7620	289140.2455	12+55.73	PC
P7	625767.5980	289218.0662	13+41.83	PT
P8	625790.8788	289241.2603	13+74.69	PC
P9	625861.6439	289270.4179	14+53.23	PT
P10	626113.4120	289269.9488	17+05.00	PC
P11	626165.1630	289263.0376	17+57.36	PT
P12	626192.8928	289255.5520	17+86.08	PCI
P13	626244.6438	289248.6407	18+38.44	PT
P14	626867.7766	289247.4798	24+61.58	PC
P15	626979.9850	289359.7491	26+37.98	PTI
P16	626978.8128	289846.9232	31+25.16	AP
P17	626987.2276	289942.6553	32+21.26	AP
P18	626986.9968	290837.6332	41+16.24	AP
P19	626996.8159	291841.9079	51+20.56	AP
P20	626997.8877	291921.2565	51+99.92	AP
P21	626998.4831	292046.2551	53+24.92	AP
P22	627001.4595	292146.2420	54+24.95	AP
P23	627006.4061	293184.6726	64+63.39	AP
P24	627006.4151	293205.2510	64+83.97	PC

POINT TABLE				
NO.	NORTHING	EASTING	STATION	DESCRIPTION
P25	626952.8790	293425.8089	67+13.10	PRC
P26	626955.9606	294197.9785	75+15.83	PRC
P27	627005.5942	294336.4932	76+63.46	PCC
P28	627011.6814	294389.2963	77+16.68	PT
P29	627015.5814	294538.8576	78+66.29	AP
P30	627014.0653	294639.8002	79+67.24	AP
P31	627042.0024	295711.1588	90+38.97	AP
P32	627042.8312	295766.1606	90+93.98	AP
P33	627043.2739	295875.0060	92+02.82	AP
P34	627046.5398	296000.2509	93+28.11	AP
P35	627052.1455	296100.1387	94+28.15	AP
P36	627079.7304	297157.9942	104+86.37	AP
P37	627079.8665	297240.0954	105+68.47	AP
P38	627095.9651	297859.8864	111+88.47	PC
P39	627097.4659	297894.5225	112+23.14	PT
P40	627102.3537	297975.0286	113+03.80	PC
P41	627103.8544	298009.6623	113+38.46	PT
P42	627129.2109	298985.7874	123+14.92	EP

Line Table		
Line #	Direction	Length
L1	S88° 07' 28.51"E	10.00'
L2	N46° 52' 31.49"E	67.98'
L3	S88° 07' 28.51"E	59.94'
L4	N44° 53' 35.72"E	32.86'
L5	N0° 06' 24.28"W	251.77'
L6	N15° 06' 24.28"W	28.72'
L7	N0° 06' 24.28"W	623.13'
L8	S89° 51' 43.73"E	487.18'
L9	N84° 58' 35.87"E	96.10'
L10	S89° 59' 06.80"E	894.98'
L11	N89° 26' 23.35"E	1004.32'
L12	N89° 13' 34.10"E	79.36'
L13	N89° 43' 37.44"E	125.00'
L14	N88° 17' 41.90"E	100.03'
L15	N89° 43' 37.44"E	1038.44'
L16	N89° 58' 29.84"E	20.58'
L17	N88° 30' 22.60"E	149.61'
L18	S89° 08' 22.20"E	100.95'
L19	N88° 30' 22.60"E	1071.72'
L20	N89° 46' 01.18"E	108.85'
L21	N88° 30' 22.60"E	125.29'
L22	N86° 47' 16.51"E	100.04'
L23	N88° 30' 22.60"E	1058.22'
L24	N89° 54' 18.22"E	82.10'
L25	N88° 30' 43.63"E	620.00'
L26	N86° 31' 32.36"E	80.65'
L27	N88° 30' 43.14"E	976.45'

Curve Table				
Curve #	Radius	Length	Delta (Δ)	TANGENT
C1	100.00'	78.54'	45.00	41.421
C2	50.00'	39.27'	45.00	20.711
C3	105.00'	86.10'	46.98	45.636
C4	100.00'	78.54'	45.00	41.421
C5	200.00'	52.36'	15.00	26.330
C6	200.00'	52.36'	15.00	26.330
C7	112.00'	176.41'	90.24	112.479
C8	480.23'	229.13'	27.34	116.789
C9	835.00'	802.73'	55.08	435.430
C10	525.00'	147.62'	16.11	74.303
C11	300.00'	53.22'	10.16	26.681
C12	2500.00'	55.01'	1.26	27.506
C13	1000.00'	34.67'	1.99	17.337
C14	1000.00'	34.67'	1.99	17.336

REVISIONS

NO.	DATE

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

	BID# XX.XXXX	DESIGNED BY:	SMB
H# H49866		DRAWN BY:	MM
DATE: 6/19/2015		CHECKED BY:	HB
SUBMITTAL STAGE:			
30% - PRELIMINARY			

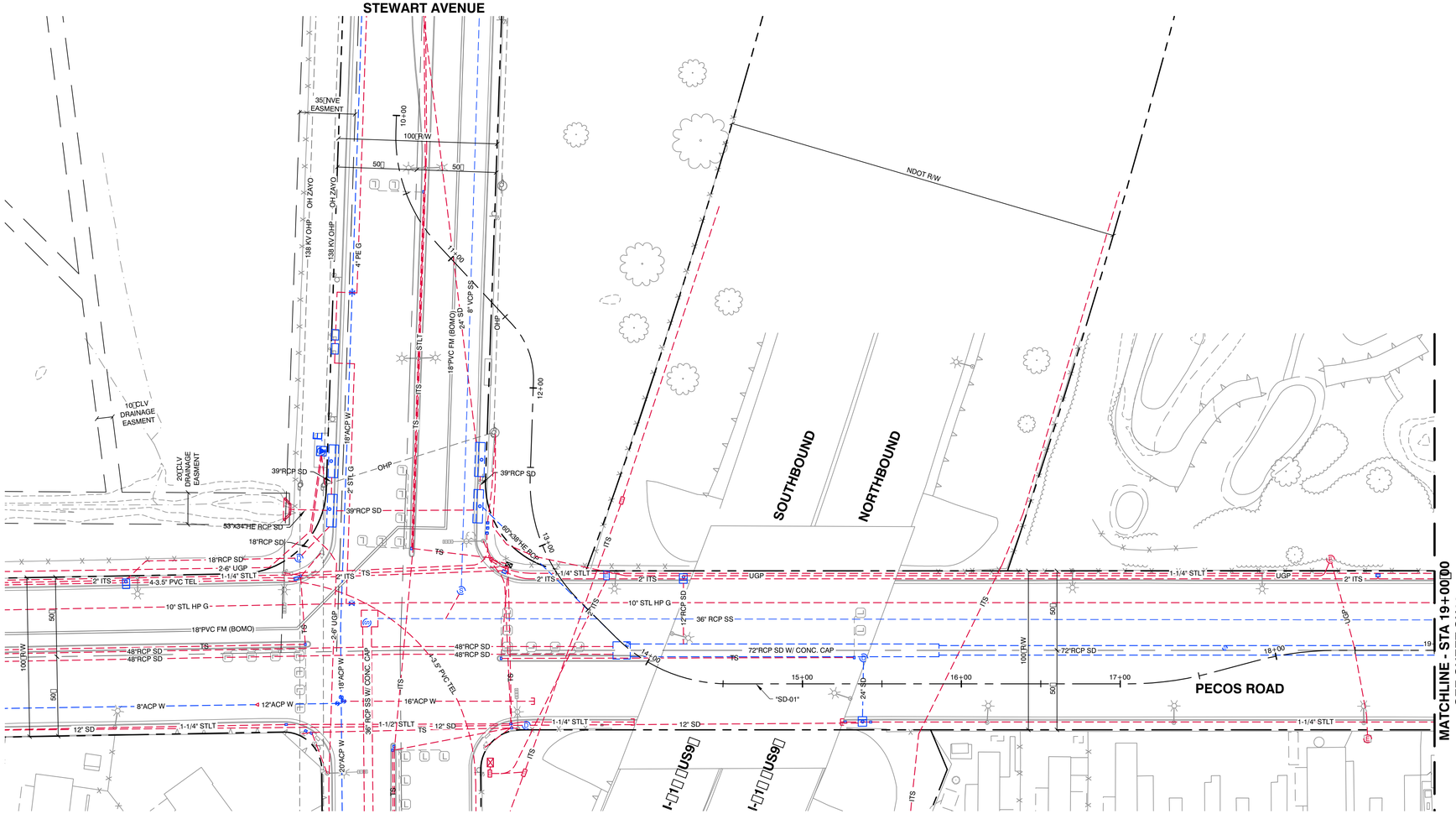
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
HORIZONAL CONTROL PLAN
POINT/LINE & CURVE TABLES

STEVEN BELMONT
PE-31-16
CIVIL
No. 19040
PROFESSIONAL ENGINEER-STATE OF NEVADA
NOT FOR CONSTRUCTION

SHEET
HC02
7 OF **31**
DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

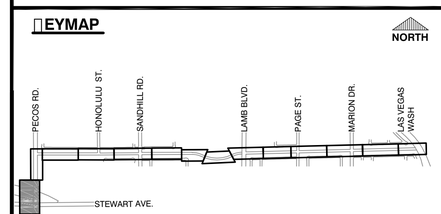
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BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

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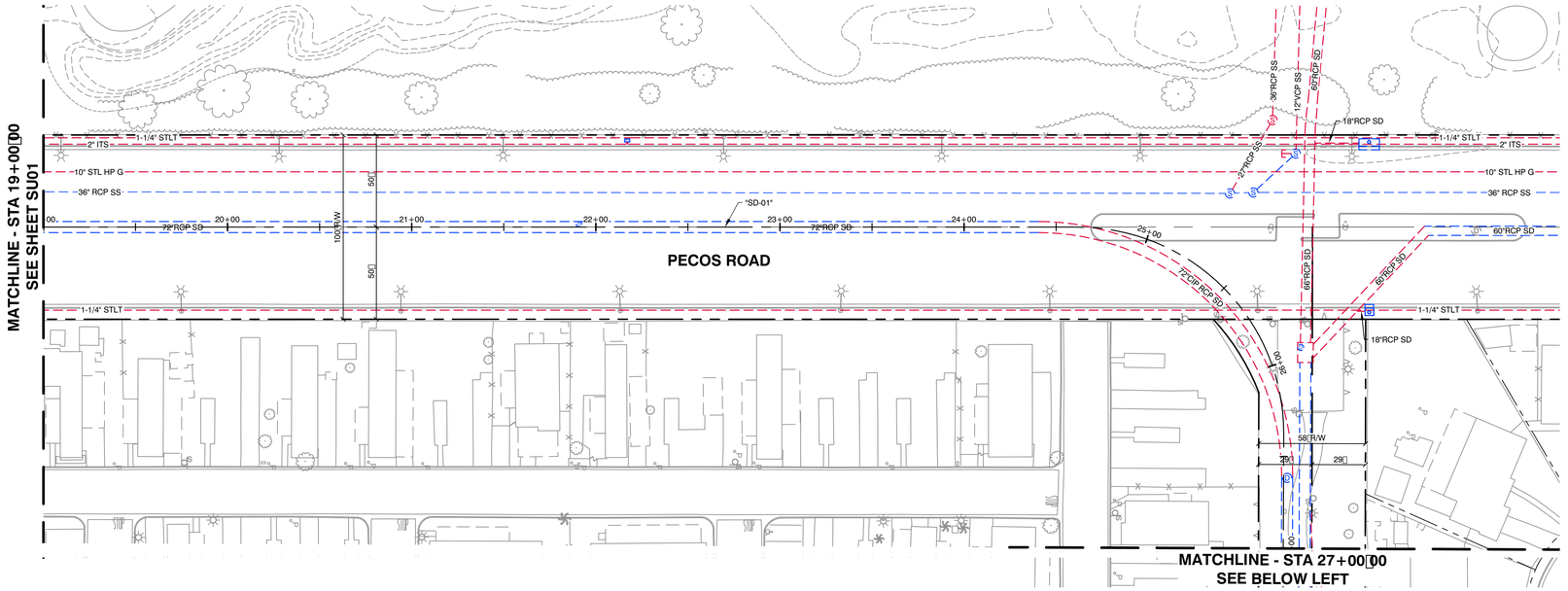
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

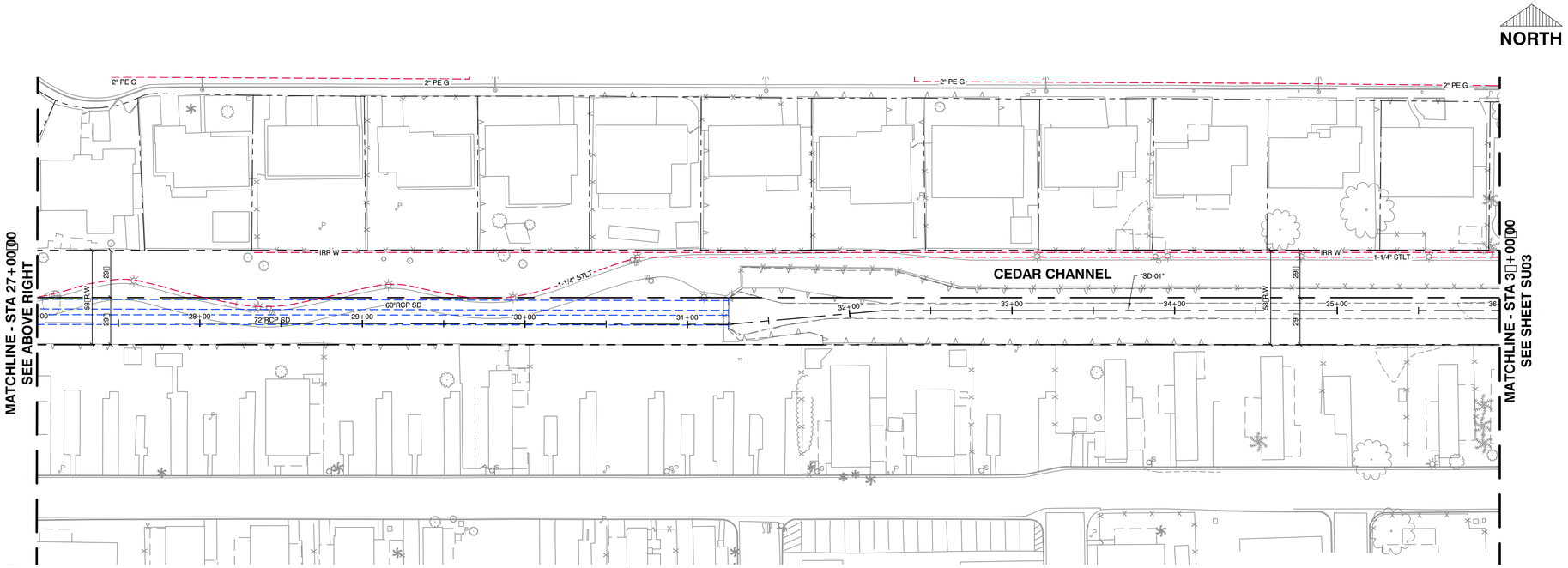
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EXISTING UTILITIES LOCATION PLAN
"SD01" 10+00 TO "SD01" 19+00

PROFESSIONAL ENGINEER
STATE OF NEVADA
STEVEN BEAMON
No. 19040
CIVIL
NOT FOR CONSTRUCTION

SHEET
SU01
8 OF 31
DRAWING NO.
XXX-XXXX

X:\Projects\100039014_Cedar\H49866\Sheet Set\DWG\H49866 SU01 16-18-15 02:39pm





GRAPHIC SCALE

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(IN FEET)

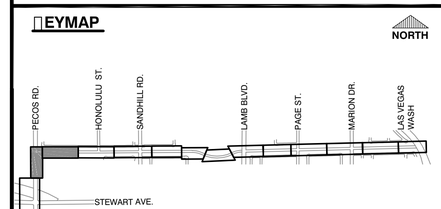
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866 | BID# XX-XXXX
DATE: 6/19/2015 | DESIGNED BY: SMB
SUBMITTAL STAGE: | DRAWN BY: MM
30% - PRELIMINARY | CHECKED BY: HD

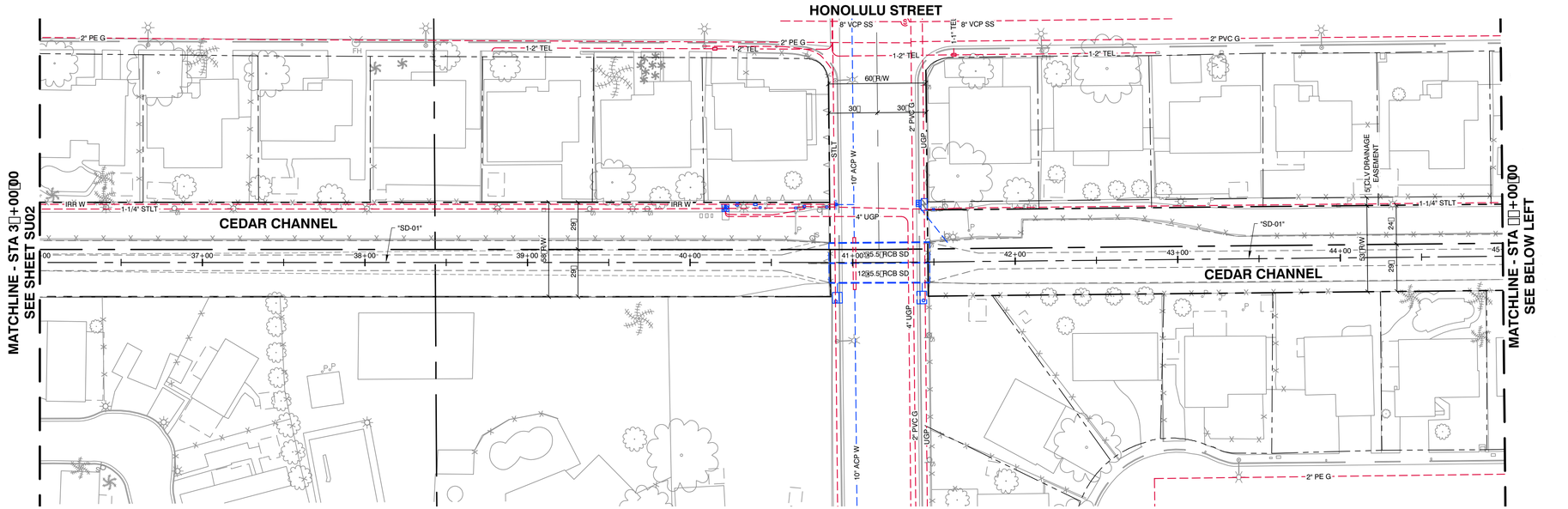
NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER
STEVEN M. BELMAR
No. 19040
CIVIL
STATE OF NEVADA
6-31-16

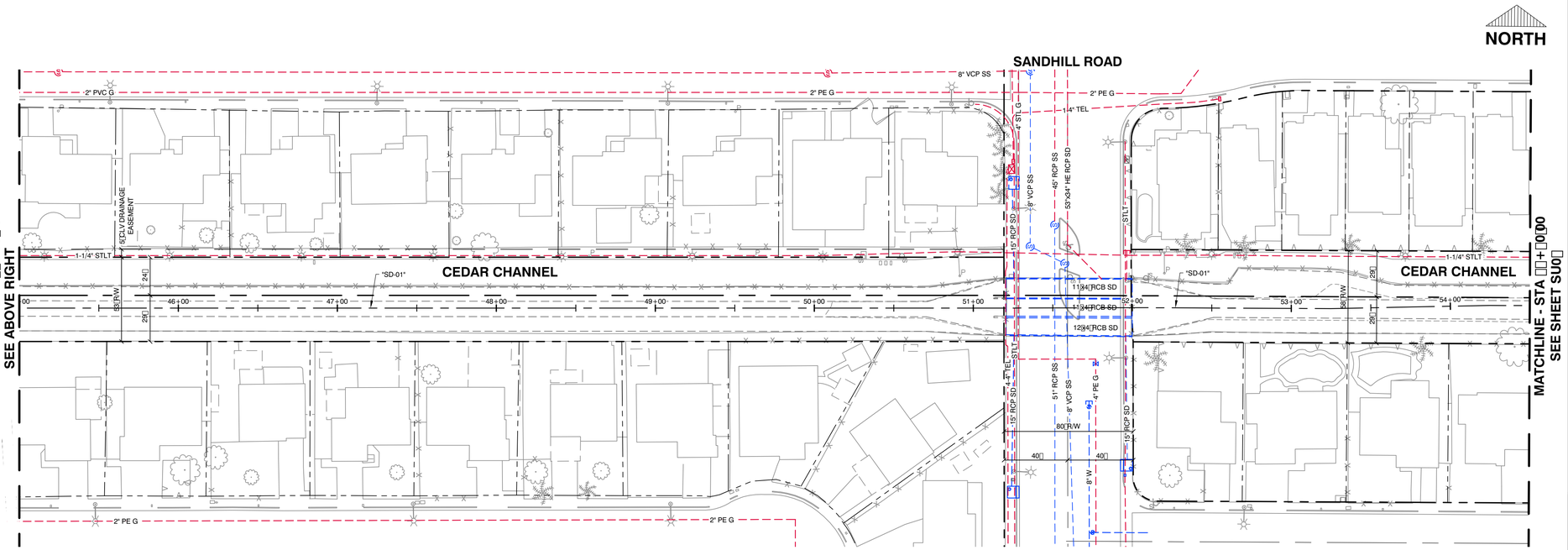
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
EXISTING UTILITIES LOCATION PLAN
"SD01" 19+00 TO "SD01" 31+00

SHEET
SU02
9 OF 31
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

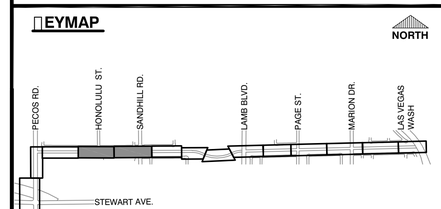
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE □UALITY A TEST HOLE LOCATION
- SUE □UALITY B
- SUE □UALITY C
- SUE □UALITY D

□EYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX-XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015		DRAWN BY: MM	
SUBMITTAL STAGE: 30% - PRELIMINARY		CHECKED BY: HD	

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

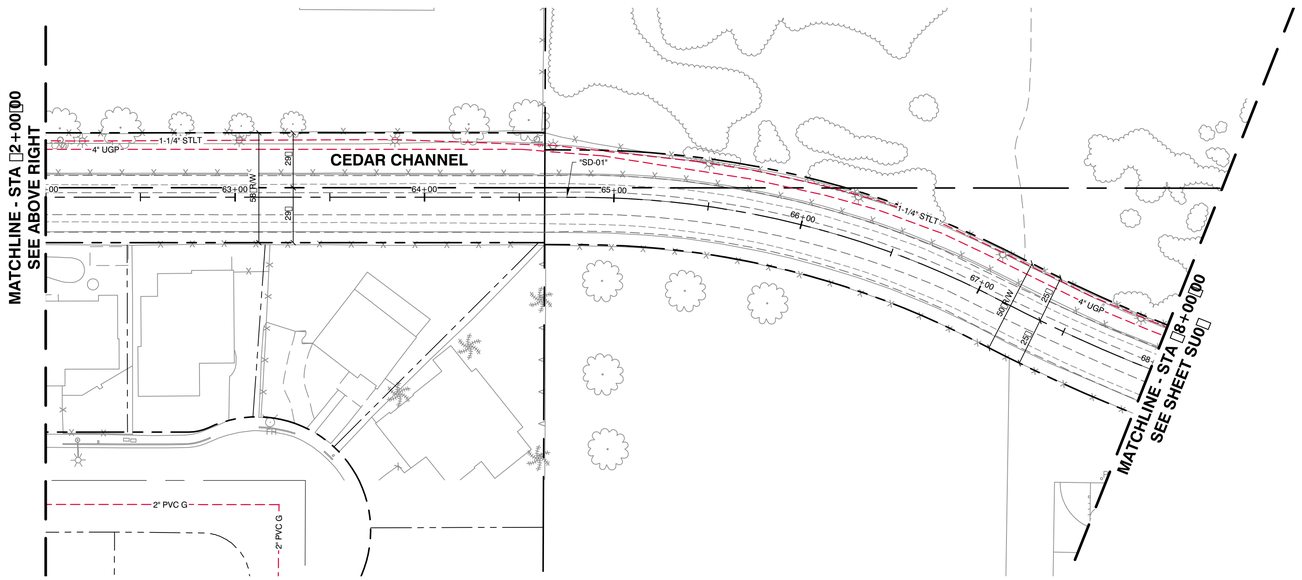
SHEET
E□ISTING UTILITIES LOCATION PLAN
"SD01" 3□+00 TO "SD01" □□+□0

STEVEN BELL — 12-31-16 — CIVIL — No. 19040 — PROFESSIONAL ENGINEER — STATE OF NEVADA — NOT FOR CONSTRUCTION

SHEET
SU03
10 OF 31
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

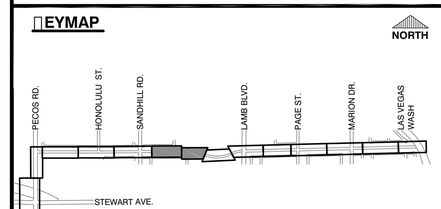
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H49866
DATE:	6/19/2015
SUBMITTAL STAGE:	30% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	SMB
DRAWN BY:	MM
CHECKED BY:	HD

STEVEN M. BELKNAP — 12-31-16 — CIVIL — No. 19040 — PROFESSIONAL ENGINEER — STATE OF NEVADA — NOT FOR CONSTRUCTION

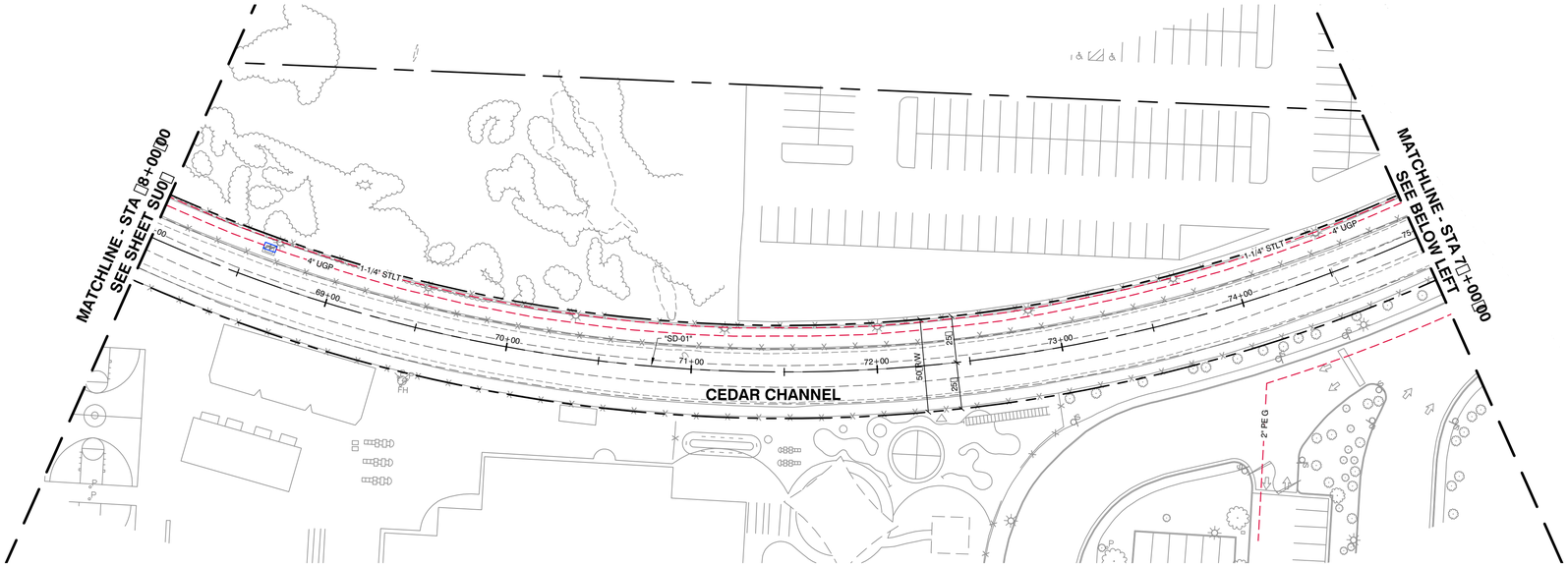
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

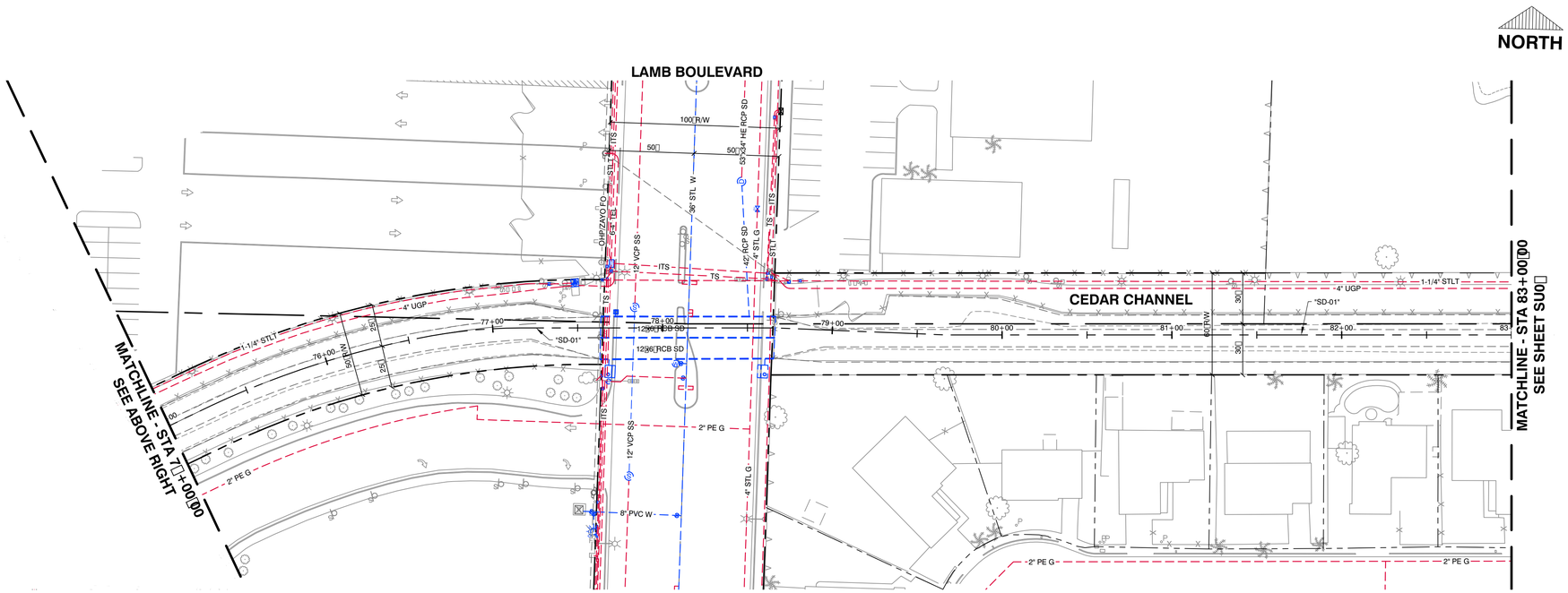
SHEET
EXISTING UTILITIES LOCATION PLAN
"SD01" 0+00 TO "SD01" 0+00

SHEET
SU0
11 OF 31

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

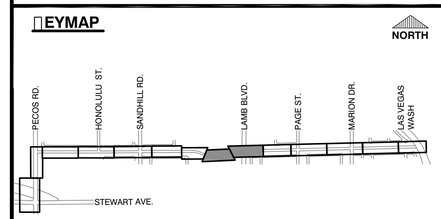
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX
- SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

QEYMAP



REVISIONS

NO.	DATE

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H49866
DATE:	6/19/2015
SUBMITTAL STAGE:	30% - PRELIMINARY
BID#	XX-XXXX
DESIGNED BY:	SMB
DRAWN BY:	MM
CHECKED BY:	HD

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER - STATE OF NEVADA
STEVEN M. BELLER
No. 19040
EXPIRES 12-31-16
CIVIL

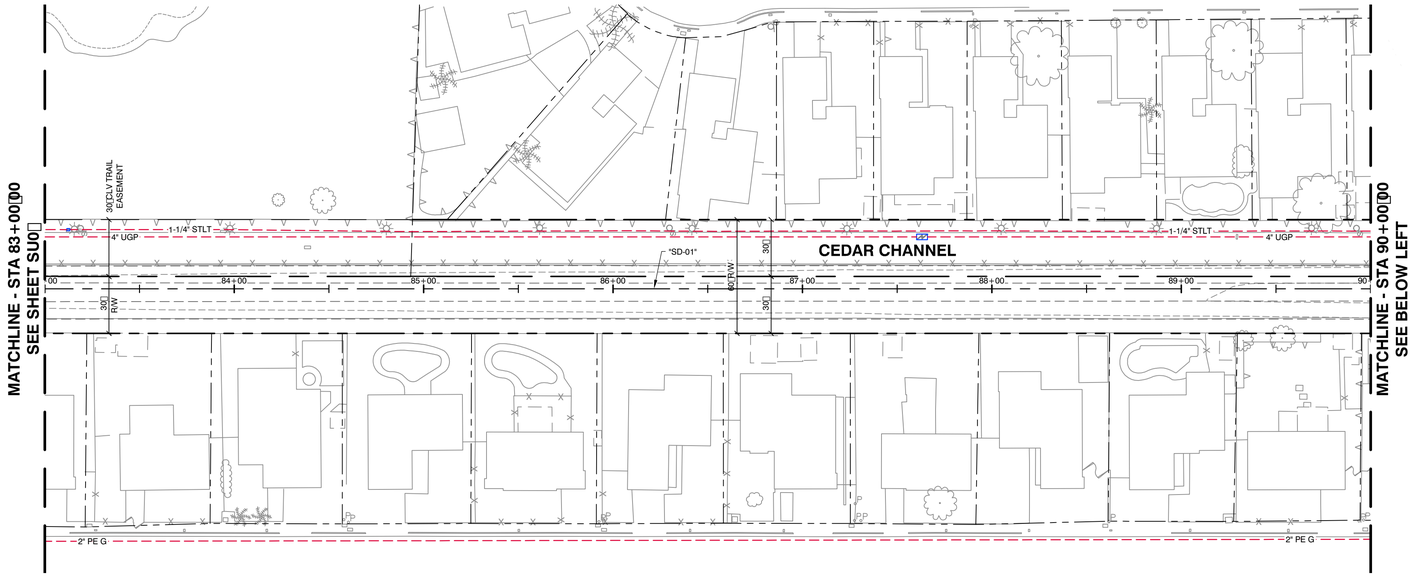
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

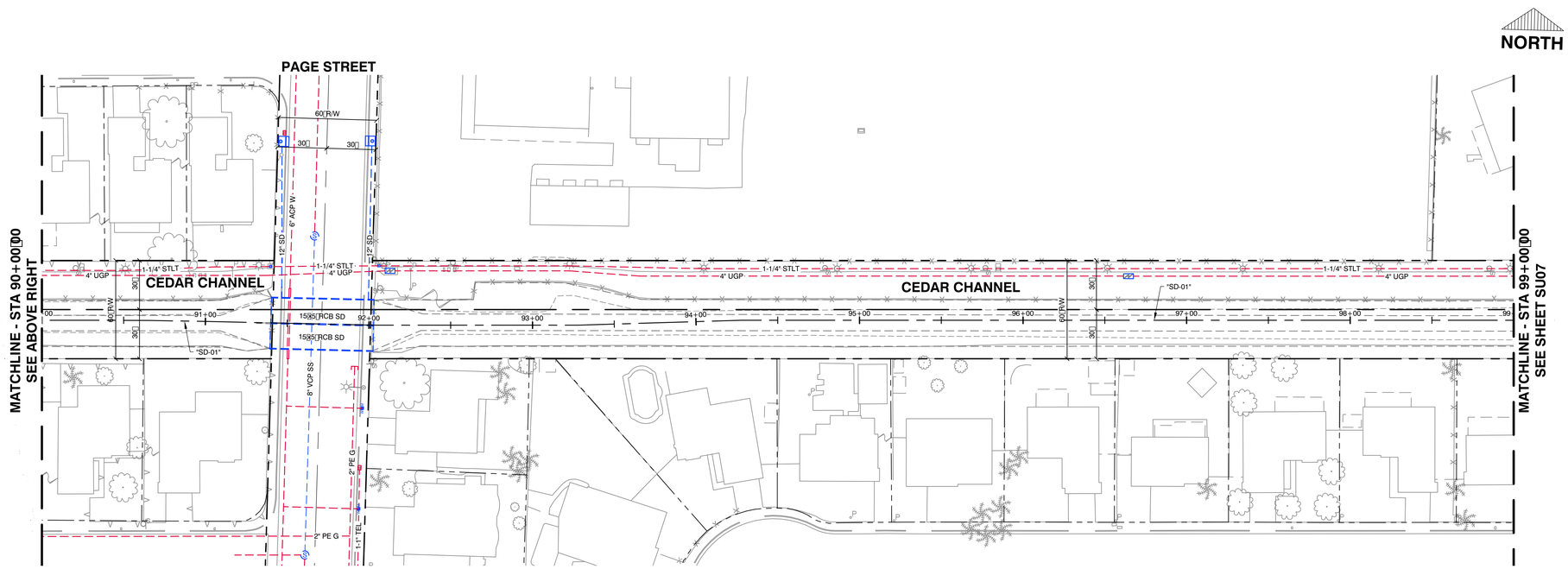
SHEET
EXISTING UTILITIES LOCATION PLAN
"SD01" +00 TO "SD01" 83+00

SHEET
SU0
12 OF 31

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

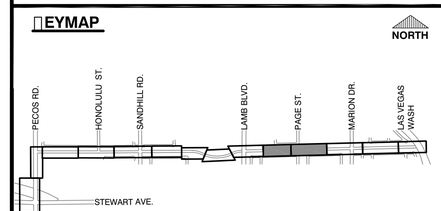
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H49866
DATE:	6/19/2015
SUBMITTAL STAGE:	30% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	SMB
DRAWN BY:	MM
CHECKED BY:	HD

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

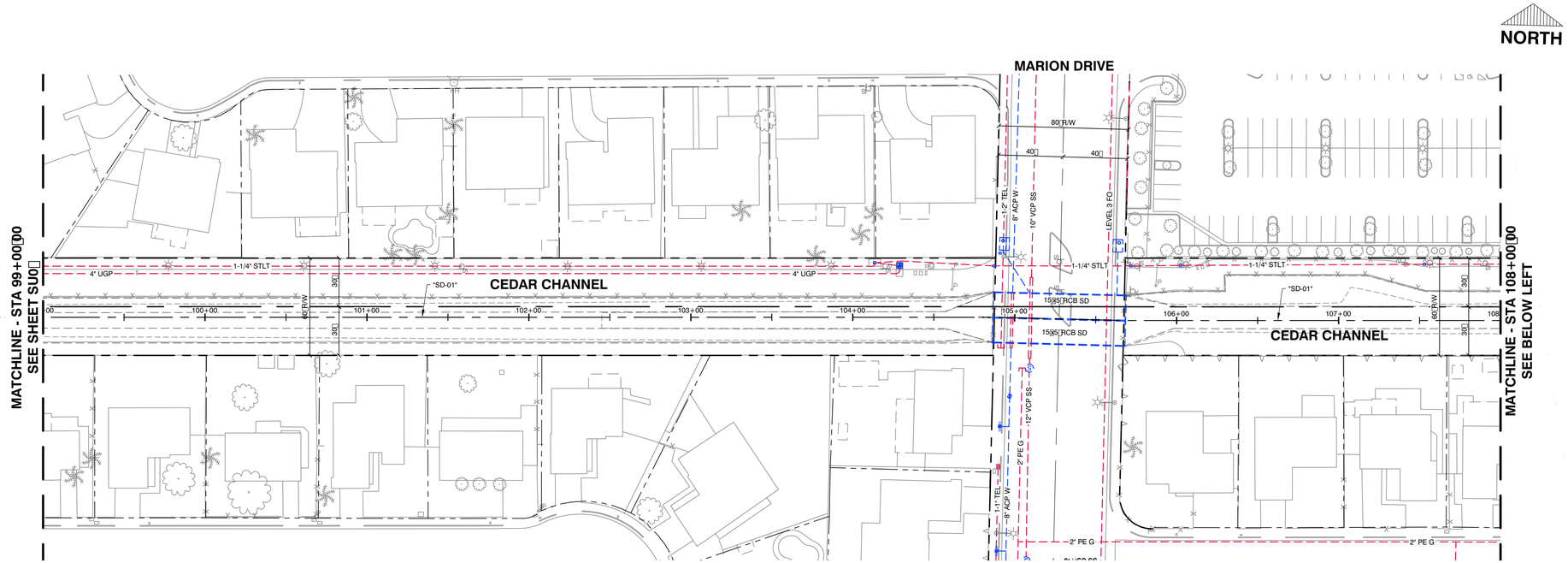
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EXISTING UTILITIES LOCATION PLAN
"SD01" 83+00 TO "SD01" 99+00

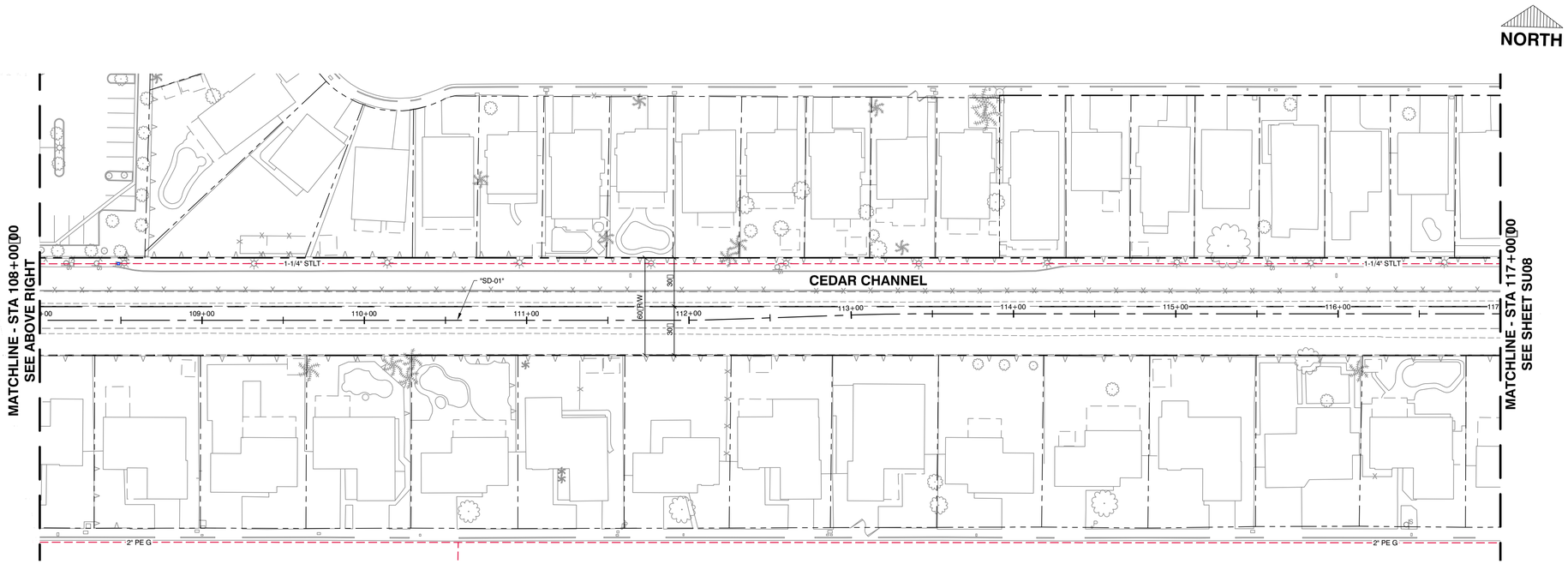
PROFESSIONAL ENGINEER - STATE OF NEVADA
STEVEN M. BELLER
No. 19040
CIVIL
6-31-16
NOT FOR CONSTRUCTION

SHEET
SU0
13 OF 31

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

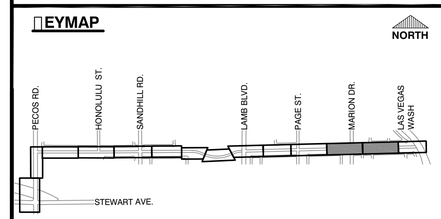
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX
- SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H49866
DATE:	6/19/2015
SUBMITTAL STAGE:	30% - PRELIMINARY
BID#	XX-XXXX
DESIGNED BY:	SMB
DRAWN BY:	MM
CHECKED BY:	HD

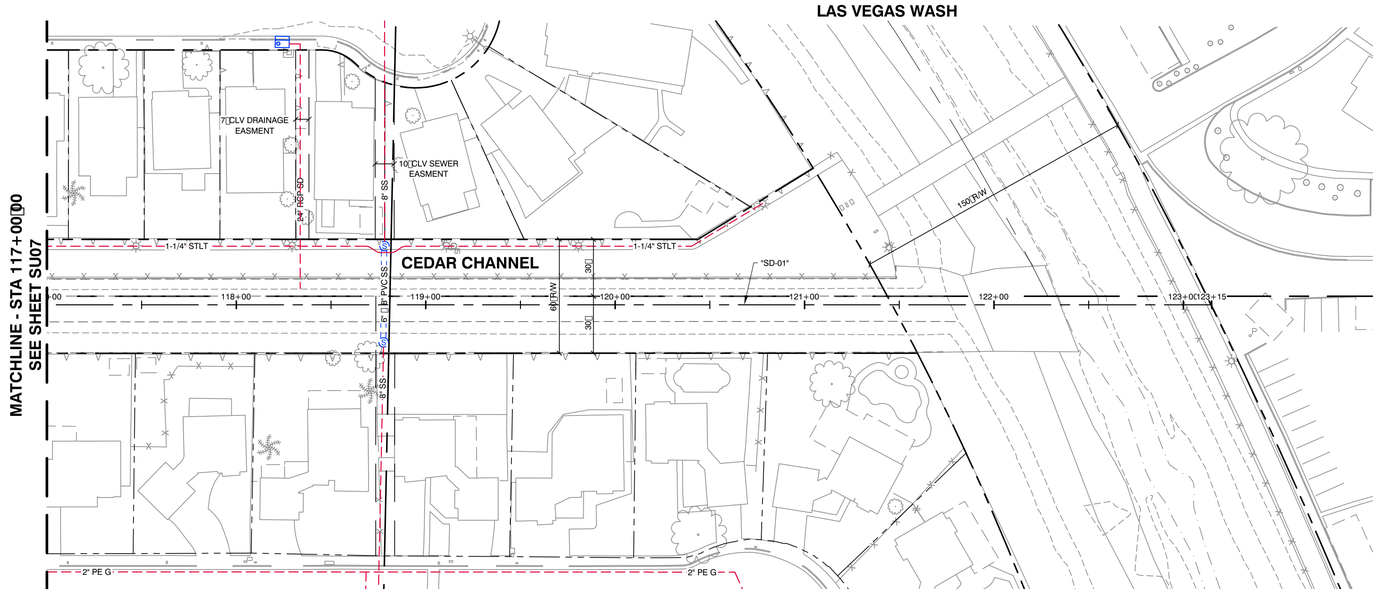
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
EXISTING UTILITIES LOCATION PLAN
"SD01" 99+00 TO "SD01" 117+00

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEVEN M. BELMONTE
No. 19040
CIVIL
6-31-16
NOT FOR CONSTRUCTION

SHEET
SU07
1 OF 31
DRAWING NO.
XXX-XXXX

X:\Projects\16003390\I_Cedar\H49866\Sheet Set\DWG\H49866 SU07 *6-18-15 02:46pm



NORTH

GRAPHIC SCALE

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(IN FEET)

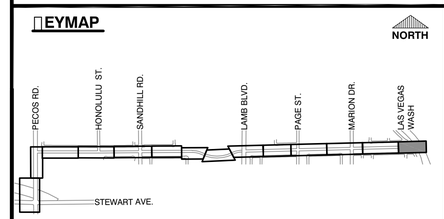
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX-XXXX	DESIGNED BY: SMB	CHECKED BY: HD
DATE: 6/19/2015	SUBMITTAL STAGE: 30% - PRELIMINARY	DRAWN BY: MM	

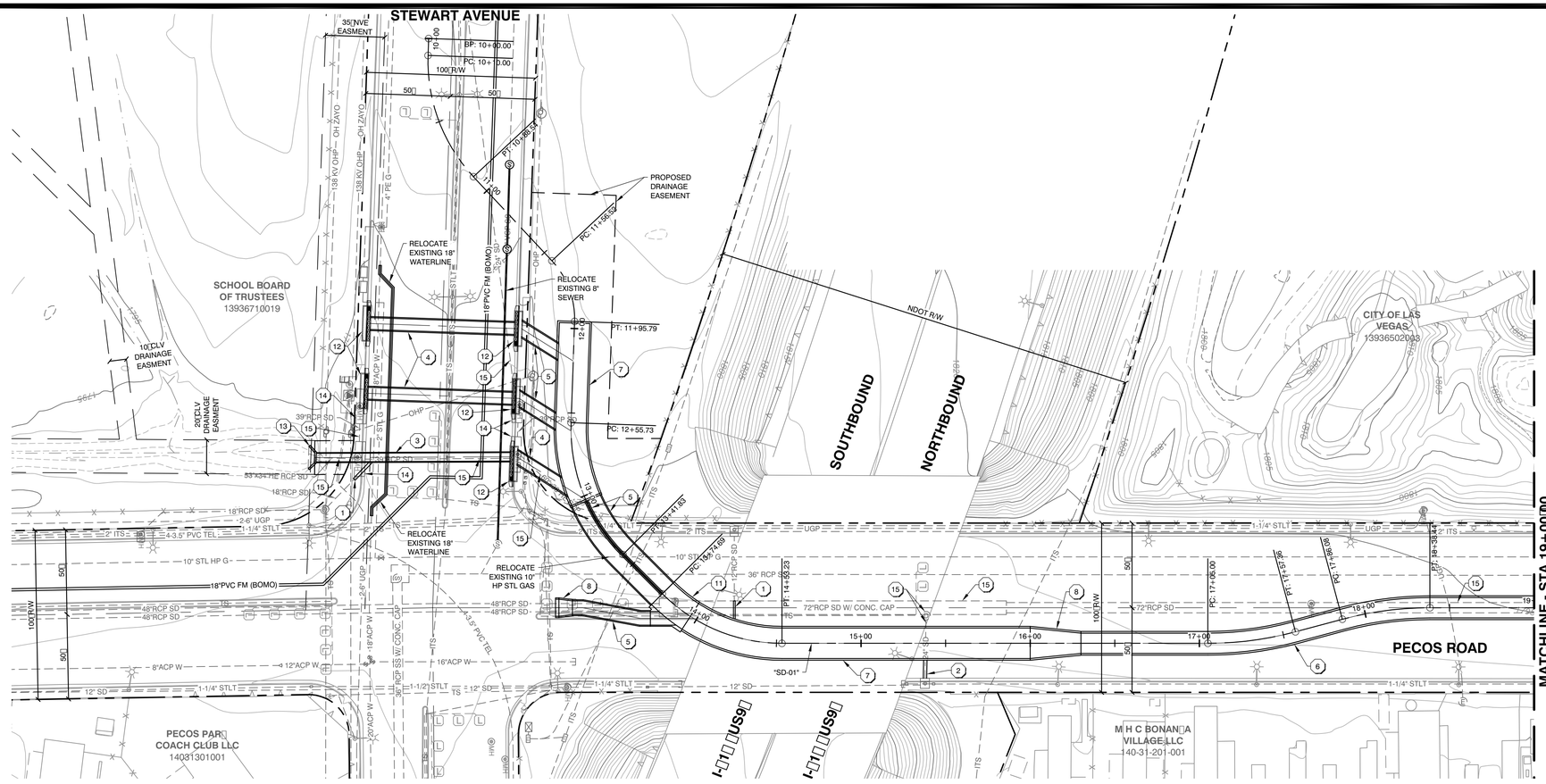
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

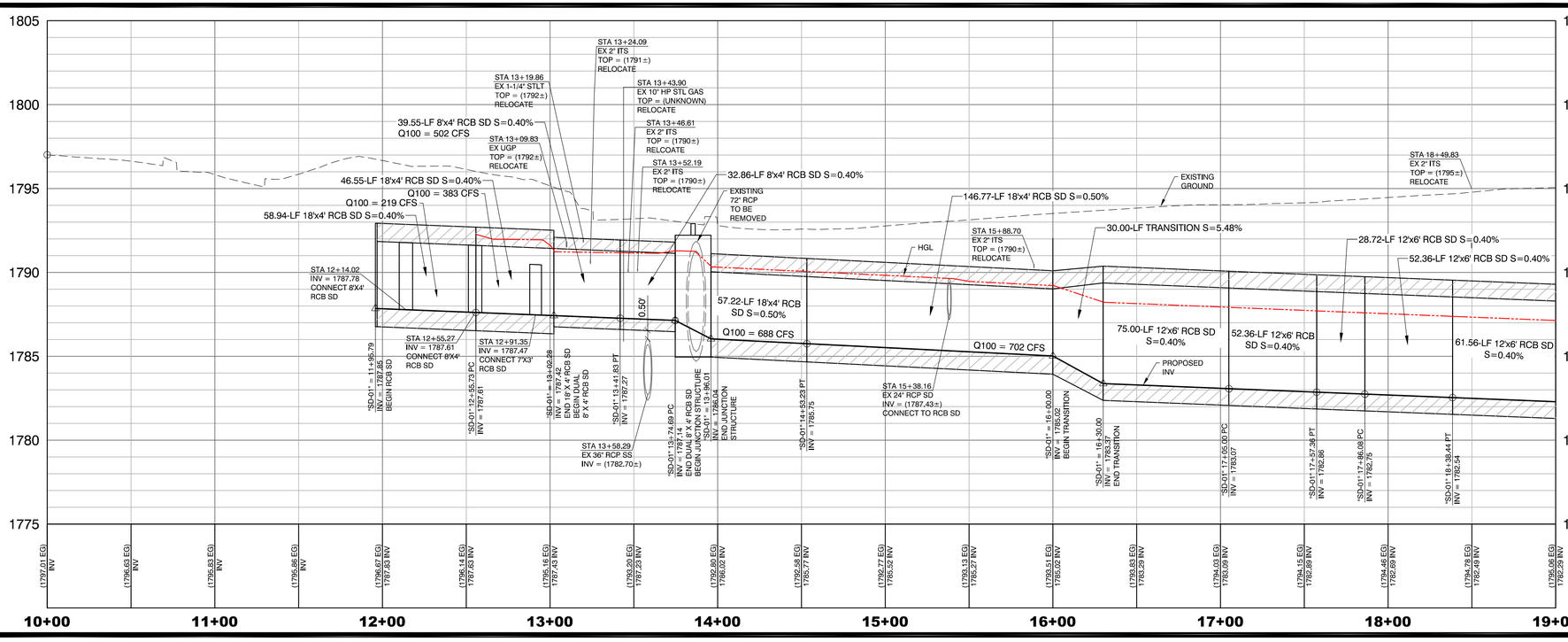
SHEET
EXISTING UTILITIES LOCATION PLAN
"SD01" 117+00 TO "SD01" 123+00

STEVEN BELKA — 31-16 — CIVIL — No. 19040 — STATE OF NEVADA — PROFESSIONAL ENGINEER — NOT FOR CONSTRUCTION

SHEET
SU08
1 OF 31
DRAWING NO.
XXX-XXXX

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X:\Projects\100039814_Cedar\H49866\Sheet Set\DWG\H49866-SD01 • 6-18-15 02:50pm

NORTH

GRAPHIC SCALE
20 0 10 20 40
(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

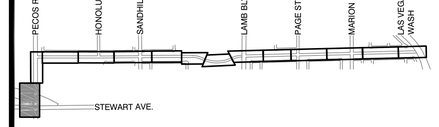
CONSTRUCTION KEY NOTES

1. INSTALL 18" RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5'X 3' RCB SD
4. INSTALL 7'X 3' RCB SD
5. INSTALL 8'X 4' RCB SD
6. INSTALL 12'X 6' RCB SD
7. INSTALL 18'X 4' RCB SD
8. INSTALL RCB TRANSITION
9. CONSTRUCT RECTANGULAR CONCRETE CHANNEL PER SHEETS TY01 AND TY02
10. CONSTRUCT CHANNEL ACCESS RAMP
11. CONSTRUCT JUNCTION STRUCTURE
12. CONSTRUCT TYPE "C" MODIFIED DROP INLET
13. CONSTRUCT HEADWALL
14. REMOVE EXISTING DROP INLET
15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# XXXXX

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

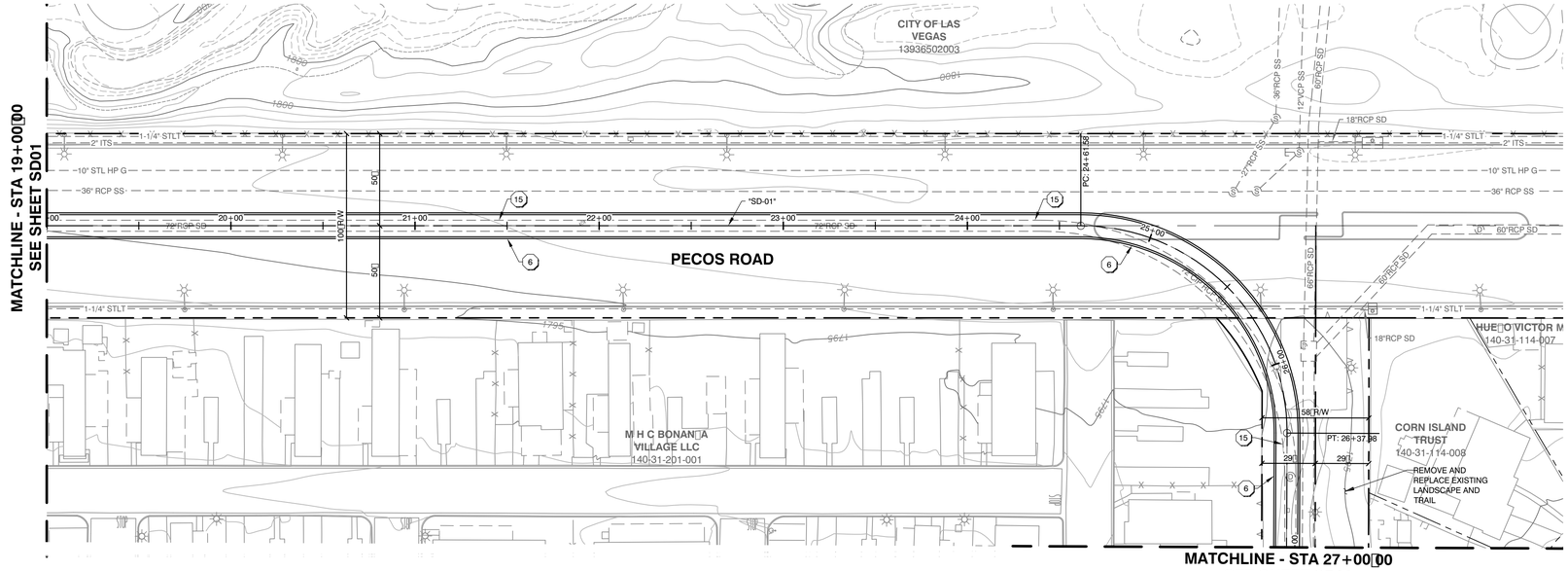
BID# XX-XXXX
H# H49866
DESIGNED BY: SMB
DRAWN BY: MM
CHECKED BY: HB
DATE: 6/19/2015
SUBMITTAL STAGE:
30% - PRELIMINARY

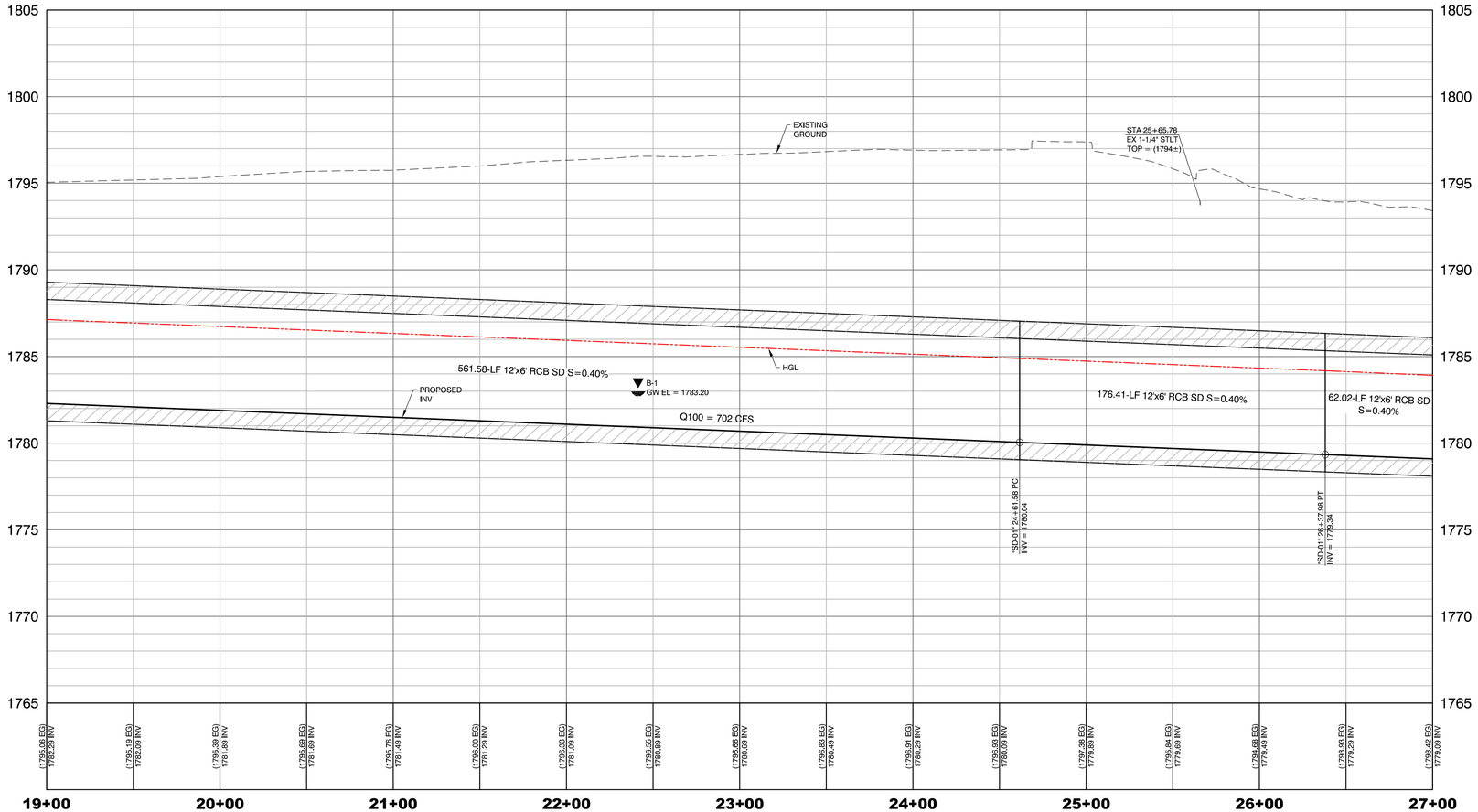
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 10+00 TO "SD01" 19+00

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEVEN BRIAN CARR
8-31-16
CIVIL
No. 19040
NOT FOR CONSTRUCTION

SHEET
SD01
10 OF 31
DRAWING NO.
XXX-XXXX





NORTH

GRAPHIC SCALE
20 0 10 20 40
(IN FEET)

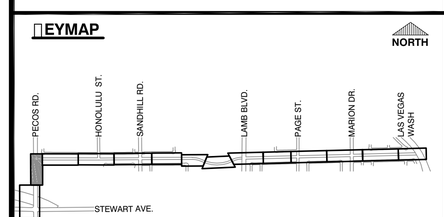
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. INSTALL 18" RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5'X 3' RCB SD
4. INSTALL 7'X 3' RCB SD
5. INSTALL 8'X 4' RCB SD
6. INSTALL 12'X 6' RCB SD
7. INSTALL 18'X 4' RCB SD
8. INSTALL RCB TRANSITION
9. CONSTRUCT RECTANGULAR CONCRETE CHANNEL PER SHEETS TY01 AND TY02
10. CONSTRUCT CHANNEL ACCESS RAMP
11. CONSTRUCT JUNCTION STRUCTURE
12. CONSTRUCT TYPE "C" MODIFIED DROP INLET
13. CONSTRUCT HEADWALL
14. REMOVE EXISTING DROP INLET
15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866 | BID# XX-XXXX | DESIGNED BY: SMB | DRAWN BY: MM | CHECKED BY: HB

DATE: 6/19/2015

SUBMITTAL STAGE:
30% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

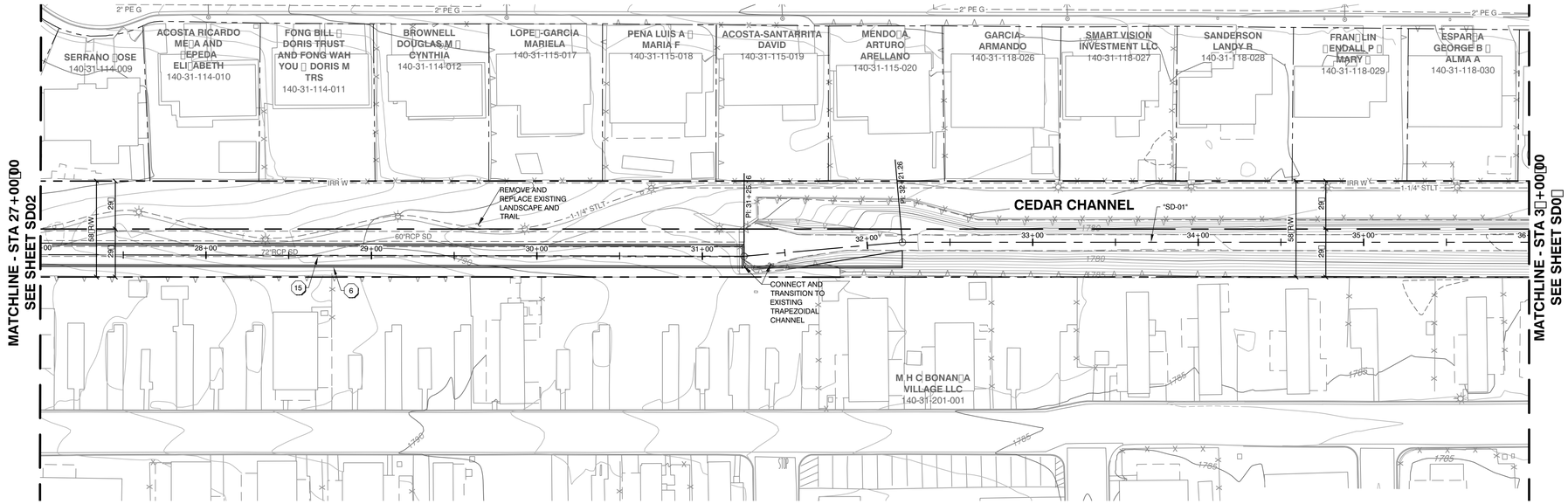
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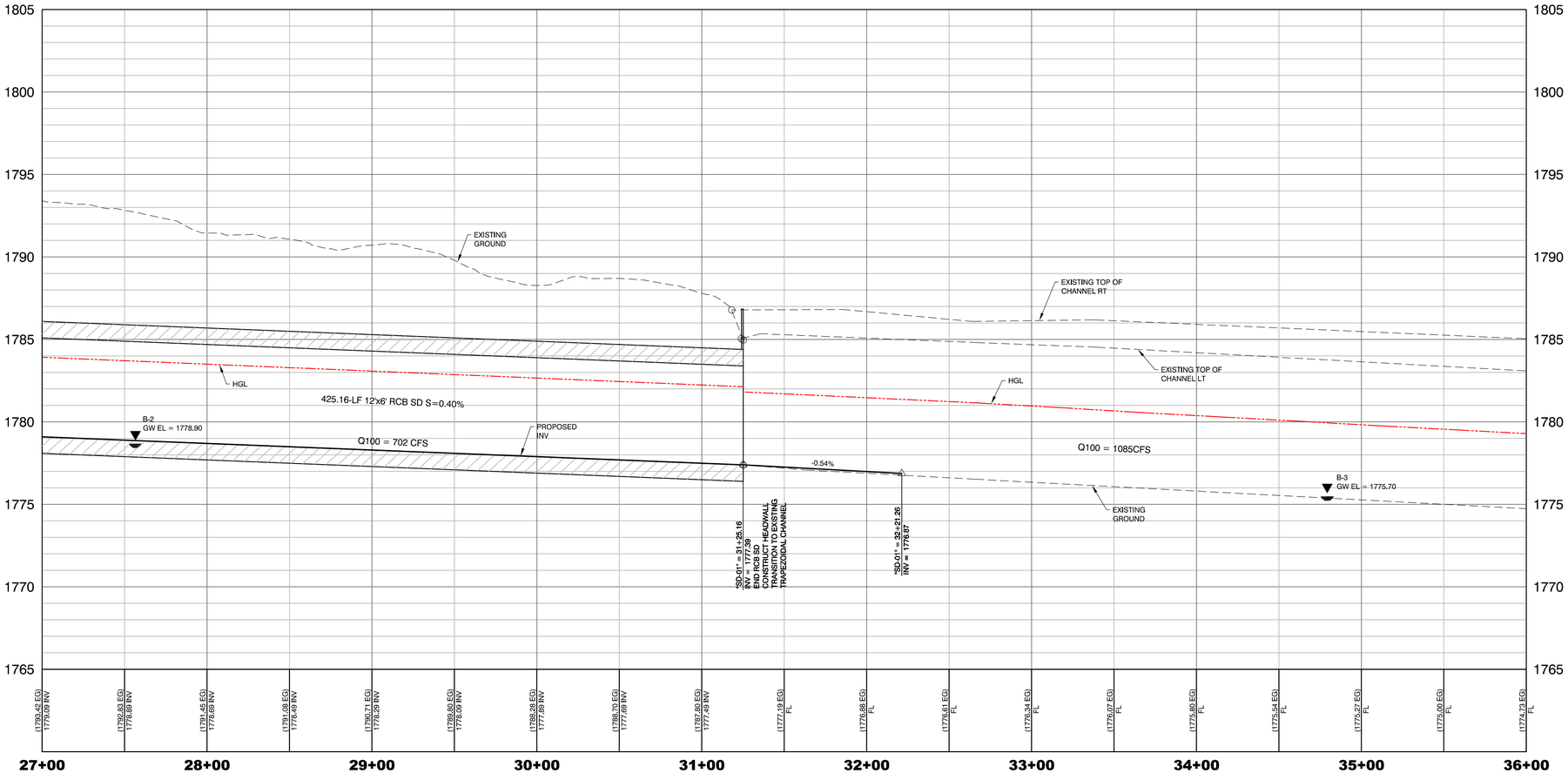
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STEVEN M. BELSHO
EXP. 12-31-16
CIVIL
No. 19040
NOT FOR CONSTRUCTION

SHEET
SD02
17 OF 31

DRAWING NO.
XXX-XXXX

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NORTH

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(IN FEET)

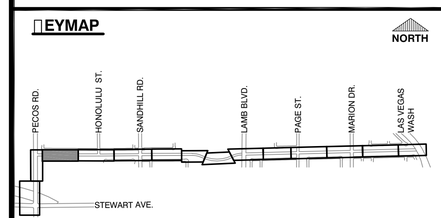
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. INSTALL 18 RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5 X 3 RCB SD
4. INSTALL 7 X 3 RCB SD
5. INSTALL 8 X 4 RCB SD
6. INSTALL 12 X 6 RCB SD
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14. REMOVE EXISTING DROP INLET
15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015	SUBMITTAL STAGE: 30% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

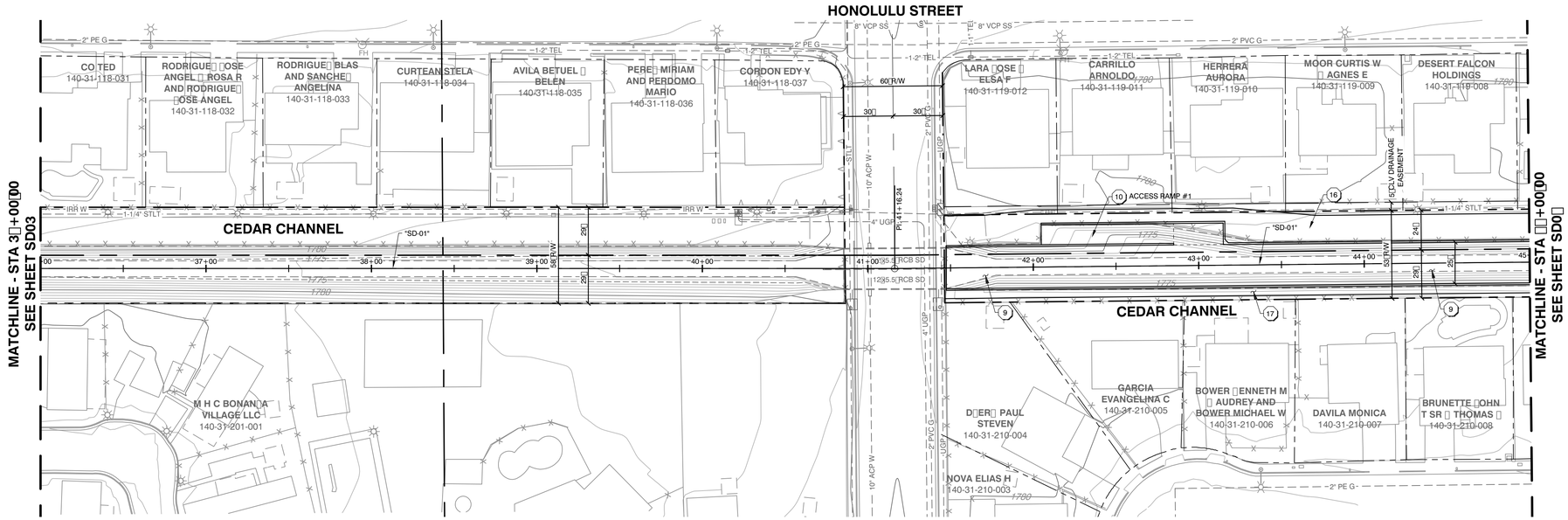
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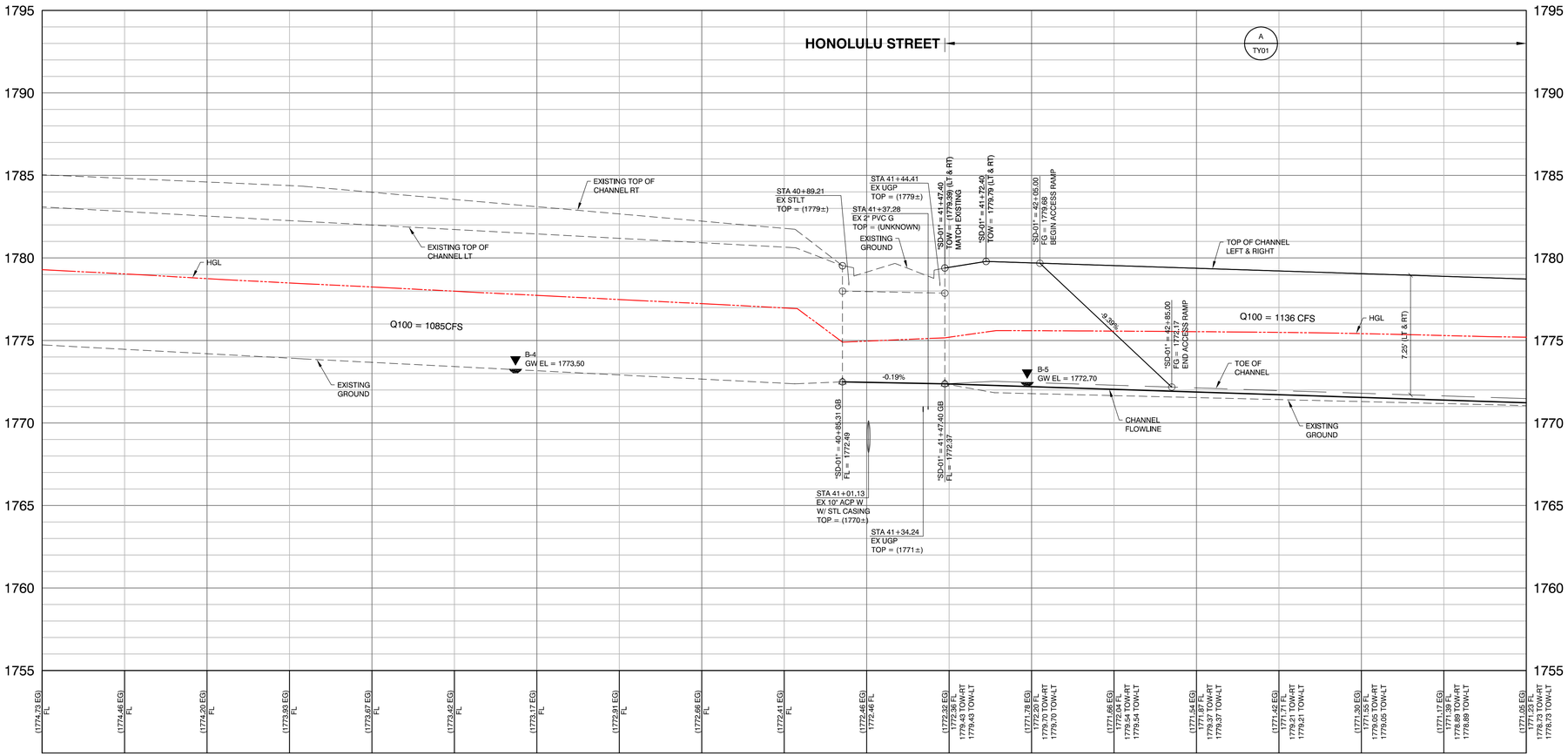
PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN M. BELSHO
EXPIRES 12-31-16
CIVIL
No. 19040
NOT APPROVED FOR CONSTRUCTION

SHEET
SD03
18 OF 31

DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE
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(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

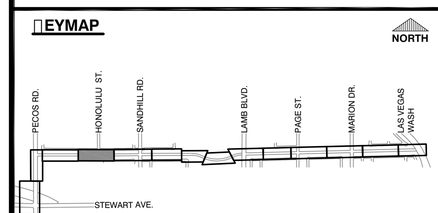
CONSTRUCTION □EY NOTES

1. INSTALL 18□RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5□X 3□RCB SD
4. INSTALL 7□X 3□RCB SD
5. INSTALL 8□X 4□RCB SD
6. INSTALL 12□X 6□RCB SD
7. INSTALL 18□X 4□RCB SD
8. INSTALL RCB TRANSITION
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10. CONSTRUCT CHANNEL ACCESS RAMP
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15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5□TYPE II AGGREGATE BASE MANWAY

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PRO□ECT# XXXXX

□EYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263-7274
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015	SUBMITTAL STAGE: **30% - PRELIMINARY**	DRAWN BY: MM	CHECKED BY: HB

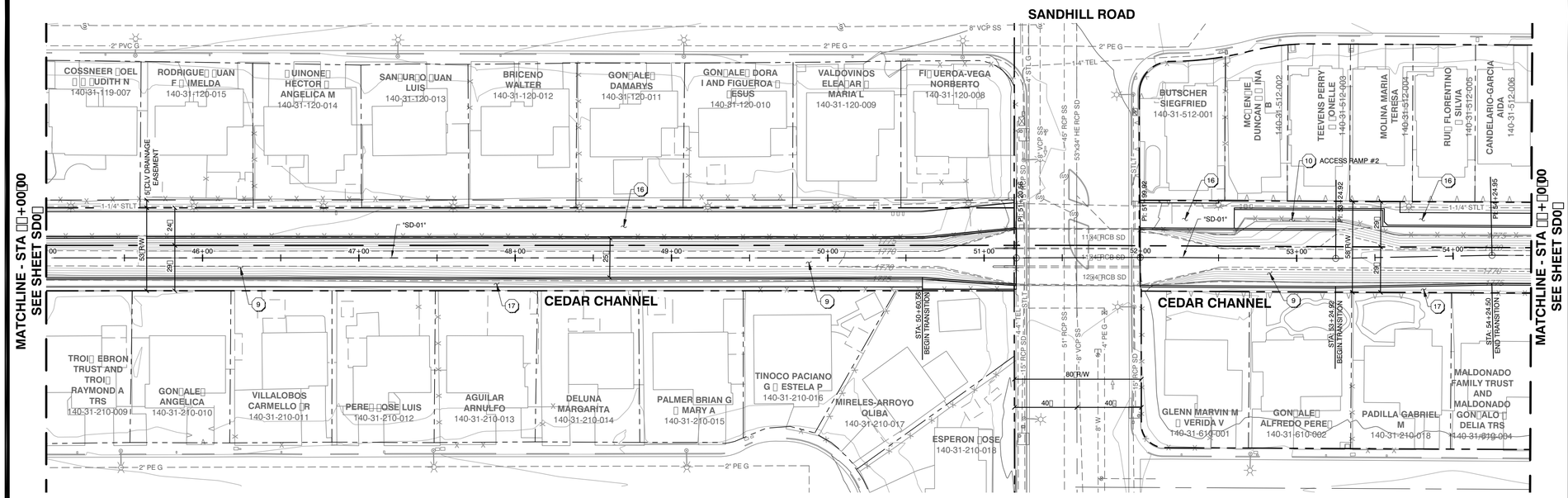
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

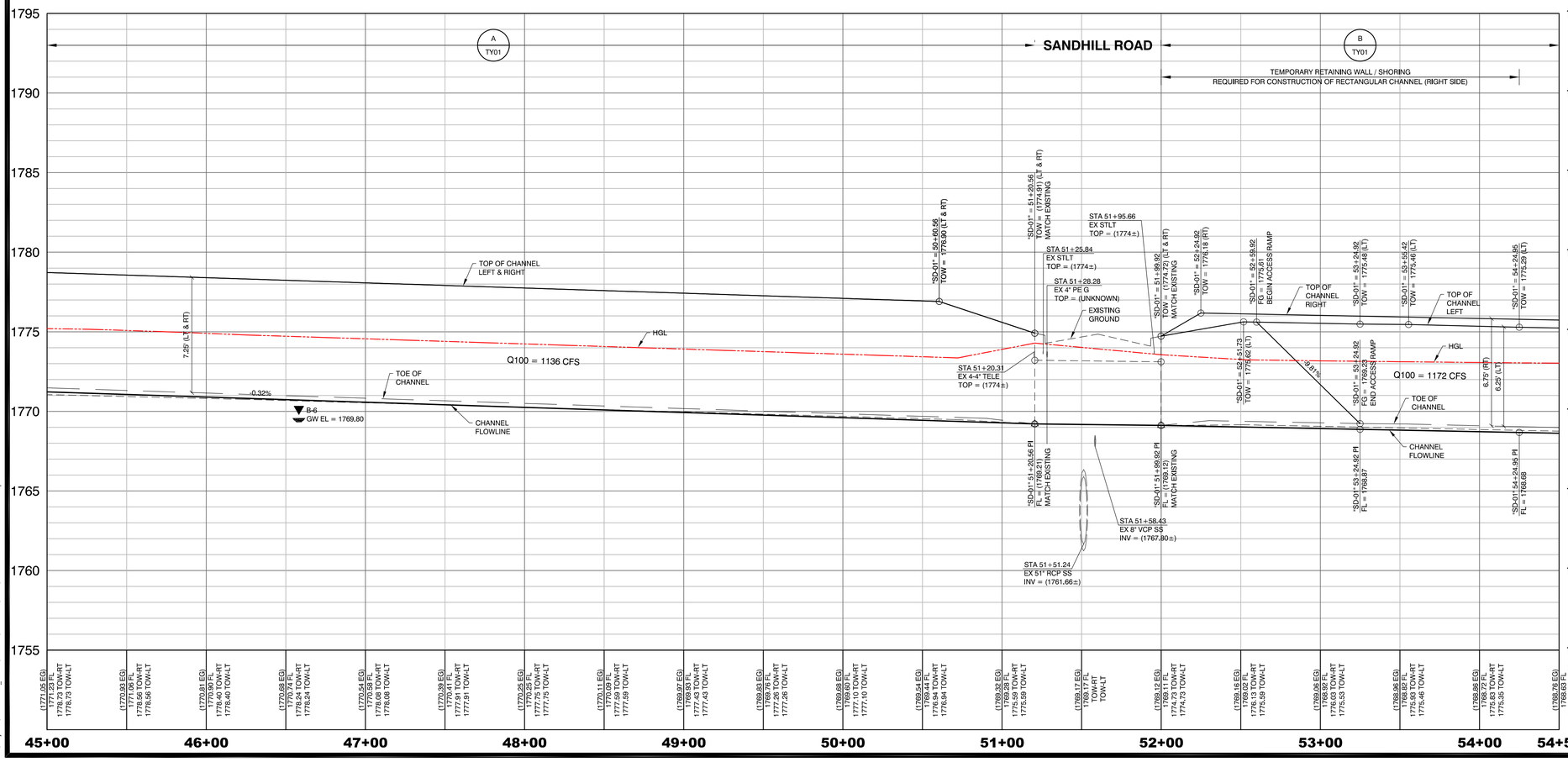
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STORM DRAIN PLAN AND PROFILE "SD01" 3□+00 TO "SD01" □□+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN BELSKY
EX. 10-31-16
CIVIL
No. 19040
NOT APPROVED FOR CONSTRUCTION

SHEET
SD0□
19 OF 31

DRAWING NO.
XXX-XXXX





NORTH

GRAPHIC SCALE
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(IN FEET)

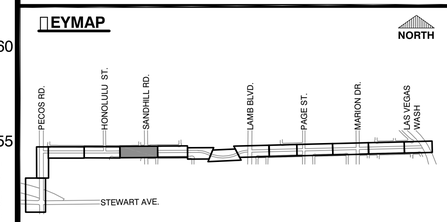
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION EY NOTES

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16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY

EYMAP



NO.	DATE	REVISIONS

PREPARED BY

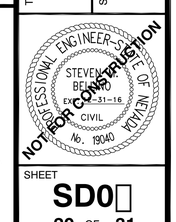
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX	DESIGNED BY: SMB	CHECKED BY: HB
DATE: 6/19/2015	SUBMITTAL STAGE: 30% - PRELIMINARY	DRAWN BY: MM	

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

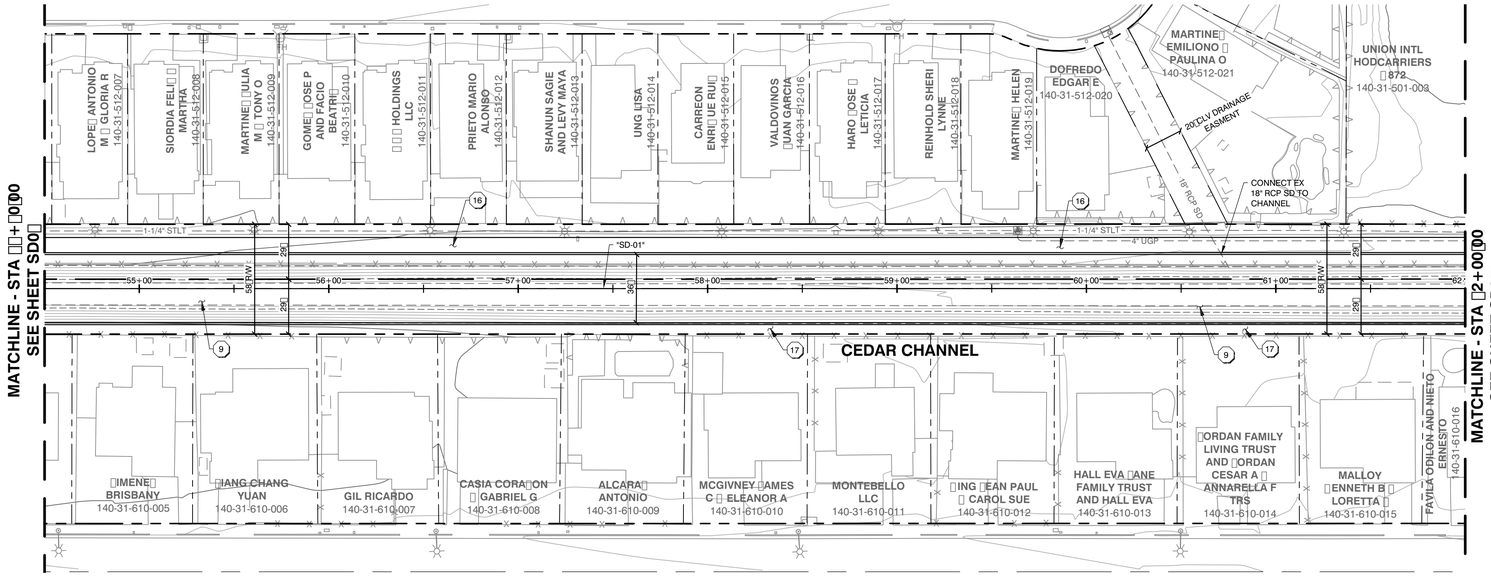
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STORM DRAIN PLAN AND PROFILE
"SD01" 00+00 TO "SD01" 00+00

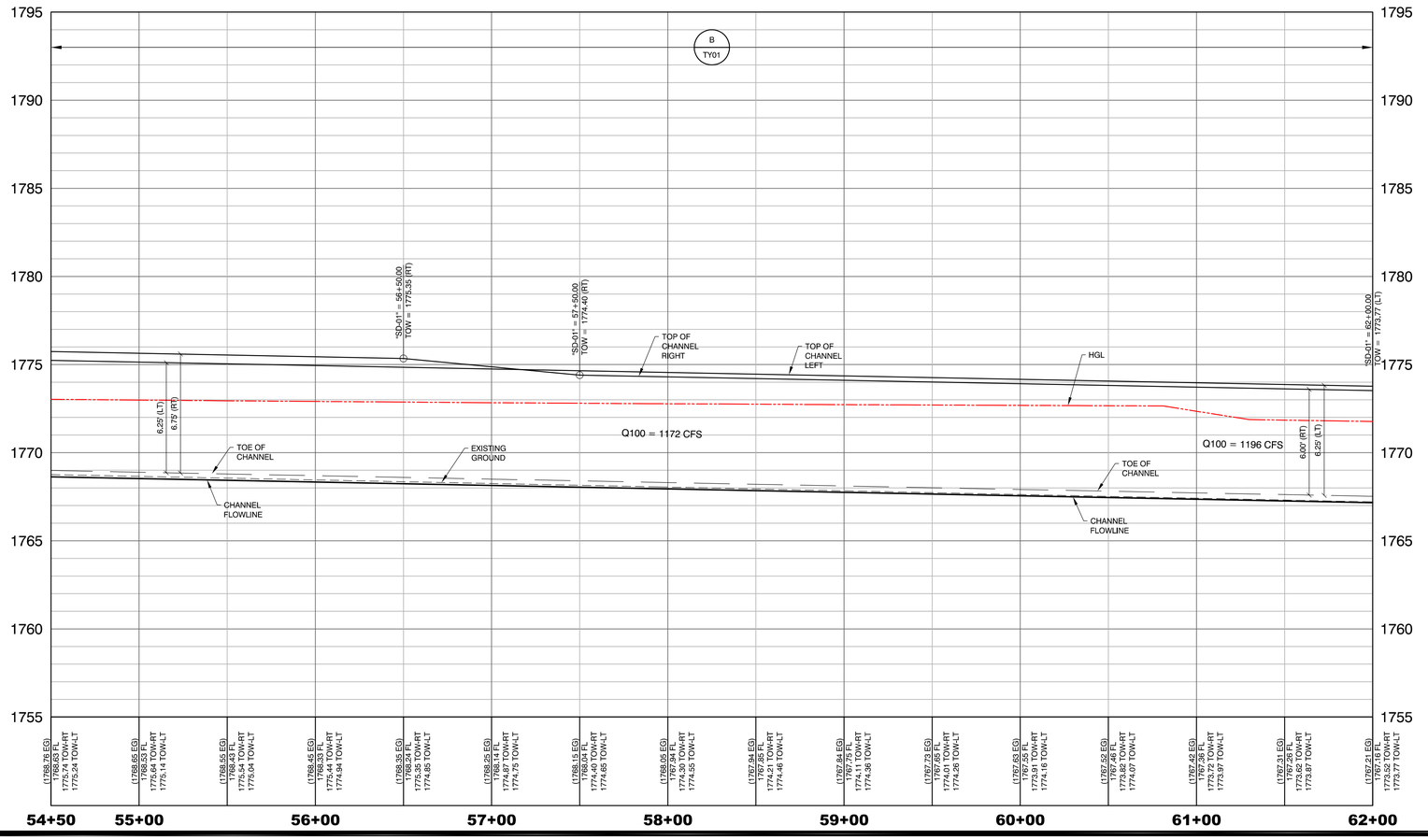


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SD0
20 OF 31

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NORTH

GRAPHIC SCALE
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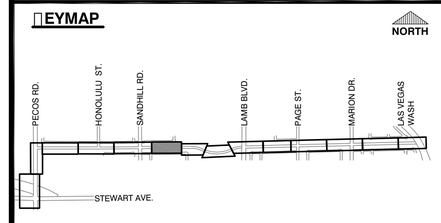
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. INSTALL 18" RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5'X 3' RCB SD
4. INSTALL 7'X 3' RCB SD
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15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 783-7274
Fax: +1 (702) 383-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015		DRAWN BY: MM	
SUBMITTAL STAGE: 30% - PRELIMINARY		CHECKED BY: HD	

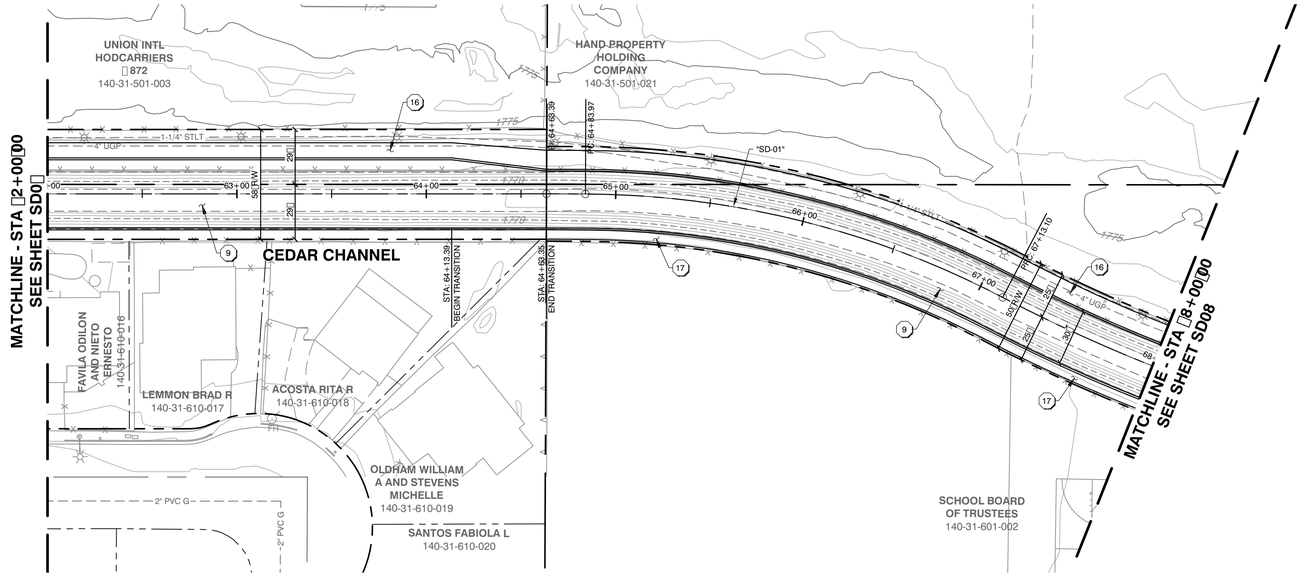
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

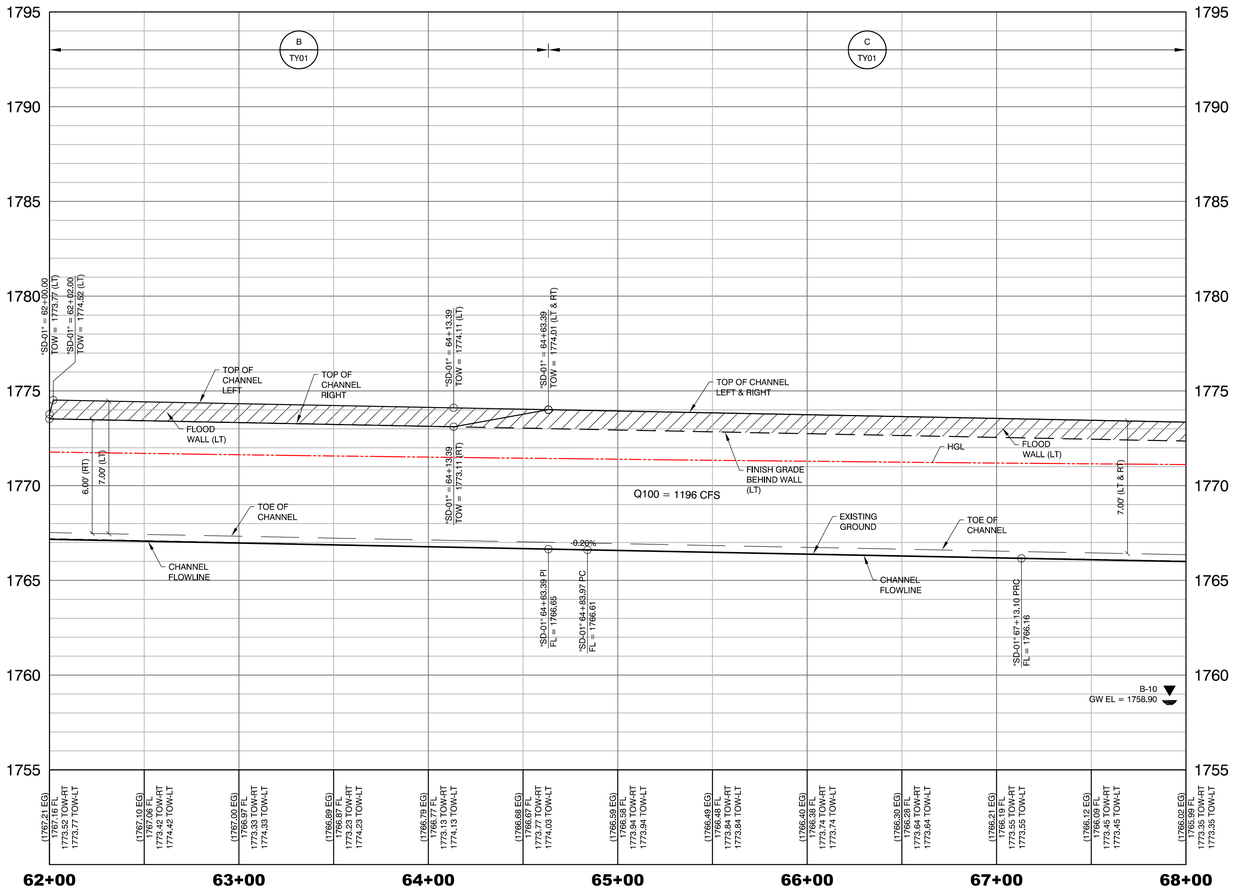
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STORM DRAIN PLAN AND PROFILE
"SD01" 1+00 TO "SD01" 2+00

PROFESSIONAL ENGINEER STATE OF NEVADA
STEVEN BERARD CIVIL No. 19040
5-31-16
NOT FOR CONSTRUCTION

SHEET
SD0
21 OF 31

DRAWING NO.
XXX-XXXX





GRAPHIC SCALE
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(IN FEET)

NORTH

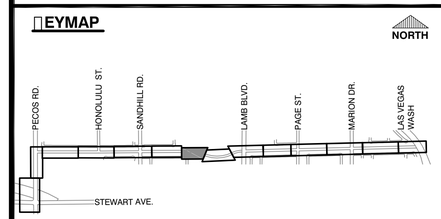
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. INSTALL 18 RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5 X 3 RCB SD
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15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
CITY OF LAS VEGAS NEVADA
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7274
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX.XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015		DRAWN BY: MM	
SUBMITTAL STAGE: 30% - PRELIMINARY		CHECKED BY: HD	

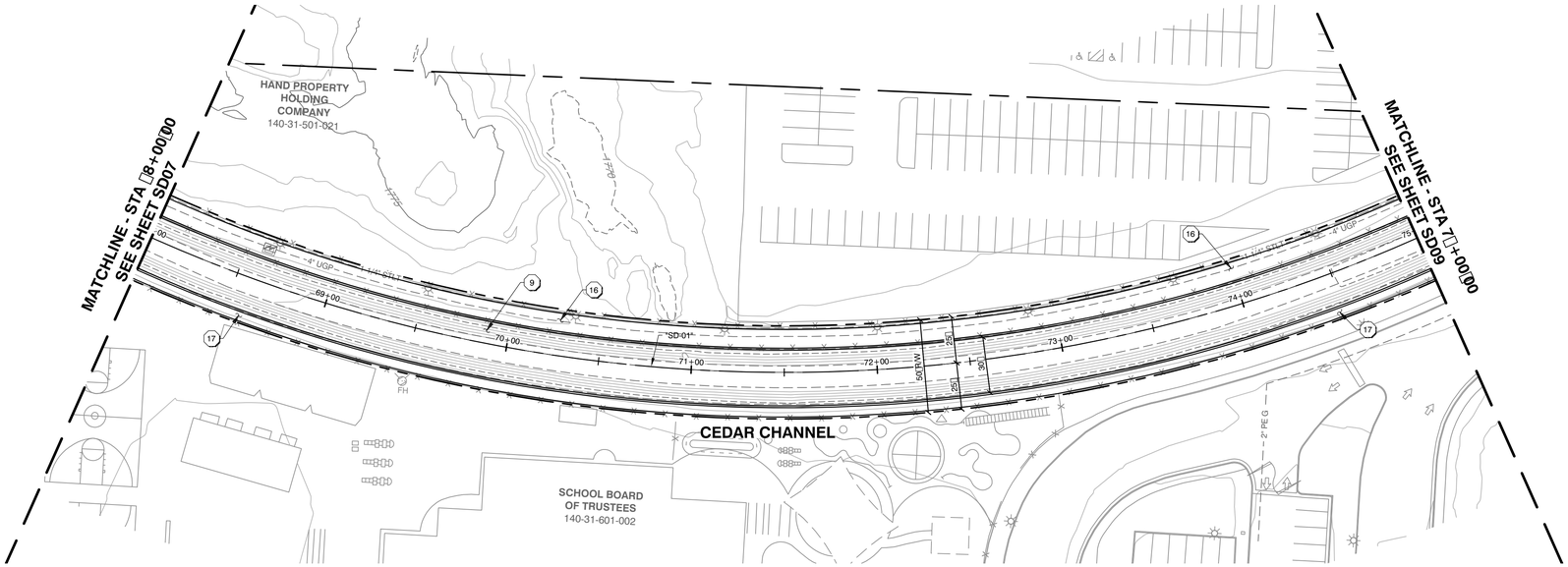
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

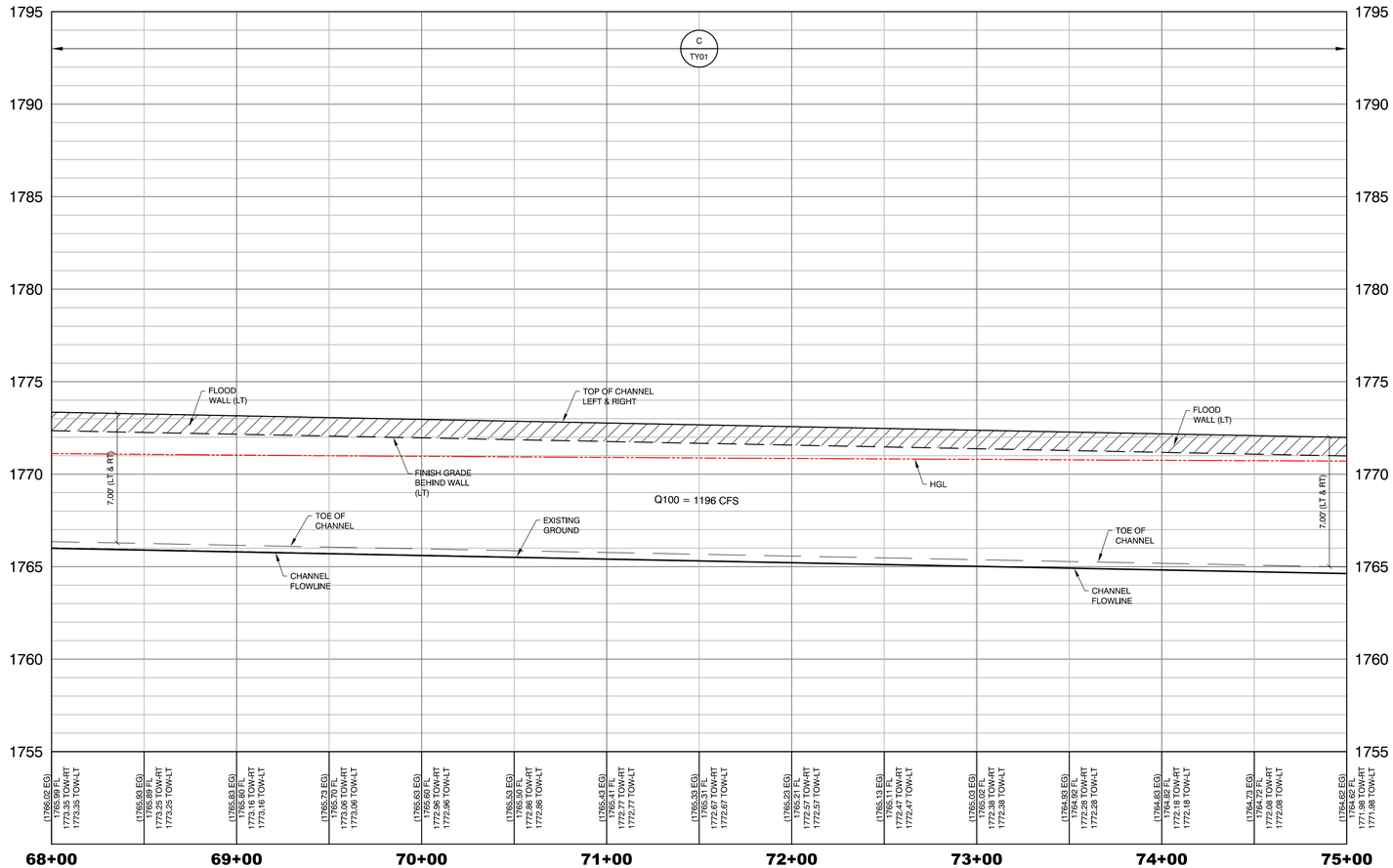
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STORM DRAIN PLAN AND PROFILE
"SD01" 2+00 TO "SD01" 8+00

STEVEN BELEW — 6-31-16 — CIVIL — No. 19040 — STATE OF NEVADA — PROFESSIONAL ENGINEER — NOT FOR CONSTRUCTION

SHEET
SD07
22 OF 31
DRAWING NO.
XXX-XXXX

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(IN FEET)

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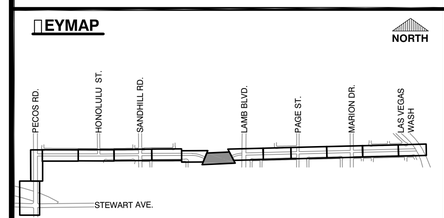
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

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17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

I#	H49866
DATE:	6/19/2015
SUBMITTAL STAGE:	30% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	SMB
DRAWN BY:	MM
CHECKED BY:	HD

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

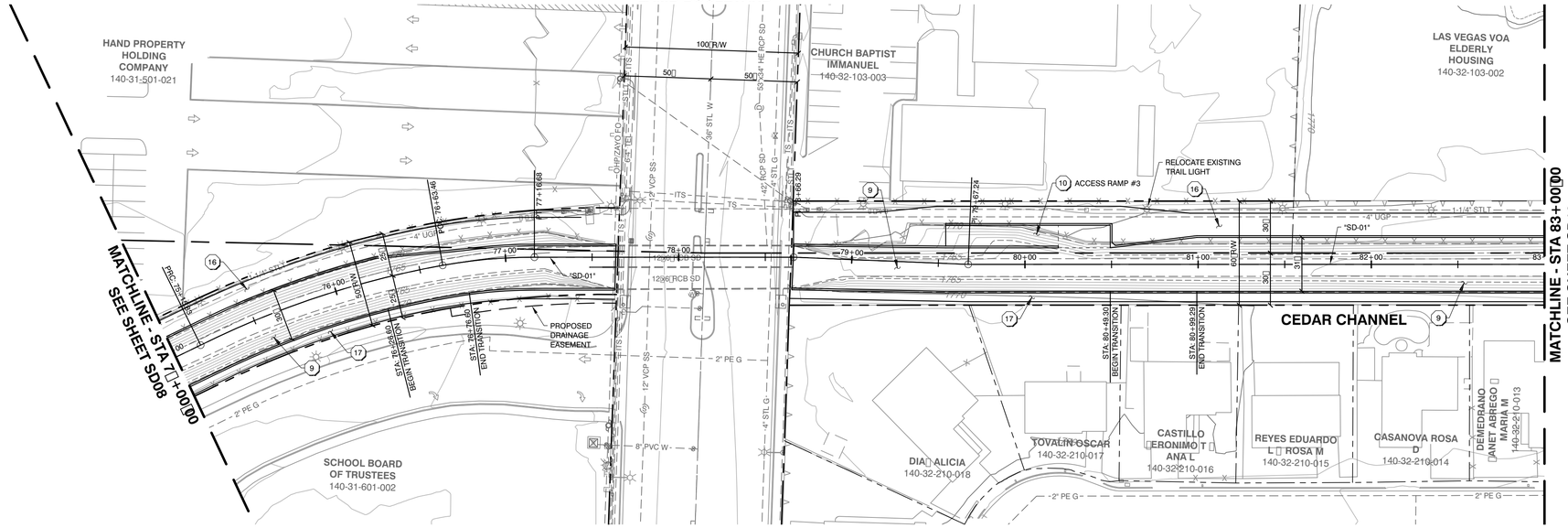
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STORM DRAIN PLAN AND PROFILE
"SD01" 8+00 TO "SD01" 7+00

PROFESSIONAL ENGINEER - STATE OF NEVADA
STEVEN B. BELOW
EXPIRES 6-30-16
CIVIL
No. 19040
NOT APPROVED FOR CONSTRUCTION

SHEET
SD08
23 OF 31

DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE
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(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

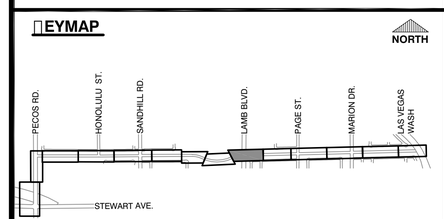
CONSTRUCTION KEY NOTES

1. INSTALL 18 RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5 X 3 RCB SD
4. INSTALL 7 X 3 RCB SD
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APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# XXXXX

EYMAP



NO.	DATE	REVISIONS

PREPARED BY
CITY OF LAS VEGAS NEVADA
ATKINS
2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

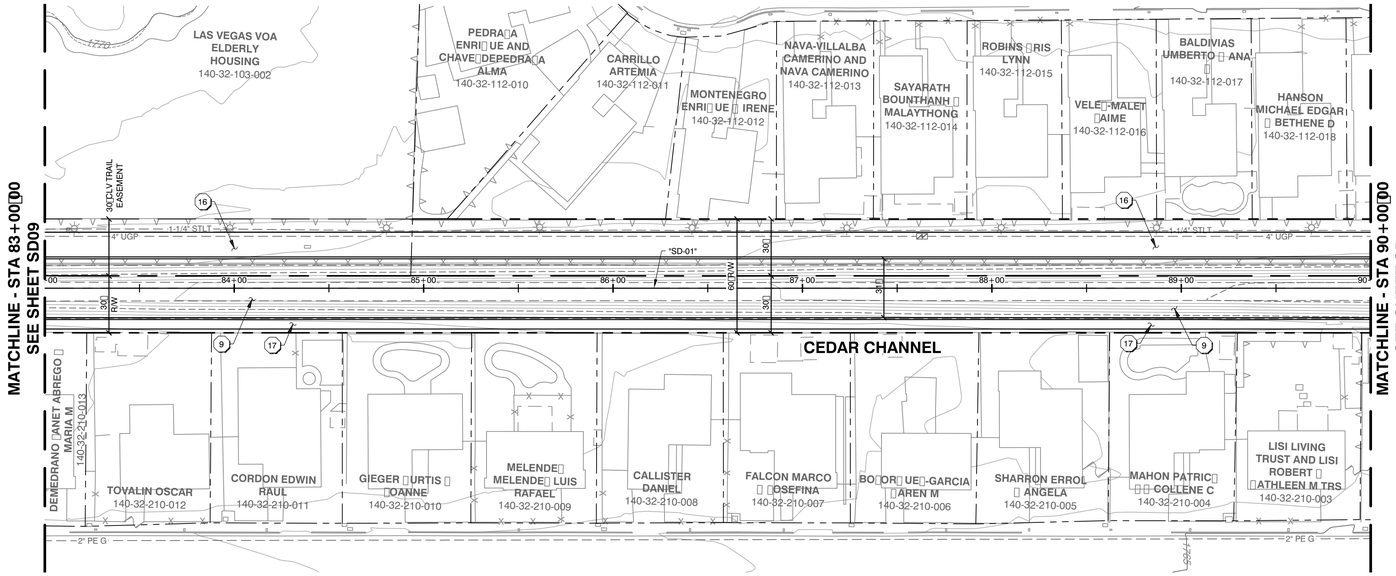
I.#	H49866	BID#	XX-XXXX
DATE:	6/19/2015	DESIGNED BY:	SMB
SUBMITTAL STAGE:	30% - PRELIMINARY	DRAWN BY:	MM
		CHECKED BY:	HD

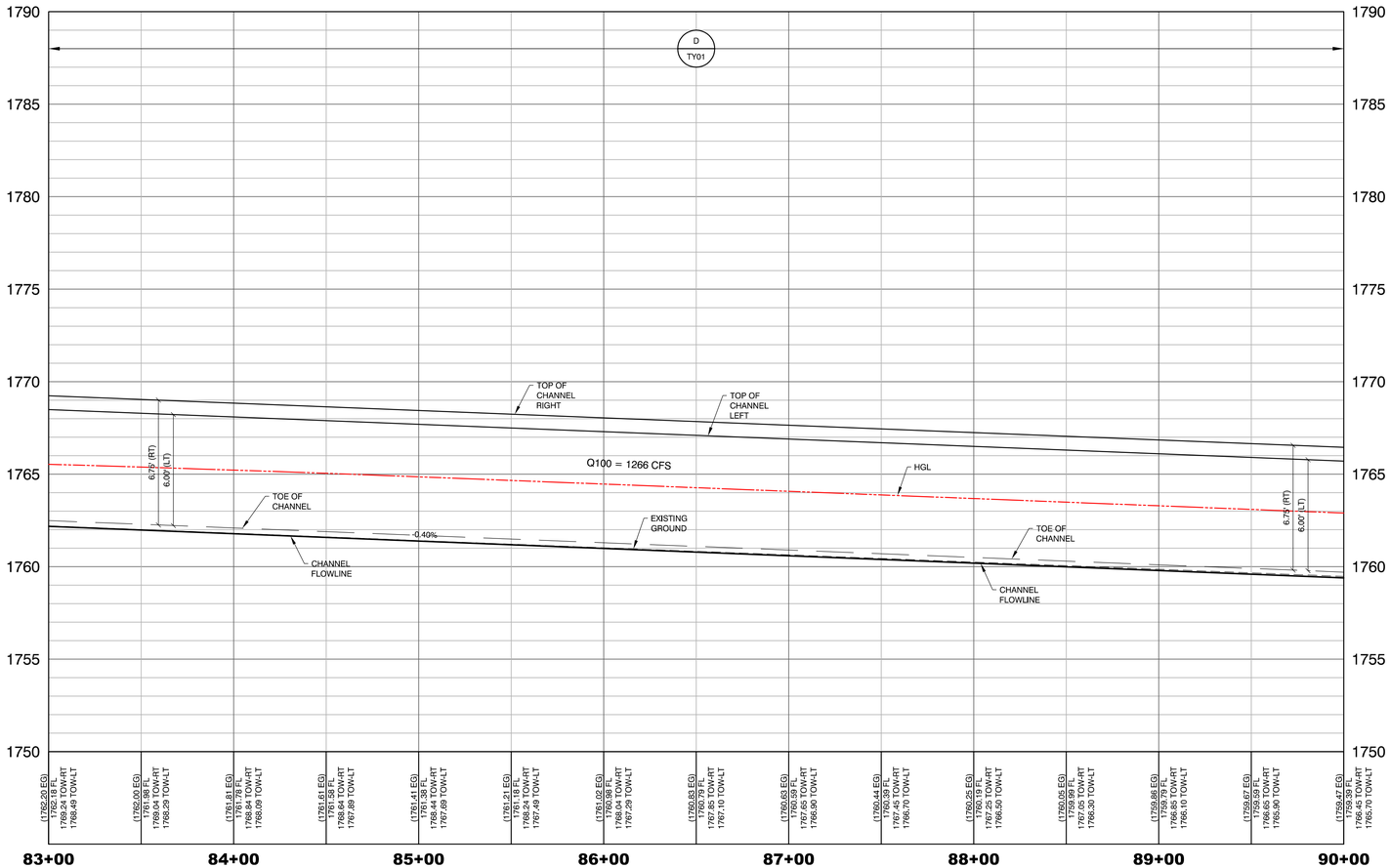
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL
STORM DRAIN PLAN AND PROFILE
"SD01" 7+00 TO "SD01" 83+00

NOT APPROVED FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN M. BELSKO
EXP. 6-30-16
CIVIL
No. 19040

SHEET
SD09
2 OF 31
DRAWING NO.
XXX-XXXX

X:\Projects\100039014_Cedar\H49866\Sheet Set\DWG\H49866-SD09 6-18-15 03:05pm





NORTH

GRAPHIC SCALE
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(IN FEET)

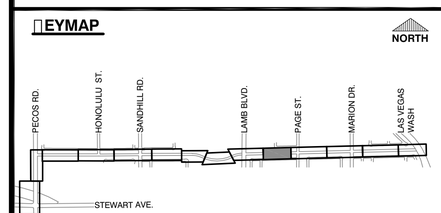
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION EY NOTES

1. INSTALL 18 RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5 X 3 RCB SD
4. INSTALL 7 X 3 RCB SD
5. INSTALL 8 X 4 RCB SD
6. INSTALL 12 X 6 RCB SD
7. INSTALL 18 X 4 RCB SD
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10. CONSTRUCT CHANNEL ACCESS RAMP
11. CONSTRUCT UNCTION STRUCTURE
12. CONSTRUCT TYPE "C" MODIFIED DROP INLET
13. CONSTRUCT HEADWALL
14. REMOVE EXISTING DROP INLET
15. REMOVE EXISTING STORM DRAIN
16. CONSTRUCT AC TRAIL
17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY

EYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 783-7272
Fax: +1 (702) 383-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX.XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015		DRAWN BY: MM	
SUBMITTAL STAGE: **30% - PRELIMINARY**		CHECKED BY: HD	

TITLE
LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

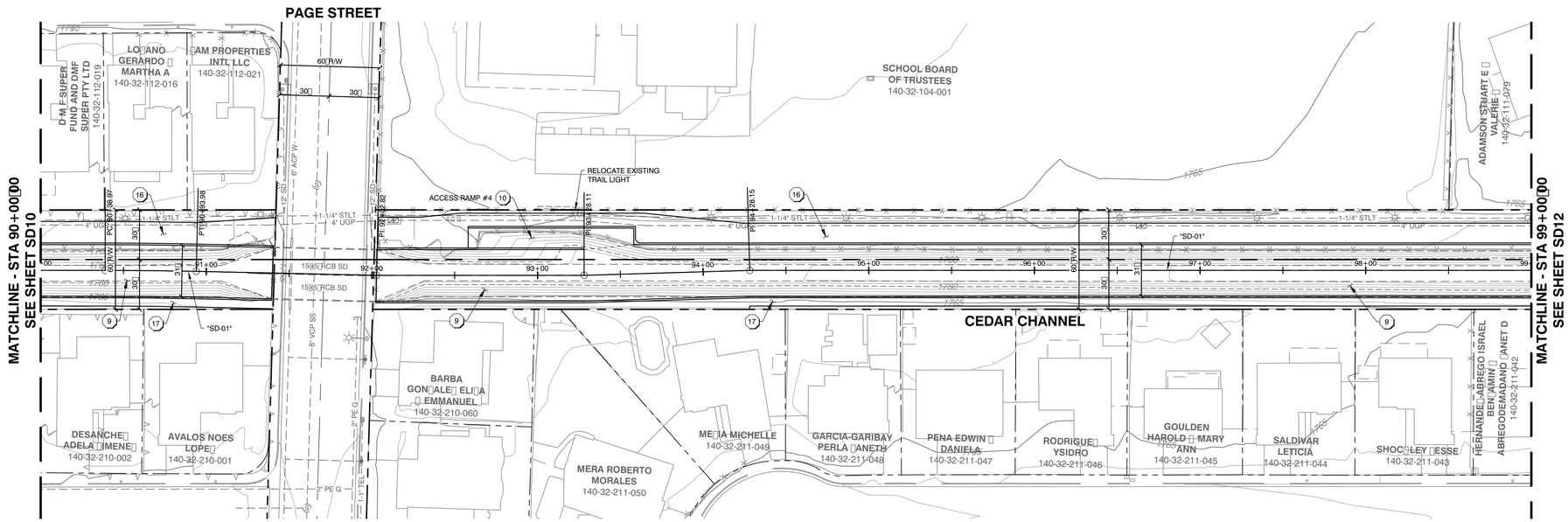
SHEET
STORM DRAIN PLAN AND PROFILE "SD01" 83+00 TO "SD01" 90+00

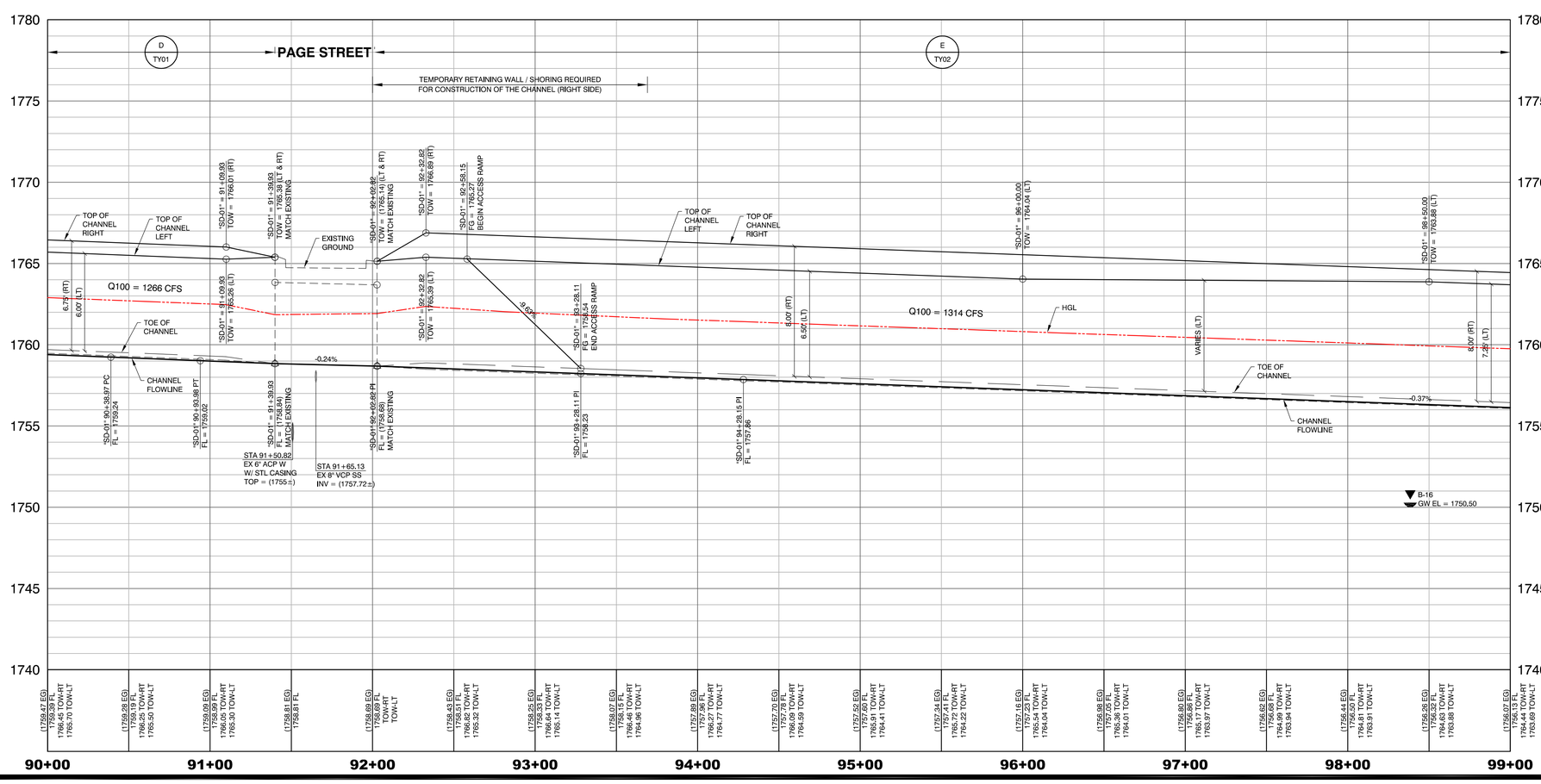
PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN BELSKI
EXPIRES 6-30-16
CIVIL
No. 19040
NOT APPROVED FOR CONSTRUCTION

SHEET
SD10
2 OF 31

DRAWING NO.
XXX-XXXX

X:\Projects\100039014_Cedar\H49866\Sheet Set\DWG\H49866-SD10 6-18-15 03:07pm





GRAPHIC SCALE
20 0 10 20 40
(IN FEET)

NORTH

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

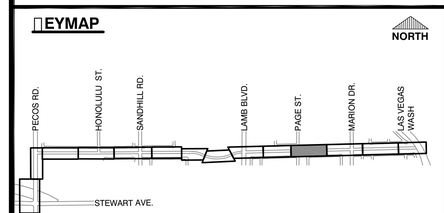
CONSTRUCTION KEY NOTES

1. INSTALL 18 RCP SD
2. INSTALL 24" RCP SD
3. INSTALL 5 X 3 RCB SD
4. INSTALL 7 X 3 RCB SD
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17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# XXXXX

KEYMAP



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ATKINS
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PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX	DESIGNED BY: SMB	
DATE: 6/19/2015		DRAWN BY: MM	
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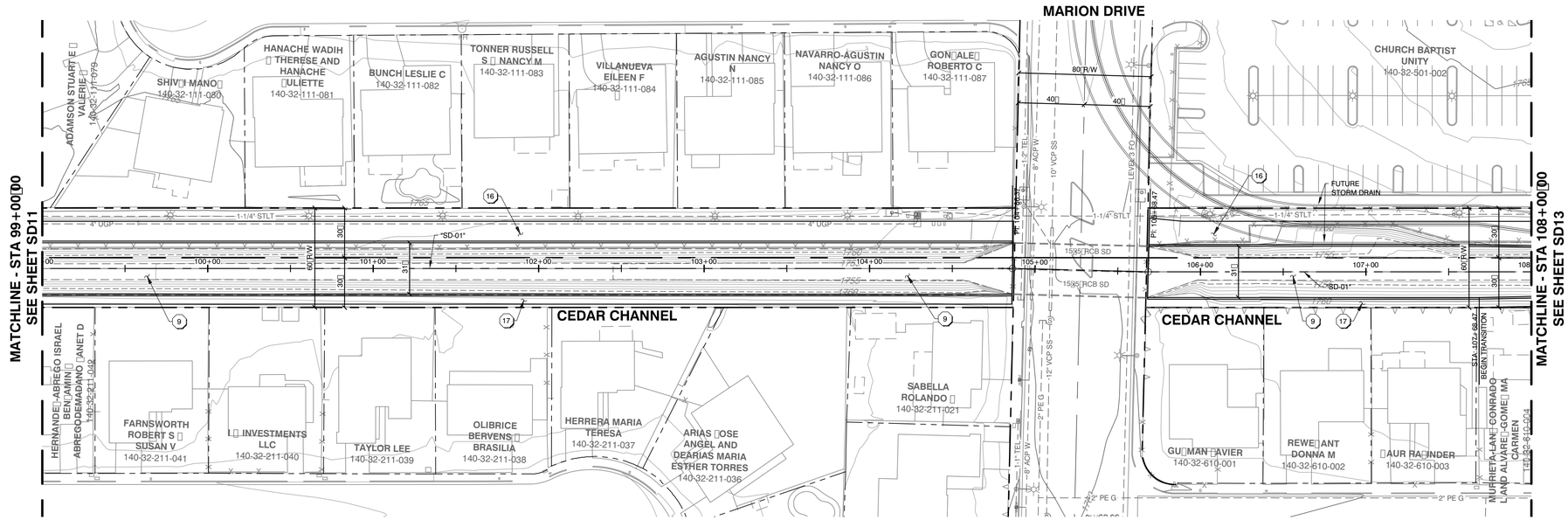
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 90+00 TO "SD01" 99+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN BELL
No. 19040
CIVIL

SHEET
SD11
2 OF 31
DRAWING NO
XXX-XXXX

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NORTH

GRAPHIC SCALE

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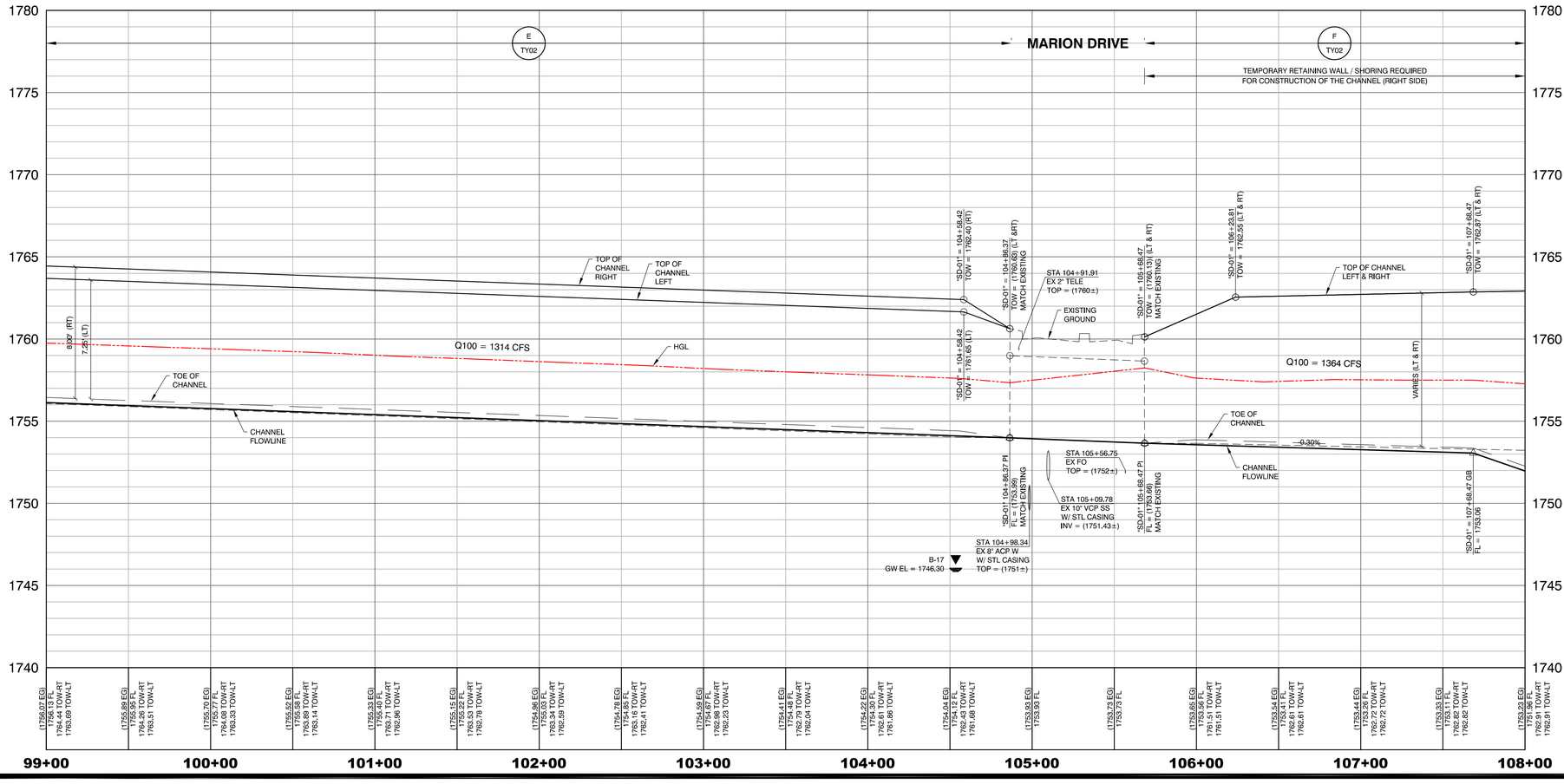
(IN FEET)

CALL BEFORE CONSTRUCTION

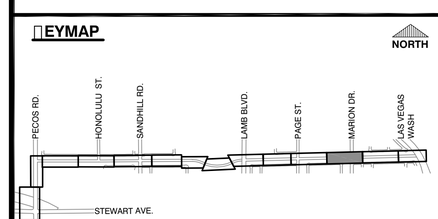
BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

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15. REMOVE EXISTING STORM DRAIN
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17. CONSTRUCT 5 TYPE II AGGREGATE BASE MANWAY



KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263-7274
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX.XXXX	DESIGNED BY: SMB	CHECKED BY: HD
DATE: 6/19/2015	SUBMITTAL STAGE: 30% - PRELIMINARY	DRAWN BY: MM	

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

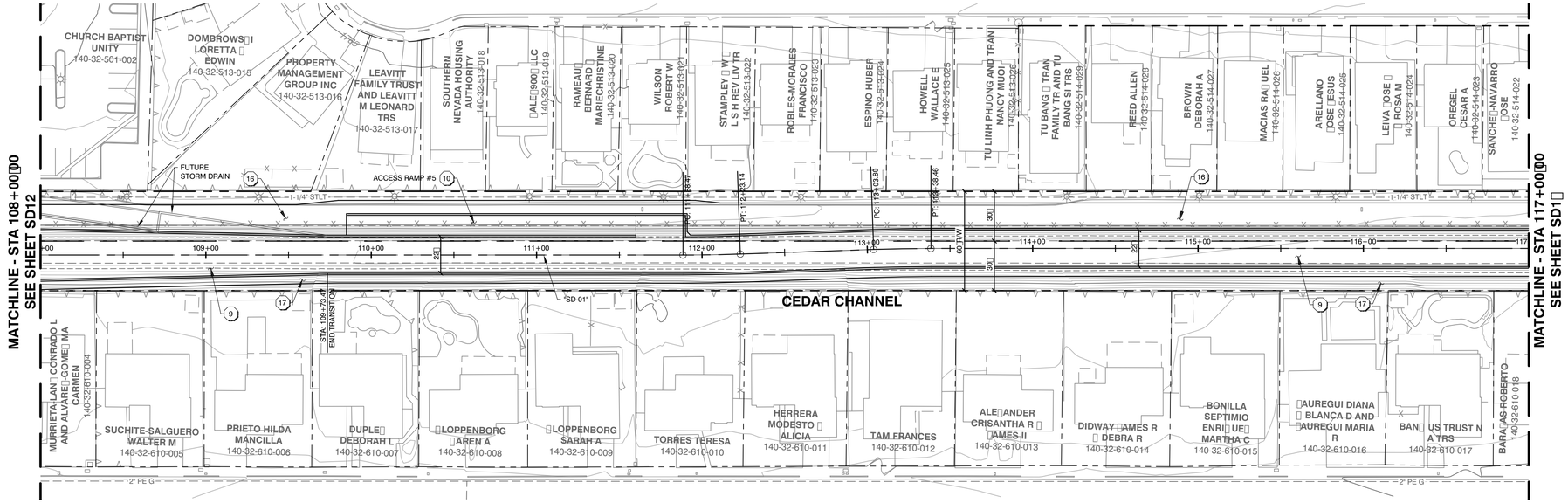
SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 99+00 TO "SD01" 108+00

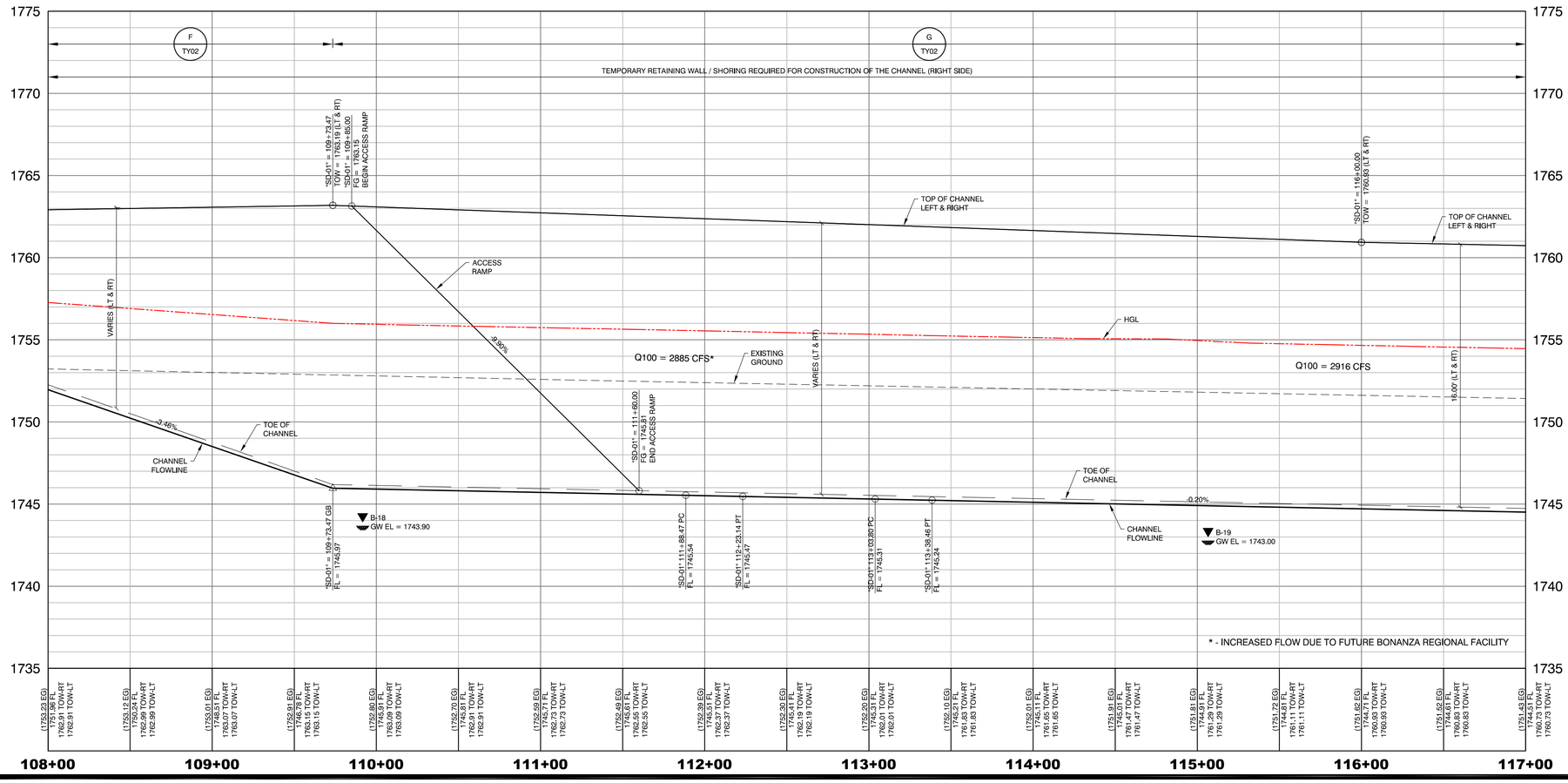
PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN BELDEN
EXP. 12-31-16
CIVIL
No. 19040
NOT APPROVED FOR CONSTRUCTION

SHEET
SD12
27 OF 31

DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE
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(IN FEET)

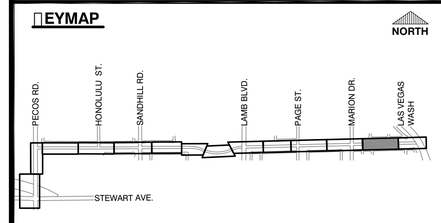
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

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2. INSTALL 24" RCP SD
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KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX		
DATE: 6/19/2015	DESIGNED BY: SMB	DRAWN BY: MM	CHECKED BY: HD
SUBMITTAL STAGE: 30% - PRELIMINARY			

TITLE
LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

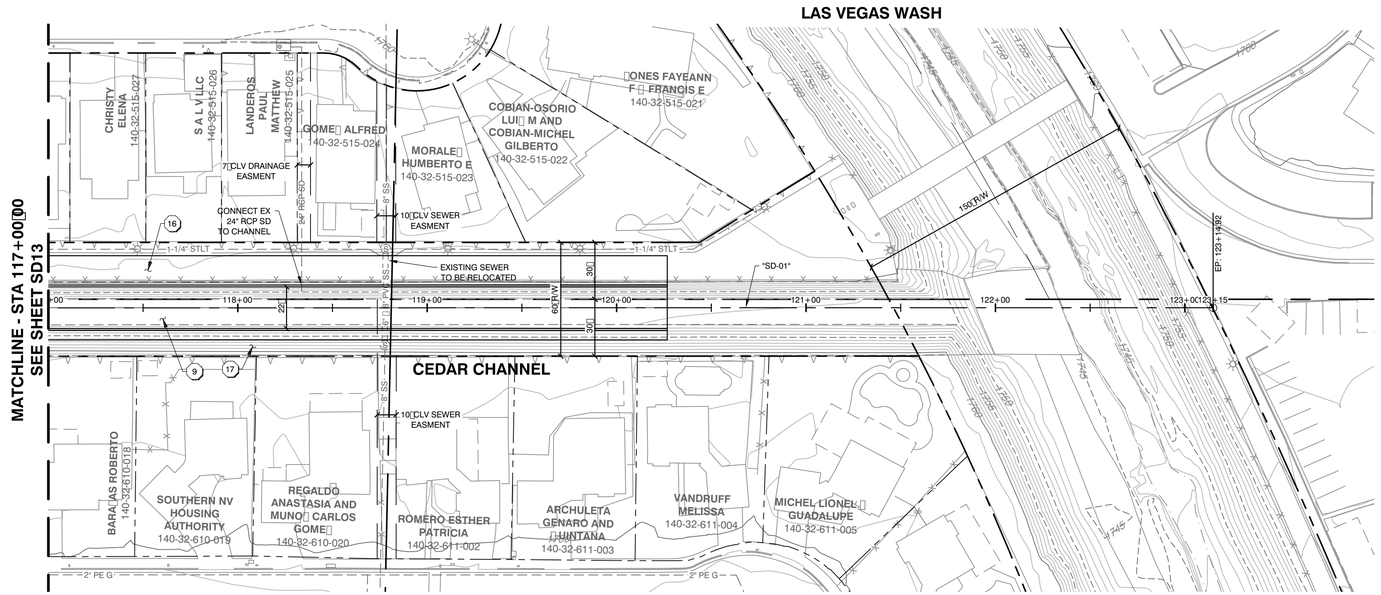
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STORM DRAIN PLAN AND PROFILE "SD01" 108+00 TO "SD01" 117+00

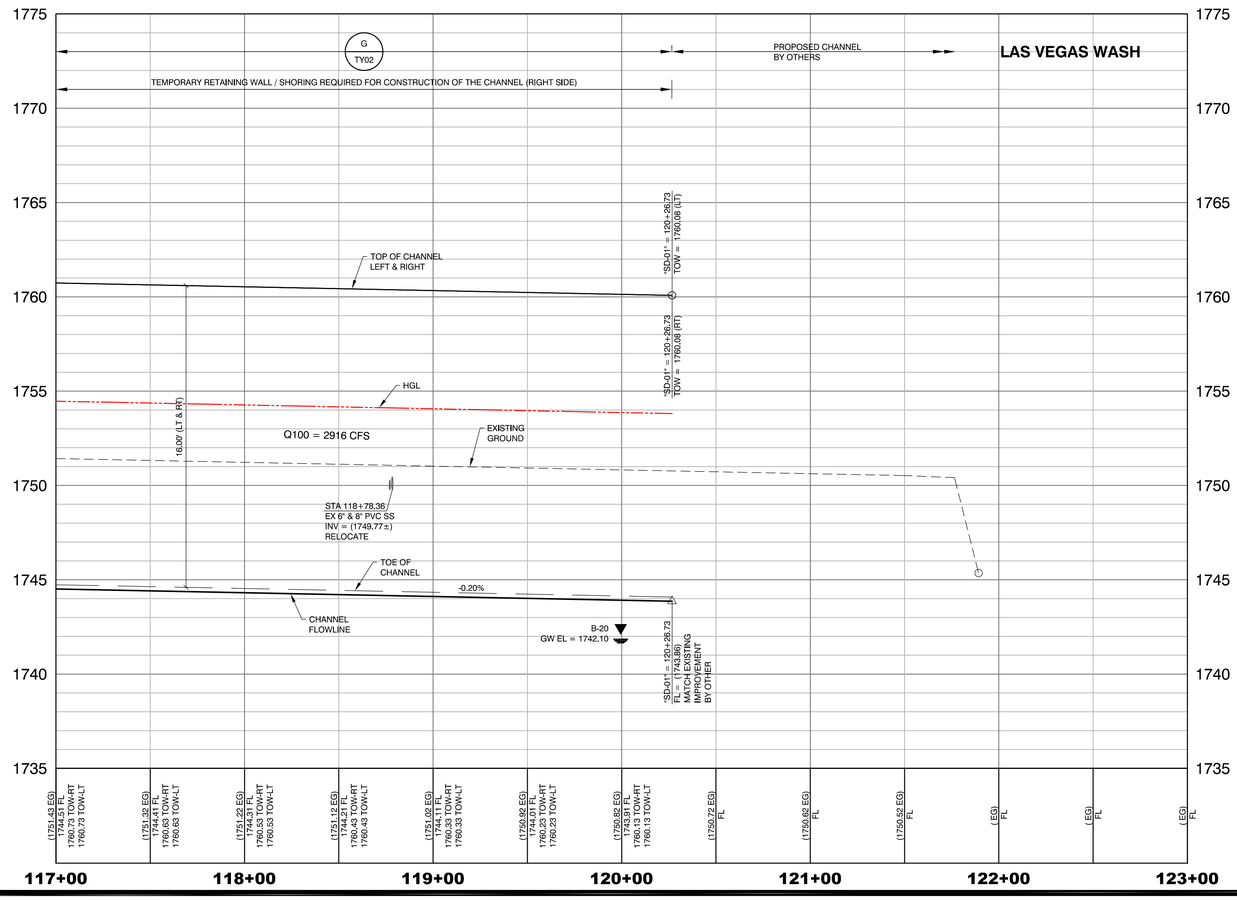
STEVEN BOND — 12-31-16 — CIVIL — No. 19040 — STATE OF NEVADA — PROFESSIONAL ENGINEER — NOT FOR CONSTRUCTION

SHEET
SD13
28 OF 31

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

NORTH

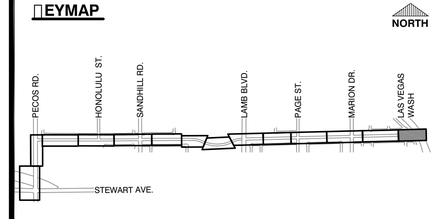
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

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KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263-7272
Fax: +1 (702) 263-7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX.XXXX	DESIGNED BY: SMB	CHECKED BY: HD
DATE: 6/19/2015	SUBMITTAL STAGE: 30% - PRELIMINARY	DRAWN BY: MM	

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

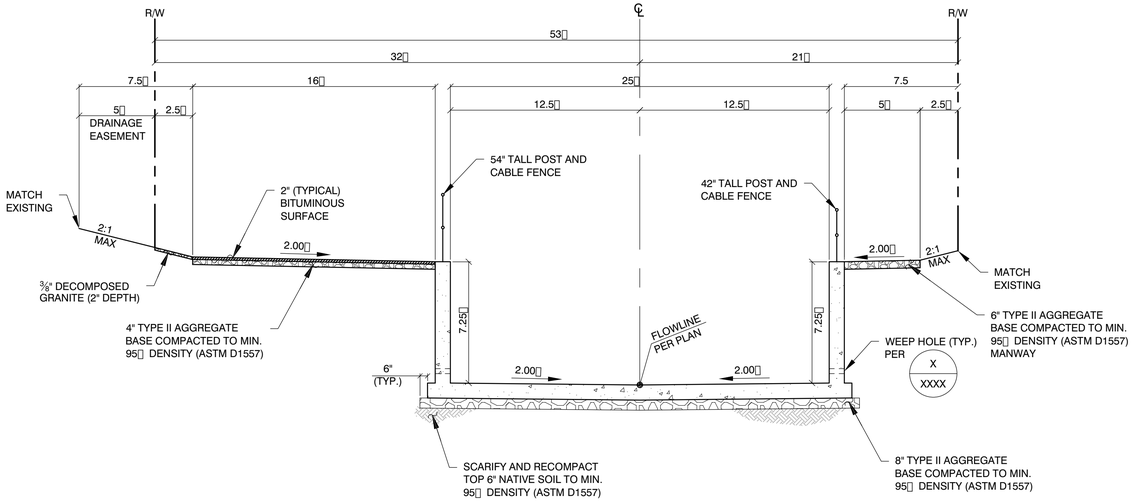
SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 117+00 TO "SD01" 123+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
STEVEN M. BELOW
5-31-16
CIVIL
No. 19040
NOT FOR CONSTRUCTION

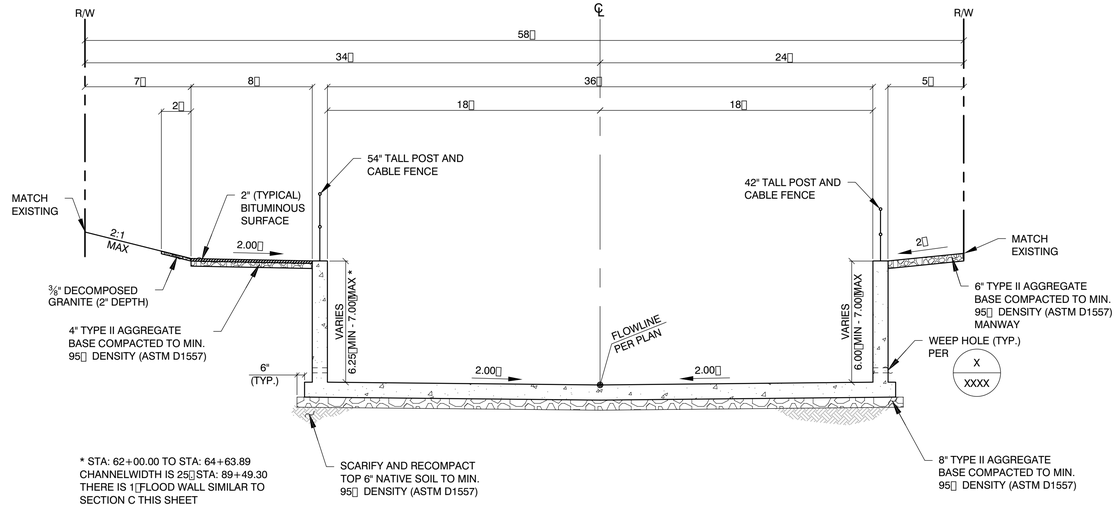
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SD1
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DRAWING NO.
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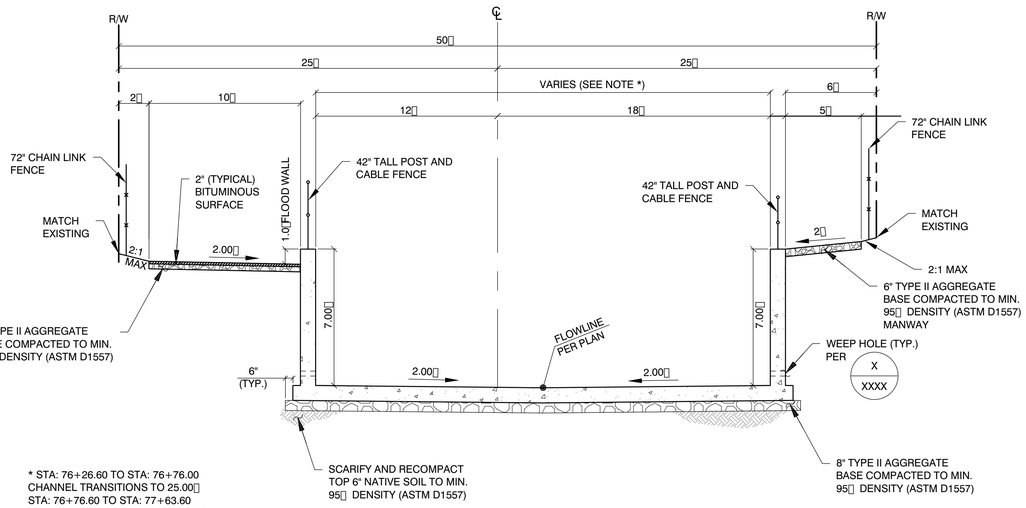


CHANNEL SECTION (A / TY01)
SCALE: NTS
STA 41+47.40 TO STA 51+20.56



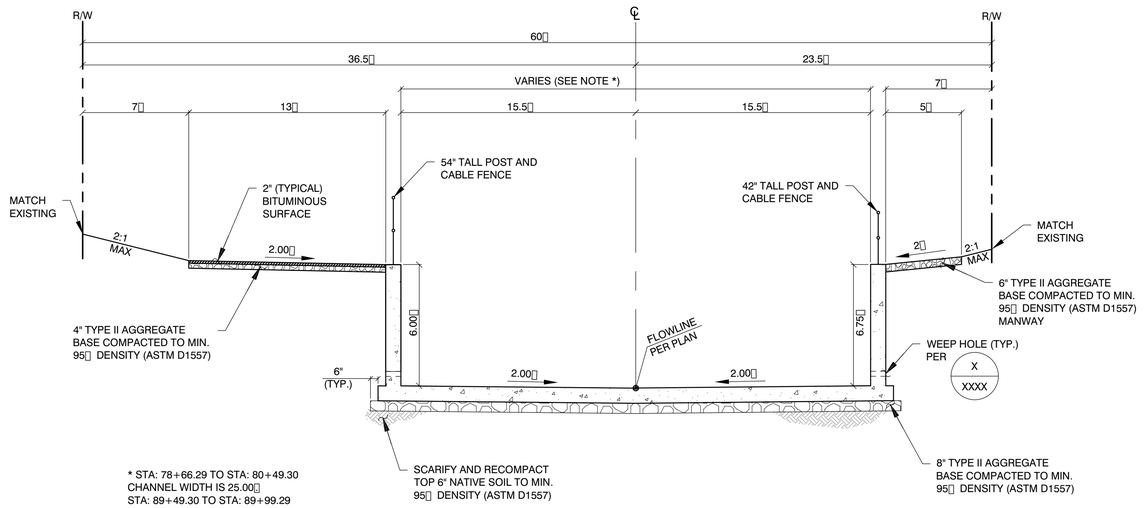
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CHANNELWIDTH IS 25'STA: 89+49.30
THERE IS 1'FLOOD WALL SIMILAR TO SECTION C THIS SHEET

CHANNEL SECTION (B / TY01)
SCALE: NTS
STA 51+99.92 TO STA 64+63.39



* STA: 76+26.60 TO STA: 76+76.00
CHANNEL TRANSITIONS TO 25.00'
STA: 76+76.60 TO STA: 77+63.60
CHANNEL CHANNEL WIDTH IS 25.00'

CHANNEL SECTION (C / TY01)
SCALE: NTS
STA 64+63.39 TO STA 77+63.60



* STA: 78+66.29 TO STA: 80+49.30
CHANNEL WIDTH IS 25.00'
STA: 89+49.30 TO STA: 89+99.29
CHANNEL TRANSITIONS TO 31.00'

CHANNEL SECTION (D / TY01)
SCALE: NTS
STA 78+66.29 TO STA 91+39.93

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ATKINS
2270 Corporate Circle, Suite 200
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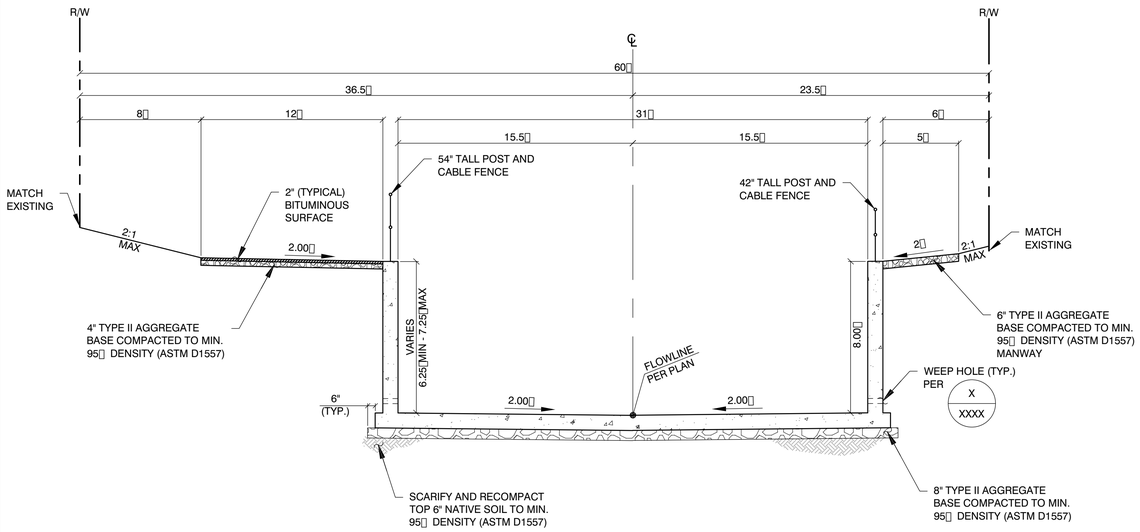
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
CHANNEL TYPICAL SECTIONS

STEVEN M. BELMONT — 12-31-16 — CIVIL — No. 19040 — PROFESSIONAL ENGINEER — STATE OF NEVADA
NOT FOR CONSTRUCTION

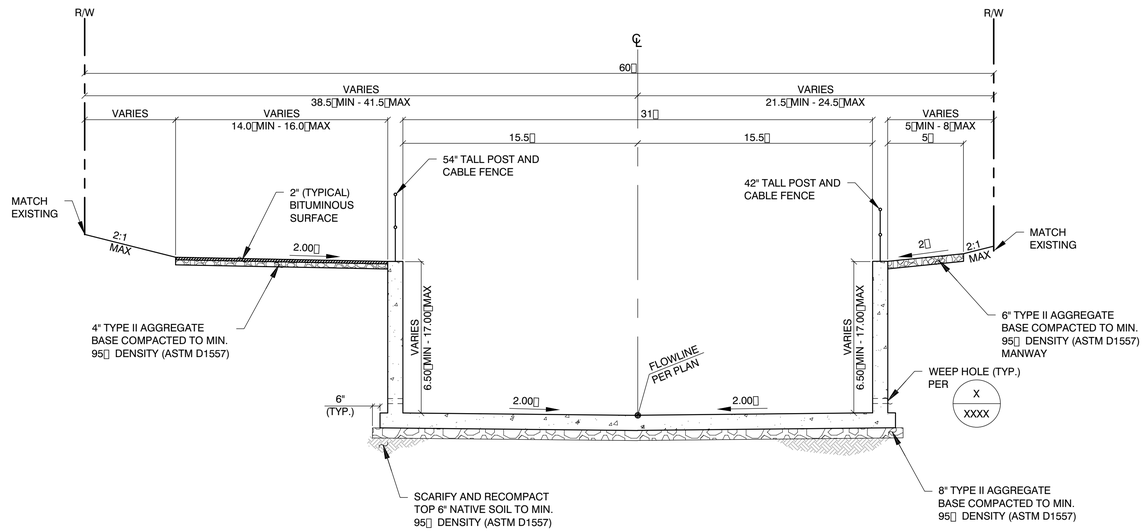
SHEET
TY01
30 OF 31
DRAWING NO.
XXX-XXXX

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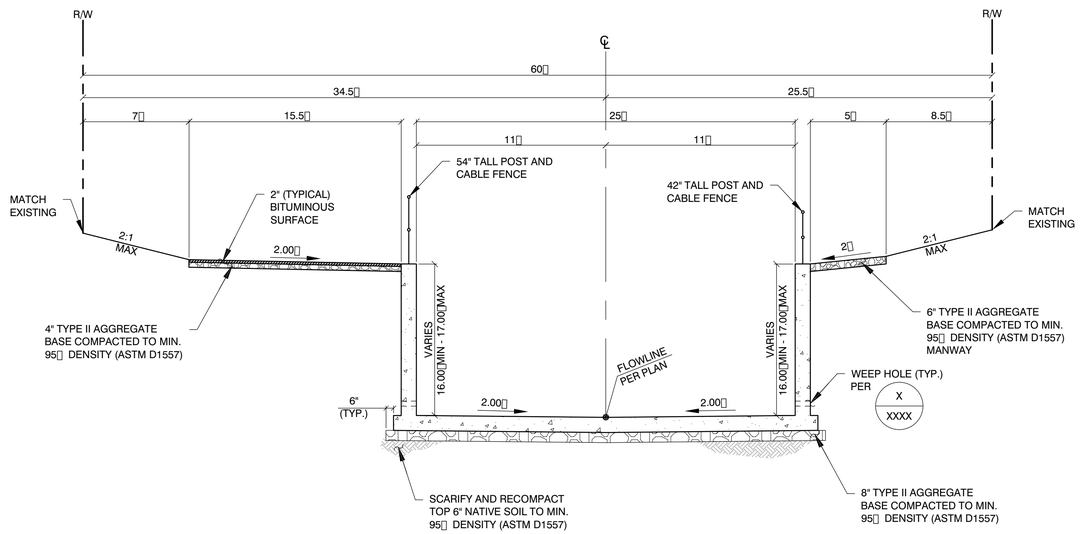
CHANNEL SECTION (E / TY02)

SCALE: NTS
STA 92+02.82 TO STA104+86.37



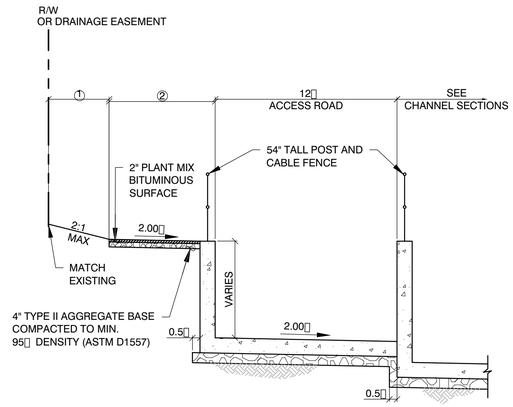
CHANNEL SECTION (F / TY02)

SCALE: NTS
STA 105+68.47 TO STA 109+73.47



CHANNEL SECTION (G / TY02)

SCALE: NTS
STA 109+73.47 TO STA 121+26.63

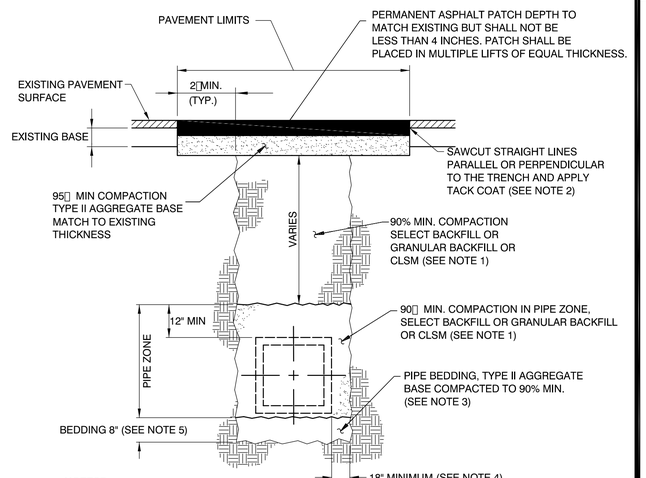


CHANNEL SECTION (H / TY02)

SCALE: NTS

ACCESS RAMP DIMENSION TABLE

ACCESS RAMP NO.	SECTION 1 (FEET)	SECTION 2 (FEET)
1	2.5	8
2	0	4.58
3	3	10
4	2	8
5	5.5	8



TYPICAL RCB TRENCH SECTION (I / TY02)

SCALE: NTS

NOTES'

1. NO STONES OR LUMPS GREATER THAN 3" PERMITTED IN TRENCH 2'DR LESS IN WIDTH.
2. IF SAWCUT IS WITHIN THREE FEET OF EDGE OF EXISTING ASPHALT CONCRETE SURFACE OR OTHER PATCH, REMOVE EXISTING PAVEMENT TO THAT EDGE AND REPLACE ENTIRE SECTION.
3. NATIVE SOILS BELOW PIPE BEDDING SHALL BE MOISTURE CONDITIONED, AND. COMPACTED TO 90' RELATIVE COMPACTION, AS EVALUATED BY ASTM D1557, UNLESS EXPOSED SOILS AT THE BASE OF THE TRENCH ARE LOOSE, SOFT, OR DISTURBED BY EXCAVATION OPERATIONS IN WHICH CASE THESE SOILS SHALL BE SCARIFIED TO A DEPTH OF 6-INCHES, MOISTURE CONDITIONED, AND COMPACTED TO 95 PERCENT RELATIVE COMPACTION, AS EVALUATED BY ASTM D1557.
4. IF CLSM IS USED FOR THE PIPE ZONE THEN THE MINIMUM WIDTH CAN BE REDUCED TO 8".
5. AT THE CONTRACTORS OPTION A 2" LEVELING COARSE OF CRUSHED ROCK CAN BE PLACED ABOVE THE RCB BEDDING.

REVISIONS

NO.	DATE

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866
DATE: 6/19/2015
SUBMITTAL STAGE: **30% - PRELIMINARY**
BID# XX.XXXX
DESIGNED BY: SMB
DRAWN BY: MM
CHECKED BY: HD

TITLE: **LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL**
SHEET: **CHANNEL TYPICAL SECTIONS**

STEVEN M. BELKO — 21-31-16 — CIVIL — No. 19040 — STATE OF NEVADA — PROFESSIONAL ENGINEER — NOT FOR CONSTRUCTION

SHEET **TY02**
31 OF **31**
DRAWING NO. **XXX-XXXX**

X:\Projects\16003390\4_Cada\H49866\Sheet Set\DWG\H49866-TY02 16-18-15 04:00pm

DEPARTMENT OF PUBLIC WORKS

Mayor:
CAROLYN G. GOODMAN

City Council:
STEVEN D. ROSS (MAYOR PRO-TERM)
LOIS TARKANIAN
STAVROS S. ANTHONY
RICKI Y. BARLOW
BOB COFFIN
BOB BEERS

City Manager:
ELIZABETH N. FRETWELL

Director of Public Works:
DAVID N. BOWERS, P.E., P.T.O.E.

City Engineer:
ALLEN E. PAVELKA, P.E.

Funded By:
CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT

70% SUBMITTAL

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

Reviewed By:

CLV CITY ENGINEER — DATE

CLV PROJECT MANAGER — DATE

CLV CITY TRAFFIC ENGINEER — DATE

CLV CONSTRUCTION MANAGER — DATE

CLARK COUNTY REGIONAL FLOOD CONTROL DISTRICT — DATE

REGIONAL TRANSPORTATION COMMISSION OF SOUTHERN NEVADA — DATE

SOUTHWEST GAS CORPORATION — DATE

CENTRAL TELEPHONE COMPANY d/b/a CENTURYLINK — DATE

THE AFFIXED CENTURYLINK NEVADA APPROVAL DOES NOT ASSUME OR GUARANTEE LIABILITY FOR KNOWN OR UNKNOWN CONFLICTS WITH EXISTING OR PROPOSED IMPROVEMENTS. RESOLUTION OF ANY CONFLICT WILL BE ACCOMPLISHED PURSUANT TO LOCAL ORDINANCES, NEVADA REVISED STATUTES AND/OR PUBLIC UTILITY COMMISSION STANDARD REGULATIONS.

COX COMMUNICATIONS LAS VEGAS, INC. — DATE

NV ENERGY – DISTRIBUTION — DATE

NV ENERGY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NV ENERGY RESERVES THE RIGHT TO ADDRESS ANY EXISTING OR FUTURE CONFLICTS ONCE THE FINAL DESIGN IS COMPLETED. THE NEW SERVICE AND THE RESOLUTION OF ANY CONFLICTS WILL BE ACCOMPLISHED PURSUANT TO THE NEVADA PUBLIC UTILITY COMMISSION'S RULES AND REGULATIONS.

NV ENERGY - TRANSMISSION — DATE

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123945
SHEETS: CV, GN01, SD01, SD04, SD09, SD11, SD12

THE SIGNATURE ABOVE ACKNOWLEDGES THAT THE UTILITY COMPANY REPRESENTATIVE HAS REVIEWED THE PLANS, AND THAT TO THE BEST OF HIS OR HER KNOWLEDGE THE UTILITY LINES ARE SHOWN IN THE CORRECT LOCATIONS AND ARE THE CORRECT SIZES. WHILE SUCH DATA HAS BEEN COLLECTED WITH REASONABLE CARE, THERE IS NO EXPRESSED OR IMPLIED GUARANTEE THAT THE LOCATIONS ARE EXACT. THE CONTRACTOR SHALL BEAR THE RESPONSIBILITY OF OBTAINING THE ACTUAL FIELD LOCATIONS.

THE SIGNATURE ABOVE FURTHER ACKNOWLEDGES THAT THE UTILITY COMPANY DOES NOT ANTICIPATE CONSTRUCTION OR MAINTENANCE IN THE PROJECT AREA FOR FIVE (5) YEARS IN CONFORMANCE WITH THE CLV NO-CUT POLICY.

NO.	DATE	SHEET	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866	BID# XX-XXXX		
DATE: 11/18/2016	DESIGNED BY: KRM		
SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HBD	

TITLE: LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

SHEET: COVER SHEET

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDAL R. MADDI
No. 19685
CIVIL
NOT FOR CONSTRUCTION

SHEET
CV
1 OF 55
DRAWING NO.
XXX-XXXX

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CITY OF LAS VEGAS GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE "UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA NEVADA", LATEST ISSUE; THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION, CLARK COUNTY AREA NEVADA", LATEST REVISED EDITION; THE "SUMMERLIN IMPROVEMENT STANDARDS" FOR WORK IN THE SUMMERLIN AREA; AND OTHER APPLICABLE APPROVED STANDARDS ISSUED BY THE CONTROLLING AGENCY; THE UNIFORM BUILDING CODE; AND ALL LOCAL CITY CODES AND ORDINANCES APPLICABLE, EXCEPT AS NOTED ON THIS SHEET AS "DEVIATIONS FROM STANDARDS".

2. THE EXISTENCE AND LOCATION OF ANY OVERHEAD OR UNDERGROUND UTILITY LINES, PIPES, OR STRUCTURES SHOWN ON THESE PLANS ARE OBTAINED BY A RESEARCH OF THE AVAILABLE RECORDS. EXISTING UTILITIES AS SHOWN FROM CLV PLANS LIBRARY ARE APPROXIMATE AND FOR RECORD PURPOSES. EXISTING UTILITIES ARE LOCATED ON PLANS ONLY FOR THE CONVENIENCE OF THE CONTRACTOR. EXISTING UTILITY SERVICE LATERALS MAY NOT BE SHOWN ON THE PLANS. THE CONTRACTOR SHALL, AT HIS OWN EXPENSE, LOCATE ALL UNDERGROUND AND OVERHEAD INTERFERENCE WHICH MAY AFFECT HIS OPERATION DURING CONSTRUCTION AND SHALL TAKE ALL NECESSARY PRECAUTIONS TO AVOID DAMAGE TO SAME. THE CONTRACTOR SHALL USE EXTREME CAUTION WHEN WORKING NEAR OVERHEAD UTILITIES SO AS TO SAFELY PROTECT ALL PERSONNEL AND EQUIPMENT, AND SHALL BE RESPONSIBLE FOR ALL COST AND LIABILITY IN CONNECTION THEREWITH.

3. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING UTILITY LINES, STRUCTURES AND STREET IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE, FROM DAMAGE, AND ALL SUCH IMPROVEMENTS OR STRUCTURES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED OR REPLACED SATISFACTORY TO THE CITY ENGINEER OR OWNING UTILITY COMPANY AT THE EXPENSE OF THE CONTRACTOR.

4. ALL CONSTRUCTION SHALL BE AS SHOWN ON THESE PLANS, ANY REVISIONS SHALL HAVE THE PRIOR WRITTEN APPROVAL OF THE CITY ENGINEER.

5. TYPE V CEMENT SHALL BE USED IN ALL OFF-SITE CONCRETE WORK. CONCRETE TO BE 3000 P.S.I. MINIMUM @ 28 DAYS. MIX DESIGN TO BE APPROVED BY THE QUALITY CONTROL DIVISION, PRIOR TO THE USE ON THE PROJECT.

6. PERMITS ARE REQUIRED FOR ANY WORK IN THE PUBLIC RIGHT-OF-WAY. THE CONTRACTOR SHALL SECURE ALL PERMITS AND INSPECTIONS REQUIRED FOR THIS CONSTRUCTION.

7. EXPANSION JOINTS REQUIRED, MAXIMUM EVERY 300' IN EXTRUDED-TYPE CURB.

8. AC PAVEMENT TO BE 1/2" ABOVE LIP OF ALL GUTTERS AFTER COMPACTION, EXCEPT AT SIDEWALK RAMPS.

9. CURB AND GUTTER WITH A GRADE OF LESS THAN FOUR-TENTHS OF ONE PERCENT SHALL BE WATER-TESTED AS SOON AS POSSIBLE AFTER CONSTRUCTION. ANY CURB AND GUTTER FOUND TO BE UNACCEPTABLE TO THE CITY SHALL BE REMOVED AND REPLACED PER USD 216.

10. SIDEWALK RAMPS SHALL BE CONSTRUCTED IN EACH QUADRANT OF AN INTERSECTION PER USD 235, CASE I. EXACT LOCATION OF RAMPS MAY BE ADJUSTED IN THE FIELD BY A CITY PROJECT REPRESENTATIVE.

11. CONTRACTOR SHALL PROVIDE ALL NECESSARY HORIZONTAL AND VERTICAL TRANSITIONS BETWEEN NEW CONSTRUCTION AND EXISTING SURFACES TO PROVIDE FOR PROPER DRAINAGE AND FOR INGRESS AND EGRESS TO NEW CONSTRUCTION. THE EXTENT OF TRANSITIONS TO BE AS SHOWN ON PLANS, OR AS DESIGNATED IN THE FIELD BY CITY PROJECT REPRESENTATIVE.

12. EXACT LOCATION OF ALL SAWCUT LINES MAY BE DETERMINED IN THE FIELD BY A CITY PROJECT REPRESENTATIVE IF LOCATION ON PLANS IS NOT CLEARLY SHOWN, OR EXISTING PAVEMENT CONDITION REQUIRES RELOCATIONS.

13. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONS NECESSARY TO PROTECT EXISTING PERMANENT SURVEY MONUMENTS. ANY MONUMENTS DISTURBED SHALL BE REPLACED, AND SHALL BE DONE ONLY BY A NEVADA PROFESSIONAL LAND SURVEYOR IN ACCORDANCE WITH THE UNIFORM STANDARD DRAWINGS - CLARK COUNTY AREA. A RECORD-OF-SURVEY FOR REPLACEMENT OF PERMANENT SURVEY MONUMENTS SHALL BE SUBMITTED TO THE CITY ENGINEER FOR APPROVAL PRIOR TO RECORDING. THE RECORD-OF-SURVEY SHALL BE PREPARED IN ACCORDANCE WITH NEVADA REVISED STATUTES 625.350.

14. UTILITY COMPANY METER BOXES, MANHOLE LIDS, VALVE COVERS, ETC., SHALL BE LOCATED OUT OF DRIVEWAYS, DRIVEWAY APRONS, FLOWLINES, AND CROSS GUTTERS UNLESS WRITTEN APPROVAL IS GRANTED BY THE AFFECTED UTILITY COMPANY AND THE CITY ENGINEER.

15. ALL WALLS, NEW OR EXISTING, ARE ONLY SHOWN ON CIVIL PLANS FOR THE PURPOSE OF REVIEWING GRADING RELATIONSHIPS; FLOOD CONTROL AND SIGHT DISTANCE AT INTERSECTIONS. NEW WALLS REQUIRE A SEPARATE PERMIT AND INSPECTION BY THE CLV BUILDING DEPARTMENT.

16. ASPHALT MIX DESIGN MUST BE SUBMITTED AND APPROVED BY THE CITY ENGINEER PRIOR TO THE PLACEMENT OF ASPHALT WITHIN CITY RIGHTS OF WAY.

17. CONTRACTOR SHALL ADJUST ALL NEW AND EXISTING INLETS, VALVE BOXES, MANHOLE RIMS, SEWER CLEANOUTS, ETC. TO FINISH GRADE AS APPLICABLE WHETHER OR NOT THEY ARE SHOWN ON THE PLANS.

18. MATERIALS, HANDLING AND PLACEMENT OF PORTLAND CEMENT CONCRETE SHALL BE IN ACCORDANCE WITH APPLICABLE SECTIONS OF NDOT AND CLARK COUNTY AREA SPECIFICATIONS (AS APPLICABLE) AND THE PLANS AND DETAILS SHOWN HEREON.

19. WHEN INSTALLING UNDERGROUND FACILITIES THAT REQUIRE UNDERGROUND LOCATING DEVICES SUCH AS MARKER BALLS, LOCATING RIBBON, ETC, THE CONTRACTOR SHALL PROVIDE WRITTEN DOCUMENTATION TO THE ENGINEER CERTIFYING THAT ALL DEVICES HAVE BEEN PLACED AND VERIFIED TO BE IN GOOD WORKING CONDITION PRIOR TO THE CONSTRUCTION OF ANY ROAD BASE.

20. SANITARY SEWER AND STORM DRAIN FINAL LOCATION INFORMATION SHALL BE PROVIDED TO THE ENGINEER PRIOR TO PROJECT ACCEPTANCE. THE INFORMATION SHALL INCLUDE THE HORIZONTAL AND VERTICAL (INVERT) LOCATION OF PUBLIC SEWER MANHOLES, STORM DRAIN MANHOLES, STORM DRAIN LATERALS AT THE CONNECTION TO THE STORM DRAIN MAIN AND AT THE CONNECTION TO A DROP INLET, AND THE CONNECTION OF SEWER SERVICE LATERALS TO THE SEWER MAIN AND WHERE THE SEWER SERVICE LATERALS EXITS THE PUBLIC RIGHT-OF-WAY. THE LOCATION SHALL BE DESCRIBED BY COORDINATES WHICH SHALL BE BASED ON THE OFFICIAL HORIZONTAL AND VERTICAL CONTROL NETWORKS OF THE CITY OF LAS VEGAS. FINAL LOCATION INFORMATION MUST BE SEALED AND CERTIFIED BY A NEVADA PROFESSIONAL LAND SURVEYOR TO HAVE POSITIONAL CERTAINTIES OF ± 0.09 METERS (± 0.3 FEET) HORIZONTALLY AND VERTICALLY. A SEPARATE ELECTRONIC COMMA DELIMITED FILE FOR THE SANITARY SEWER AND STORM DRAIN COORDINATES SHALL ALSO ACCOMPANY THE SANITARY SEWER AND STORM DRAIN FINAL LOCATION INFORMATION.

21. CCTV VIDEO INSPECTION IS REQUIRED FOR ALL SEWER AND STORM DRAINS. THE CCTV VIDEO INSPECTIONS NEED TO BE PERFORMED PER THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS LATEST ADDITION.

22. A SEPARATE BORING PERMIT IS REQUIRED FOR ALL BORING ACTIVITIES.

REVISED JANUARY 23, 2014 (CPM VERSION)

ABBREVIATIONS

@	AT	MLCP	MULTI-LAYER COMPOSITE PIPE
AC	ASPHALTIC CONCRETE	NTS	NOT TO SCALE
ACP	ASBESTOS CEMENT PIPE	NVE	NV ENERGY
AEP	AUTHORIZATION TO ENTER PROPERTY	OHP	OVERHEAD POWER LINE
APPROX.	APPROXIMATE	PC	POINT OF CURVE
B/C, BC	BACK OF CURB	PE	POLYETHYLENE
BCR	BACK OF CURB RADIUS	P.I.P.	PROTECT IN PLACE
BM	BENCHMARK	PP	POWER POLE
BOT	BOTTOM	PT	POINT OF TANGENCY
B.R.	BACK OF RAMP	PRC	POINT OF REVERSE CURVE
$\mathcal{Q}$_ CL	CENTERLINE	PB	PULLBOX
CATV	CABLE T.V.	P , PL	PROPERTY LINE
CIPP	CURED-IN-PLACE PIPE	PVC	POLYVINYL CHLORIDE
CLV	CITY OF LAS VEGAS	R	RADIUS
CONC.	CONCRETE	RT	RIGHT
COND.	CONDUCTOR	R/W, R.O.W.	RIGHT OF WAY
CLSM	CONTROLLED LOW STRENGTH MATERIAL	SCCP	STEEL CYLINDER CONCRETE PIPE
C & G	CURB AND GUTTER	SD	STORM DRAIN
D/W	DRIVEWAY	SF	SQUARE FOOT
DWG.	DRAWING	SS	SANITARY SEWER
ECR	END OF CURB RETURN (AT B/C)	STA.	STATION
ELEC.	ELECTRIC	STD	STANDARD
EOP, EP	EDGE OF PAVEMENT	STL	STEEL
ELEV.	ELEVATION	SY	SQUARE YARD
EXIST., EX.	EXISTING	S/W	SIDEWALK
EXOH	EXISTING OVERHEAD UTILITY	T	TELEPHONE LINE
FD	FOUND	TC	TOP OF CURB
FL	FLOWLINE	TEL	TELEPHONE
FG	FINISHED GRADE	TRANS.	TRANSITION
FH	FIRE HYDRANT	T.R.C.	TOP OF RAMP CURB
FT.	FOOT/FEET	TS	TRAFFIC SIGNAL
FC	FACE OF CURB	TYP.	TYPICAL
G	GAS	USD	UNIFORM STD DRAWING
GV	GAS VALVE	USS	UNIFORM STD SPECIFICATIONS
GW	GUY WIRE	W	WATER LINE
HP	HIGH PRESSURE	WC	WHEEL CHAIR
INT.	INTERSECTION	WM	WATER METER
IRR	IRRIGATION	WV	WATER VALVE
L	LENGTH	W/	WITH
LF	LINEAL FOOT, LINEAR FEET	△	INCLUDED DELTA ANGLE
LT	LEFT		
MH	MANHOLE		

RTC NOTES

1. THE CONTRACTOR SHALL NOT BE ALLOWED TO CLOSE MORE THAN ONE CONSECUTIVE BUS STOP ON THE SAME SIDE OF THE STREET. TEMPORARY CLOSURES SHALL BE PWD (PERSONS WITH DISABILITY) ACCESSIBLE BEFORE ANY BUS STOP CAN BE CLOSED. THE CONTRACTOR SHALL NOTIFY CARL SCARBROUGH AT (702) 676-1608 OR ERIC TRAASDAHL AT (702) 676-1633, AT LEAST SEVEN WORKING DAYS IN ADVANCE.

2. THE CONTRACTOR SHALL SUBMIT A BUS STOP CLOSURES SCHEDULE WITH THE TRAFFIC CONTROL PLAN. THE BUS STOP CLOSURE SCHEDULE SHALL IDENTIFY SPECIFIC DURATIONS AND TIMES OF THE DAY FOR ALL PROPOSED BUS STOP CLOSURES. BUS STOP CLOSURES ARE NOT TO EXCEED TWO CONSECUTIVE STOPS AT ONE TIME, OR MORE THAN 1,000 FEET AT A TIME. PERSONS WITH DISABILITIES SHALL HAVE ACCESS TO BUS STOPS. THE CONTRACTOR SHALL PROVIDE A 100 FOOT LONG BY 10 FEET WIDE GRAVELED TURN OUT AT TEMPORARY BUS STOPS.

REVISED FEBRUARY 14, 2013

BASIS OF BEARINGS

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
RIVET & PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION = 536.414 METERS
= 1759.89 FEET

CITY OF LAS VEGAS GRADING NOTES

1. IN THE EVENT THAT ANY UNFORESEEN CONDITIONS NOT COVERED BY THESE NOTES ARE ENCOUNTERED DURING GRADING OPERATIONS, THE OWNER/ENGINEER SHALL BE IMMEDIATELY NOTIFIED FOR DIRECTION.

2. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO PERFORM ALL NECESSARY CUTS AND FILLS WITHIN THE LIMITS OF THIS PROJECT AND THE RELATED OFF-SITE WORK, SO AS TO GENERATE THE DESIRED SUBGRADE, FINISH GRADES AND SLOPES SHOWN.

3. CONTRACTOR SHALL TAKE FULL RESPONSIBILITY FOR ALL EXCAVATION. ADEQUATE SHORING SHALL BE DESIGNED AND PROVIDED BY THE CONTRACTOR TO PREVENT UNDERMINING OF ANY ADJACENT FEATURES OR FACILITIES AND/OR CAVING OF THE EXCAVATION.

4. THE GRADING CONTRACTOR IS RESPONSIBLE TO COORDINATE WITH THE OWNER TO PROVIDE FOR THE REQUIREMENTS OF THE PROJECT STORM WATER POLLUTION PREVENTION PLAN (SWPPP) AND ASSOCIATED PERMIT.

5. CONTRACTOR SHALL GRADE TO THE LINES AND ELEVATIONS SHOWN ON THE PLANS WITHIN THE FOLLOWING HORIZONTAL AND VERTICAL TOLERANCES AND DEGREES OF COMPACTION, IN THE AREAS INDICATED:

	HORIZONTAL	VERTICAL
A. PAVEMENT AREA SUBGRADE	0.1'±	+0.0' TO -0.1'
B. ENGINEERED FILL	0.5'±	+0.1' TO -0.1'

COMPACTION TESTING WILL BE PERFORMED BY THE OWNER OR HIS REPRESENTATIVE. COMPACTION SHALL COMPLY WITH THE REQUIREMENTS OF THE ENGINEER.

6. ALL CUT AND FILL SLOPES SHALL BE PROTECTED UNTIL EFFECTIVE EROSION CONTROL HAS BEEN ESTABLISHED.

7. THE USE OF POTABLE WATER WITHOUT A SPECIAL PERMIT FOR BUILDING OR CONSTRUCTION PURPOSES INCLUDING CONSOLIDATION OF BACKFILL OR DUST CONTROL IS PROHIBITED. THE CONTRACTOR SHALL OBTAIN ALL NECESSARY PERMITS FOR CONSTRUCTION WATER.

8. THE CONTRACTOR SHALL MAINTAIN THE STREETS, SIDEWALKS AND ALL OTHER PUBLIC RIGHT- OF-WAY IN A CLEAN, SAFE AND USABLE CONDITION. ALL SPILLS OF SOIL, ROCK OR CONSTRUCTION DEBRIS SHALL BE PROMPTLY REMOVED FROM THE PUBLICLY OWNED PROPERTY DURING CONSTRUCTION AND UPON COMPLETION OF THE PROJECT. ALL ADJACENT PROPERTY, PRIVATE OR PUBLIC SHALL BE MAINTAINED IN A CLEAN, SAFE AND USABLE CONDITION.

9. IN THE EVENT THAT ANY TEMPORARY CONSTRUCTION ITEM IS REQUIRED THAT IS NOT SHOWN ON THESE DRAWINGS, SUCH ITEM SHALL BE PROVIDED, AS DIRECTED BY THE CITY ENGINEER, AT NO EXPENSE TO THE CITY OF LAS VEGAS. TEMPORARY CONSTRUCTION INCLUDES DITCHES, BERMS, ROAD SIGNS AND BARRICADES, ETC.

REVISED JULY 2008 (CPM VERSION)

CITY OF LAS VEGAS TRAFFIC NOTES

1. ALL CONSTRUCTION SIGNING, BARRICADING, AND TRAFFIC DELINEATION SHALL CONFORM TO THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES", LATEST EDITION.

2. THE STREET SIGN CONTRACTOR SHALL OBTAIN STREET NAMES AND BLOCK NUMBERING FROM THE PLANNING DEPARTMENT PRIOR TO CONSTRUCTION.

3. BEFORE ANY WORK IS STARTED IN THE RIGHT-OF-WAY, THE CONTRACTOR SHALL INSTALL ALL ADVANCE WARNING SIGNS FOR THE CONSTRUCTION ZONE. THE CONTRACTOR SHALL INSTALL TEMPORARY STOP SIGNS AT ALL NEW STREET ENCROACHMENTS INTO EXISTING CITY STREETS WHERE WARRANTED IMMEDIATELY AFTER FIRST GRADING WORK IS ACCOMPLISHED, AND SHALL MAINTAIN SAID SIGNS UNTIL PERMANENT SIGNS ARE INSTALLED.

4. WHEN A DESIGNATED "SUGGESTED ROUTE TO SCHOOL" IS ENCROACHED UPON BY A CONSTRUCTION WORK ZONE AND PUBLIC WORKS STAFF IDENTIFIES A NEED FOR STUDENTS TO BE ASSISTED IN THE SAFE CROSSING THROUGH THAT WORK ZONE, THE CONTRACTOR SHALL BE REQUIRED TO PROVIDE A QUALIFIED "CROSSING GUARD". THE GUARD SHALL BE PRESENT FOR THE FULL DURATION OF TIME THAT CHILDREN ARE LIKELY TO BE PRESENT.

5. IF THE IMPROVEMENTS NECESSITATE THE OBLITERATION, TEMPORARY OBSTRUCTION, TEMPORARY REMOVAL OR RELOCATION OF ANY EXISTING TRAFFIC PAVEMENT MARKING, SUCH PAVEMENT MARKING SHALL BE RESTORED OR REPLACED WITH LIKE MATERIALS TO THE SATISFACTION OF THE CITY TRAFFIC ENGINEER.

6. THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROVIDING AND INSTALLING ALL PERMANENT SIGNS SHOWN ON THE PLANS. ALL NEW TRAFFIC SIGNS SHALL UTILIZE TYPE XI RETROREFLECTIVE SHEETING IN ACCORDANCE WITH CCAUSS 627 AND 716 AND SHALL HAVE AN ANTI-GRAFFITI PROTECTIVE OVERLAY FILM THAT IS A MATCHING COMPONENT TO, AND OF THE SAME MANUFACTURER AS THE RETROREFLECTIVE SHEETING TO WHICH IT IS APPLIED. STREET NAME SIGNS SHALL CONFORM IN THEIR ENTIRETY TO CURRENT CITY STANDARDS. ALL OTHER SIGNS SHALL BE STANDARD SIZE UNLESS OTHERWISE SPECIFIED ON THE PLANS. ALL SIGN POSTS SHALL BE INSTALLED IN ACCORDANCE WITH THE CURRENT CITY STANDARDS.

7. WHEN A PROPOSED STREET LIGHT STANDARD IS LOCATED WITHIN FIVE (5') FEET OF ANY PROPOSED SIGN SHOWN ON THE PLANS TO BE MOUNTED ON A SIGNPOST, THE SIGN SHALL BE MOUNTED ON THE STREET LIGHT STANDARD AND THE SIGNPOST SHALL BE ELIMINATED.

8. ALL PERMANENT TRAFFIC CONTROL DEVICES CALLED FOR HEREON SHALL BE IN PLACE AND IN FINAL POSITION PRIOR TO ALLOWING ANY PUBLIC TRAFFIC ONTO THE PORTIONS OF THE ROAD(S) BEING IMPROVED HERE UNDER, REGARDLESS OF THE STATUS OF COMPLETION OF PAVING OR OTHER OFF-SITE IMPROVEMENTS CALLED FOR BY THESE PLANS.

9. STREET SIGNS AND STOP SIGNS SHALL BE INSTALLED PER CITY STANDARD SPECIFICATIONS FOR PLACEMENT OF STREET NAME SIGNS.

10. THE CONTRACTOR SHALL PROVIDE ALL NECESSARY TRAFFIC CONTROL DEVICES AND FLAGGERS TO INSURE THE SAFETY OF THE PUBLIC IN OR AROUND THE WORK AREA. THE CONTRACTOR SHALL HAVE A CERTIFIED ATSSA TRAFFIC CONTROL TECHNICIAN OR IMSA WORK ZONE SAFETY SPECIALIST SET UP, MAINTAIN AND/OR REMOVE ALL TRAFFIC CONTROL DEVICES IN THE CITY OF LAS VEGAS RIGHT OF WAY.

11. WORK IN PUBLIC STREETS, ONCE BEGUN, SHALL BE EXPEDITED TO COMPLETION SO AS TO PROVIDE MINIMUM INCONVENIENCE TO ADJACENT PROPERTY OWNERS AND TO THE TRAVELING PUBLIC.

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR NOTIFYING RTC TRANSIT IF THE CONSTRUCTION INTERRUPTS OR RELOCATES A BUS STOP OR HAS AN ADVERSE EFFECT ON BUS SERVICE ON THAT STREET TO ARRANGE FOR TEMPORARY RELOCATION OF STOP.

13. GUARDS SHALL BE OBTAINED BY CONTACTING THE METROPOLITAN POLICE DEPARTMENT SPECIAL EVENTS UNIT (PHONE # 828-3442) WHO WILL PROVIDE OFFICERS PROPERLY TRAINED IN TRAFFIC CONTROL. FEES FOR THE USE OF THESE OFFICERS SHALL BE SET BY METRO AND WILL BE PAID BY THE CONTRACTOR. THE CONTRACTOR IS RESPONSIBLE FOR ALL ARRANGEMENTS WITH METRO.

14. ANY WORK WITHIN 300' OF A SIGNALIZED INTERSECTION WILL BE NIGHT WORK, UNLESS DIRECTED BY THE CITY OF LAS VEGAS TRAFFIC ENGINEER.

15. THE CONTRACTOR SHALL CONTACT THE TRAFFIC ENGINEERING DIVISION (TRANSPORTATION SECTION) THROUGH THE PROJECT'S OFFSITE INSPECTOR PRIOR TO INITIATING PAVING TO RECEIVE DIRECTION FOR ANY PERMANENT OR TEMPORARY MODIFICATIONS TO THE APPROVED DRAWINGS REGARDING FINAL PAVEMENT TRANSITIONS, MARKINGS AND SIGNING THAT ARE REQUIRED TO MATCH ADJACENT ROADWAY SEGMENTS. THE CONTRACTOR SHALL PROVIDE A DRAWING FOR APPROVAL BY THE TRAFFIC ENGINEERING DIVISION DEPICTING ANY ADJUSTMENTS TO THE FINAL PAVEMENT MARKINGS AND TRAFFIC CONTROL SIGNS SUCH THAT ADEQUATE TRANSITIONS AND LANE TERMINATIONS BETWEEN ADJACENT ROADWAY SEGMENTS ARE CONSTRUCTED.

REVISED JULY 13, 2013

CITY OF LAS VEGAS SEWER NOTES

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE DESIGN AND CONSTRUCTION STANDARDS FOR WASTEWATER COLLECTION SYSTEMS AND THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS' CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA, AS AMENDED. IT WILL BE THE RESPONSIBILITY OF THE CONTRACTOR TO BE AWARE OF THE CONTENTS OF THE ABOVE SPECIFICATIONS.

2. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO PERFORM CONSTRUCTION AS PER PLANS. ANY ADDITIONS, DELETIONS, OR CHANGES SHALL FIRST MEET WITH THE APPROVAL OF THE CITY PLANNING ENGINEER.

3. CHISEL "S" OR "G" IN CURBS WHERE SEWER OR GAS LATERALS PASS UNDER THE CURB.

4. POLYVINYL (PVC) SEWER PIPE SHALL MEET ASTM D-3034 SDR 35 SPECIFICATIONS, INSTALLED WITH SAND BEDDING AND BACKFILL OF TYPE II AGGREGATE BASE.

5. ALL MANHOLES PAVED IN STREETS EIGHTY (80') FOOT R/W AND LARGER SHALL HAVE CONCRETE COLLARS. STREETS LESS THAN EIGHTY (80') FOOT R/W WILL REQUIRE RETROFIT IF PAVING DOES NOT CONFORM TO CITY STANDARDS AT THE MANHOLE.

6. TEE SADDLES SHALL BE USED TO CONNECT SEWER LATERALS TO EXISTING MAIN LINES UP TO TWELVE INCH (12") DIAMETER. CONNECTIONS TO FIFTEEN INCH (15") OR LARGER MAINS SHALL REQUIRE SPECIAL PROCEDURES. IN LINE "Y" S SHALL BE USED ON LINES TWELVE INCHES (12") OR ABOVE.

7. WATER MAINS SHALL BE PROTECTED IN ACCORDANCE WITH LVVWD STANDARDS WHENEVER A SEWER MAIN CROSSES OVER A WATER MAIN OR THE SEWER IS LESS THAN EIGHTEEN INCH (18") UNDER A WATER MAIN.

8. ALL CONTRACTORS INSTALLING SEWER MAINS THAT WILL BE UNDER THE JURISDICTION OF THE CITY OF LAS VEGAS MUST BE STATE OF NEVADA CLASS "A" CONTRACTORS.

9. THE CITY OF LAS VEGAS WILL NOT ACCEPT ANY SEWER MAINS WHICH HAVE A VERTICAL DEFLECTION OF MORE THAN ONE TENTH (0.1) OF A FOOT FROM THE APPROVED CONSTRUCTION PLANS AT ANY LOCATION. SEWER MAINS FOUND TO EXCEED THIS TOLERANCE WILL HAVE TO BE REPAIRED OR REMOVED OR REPLACED TO THE SATISFACTION OF THE CITY PLANNING ENGINEER PRIOR TO ACCEPTANCE BY THE CITY OF LAS VEGAS.

10. INSTALLATION OF CURVED SEWERS REQUIRES THE USE OF C-900 PVC PIPE WHICH ALLOWS FOR PIPE DEFLECTION AT THE JOINTS.

REVISED JANUARY 2008

LVVWD STANDARD NOTES

LVVWD PROJECT # 123945

1. NO WORK SHALL BEGIN UNTIL THE WATER PLANS HAVE BEEN APPROVED FOR CONSTRUCTION BY THE LVVWD. FOLLOWING WATER PLAN APPROVAL, NOTICE SHALL BE GIVEN TO THE LVVWD COMMUNICATION SUPPORT CENTER (258-7171) TWO (2) WORKING DAYS PRIOR TO THE START OF CONSTRUCTION. FOR FUTURE INSPECTIONS, NOTICE MUST BE GIVEN BY 2:00 P.M. THE BUSINESS DAY PRIOR TO THE REQUESTED LVVWD INSPECTION. WHEN REQUESTING INSPECTIONS, PLEASE REFER TO THE PROJECT# IDENTIFIED ABOVE.

2. ALL WORK SHALL CONFORM TO LVVWD STANDARD PLATES, DRAWINGS, AND SPECIFICATIONS, AND TO THE 2010 EDITION OF THE UNIFORM DESIGN AND CONSTRUCTION STANDARDS FOR POTABLE WATER SYSTEMS (UDACS). THE LATEST EDITION OF UDACS SHALL SUPERSEDE ANY CONFLICTS CONTAINED IN THE APPROVED DRAWINGS AND/OR SPECIFICATIONS.

3. ALL WORK, EXCEPT AS MODIFIED BY THESE PLANS OR BY NOTE 2 ABOVE, SHALL BE DONE IN ACCORDANCE WITH THE MOST RECENT DRAFT OR EDITION OF THE UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION OFFSITE IMPROVEMENT, CLARK COUNTY AREA.

4. A SINGLE PIPE MATERIAL SHALL BE USED THROUGHOUT THE PROJECT UNLESS OTHERWISE APPROVED BY THE LVVWD.

5. ALL SERVICE LATERALS TWO (2) INCHES IN DIAMETER AND SMALLER SHALL BE TYPE K COPPER TUBING WITH LVVWD APPROVED SERVICE SADDLES.

6. ALL WATER METER BOXES SHALL BE LOCATED OUTSIDE OF DRIVEWAY AREAS.

7. ALL VALVES SHALL BE LOCATED OUTSIDE OF DRIVEWAYS, VALLEY AND CURB GUTTERS.

8. ALL WATER AND STORM DRAIN OR SANITARY SEWER CROSSINGS SHALL CONFORM TO SECTION 2.22 OF THE 2010 EDITION OF THE UDACS.

9. ALL WATER FACILITIES SHALL BE FILLED, DISINFECTED, PRESSURE TESTED, FLUSHED, FILLED AND AN ACCEPTABLE WATER SAMPLE OBTAINED, PRIOR TO CONNECTION TO THE LVVWD DISTRIBUTION SYSTEM.

10. THE CONTRACTOR MUST OBTAIN ALL METERS TWO (2) INCHES AND SMALLER FROM LVVWD CENTRAL STORES. TELEPHONE 258-3152 OR 258-3802, TWO (2) WORKING DAYS PRIOR TO METER PICKUP.

11. ANY INTERRUPTION OF SERVICE MUST BE PERFORMED IN ACCORDANCE WITH UDACS SECTION 3.14.01, AND APPROVED BY THE LVVWD INSPECTION DIVISION PRIOR TO SHUTDOWN. PROPER WRITTEN NOTIFICATION MUST BE GIVEN TO ALL AFFECTED CUSTOMERS.

12. ALL WATER FACILITY CONSTRUCTION MATERIALS USED MUST BE AS LISTED ON THE LVVWD PRE-APPROVED MATERIALS AND MANUFACTURER'S LISTING FOR NEW FACILITIES, LATEST REVISION, OR SPECIFICALLY APPROVED ON THESE PLANS.

13. TELEPHONE "CALL BEFORE YOU DIG" AT "811" OR 1-800-227-2600

14. THE INSTALLATION OF LAS VEGAS VALLEY WATER DISTRICT (LVVWD) MUNICIPAL WATER FACILITIES WITHIN ALL STREETS IS ASSUMED TO BE IN COMPLIANCE WITH THE UNIFORM STANDARDS, INCLUDING THE PLACEMENT OF ASPHALT PAVING STREET SURFACES. ANY REPAIR WORK DONE BY THE LVVWD TO THE MUNICIPAL FACILITIES WILL INCLUDE THE PLACEMENT OF ANY APPROPRIATELY SIZED ASPHALT REPAIR PATCH ON THE STREET SURFACE.

ANY DECORATIVE PAVING SURFACE WITHIN THE STREET IS THE RESPONSIBILITY OF THE OWNER'S ASSOCIATION, OR THE INDIVIDUAL PROPERTY OWNERS IF NO OWNER'S ASSOCIATION IS IN EXISTENCE, OR THE AGENCY HAVING JURISDICTION. DECORATIVE SURFACE MATERIALS PLACED WITHIN THE TEN FOOT EASEMENT ABUTTING A PUBLIC OR PRIVATE STREET, IF DISTURBED BY THE LVVWD DURING THE REPAIR OR OPERATION OF ITS FACILITIES, WILL BE REPLACED BY LVVWD WITH AN APPROPRIATELY SIZED PLAIN FINISH CONCRETE PATCH. THE LVVWD WILL NOT RESTORE, AND WILL NOT BE RESPONSIBLE FOR THE RESTORATION OF, ANY DECORATIVE PAVING SURFACE WITHIN THE STREET. THE LVVWD WILL NOT ATTEMPT TO MATCH COLOR OR FINISH OF ANY ADJACENT MATERIALS.

APPROVED FOR CONSTRUCTION	
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER	
DATE:	PROJECT# 123945

CITY OF LAS VEGAS STREET LIGHT NOTES

1. ALL STREET LIGHTING INSTALLATIONS SHALL BE IN ACCORDANCE WITH THE STREET LIGHTING PLANS, THE "UNIFORM STANDARD SPECIFICATION FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA", LATEST REVISION, AND THE "UNIFORM STANDARD DRAWINGS FOR PUBLIC WORKS CONSTRUCTION OFF-SITE IMPROVEMENTS, CLARK COUNTY AREA, NEVADA", LATEST REVISION.

2. NO DEVIATION OF STREET LIGHT, PULL BOX, CONDUITS (ETC.) LOCATIONS SHALL BE PERMITTED WITHOUT WRITTEN APPROVAL OF THE TRAFFIC AND CITY ENGINEER. ANY DEVIATION FROM THE PLAN LOCATION WILL REQUIRE COMPLIANCE WITH SECTION 623 OF THE SPECIFICATIONS.

3. ALL EXISTING STREET LIGHTING SHALL REMAIN OPERATIONAL DURING CONSTRUCTION.

4. ALL EMPTY CONDUIT SHALL HAVE PULL STRINGS AND A #8 AWG TRACER WIRE INSTALLED PER SECTION 623 G.02.01 OF THE SPECIFICATIONS PRIOR TO BACKFILLING AND FINAL INSPECTION.

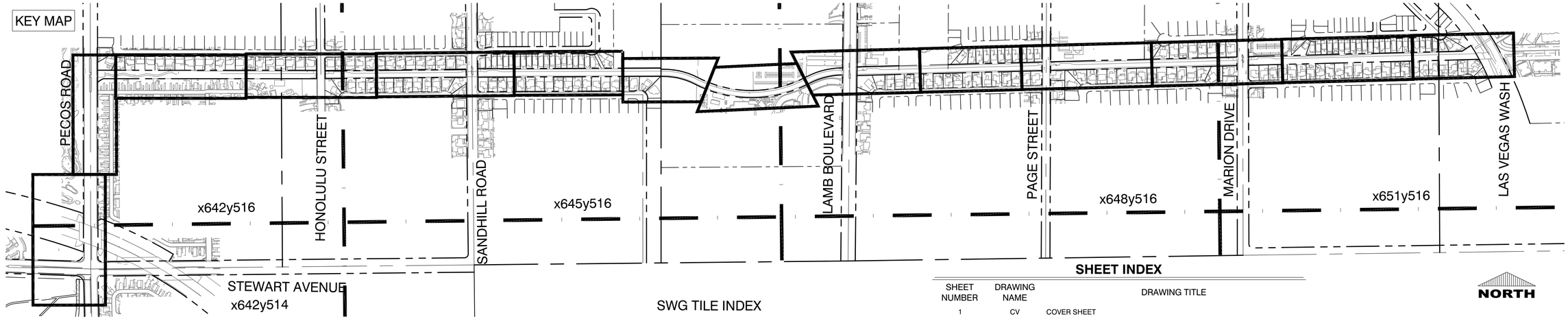
5. ANY STRUCTURE SUCH AS BLOCK WALLS, CHAIN LINK FENCES, RETAINING WALLS, ETC., SHALL LEAVE A MINIMUM CLEARANCE IN COMPLIANCE WITH USD NO. 320A WHEN POLE IS INSTALLED BEHIND SIDEWALK, AND SHALL AT NO TIME COMPLETELY ENCLOSE THE STREET LIGHTING POLE.

6. AS-BUILT DRAWINGS SHALL BE SUPPLIED TO THE TRAFFIC ENGINEERING DIVISION PRIOR TO ANY PRE-FINAL INSPECTION. THE AS-BUILT DRAWING NEEDS TO BE STAMPED AS-BUILT AND SIGNED BY THE PREPARER.

7. SERVICE POINTS SHALL BE COORDINATED WITH NV ENERGY, AND WHEREVER POSSIBLE, BE LOCATED NEAR THE CENTER OF THE CIRCUIT OR AS SHOWN ON THE PLANS.

8.

KEY MAP



SWG TILE INDEX

CITY OF LAS VEGAS FIRE AND RESCUE NOTES

1. ALL WORK SHALL BE DONE IN STRICT ACCORDANCE WITH THE LAS VEGAS FIRE AND RESCUE ADOPTED FIRE CODE ORDINANCE #6124 FOR HYDRANT SPECIFICATIONS AND HYDRANT INSTALLATION SPECIFICATIONS.
2. AUTHORIZED FIRE HYDRANTS ARE AS FOLLOWS;
   KENNEDY - GUARDIAN MODELS K81A AND K81D
   MUELLER - SUPER CENTURION 250, MODEL A-423
   CLOW - MEDALLION MODEL F-2546LVD
   TROY VALVE - PATRIOT MODEL PT8100N, NEVADA HYDRANT
   U.S.PIPE - METROFLOW/M-03
3. A PERMIT IS REQUIRED FROM LAS VEGAS FIRE AND RESCUE FOR THE INSTALLATION OF ON-SITE WATER LINES AND FIRE HYDRANTS. THE PERMIT AND CONTRACTORS MATERIAL TEST CERTIFICATE FOR UNDERGROUND PIPING FORM SHALL BE OBTAINED FROM THE FIRE PROTECTION ENGINEER BEFORE COMMENCEMENT OF WORK. IFC § 105.7.11
4. ON ANY RESIDENTIAL OR COMMERCIAL INSTALLATIONS, FIRE HYDRANTS SHALL BE INSTALLED AND FIRE APPARATUS ACCESS ROADS SHALL BE MAINTAINED BEFORE COMMENCEMENT OF ANY COMBUSTIBLE CONSTRUCTION. ALL FIRE HYDRANTS SHALL BE IN GOOD WORKING ORDER AND SHALL BE CAPABLE OF DELIVERING THE REQUIRED FIRE FLOW. IFC § 1412.
5. TO IDENTIFY THE FIRE HYDRANT LOCATIONS, THE CONTRACTOR SHALL PLACE A BLUE REFLECTIVE MARKER AT THE CENTER LINE OF THE STREET ADJACENT TO THE FIRE HYDRANTS. IFC § 507.5.7.3
6. ALL UNDERGROUND INSPECTIONS, PRESSURE AND FLUSH VERIFICATIONS OF ALL FIRE HYDRANTS AND FIRE LINES, SHALL BE CONDUCTED BEFORE COVERING THE LINES. CENTER LOADING IS ACCEPTABLE FOR THE HYDRO TESTS WITH PRIOR FIRE PREVENTION APPROVAL
7. ALL ON-SITE UNDERGROUND WATER MAINS AND MATERIALS SHALL BE U.L. LISTED, A.W.W.A APPROVED AND SHALL BE RATED FOR THE APPROPRIATE WORKING PRESSURE. IFC § 507.2.1, NFPA 24
8. PAINTING OF CURBS, FIRE HYDRANTS, PADS, PROTECTION OF FIRE HYDRANTS FROM PHYSICAL DAMAGE, AND ALL OTHER WORK NECESSARY PER PLANS SHALL BE COMPLETED BEFORE APPROVAL BY LAS VEGAS FIRE AND RESCUE, FIRE PREVENTION DIVISION. IFC § 507; 507.5.7
9. PRIVATE HYDRANTS SHALL BE PAINTED RED. IFC § 507.5.7.1
10. PREVENTION DIVISION TO VERIFY AVAILABILITY OF THE REQUIRED FIRE FLOW. IFC § 507; 507.1
11. FIRE HYDRANT SPACING SHALL BE AS FOLLOWS: IFC § C102
    RESIDENTIAL - 500 FT UNSPRINKLERED; 600 FT SPRINKLERED.
    COMMERCIAL - 300 FT UNSPRINKLERED; 400 FT SPRINKLERED.
12. WHERE THE WATER MAINS ARE EXTENDED ALONG STREETS OR NEW STREETS ARE INSTALLED WHERE FIRE HYDRANTS ARE NOT NEEDED FOR PROTECTION OF THE STRUCTURES, FIRE HYDRANTS SHALL BE INSTALLED AT A MAXIMUM OF 1000 FT SPACING, TO PROVIDE FOR TRANSPORTATION HAZARDS. WHERE STREETS ARE PROVIDED WITH MEDIAN DIVIDERS OR HAVE FOUR (4) OR MORE TRAFFIC LANES AND HAVE A TRAFFIC COUNT OF MORE THAN 30,000 PER DAY, HYDRANTS ARE REQUIRED ON EACH SIDE OF THE STREET SPACED AT 500 FT ON AN ALTERNATING BASIS. IFC § C102.14
13. NO FIRE HYDRANTS SHALL BE LOCATED WITHIN THE RADIUS OF A CUL-DE-SAC OR WITHIN 20 FT OF THE PERIMETER OF THE RADIUS OF THE CUL-DE-SAC.
14. NO FIRE HYDRANTS SHALL BE LOCATED WITHIN 6 FT OF ANY CURB RETURN, DRIVEWAY, POWER POLE, STREETLIGHT OR ANY OTHER OBSTRUCTION. IFC § C102.12
15. A MAXIMUM DISTANCE FROM A FIRE HYDRANT TO A ONE-TWO FAMILY DWELLING SHALL NOT EXCEED 300 FT, AS MEASURED BY AN APPROVED ROUTE. IFC § 102.4
16. THE MAXIMUM DISTANCE FROM A FIRE HYDRANT TO A FIRE DEPARTMENT CONNECTION (FDC) SHALL NOT EXCEED 100 FT, AS MEASURED BY AN APPROVED ROUTE. IFC § C102.7
17. THE MAXIMUM DISTANCE FROM A HYDRANT TO THE END OF A DEAD-END STREET SHALL NOT EXCEED 200 FT. IFC § C102.6
18. TWO (2) SOURCES OF SUPPLY ARE REQUIRED WHENEVER THERE IS 4 OR MORE FIRE HYDRANTS/SPRINKLER LEAD-INS ARE INSTALLED ON A SINGLE SYSTEM. SECTIONAL CONTROL VALVES SHALL BE INSTALLED SO THAT NO MORE THAN 2 FIRE HYDRANTS CAN BE OUT OF SERVICE DUE TO A BREAK IN A WATER MAIN. IFC § C104.1
19. ALL FIRE APPARATUS ACCESS ROADS SHALL BE PAVED TO PROVIDE ALL-WEATHER DRIVING CAPABILITIES, AND SHALL BE DESIGNED AND MAINTAINED TO SUPPORT THE IMPOSED LOADS OF THE FIRE APPARATUS. IFC § 503.2.3
20. THE GRADIENT FOR THE FIRE APPARATUS ACCESS ROADS SHALL NOT EXCEED 12%. ANGLES OF APPROACH AND ANGLES OF DEPARTURE SHALL NOT EXCEED 6% FOR 25 FT PRIOR TO OR AFTER THE GRADE CHANGE. ADJACENT TO THE STRUCTURES GRADIENT SHALL NOT EXCEED 6%. IFC § 503.2.7; 503.2.8
21. THE TURNING RADIUS OF THE FIRE APPARATUS ACCESS ROADS SHALL BE NO LESS THAN 52 FT OUTSIDE AND 28 FT INSIDE TURNING RADIUS. IFC § 503.2.4
22. VERTICAL CLEARANCE OF ALL FIRE APPARATUS ACCESS ROADS SHALL NOT BE LESS THAN 13FT 6 INS. IFC § 503.2.1.1
23. FIRE DEPARTMENT ACCESS ROADS IN ALL RESIDENTIAL DEVELOPMENTS (EXCEPT APARTMENT BUILDINGS) SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF NOT LESS THAN 36 FT FLOW LINE TO FLOW LINE (THIS WIDTH MAY BE REDUCED TO 24 FT IF ALL BUILDINGS FRONTING THE STREET ARE SPRINKLERED) FOR MAIN RESIDENTIAL STREETS, WITH PARKING PERMITTED ON BOTH SIDES OF THE STREET. PRIVATE DRIVE AISLES, DRIVEWAYS, ETC. SHALL BE ALLOWED TO BE REDUCED TO A MINIMUM WIDTH OF 24 FT FLOW LINE TO FLOW LINE WHEN SERVING NO MORE THE 6 RESIDENTS, AND WHEN ON STREET PARKING IS DISALLOWED. IFC § 503.2.1; 503.2.11
24. ALL FIRE APPARATUS ACCESS ROADS IN COMMERCIAL DEVELOPMENTS AND APARTMENT COMPLEXES SHALL HAVE A MINIMUM UNOBSTRUCTED WIDTH OF NOT LESS THAN 24 FT (FLOW LINE TO FLOW LINE), PROVIDED NO PARKING IS ALLOWED ON EITHER SIDE; 32 FT (FLOW LINE TO FLOW LINE), WITH PARALLEL PARKING ON ONE SIDE. AND 36 FT (FLOW LINE TO FLOW LINE), IF PARALLEL PARKING IS ALLOWED ON BOTH SIDES. THESE WIDTHS MAY BE REDUCED TO 24 FT IF SPRINKLERED. IFC § 503.2.1.1
25. A FIRE APPARATUS ACCESS ROAD SHALL BE REQUIRED WHEN ANY PORTION OF AN EXTERIOR WALL OF THE FIRST STORY IS LOCATED MORE THAN 150 FT FROM A FIRE DEPARTMENT VEHICLE ACCESS. THIS DISTANCE COULD BE INCREASED TO 250 FT IF THE BUILDING IS SPRINKLERED. IFC § 503.1.1; 503.11
26. APPROVED SECONDARY FIRE APPARATUS ACCESS SHALL BE PROVIDED FOR 100 OR MORE DWELLING UNITS, ROAD(S) WITH DEAD-ENDS OR WITH A SINGLE POINT OF ACCESS IN EXCESS OF 600 FT, AND FOR ALL COMMERCIAL, INDUSTRIAL, AND MULTI-FAMILY RESIDENTIAL DEVELOPMENTS. IFC § 503.1.2
27. ALL DEAD-END FIRE APPARATUS ROADS AND/OR FIRE LANES, PUBLIC OR PRIVATE, IN EXCESS OF 150 FT IN LENGTH SHALL BE PROVIDED WITH AN APPROVED TURN AROUND HAVING A MINIMUM DIAMETER OF 81 FT. IFC § 503.2.5
28. ALL FIRE APPARATUS ACCESS ROADS SHALL BE MARKED BY PLACING APPROVED SIGNS AT THE START OF THE DESIGNATED FIRE LANE, ONE SIGN AT THE END OF THE FIRE LANE AND WITH SIGNS AT INTERVALS OF 100 FT ALONG THE DESIGNATED FIRE LANES. SIGNS TO BE PLACED ON BOTH SIDES OF AN ACCESS ROADWAY IF NEEDED TO PREVENT PARKING ON EITHER SIDE. SIGNS TO BE INSTALLED NO HIGHER THAN 10 FT OR LESS THAN 6 FT FROM THE ROADWAY LEVEL. THE CURB ALONG OR ON THE PAVEMENT OR CEMENT (IF NO CURB IS PROVIDED) SHALL BE PAINTED WITH A RED WEATHER RESISTANT PAINT IN ADDITION TO THE SIGNS. IFC § 503.3
29. ELECTRICALLY CONTROLLED ACCESS GATES SHALL BE PROVIDED WITH AN APPROVED EMERGENCY VEHICLE DETECTOR/RECEIVER SYSTEM. SAID SYSTEM SHALL BE INSTALLED IN ACCORDANCE WITH THE CITY OF LAS VEGAS GUIDELINES FOR AUTOMATIC EMERGENCY VEHICLE ACCESS GATES. IFC § 503.6

REVISED FEBRUARY 1, 2011

SHEET INDEX

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2	GN01	GENERAL NOTES, LEGEND, VICINTIY	MAP & ABBREVITATIONS
3	GN02	GENERAL NOTES & SHEET INDEX	
4	SC01	SURVEY CONTROL PLAN	
5	SC02	SURVEY CONTROL PLAN	
6	HC01	HORIZONAL CONTROL PLAN	
7	HC02	HORIZONAL CONTROL PLAN	POINT, LINE & CURVE TABLES
8	SU01	EXISTING UTILITIES LOCATION PLAN	"SD01" 10+00 TO "SD01" 19+00
9	SU02	EXISTING UTILITIES LOCATION PLAN	"SD01" 19+00 TO "SD01" 36+00
10	SU03	EXISTING UTILITIES LOCATION PLAN	"SD01" 36+00 TO "SD01" 54+50
11	SU04	EXISTING UTILITIES LOCATION PLAN	"SD01" 54+50 TO "SD01" 66+00
12	SU05	EXISTING UTILITIES LOCATION PLAN	"SD01" 66+00 TO "SD01" 83+00
13	SU06	EXISTING UTILITIES LOCATION PLAN	"SD01" 83+00 TO "SD01" 99+00
14	SU07	EXISTING UTILITIES LOCATION PLAN	"SD01" 99+00 TO "SD01" 117+00
15	SU08	EXISTING UTILITIES LOCATION PLAN	"SD01" 117+00 TO "SD01" 123+00
16	DR01	REMOVAL PLAN	"SD01" 10+00 TO "SD01" 19+00
17	DR02	REMOVAL PLAN	"SD01" 19+00 TO "SD01" 36+00
18	DR03	REMOVAL PLAN	"SD01" 36+00 TO "SD01" 54+50
19	DR04	REMOVAL PLAN	"SD01" 54+50 TO "SD01" 66+00
20	DR05	REMOVAL PLAN	"SD01" 66+00 TO "SD01" 83+00
21	DR06	REMOVAL PLAN	"SD01" 83+00 TO "SD01" 99+00
22	DR07	REMOVAL PLAN	"SD01" 99+00 TO "SD01" 117+00
23	DR08	REMOVAL PLAN	"SD01" 117+00 TO "SD01" 123+00
24	SD01	STORM DRAIN PLAN AND PROFILE	"SD01" 10+00 TO "SD01" 19+00
25	SD02	STORM DRAIN PLAN AND PROFILE	"SD01" 19+00 TO "SD01" 27+00
26	SD03	STORM DRAIN PLAN AND PROFILE	"SD01" 27+00 TO "SD01" 36+00
27	SD04	STORM DRAIN PLAN AND PROFILE	"SD01" 36+00 TO "SD01" 45+00
28	SD05	STORM DRAIN PLAN AND PROFILE	"SD01" 45+00 TO "SD01" 54+50
29	SD06	STORM DRAIN PLAN AND PROFILE	"SD01" 54+50 TO "SD01" 62+00
30	SD07	STORM DRAIN PLAN AND PROFILE	"SD01" 62+00 TO "SD01" 68+00
31	SD08	STORM DRAIN PLAN AND PROFILE	"SD01" 68+00 TO "SD01" 75+00
32	SD09	STORM DRAIN PLAN AND PROFILE	"SD01" 75+00 TO "SD01" 83+00
33	SD10	STORM DRAIN PLAN AND PROFILE	"SD01" 83+00 TO "SD01" 90+00
34	SD11	STORM DRAIN PLAN AND PROFILE	"SD01" 90+00 TO "SD01" 99+00
35	SD12	STORM DRAIN PLAN AND PROFILE	"SD01" 99+00 TO "SD01" 108+00
36	SD13	STORM DRAIN PLAN AND PROFILE	"SD01" 108+00 TO "SD01" 117+00
37	SD14	STORM DRAIN PLAN AND PROFILE	"SD01" 117+00 TO "SD01" 123+00
38	SD15	STORM DRAIN LATERAL	PLAN AND PROFILE
39	SD16	STORM LATERAL DRAIN	PLAN AND PROFILE
40	SD17	STORM DRAIN DETAILS	
41	SD18	STORM DRAIN DETAILS	
42	SD19	STORM DRAIN DETAILS	
43	TY01	CHANNEL TYPICAL SECTIONS	
44	TY02	CHANNEL TYPICAL SECTIONS	
45	RD01	ROADWAY PLAN	"SD01" 10+00 TO "SD01" 19+00
46	RD02	ROADWAY PLAN	"SD01" 19+00 TO "SD01" 27+00
47	RD03	ROADWAY DETAILS	
48	SM01	SIGNING AND STRIPING PLAN	"SD01" 10+00 TO "SD01" 19+00
49	SM02	SIGNING AND STRIPING PLAN	"SD01" 19+00 TO "SD01" 27+00
50	SS01	SANITARY SEWER	RELOCATION PLAN
51	WT01	WATER RELOCATION	PLAN
52	TC01	DETOUR PLAN 1	
53	TC02	DETROU PLAN 2	
54	ST01	GENERAL STRUCTURAL NOTES	AND DETAILS
55	ST02	STRUCTURAL DETAILS	

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

REVISIONS

NO.	DATE

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866 | BID# XX.XXXX | DESIGNED BY: KRM | DRAWN BY: MM | CHECKED BY: HBD

DATE: 11/18/2016

SUBMITTAL STAGE:
70% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
GENERAL NOTES & SHEET INDEX

PROFESSIONAL ENGINEER — KONDAL RAO VARMI — EXP. 6-30-17 — CIVIL — No. 19685 — STATE OF NEVADA
NOT FOR CONSTRUCTION

SHEET
GN02
3 OF 55

DRAWING NO.
XXX-XXXX

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BASIS OF BEARING

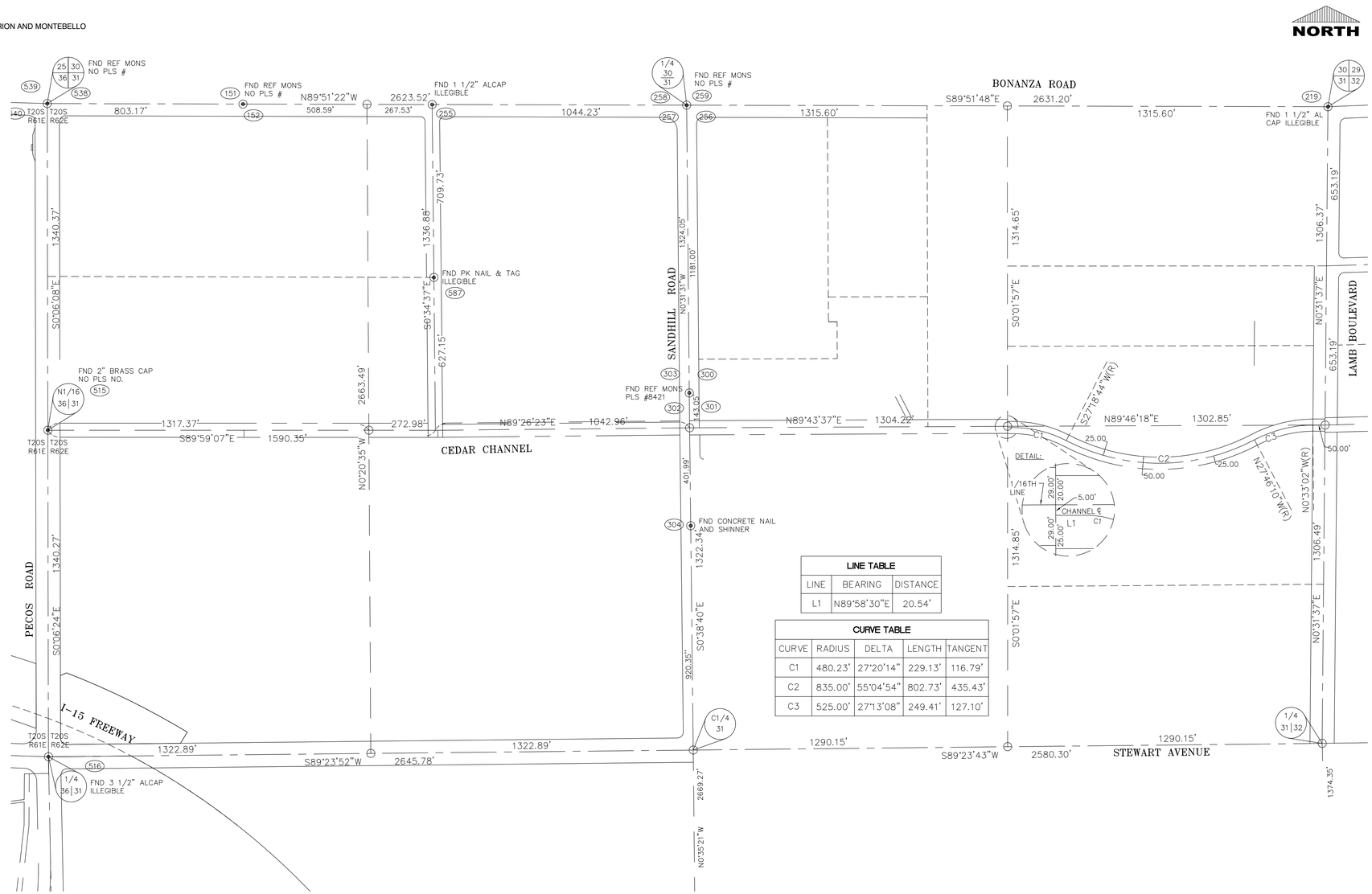
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
RIVET & PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION = 536.414 METERS
= 1759.89 FEET

HORIZONTAL CONTROL PLANS ARE BASED ON RECORD OF SURVEY AS RECORDED BY ATKINS FILE 196, PAGE 33.



LINE TABLE		
LINE	BEARING	DISTANCE
L1	N89°58'30"E	20.54'

CURVE TABLE				
CURVE	RADIUS	DELTA	LENGTH	TANGENT
C1	480.23'	27°20'14"	229.13'	116.79'
C2	835.00'	55°04'54"	802.73'	435.43'
C3	525.00'	27°13'08"	249.41'	127.10'

LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED

GRAPHIC SCALE
250 0 125 250 500
(IN FEET)

NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866	BID# XX.XXXX
DATE: 11/18/2016	DESIGNED BY: TH
SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM
	CHECKED BY: EC

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
SURVEY CONTROL PLAN

NOT FOR CONSTRUCTION
PROFESSIONAL LAND SURVEYOR STATE OF NEVADA
ERIC CHRISTENSON
Exp 12-31-16
No. 8895

SHEET
SC01
4 OF 55
DRAWING NO.
XXX-XXXX

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BASIS OF BEARING

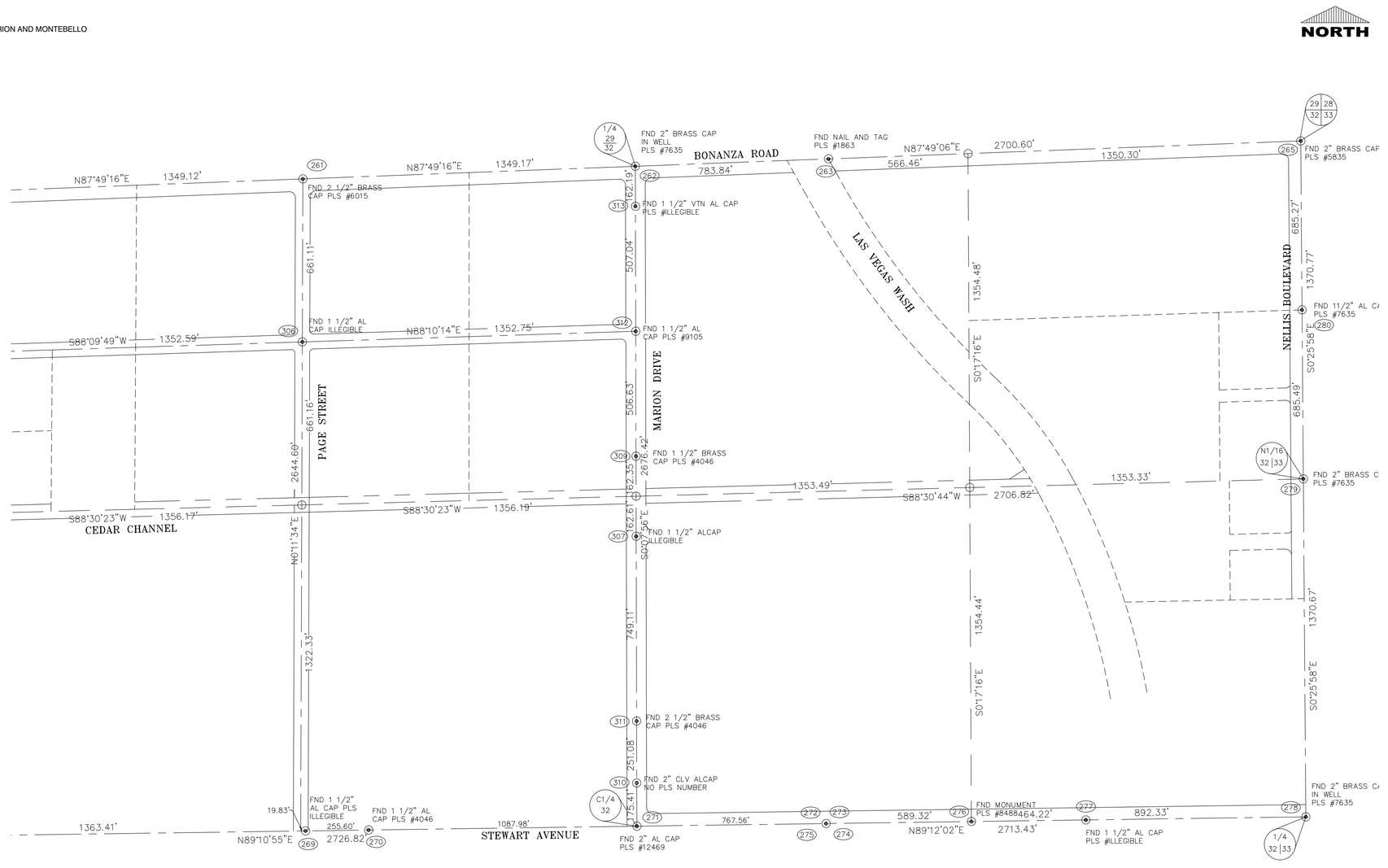
GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
RIVET & PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
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HORIZONTAL CONTROL PLANS ARE BASED ON RECORD OF SURVEY AS RECORDED BY ATKINS FILE 196, PAGE 33.



LEGEND

- STREET CENTERLINE
- CHANNEL RIGHT-OF-WAY LINE
- ASSESSOR'S PARCEL LINE
- FOUND MONUMENT AS INDICATED

GRAPHIC SCALE
250 0 125 250 500
(IN FEET)

NO.	DATE	REVISIONS

PREPARED BY
CITY OF LAS VEGAS NEVADA
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

# H49866	BID# XX-XXXX	DESIGNED BY: TH	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: 70% - PRELIMINARY		CHECKED BY: EC	

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

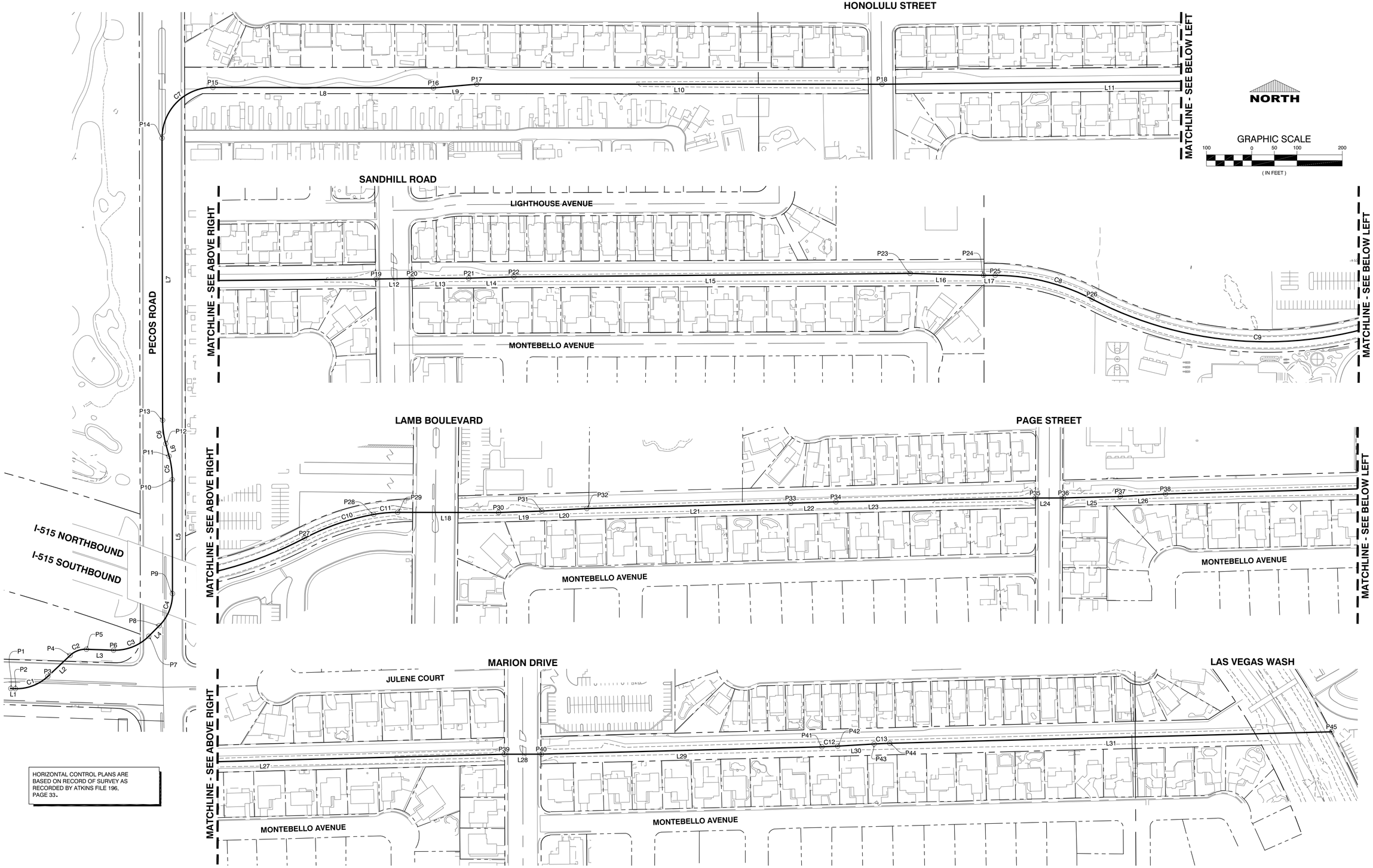
SHEET
SURVEY CONTROL PLAN

NOT FOR CONSTRUCTION
PROFESSIONAL LAND SURVEYOR
ERIC CHRISTENSON
STATE OF NEVADA
Exp 12-31-16
No. 8895

SHEET
SC02
5 OF 55

DRAWING NO.
XXX-XXXX

M:\Projects\100036914_Cedar\H49866\Sheet Set\DWG\H49866-SC02 • 11-21-16 01:15pm



HORIZONTAL CONTROL PLANS ARE BASED ON RECORD OF SURVEY AS RECORDED BY ATKINS FILE 196, PAGE 33.

BASIS OF BEARING

GRID NORTH AS DEFINED BY THE CENTRAL MERIDIAN OF THE NEVADA COORDINATE REFERENCE SYSTEM, LAS VEGAS ZONE, NORTH AMERICAN DATUM OF 1983; SAID MERIDICAN BEING COINCIDENT WITH 114°58' WEST OF THE GREENWISH MERIDIAN. THE REFERENCE FRAME BEING NAD 83 (CORS96) EPOCH 2002.0.

BENCHMARK

CITY OF LAS VEGAS BENCHMARK
RIVET & PLATE IN TOP OF CURB AT NORTHEAST CORNER OF MARION AND MONTEBELLO

NAV 1988 DATUM
ELEVATION = 536.414 METERS
= 1759.89 FEET

SEE SHEET HC02 FOR POINT, LINE, AND CURVE TABLES

NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

H# H49866 | BID# XX-XXXX
DATE: 11/18/2016 | DESIGNED BY: KRM
SUBMITTAL STAGE: | DRAWN BY: MM
70% - PRELIMINARY | CHECKED BY: HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
HORIZONAL CONTROL PLAN

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALARAO MUTHI
No. 19685
11-21-17
CIVIL

SHEET
HC01
6 OF 55
DRAWING NO
XXX-XXXX

M:\Projects\100038914_Cedar\H49866\Sheet Set\DWG\H49866-HC01 11-21-16 01:17pm

POINT TABLE				
NO.	NORTHING	EASTING	STATION	DESCRIPTION
P1	625652.1445	288913.2784	10+00.00	BP
P2	625651.8172	288923.2731	10+10.00	PC
P3	625678.7768	288994.9044	10+88.54	PT
P4	625725.2440	289044.5177	11+56.52	PC
P5	625738.7238	289080.3334	11+95.79	PT
P6	625736.7620	289140.2455	12+55.73	PC
P7	625767.5980	289218.0662	13+41.83	PT
P8	625790.8788	289241.2603	13+74.69	PC
P9	625861.6439	289270.4179	14+53.23	PT
P10	626113.4120	289269.9488	17+05.00	PC
P11	626165.1630	289263.0376	17+57.36	PT
P12	626192.8928	289255.5520	17+86.08	PC
P13	626244.6438	289248.6407	18+38.44	PT
P14	626867.7766	289247.4798	24+61.58	PC
P15	626979.9850	289359.7491	26+37.98	PT
P16	626978.8128	289846.9232	31+25.16	AP
P17	626987.2276	289942.6553	32+21.26	AP
P18	626986.9968	290837.6332	41+16.24	AP
P19	626996.8159	291841.9079	51+20.56	AP
P20	626997.8877	291921.2565	51+99.92	AP
P21	626998.4831	292046.2551	53+24.92	AP
P22	627001.4595	292146.2420	54+24.95	AP
P23	627009.0088	293021.2616	63+00.00	AP

POINT TABLE				
NO.	NORTHING	EASTING	STATION	DESCRIPTION
P24	627004.9059	293183.7949	64+62.59	AP
P25	627004.9007	293209.2088	64+88.00	PC
P26	626952.4929	293423.3117	67+10.55	PRC
P27	626954.3677	294198.1816	75+16.30	PRC
P28	627006.8883	294351.2052	76+78.73	PCC
P29	627011.4936	294404.0735	77+31.87	PT
P30	627011.1206	294626.9176	79+54.72	AP
P31	627014.2716	294722.4517	80+50.30	AP
P32	627019.8526	294821.9951	81+50.00	AP
P33	627031.5791	295272.3139	86+00.47	AP
P34	627034.5178	295372.1643	87+00.37	AP
P35	627043.0616	295812.1138	91+40.40	AP
P36	627043.2739	295875.0060	92+03.29	AP
P37	627046.5398	296000.2509	93+28.58	AP
P38	627052.1455	296100.1387	94+28.62	AP
P39	627079.7304	297157.9942	104+86.84	AP
P40	627079.8665	297240.0954	105+68.94	AP
P41	627095.9651	297859.8864	111+88.94	PC
P42	627097.4659	297894.5225	112+23.61	PT
P43	627102.3537	297975.0286	113+04.27	PC
P44	627103.8544	298009.6623	113+38.93	PT
P45	627129.2109	298985.7874	123+15.39	EP

Line Table		
Line #	Direction	Length
L1	S88° 07' 28.51"E	10.00'
L2	N46° 52' 31.49"E	67.98'
L3	S88° 07' 28.51"E	59.94'
L4	N44° 53' 35.72"E	32.86'
L5	N0° 06' 24.28"W	251.77'
L6	N15° 06' 24.28"W	28.72'
L7	N0° 06' 24.28"W	623.13'
L8	S89° 51' 43.73"E	487.18'
L9	N84° 58' 35.87"E	96.10'
L10	S89° 59' 06.80"E	894.98'
L11	N89° 26' 23.35"E	1004.32'
L12	N89° 13' 34.10"E	79.36'
L13	N89° 43' 37.44"E	125.00'
L14	N88° 17' 41.90"E	100.03'
L15	N89° 30' 20.48"E	875.05'
L16	S88° 33' 14.29"E	162.59'
L17	S89° 59' 18.45"E	25.41'
L18	S89° 54' 14.72"E	222.84'
L19	N88° 06' 39.18"E	95.59'
L20	N86° 47' 27.60"E	99.70'
L21	N88° 30' 29.99"E	450.47'
L22	N88° 18' 51.25"E	99.89'
L23	N88° 53' 14.84"E	440.03'

Line Table		
Line #	Direction	Length
L24	N89° 48' 23.83"E	62.89'
L25	N88° 30' 22.60"E	125.29'
L26	N86° 47' 16.51"E	100.04'
L27	N88° 30' 22.60"E	1058.22'
L28	N89° 54' 18.22"E	82.10'
L29	N88° 30' 43.63"E	620.00'
L30	N86° 31' 32.36"E	80.65'
L31	N88° 30' 43.14"E	976.45'

Curve Table				
Curve #	Radius	Length	Delta (Δ)	TANGENT
C1	100.00'	78.54'	45.00	41.421
C2	50.00'	39.27'	45.00	20.711
C3	105.00'	86.10'	46.98	45.636
C4	100.00'	78.54'	45.00	41.421
C5	200.00'	52.36'	15.00	26.330
C6	200.00'	52.36'	15.00	26.330
C7	112.00'	176.41'	90.24	112.479
C8	463.93'	222.55'	27.49	113.460
C9	835.26'	805.75'	55.27	437.329
C10	526.91'	162.43'	17.66	81.863
C11	296.54'	53.14'	10.27	26.641
C12	1000.00'	34.67'	1.99	17.337
C13	1000.00'	34.67'	1.99	17.336

REVISIONS

NO. | DATE

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I/# H49866	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: **70% - PRELIMINARY**		CHECKED BY: HB	

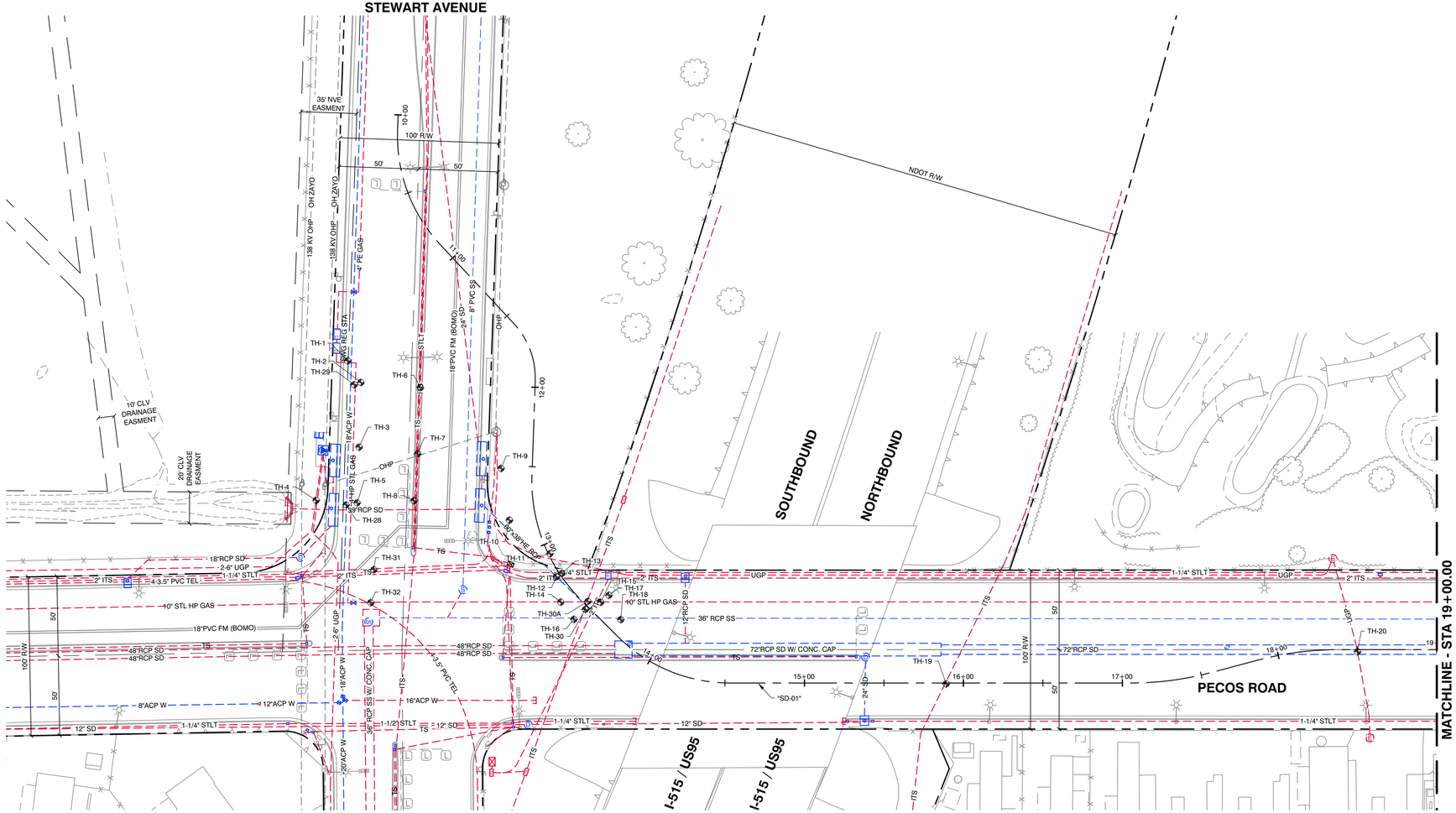
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
HORIZONAL CONTROL PLAN
POINT, LINE & CURVE TABLES

PROFESSIONAL ENGINEER
KONDAL RAO MANTRI
12-31-17
CIVIL
No. 19685
STATE OF NEVADA
NOT FOR CONSTRUCTION

SHEET
HC02
7 OF 55
DRAWING NO.
XXX-XXXX

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(IN FEET)

NORTH

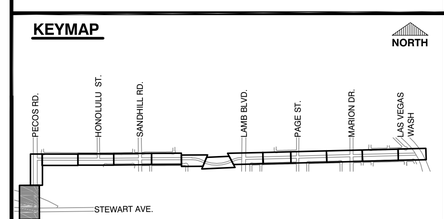
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

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CITY OF LAS VEGAS

	BID# XX-XXXX	DESIGNED BY: KRM	CHECKED BY: HB
H# H49866		DRAWN BY: MM	
DATE: 11/18/2016	SUBMITTAL STAGE:	70% - PRELIMINARY	

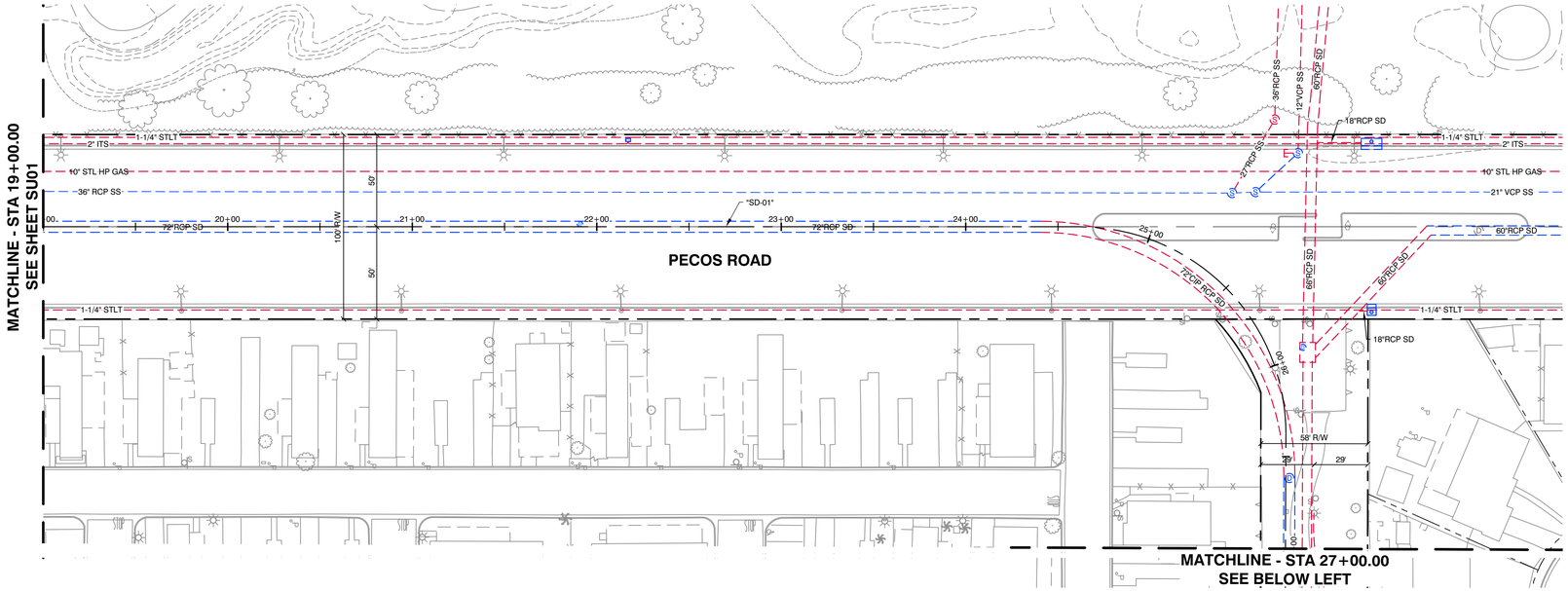
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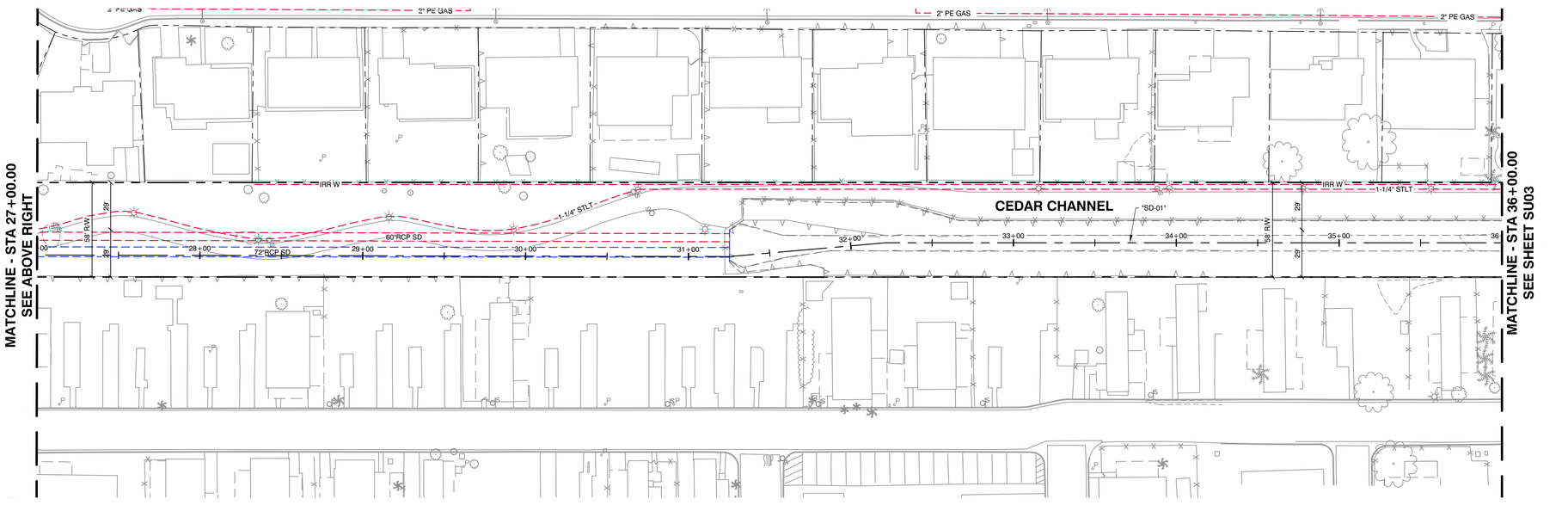
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PROFESSIONAL ENGINEER
KONDAL RAO VARRI
No. 19655
CIVIL
STATE OF NEVADA
NOT FOR CONSTRUCTION

SHEET
SU01
8 OF 55
DRAWING NO.
XXX-XXXX

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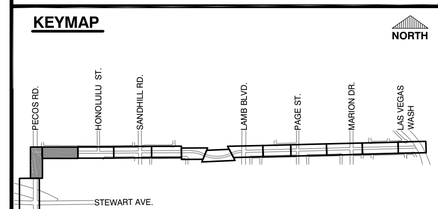
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: 70% - PRELIMINARY		CHECKED BY: HB	

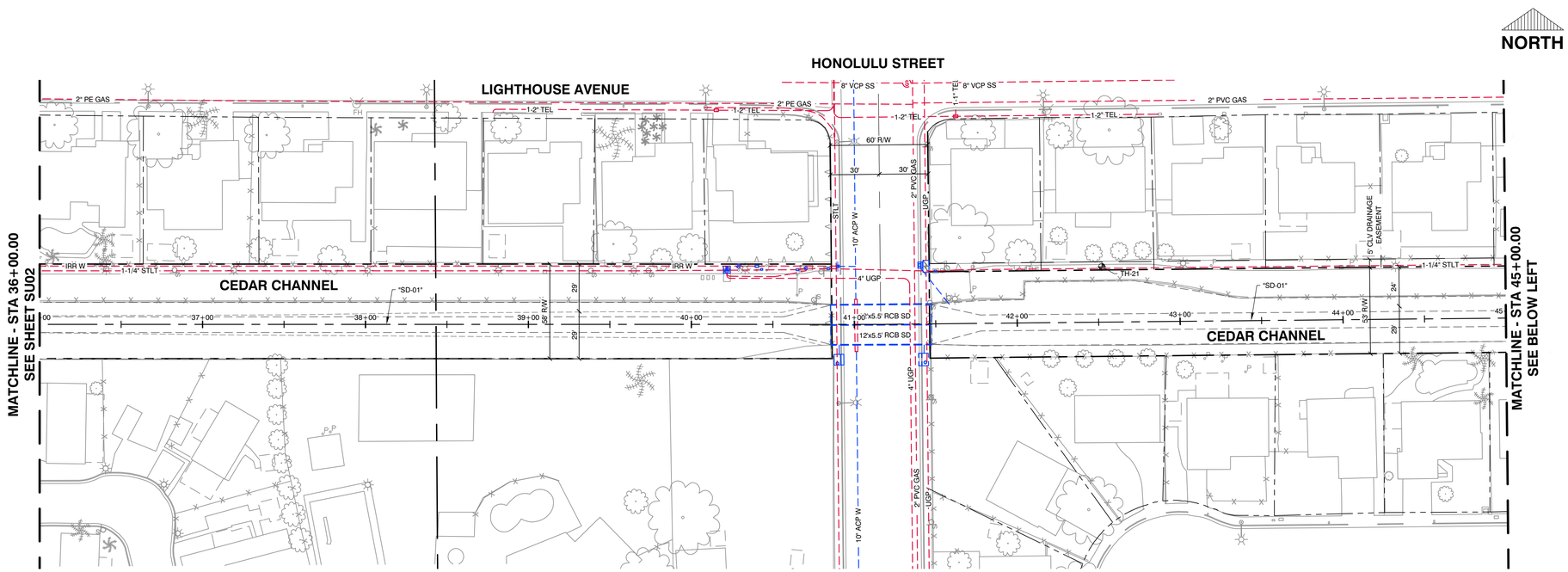
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CEDAR AVENUE CHANNEL

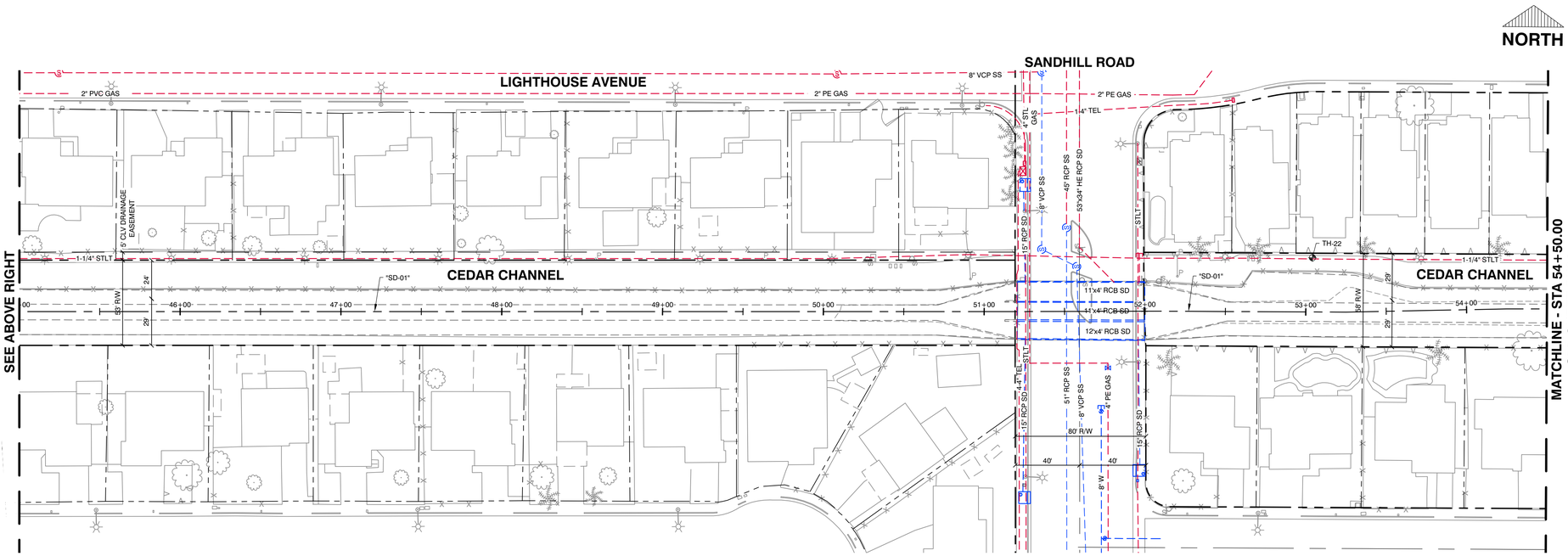
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EXISTING UTILITIES LOCATION PLAN
"SD01" 19+00 TO "SD01" 36+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER - STATE OF NEVADA
KONDALA RAO MANTRI
12-31-17
CIVIL
No. 19685

SHEET
SU02
9 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

NOT FOR CONSTRUCTION

PROFESSIONAL ENGINEER STAMP
KONDALRAO MURTHY
12-31-17
CIVIL
No. 19655
STATE OF NEVADA

REVISIONS

NO.	DATE

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

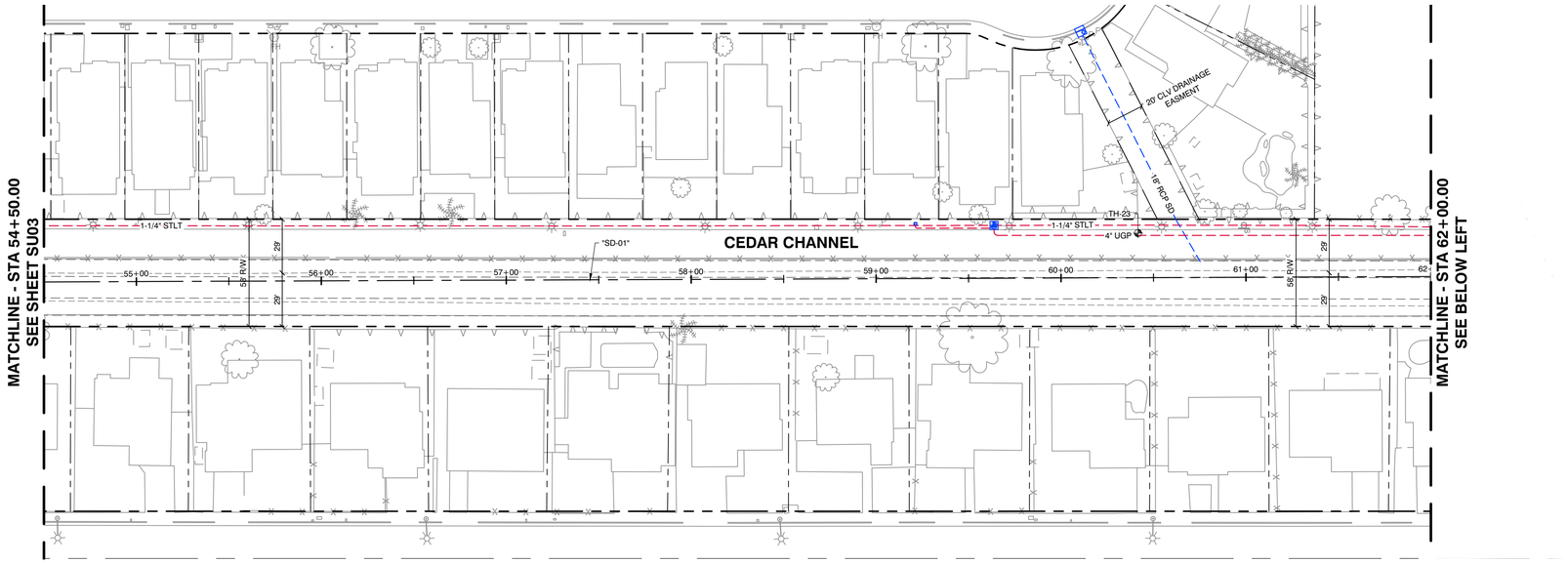
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DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HB

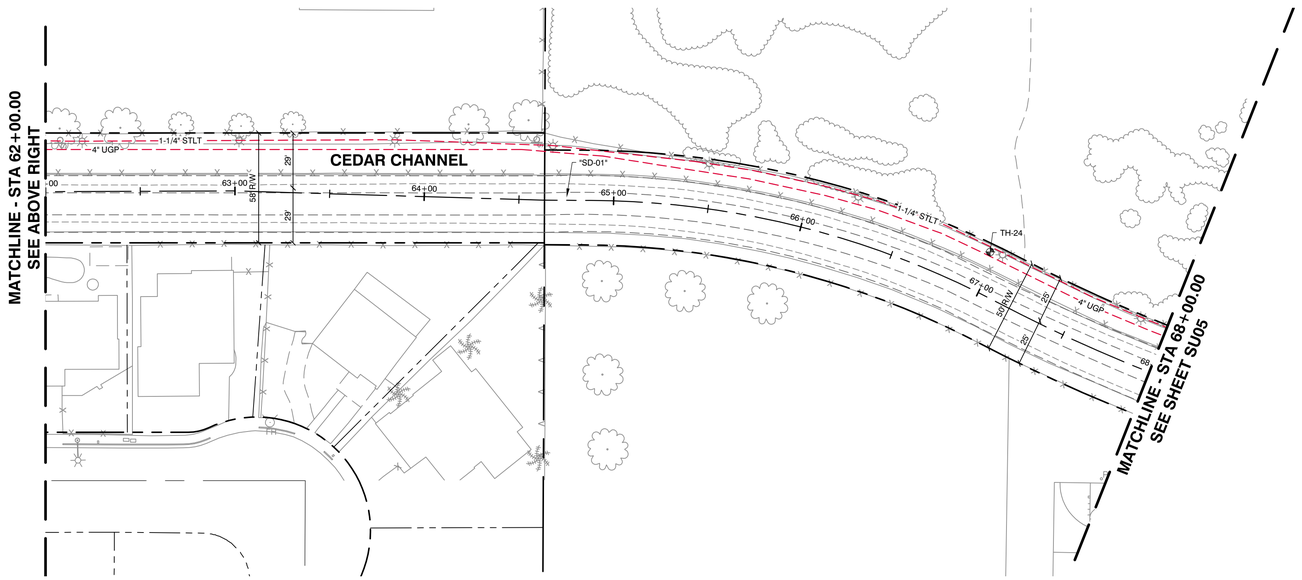
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
EXISTING UTILITIES LOCATION PLAN
"SD01" 36+00 TO "SD01" 54+50

SHEET
SU03
10 OF 55
DRAWING NO.
XXX-XXXX

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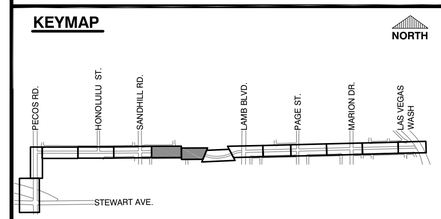
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866 | BID# XX-XXXX | DESIGNED BY: KRM

DATE: 11/18/2016 | DRAWN BY: MM

SUBMITTAL STAGE: 70% - PRELIMINARY | CHECKED BY: HB

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER - STATE OF NEVADA
KONDALA RAO MOTHRI
12-31-17
CIVIL
No. 19685

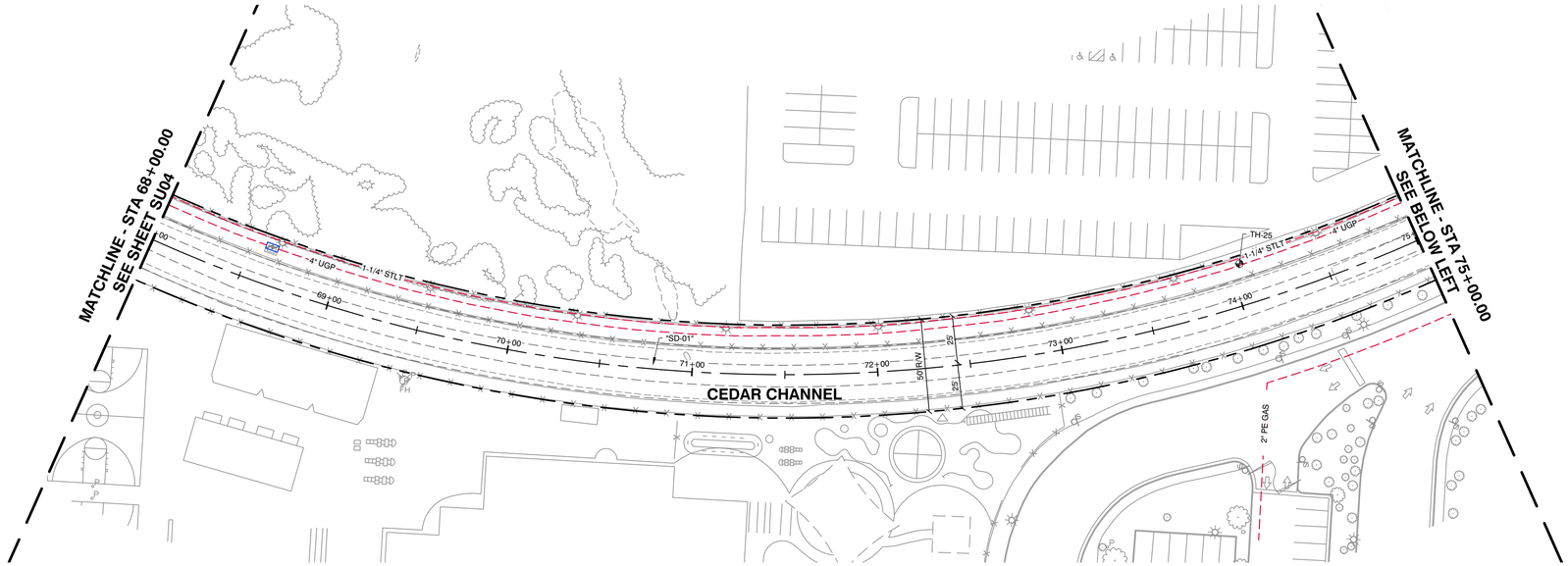
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CEDAR AVENUE CHANNEL

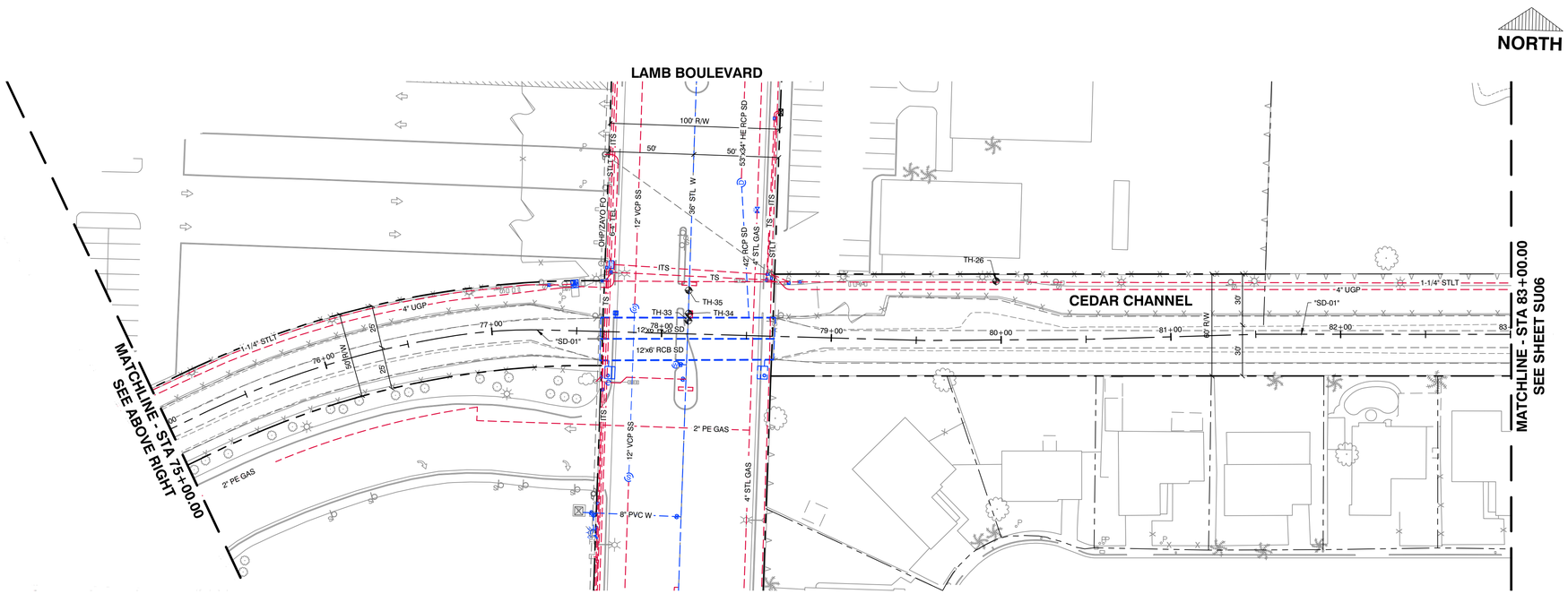
SHEET
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"SD01" 54+50 TO "SD01" 66+00

SHEET
SU04
11 OF 55

DRAWING NO.
XXX-XXXX

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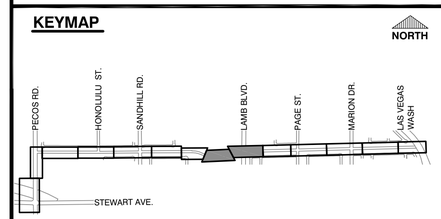
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: 70% - PRELIMINARY		CHECKED BY: HB	

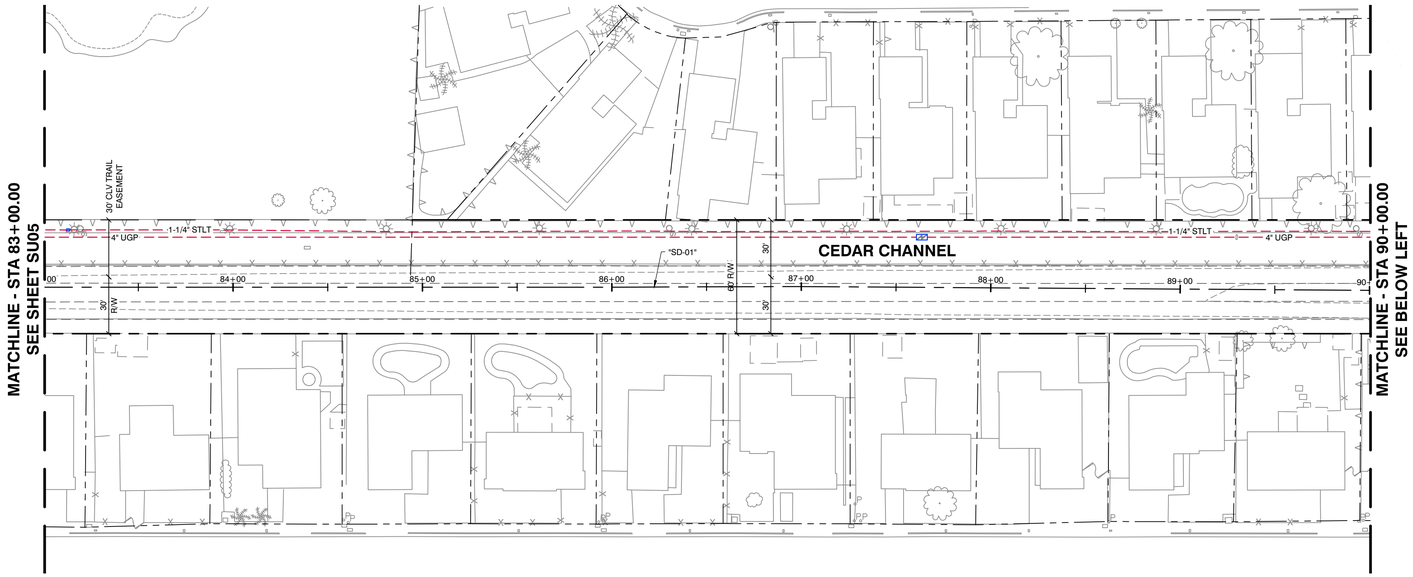
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CEDAR AVENUE CHANNEL

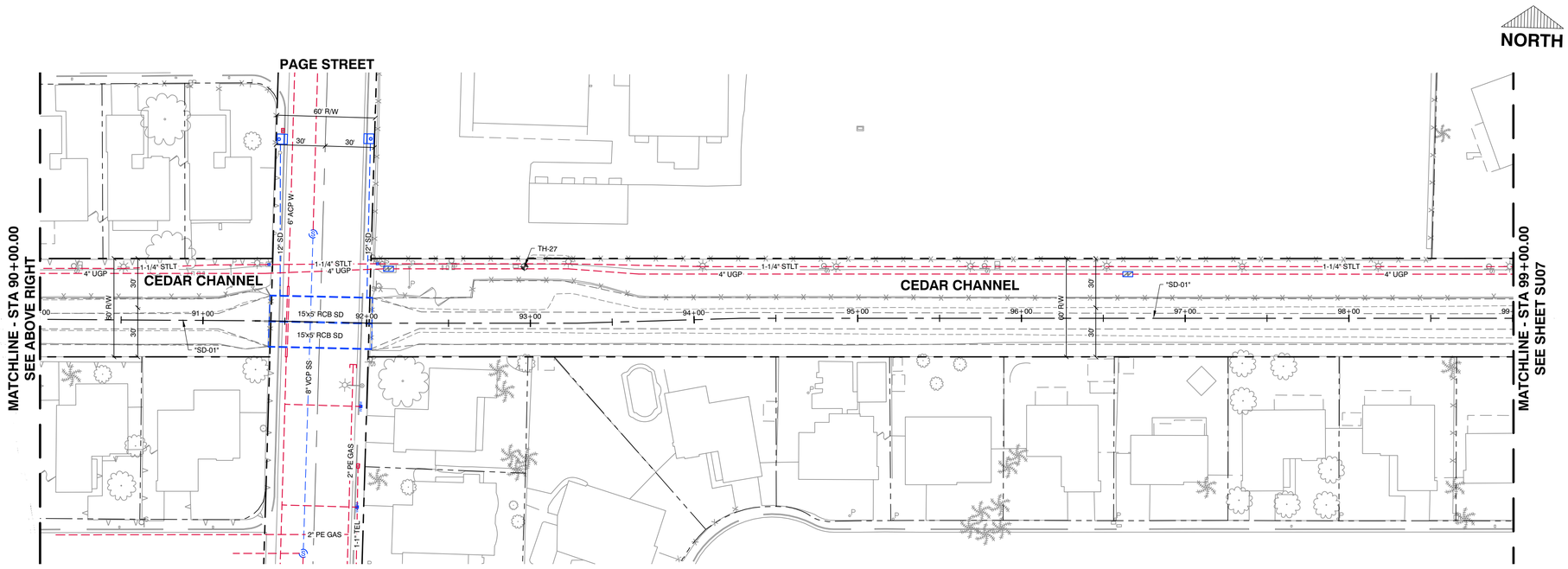
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EXISTING UTILITIES LOCATION PLAN
"SD01" 66+00 TO "SD01" 83+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER STAMP
KONDALA RAO MURTHY
12-31-17
CIVIL
No. 19685
STATE OF NEVADA

SHEET
SU05
12 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

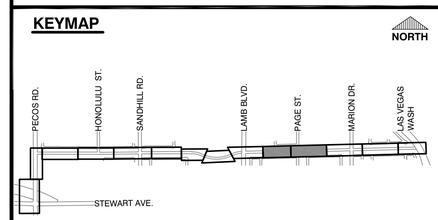
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866
DATE: 11/18/2016
SUBMITTAL STAGE:
70% - PRELIMINARY

BID# XX.XXXX
DESIGNED BY: KRM
DRAWN BY: MM
CHECKED BY: HB

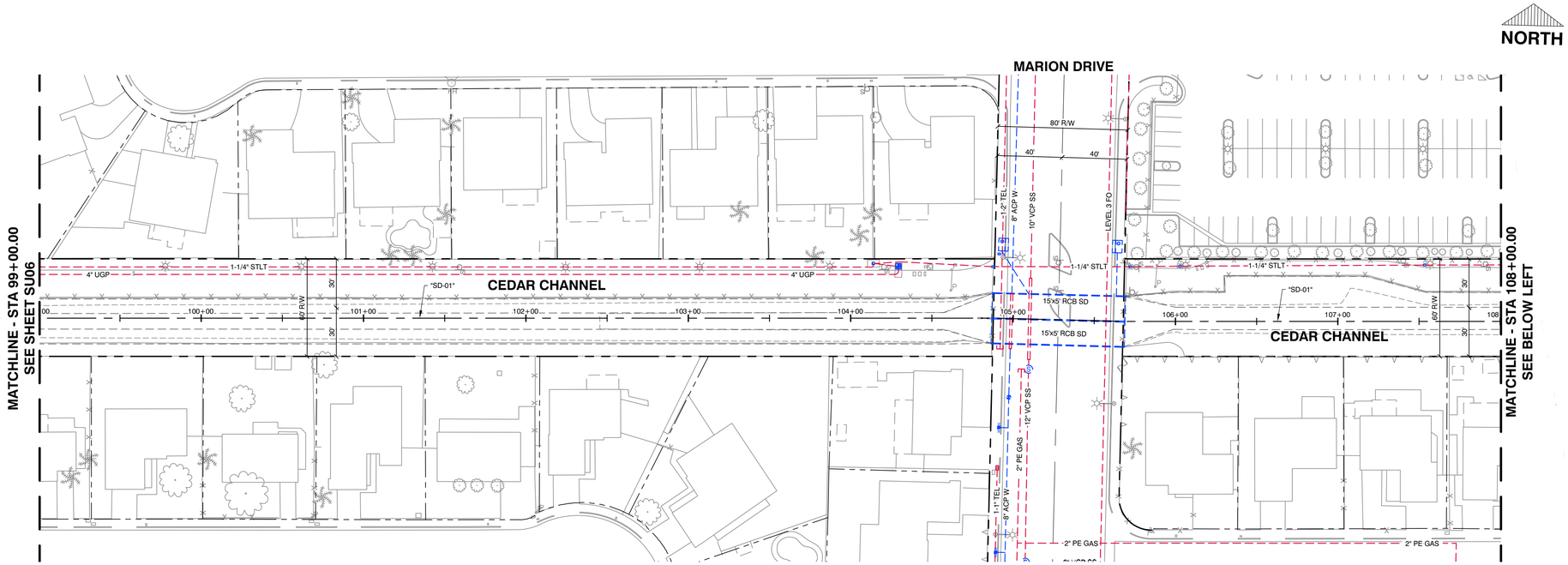
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CEDAR AVENUE CHANNEL

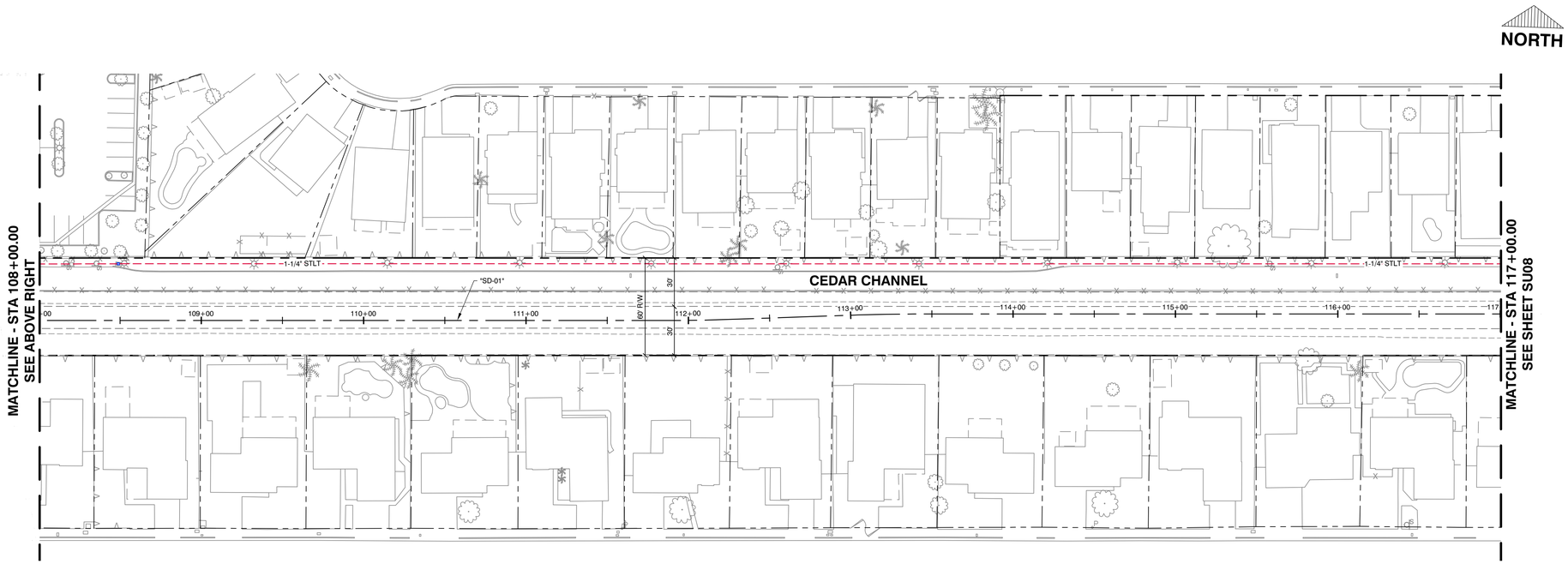
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EXISTING UTILITIES LOCATION PLAN
"SD01" 83+00 TO "SD01" 99+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALA RAO MURTHY
12-31-17
CIVIL
No. 19685

SHEET
SU06
13 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

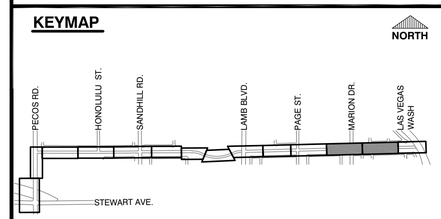
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- (P) TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

TITLE

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET

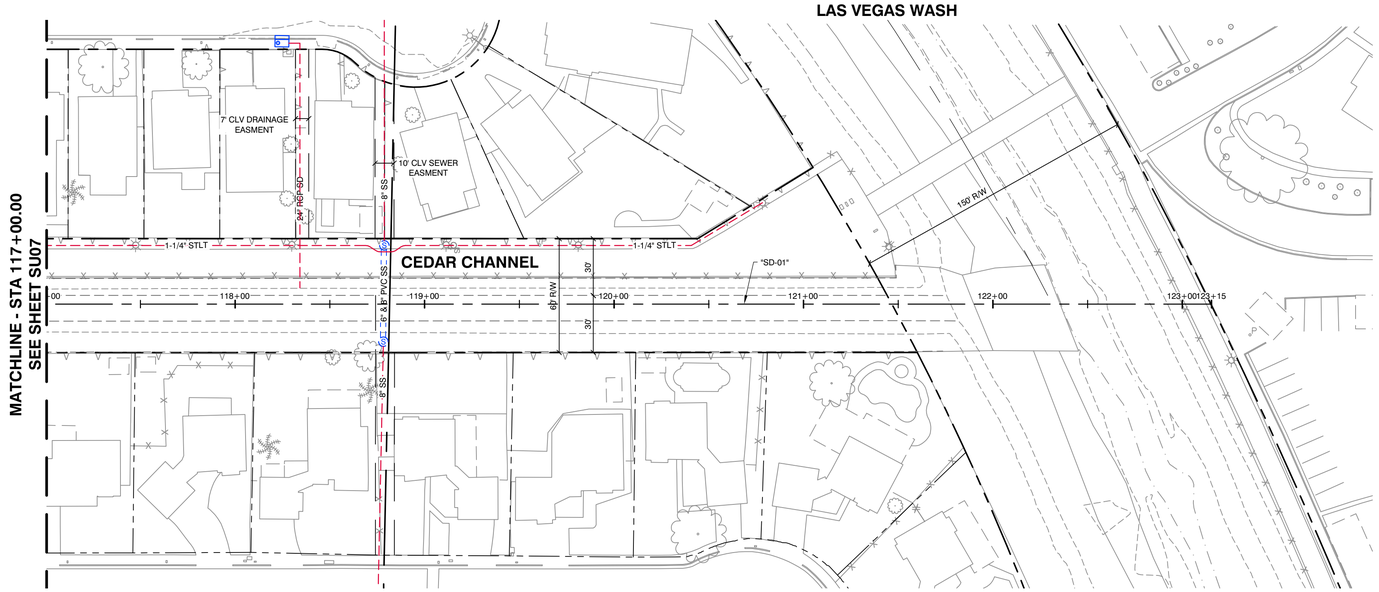
EXISTING UTILITIES LOCATION PLAN
"SD01" 99+00 TO "SD01" 117+00

PROFESSIONAL ENGINEER STAMP
KONDALARAO MOTKURI
No. 19685
CIVIL
12-31-17
NOT FOR CONSTRUCTION UNLESS SIGNED

SHEET
SU07
14 OF 55

DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE

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(IN FEET)

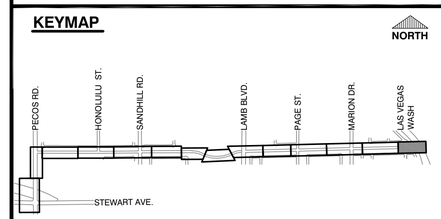
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- Ⓟ TH-XX — SUE QUALITY A TEST HOLE LOCATION
- SUE QUALITY B
- SUE QUALITY C
- SUE QUALITY D

KEYMAP



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Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HB
I#	H49866
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

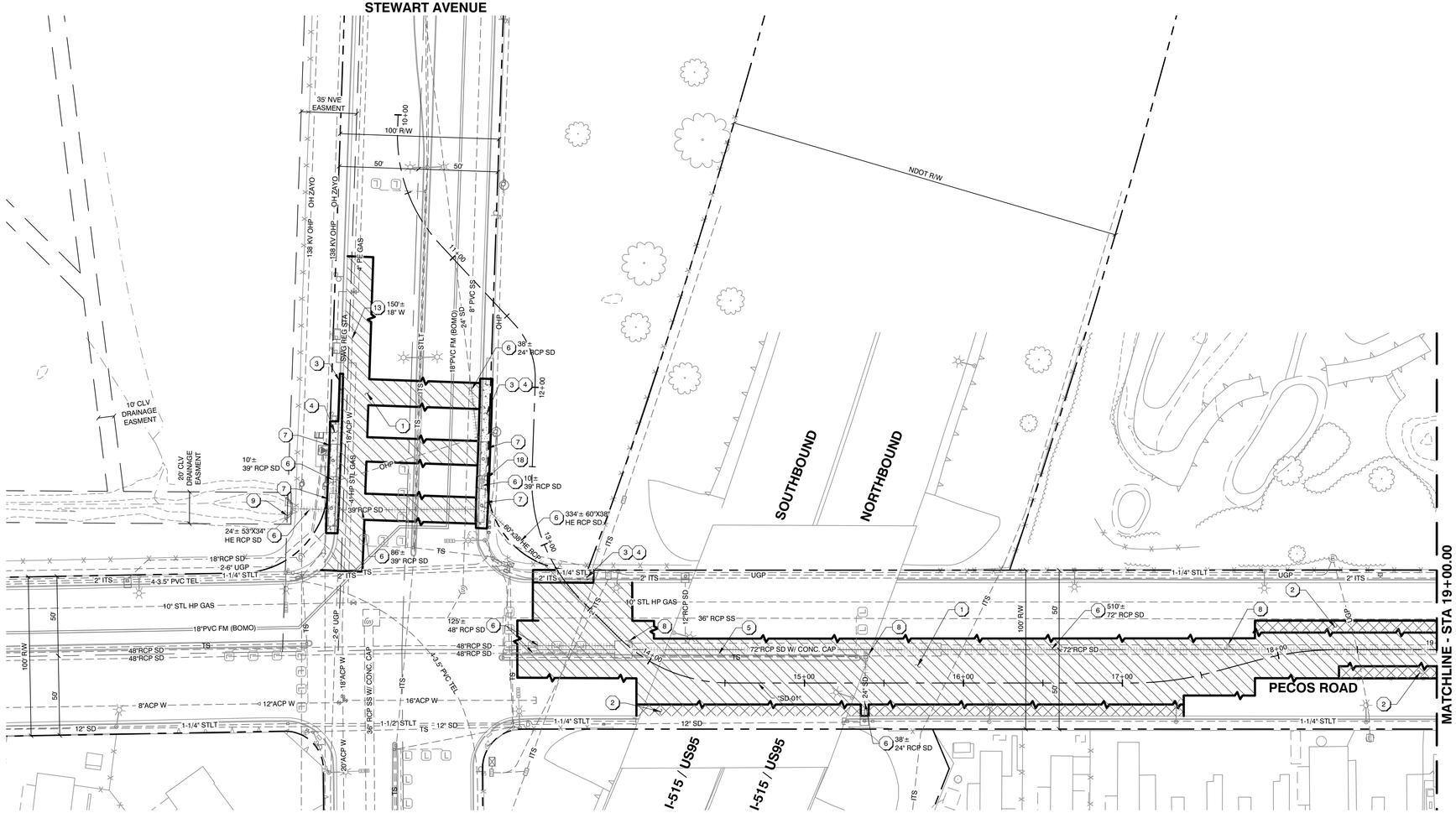
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EXISTING UTILITIES LOCATION PLAN "SD01" 117+00 TO "SD01" 123+00

PROFESSIONAL ENGINEER — STATE OF NEVADA
KONDALA RAO MANTRI
12-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
SU08
15 OF 55

DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

DEMOLITION KEY NOTES

1. EXISTING PAVEMENT SECTION TO BE REMOVED
2. EXISTING PAVEMENT TO BE MILLED 2"
3. EXISTING CURB AND GUTTER TO BE REMOVED
4. EXISTING CONCRETE SIDEWALK TO BE REMOVED
5. EXISTING MEDIAN ISLAND TO BE REMOVED
6. EXISTING STORM DRAIN TO BE REMOVED
7. EXISTING DROP INLET TO BE REMOVED
8. EXISTING STORM DRAIN MANHOLE TO BE REMOVED
9. EXISTING HEADWALL TO BE REMOVED
10. EXISTING CHANNEL TO BE REMOVED
11. EXISTING TRAIL TO BE REMOVED
12. EXISTING LANDSCAPING TO BE REMOVED (SEE NOTES 2 AND 3 BELOW)
13. EXISTING WATERLINE TO BE RELOCATED, SEE "W" SHEETS FOR DETAILS
14. EXISTING WATER VALVE TO BE REMOVED AND REPLACED
15. EXISTING SANITARY SEWER LINE TO BE RELOCATED
16. EXISTING SANITARY SEWER MANHOLE TO BE REMOVED
17. EXISTING TRAIL ACCESS GATE TO BE REMOVED
18. EXISTING SIGN TO BE REMOVED AND REPLACED
19. EXISTING POST AND CABLE FENCE TO BE REMOVED
20. EXISTING BOLLARDS TO BE REMOVED
21. EXISTING STREET LIGHT CONDUIT TO BE REMOVED AND REPLACED
22. EXISTING TRAFFIC SIGNAL CONDUIT TO BE REMOVED AND REPLACED

NOTES

1. THE ACTUAL LOCATION OF SAWCUT LINES AND LIMITS OF MILLING SHALL BE DETERMINED IN THE FIELD BY THE RESIDENT PROJECT REPRESENTATIVE.
2. CONTRACTOR SHALL REMOVE EXISTING LANDSCAPING, IRRIGATION, BOULDERS, LIGHTING, AMENITIES ETC. THAT ARE IMPACTED BY THE CONSTRUCTION AND REPLACE THEM TO EXISTING OR BETTER CONDITION PER THE CITY OF LAS VEGAS STANDARDS AND TO THE ENGINEER'S SATISFACTION.
3. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT FROM DAMAGING EXISTING IMPROVEMENTS WHICH ARE TO REMAIN IN PLACE. CONTRACTOR SHALL, AT HIS OWN EXPENSE, REPAIR, REPLACE, OR RECONSTRUCT ALL SUCH IMPROVEMENTS OR OTHER STRUCTURES DAMAGED BY HIS WORK.

LEGEND

- EXISTING PAVEMENT SECTION TO BE REMOVED
- EXISTING PAVEMENT TO BE COLD MILLED 2"
- EXISTING CURB & GUTTER AND SIDEWALK TO BE REMOVED
- EXISTING LANDSCAPING TO BE REMOVED
- EXISTING CHANNEL TO BE REMOVED
- EXISTING TRAIL TO BE REMOVED
- EXISTING UTILITY TO BE REMOVED

UTILITY NOTE:

ALL EXISTING UTILITY LOCATIONS SHOWN HEREON ARE APPROXIMATE ONLY. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDERGROUND UTILITIES PRIOR TO COMMENCING CONSTRUCTION.

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AND GRADING THE SUBBASE IN THE VICINITY TO AVOID DAMAGE TO THE LATTER.

KEYMAP

NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I.#:	H49866
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

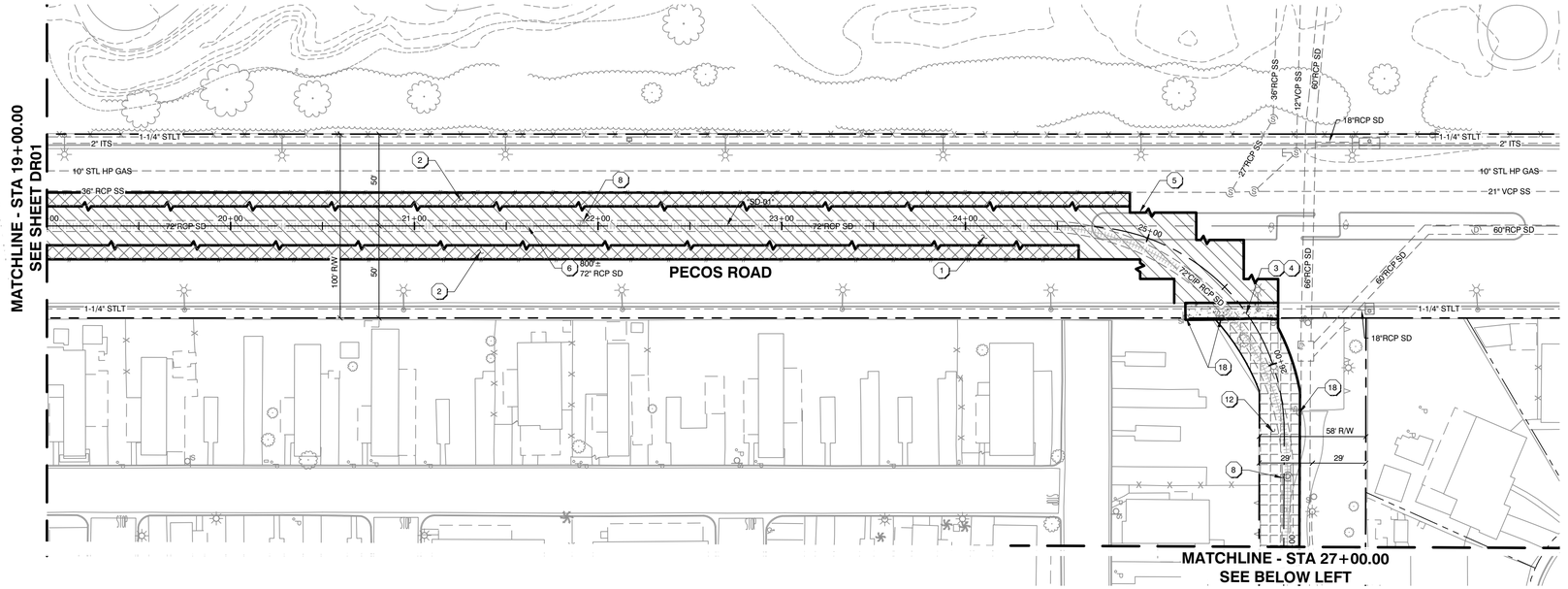
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REMOVAL PLAN
"SD01" 10+00 TO "SD01" 19+00

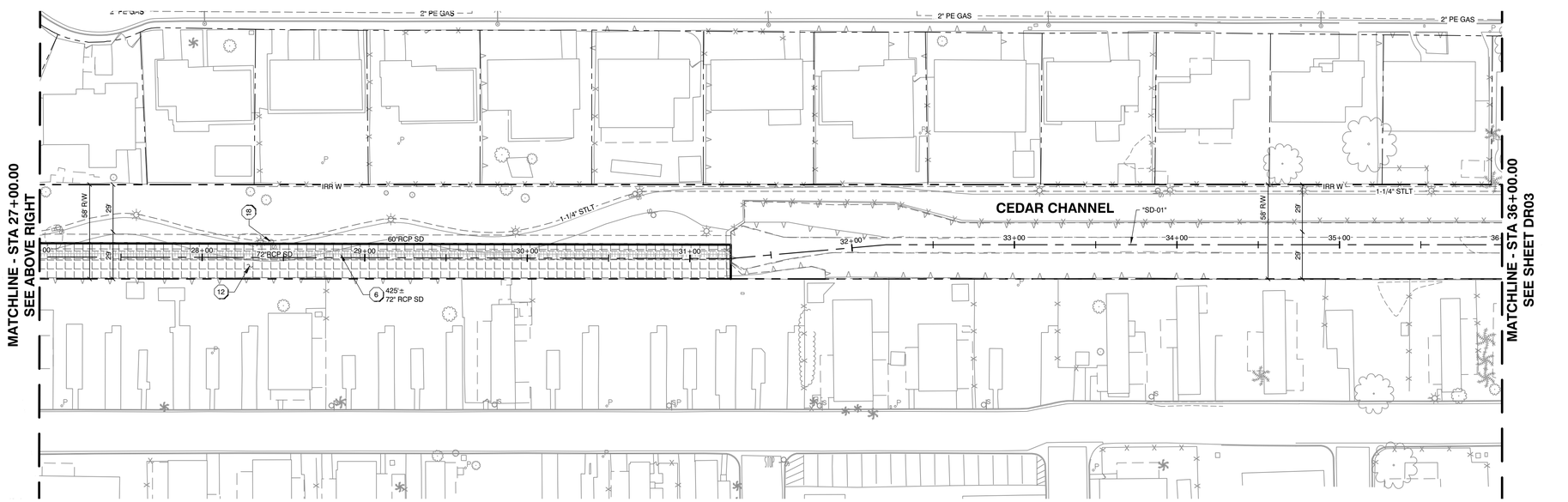
NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALARAO MATRI
No. 19685
11-21-17
CIVIL

SHEET
DR01
16 OF 55

DRAWING NO
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

DEMOLITION KEY NOTES

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2. EXISTING PAVEMENT TO BE MILLED 2"
3. EXISTING CURB AND GUTTER TO BE REMOVED
4. EXISTING CONCRETE SIDEWALK TO BE REMOVED
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LEGEND

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- EXISTING LANDSCAPING TO BE REMOVED
- EXISTING CHANNEL TO BE REMOVED
- EXISTING TRAIL TO BE REMOVED
- EXISTING UTILITY TO BE REMOVED

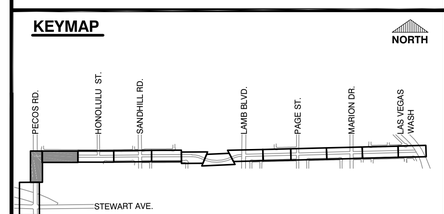
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AND GRADING THE SUBBASE IN THE VICINITY TO AVOID DAMAGE TO THE LATTER.

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

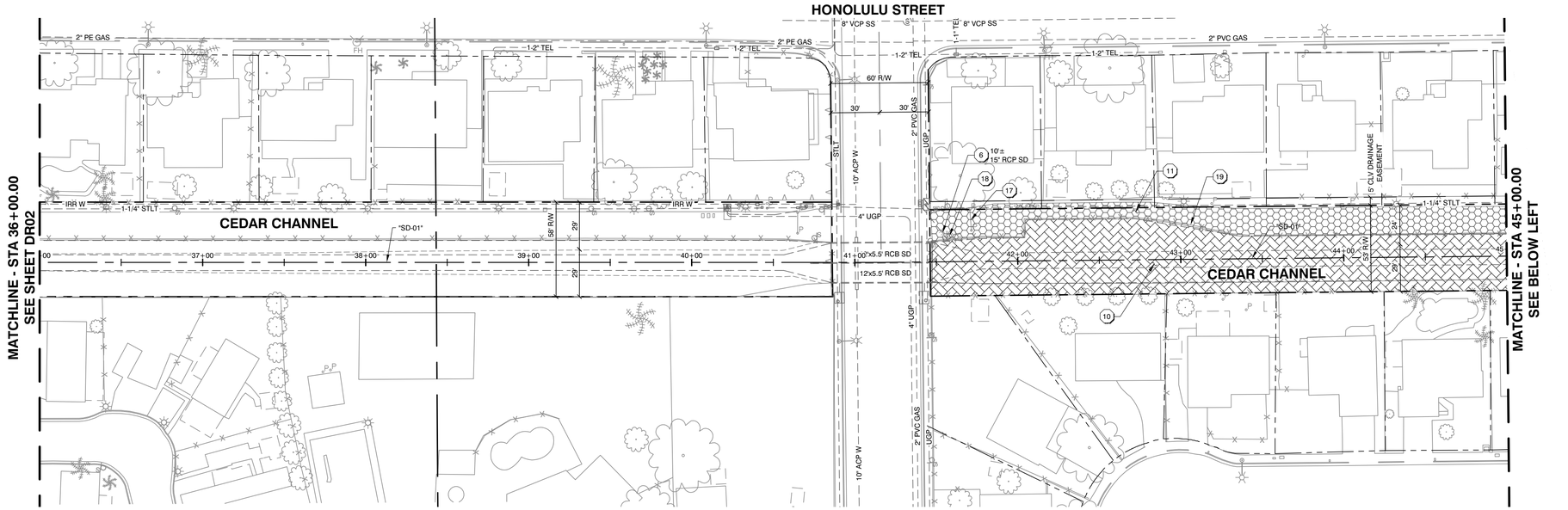
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REMOVAL PLAN
"SD01" 19+00 TO "SD01" 36+00

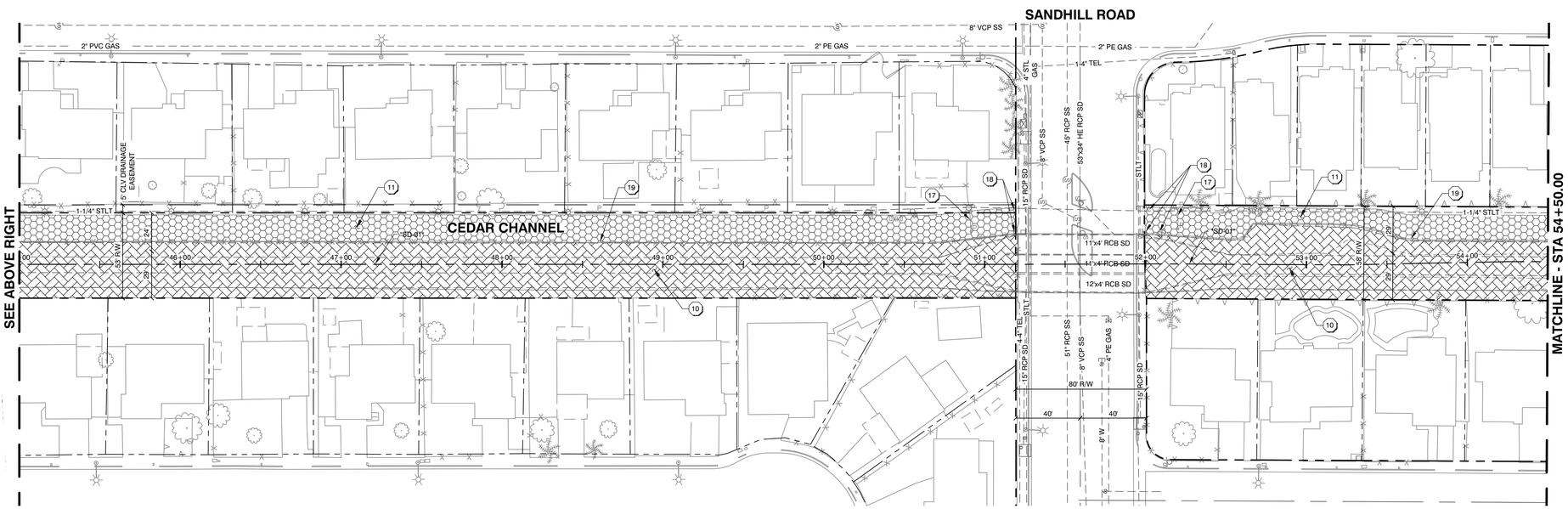
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDAL S. MANDRI
11-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
DR02
17 OF 55

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

DEMOLITION KEY NOTES

1. EXISTING PAVEMENT SECTION TO BE REMOVED
2. EXISTING PAVEMENT TO BE MILLED 2"
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KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

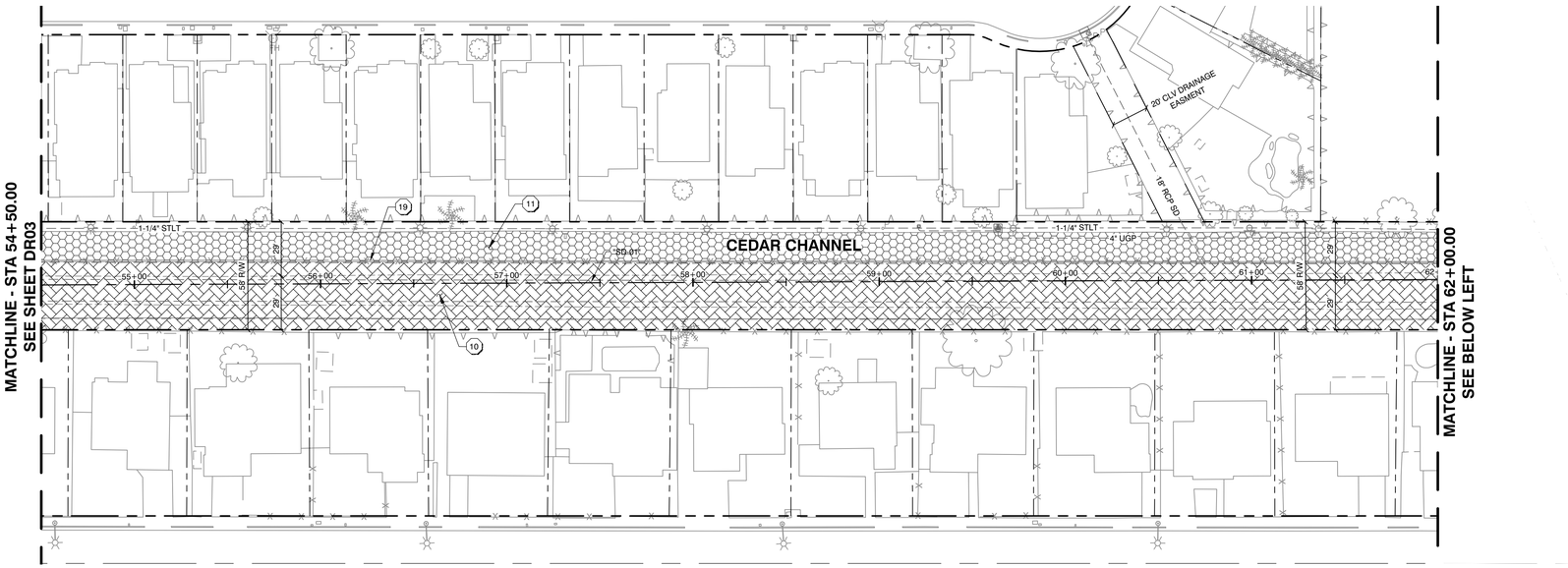
1# H49866	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

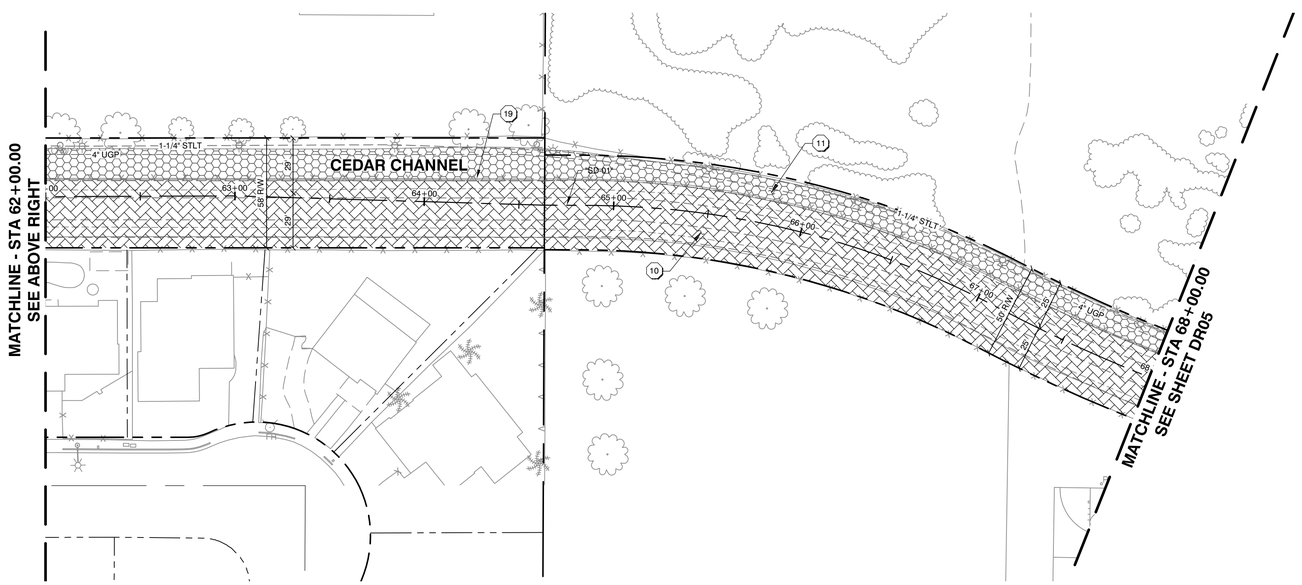
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
REMOVAL PLAN
"SD01" 36+00 TO "SD01" 54+50

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALA KRISHNA MANNAM
No. 19685
CIVIL
NOT FOR CONSTRUCTION

SHEET
DR03
18 OF 55
DRAWING NO.
XXX-XXXX





GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

DEMOLITION KEY NOTES

1. EXISTING PAVEMENT SECTION TO BE REMOVED
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- EXISTING TRAIL TO BE REMOVED
- EXISTING UTILITY TO BE REMOVED

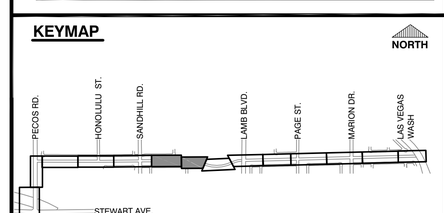
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KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866	BID# XX.XXXX	DESIGNED BY: KRM	CHECKED BY: HB
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	

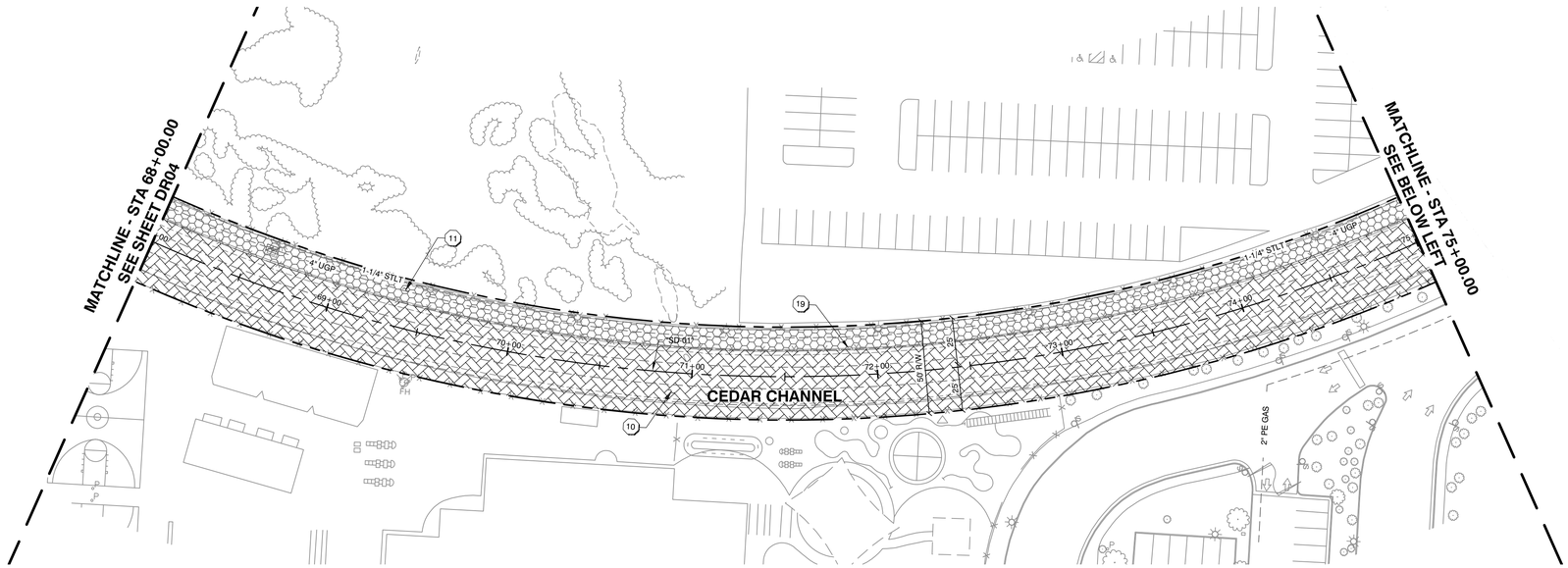
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CEDAR AVENUE CHANNEL

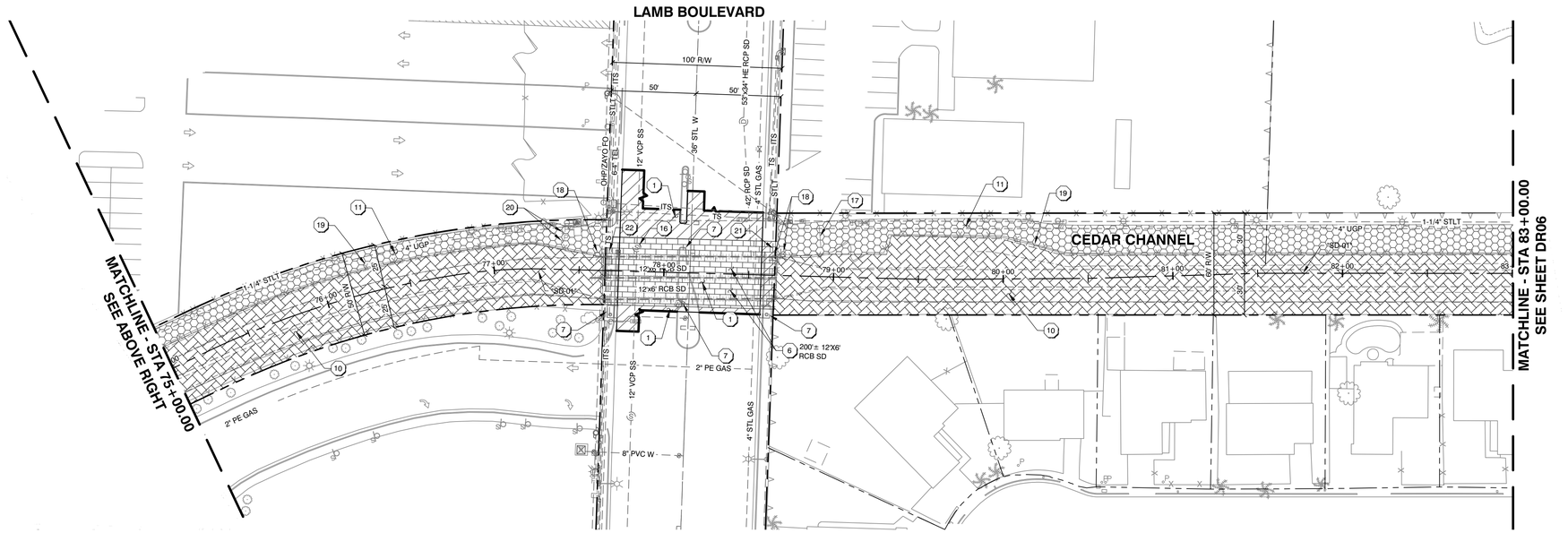
SHEET
REMOVAL PLAN
"SD01" 54+50 TO "SD01" 66+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALAH MANJI
11-21-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
DR04
19 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

DEMOLITION KEY NOTES

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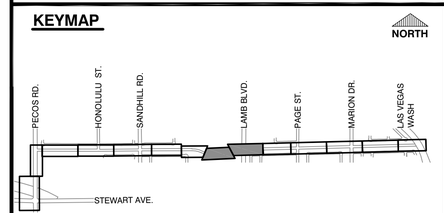
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PREPARED FOR
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I# H49866	BID# XX-XXXX	DESIGNED BY: KRM	
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TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

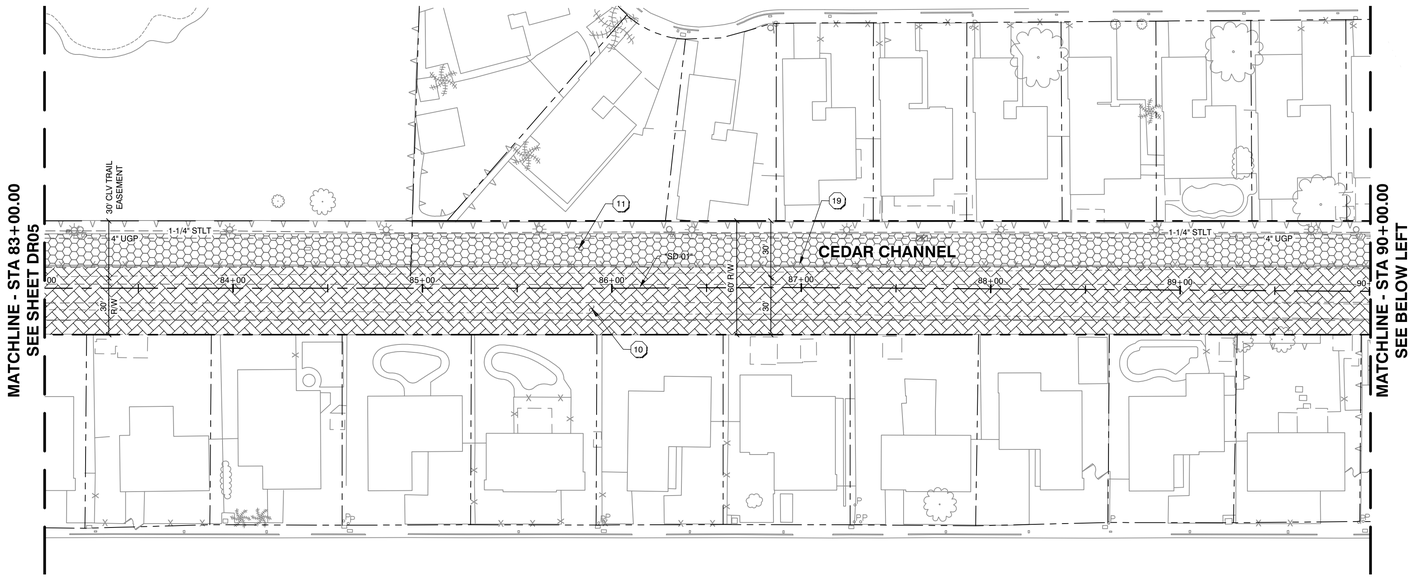
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"SD01" 66+00 TO "SD01" 83+00

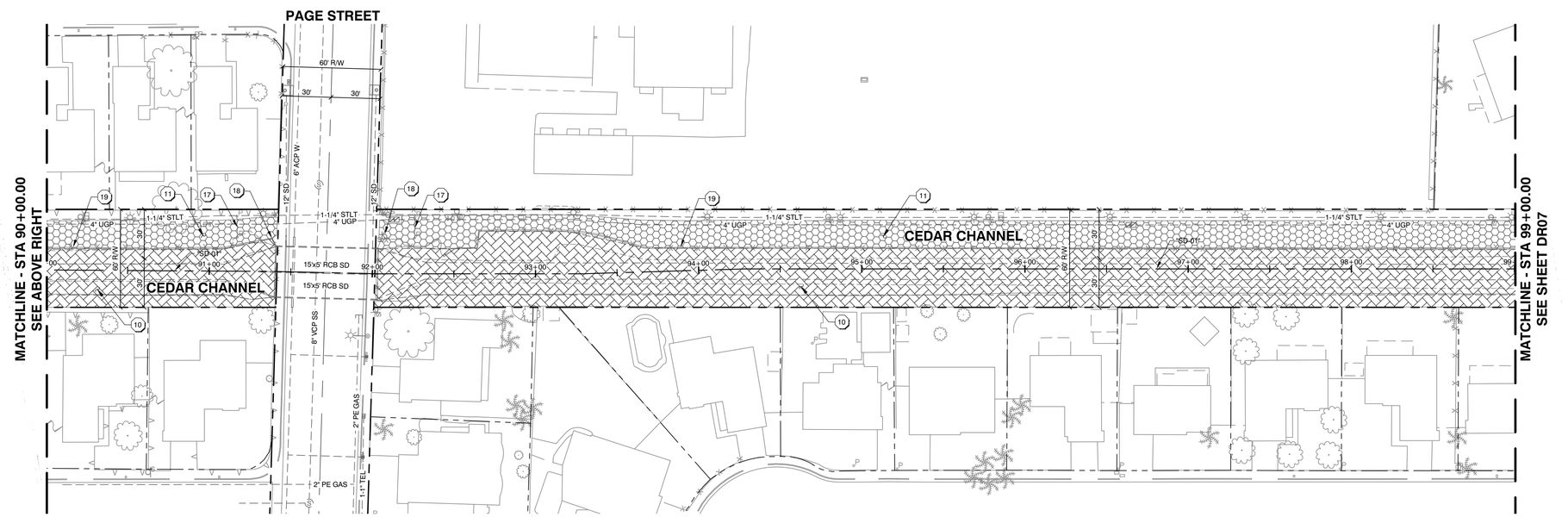
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALRAO MANNI
No. 19665
CIVIL
NOT FOR CONSTRUCTION

SHEET
DR05
20 OF 55

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
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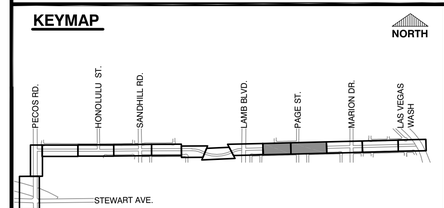
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ATKINS
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Fax: +1 (702) 263 7200

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CITY OF LAS VEGAS

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SUBMITTAL STAGE: 70% - PRELIMINARY		CHECKED BY: HB	

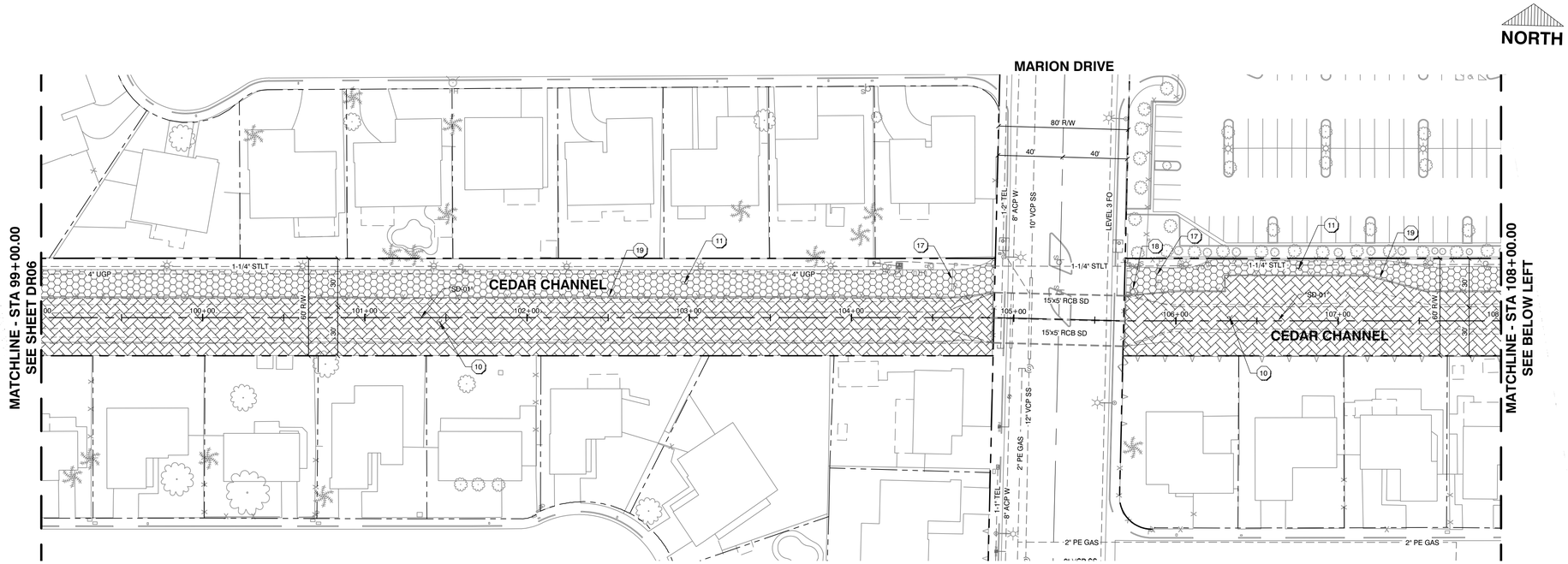
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CEDAR AVENUE CHANNEL

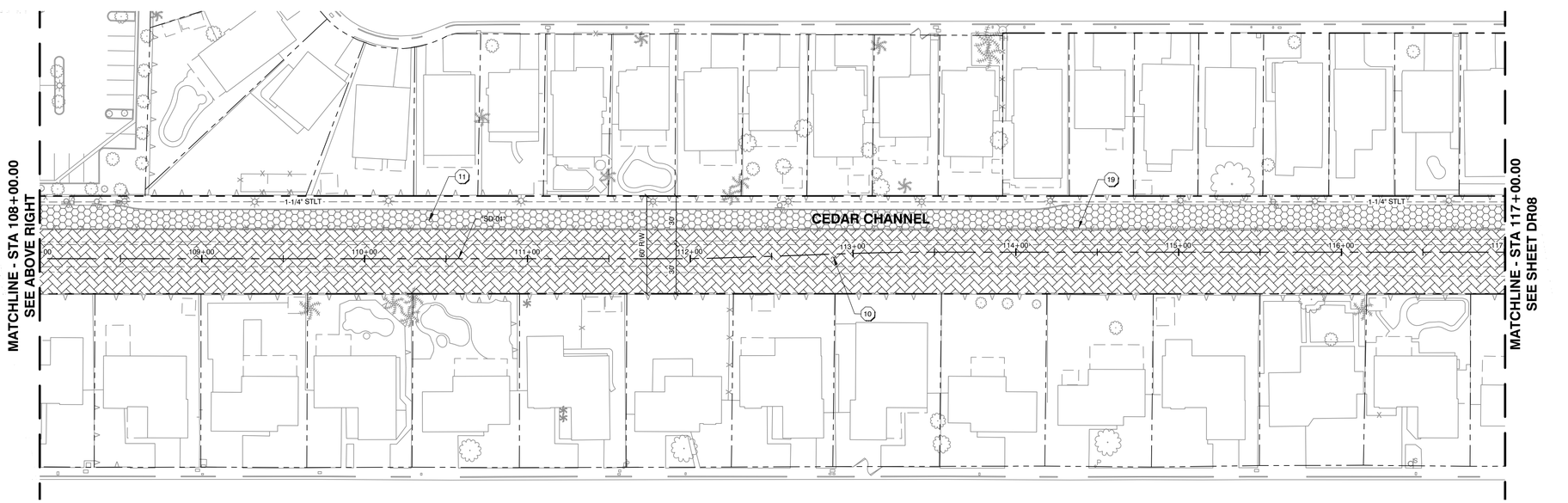
SHEET
REMOVAL PLAN
"SD01" 83+00 TO "SD01" 99+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALRAO MANNAM
No. 19665
CIVIL
NOT FOR CONSTRUCTION

SHEET
DR06
21 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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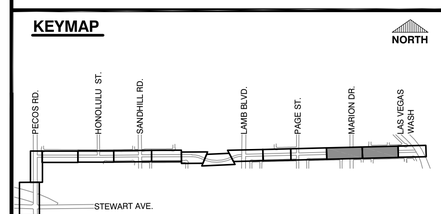
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ATKINS
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PREPARED FOR
CITY OF LAS VEGAS

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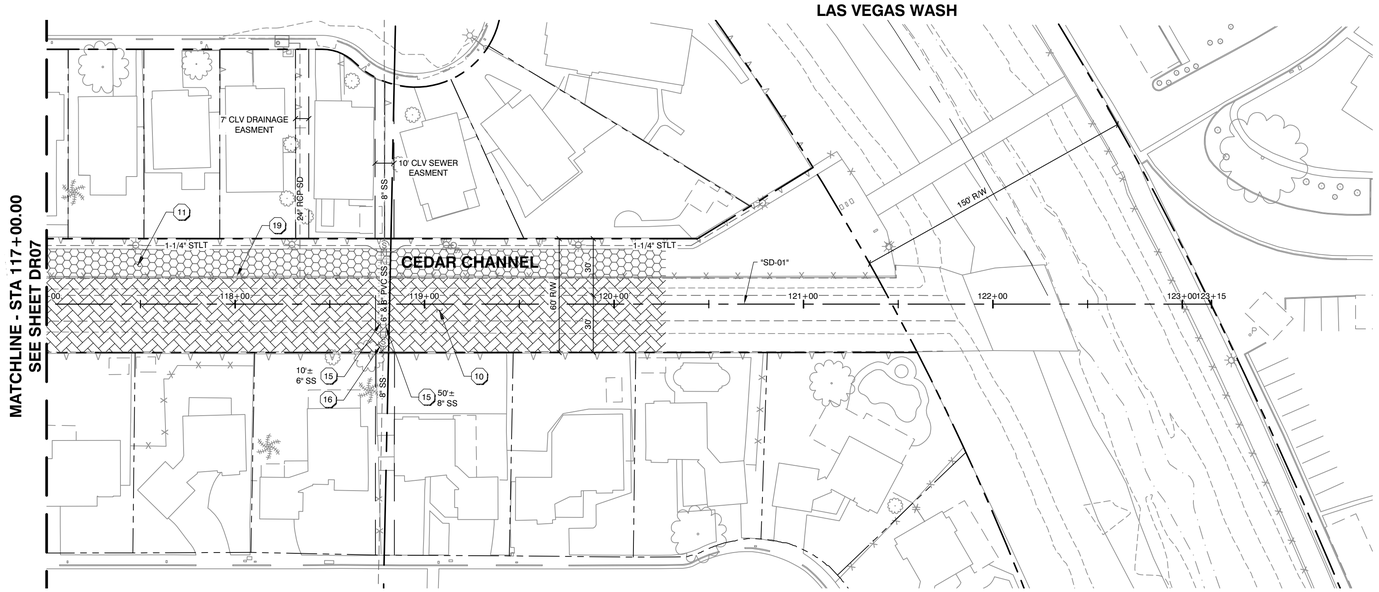
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
REMOVAL PLAN
"SD01" 99+00 TO "SD01" 117+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALA MANAN
EXP. 12-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
DR07
22 OF 55
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XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

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BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
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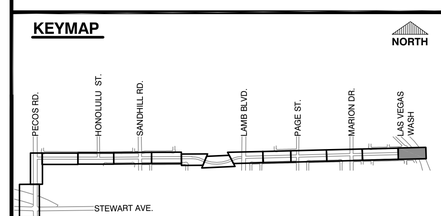
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CITY OF LAS VEGAS

1# H49866 | BID# XX-XXXX | DESIGNED BY: KRM
DATE: 11/18/2016 | SUBMITTAL STAGE: 70% - PRELIMINARY | DRAWN BY: MM | CHECKED BY: HB

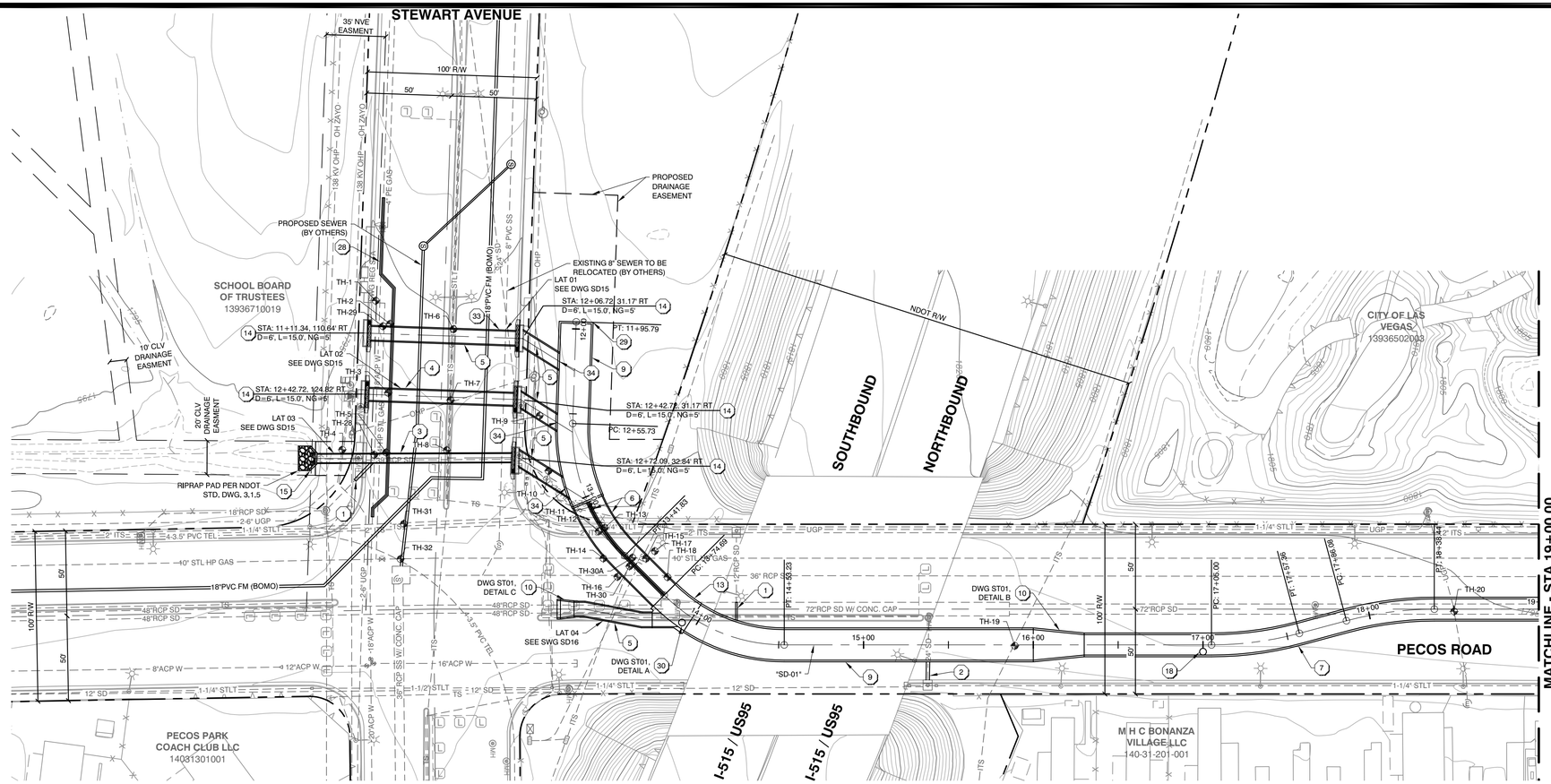
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CEDAR AVENUE CHANNEL

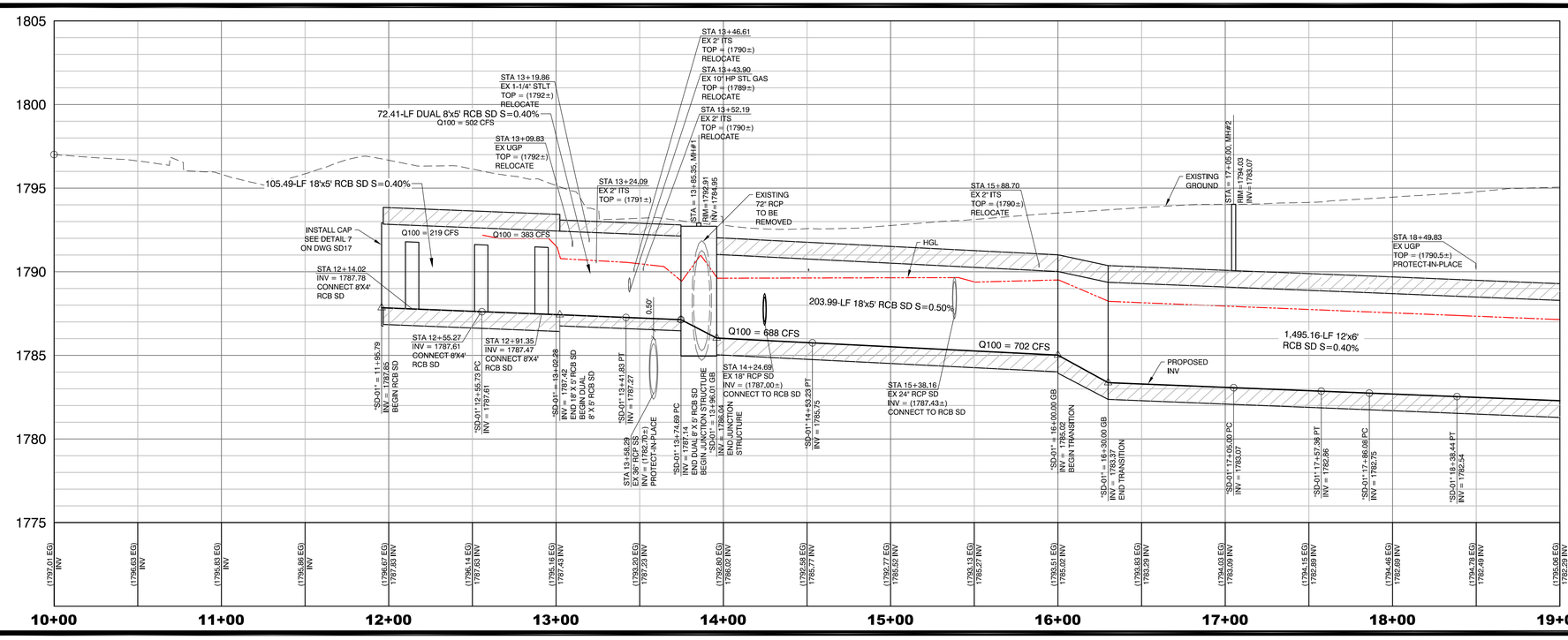
SHEET
REMOVAL PLAN
"SD01" 117+00 TO "SD01" 123+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALA RAO MANNAM
11-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
DR08
23 OF 55
DRAWING NO.
XXX-XXXX

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M:\Projects\100036014_Cedar\H49866\Sheet Set\DWG\H49866-SD01 11-21-16 02:04pm

NORTH

GRAPHIC SCALE
20 0 10 20 40
(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

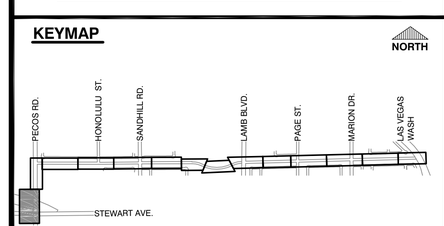
CONSTRUCTION KEY NOTES

1. INSTALL 18" RCP SD AND CONNECT TO EXISTING PIPE AND PROPOSED RCBC
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3. INSTALL 5' X 3' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
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7. INSTALL 12' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
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10. INSTALL RCB TRANSITION SEE DETAILS ON DRAWING ST01
11. CONSTRUCT RECTANGULAR CONCRETE CHANNEL PER DRAWINGS TY01 AND TY02
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13. CONSTRUCT JUNCTION STRUCTURE, SEE STRUCTURAL DETAIL A ON DRAWING ST01
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15. CONSTRUCT TYPE I HEADWALL PER NDOT STD. DWG. B-20.15
16. CONSTRUCT AC TRAIL (2" AC OVER 4" TYPE II AGGREGATE BASE), PER TYPICAL SECTION DRAWINGS
17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY
18. INSTALL 48" ACCESS SDMH PER DETAIL 2 DRAWING SD17
19. CONSTRUCT ACCESS GATE PER DETAIL 1 DRAWING SD18
20. RELOCATE EXISTING UTILITY (BY OTHERS)
21. PIPE PENETRATION PER DETAIL XX DRAWING SD17
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23. PROTECT-IN-PLACE. CONTRACTOR TO SUPPORT UTILITY ACROSS THE TRENCH. ANY DESIGN REQUIRED TO SUPPORT THE UTILITY SHALL BE DONE BY THE CONTRACTOR'S ENGINEER AND SHALL BE LICENSED IN THE STATE OF NEVADA. (NO DIRECT PAYMENT)
24. CONSTRUCT POST AND CABLE FENCE PER DETAILS 4, 5, 6, AND 7, DRAWING SD19 (SEE TY DRAWINGS FOR FENCE HEIGHTS)
25. CONSTRUCT 12' WIDE CHANNEL ACCESS GATE PER DETAIL XX, DRAWING SDXX
26. CONSTRUCT COLLAPSIBLE BOLLARDS PER DETAIL 5, DRAWING ST02
27. CONSTRUCT TRANSITION FROM 12'X6' RCB TO THE EXISTING TRAPEZOIDAL CHANNEL PER DETAILS 1, 2, AND 3, DRAWING ST02
28. RELOCATE EXISTING 18" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
29. CONSTRUCT STORM DRAIN END CAP PER DETAIL 7, DRAWING SD17
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31. RELOCATE EXISTING 36" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
32. REPROFILE EXISTING 12" SANITARY SEWER, SEE DRAWING SS01 FOR PLAN AND PROFILE
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35. CONSTRUCT PIER NOSE PER DETAIL 4, DRAWING ST02
36. INSTALL ACCESS LADDER PER DETAILS 1, 2, AND 3, DRAWING SD19
37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123945

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

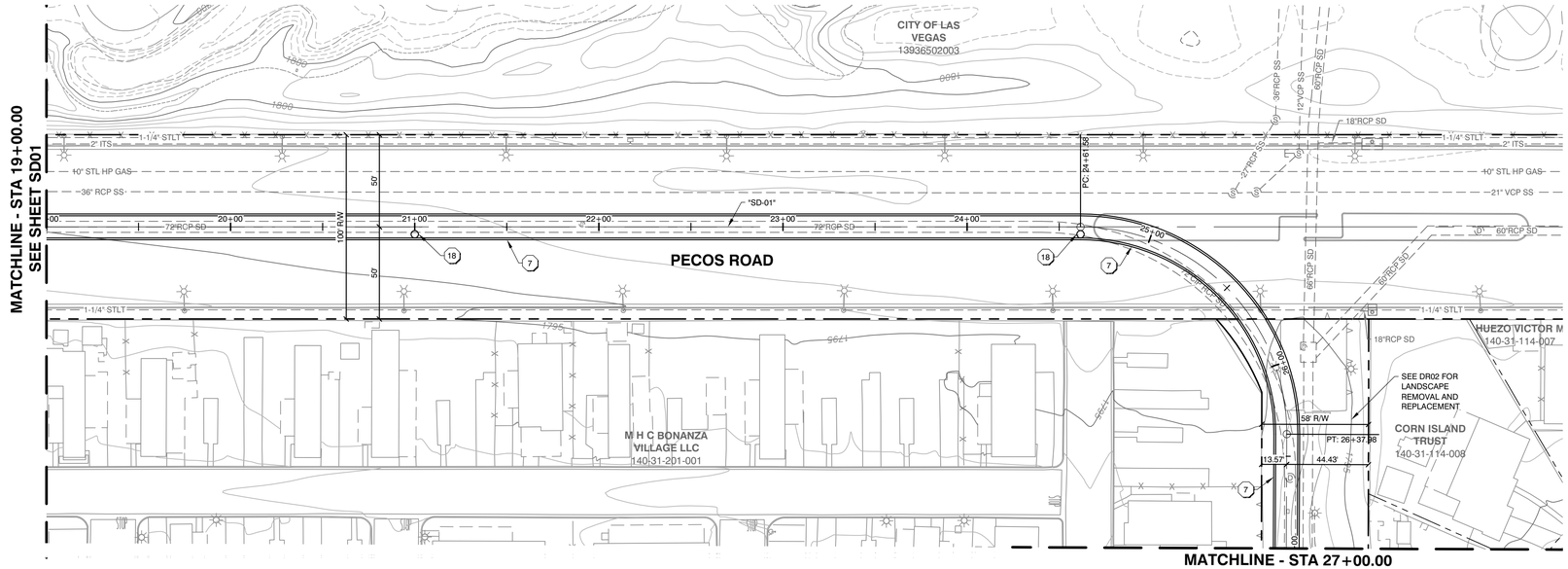
I.#: H49866	BID#: XX-XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

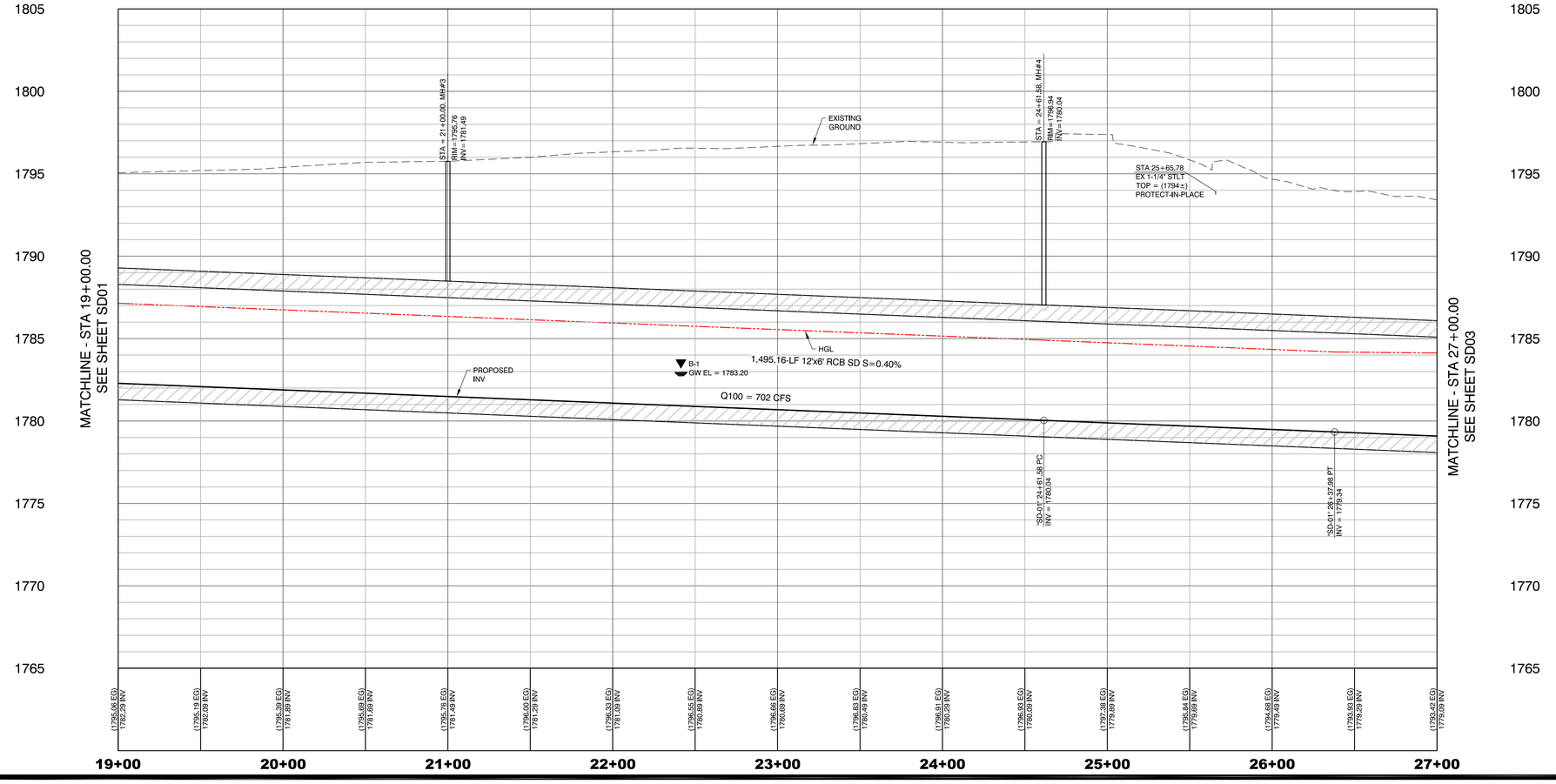
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 10+00 TO "SD01" 19+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALAH KRISHNAMURTHY
No. 19685
CIVIL

SHEET
SD01
24 OF 55
DRAWING NO.
XXX-XXXX





NORTH

GRAPHIC SCALE
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(IN FEET)

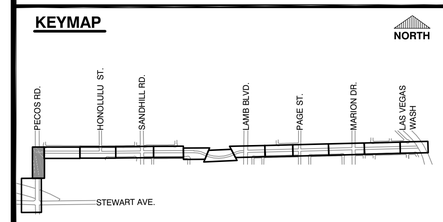
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

#: H49866	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

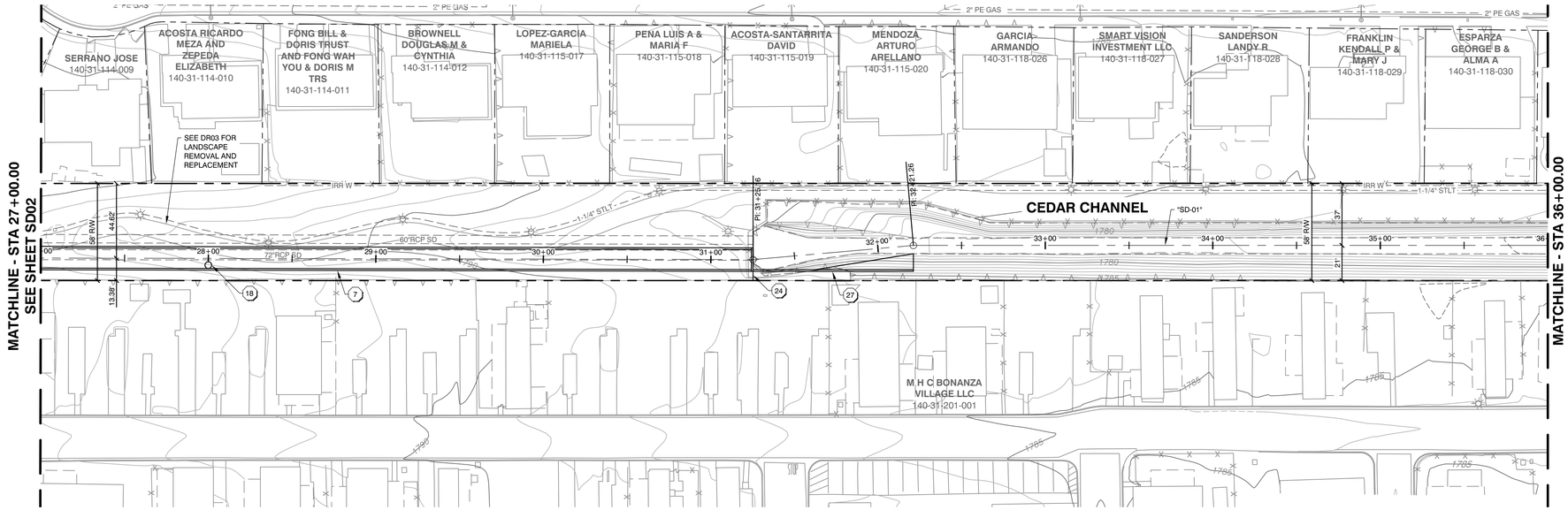
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

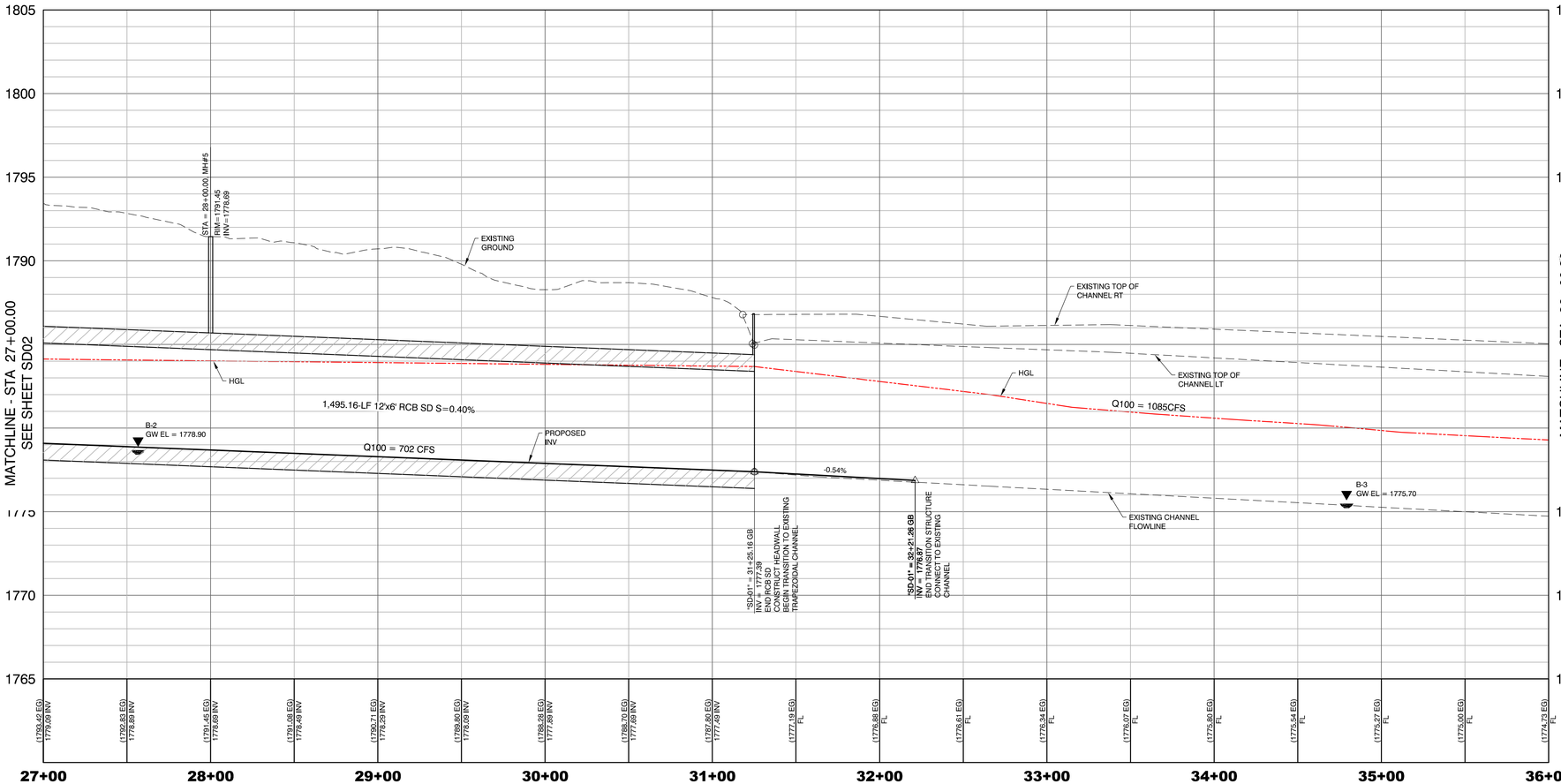
SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 19+00 TO "SD01" 27+00

PROFESSIONAL ENGINEER STATE OF NEVADA
KONDALRAO MOORI
12-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
SD02
25 OF 55
DRAWING NO.
XXX-XXXX

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M:\Projects\100036014_Cedar\H49866\Sheet Set\DWG\H49866-SD03 11-21-16 02:11 pm

NORTH

GRAPHIC SCALE
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(IN FEET)

CALL BEFORE CONSTRUCTION

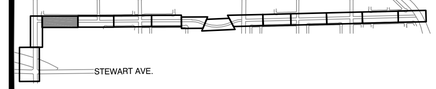
BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP

NORTH



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID#	XX-XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HB

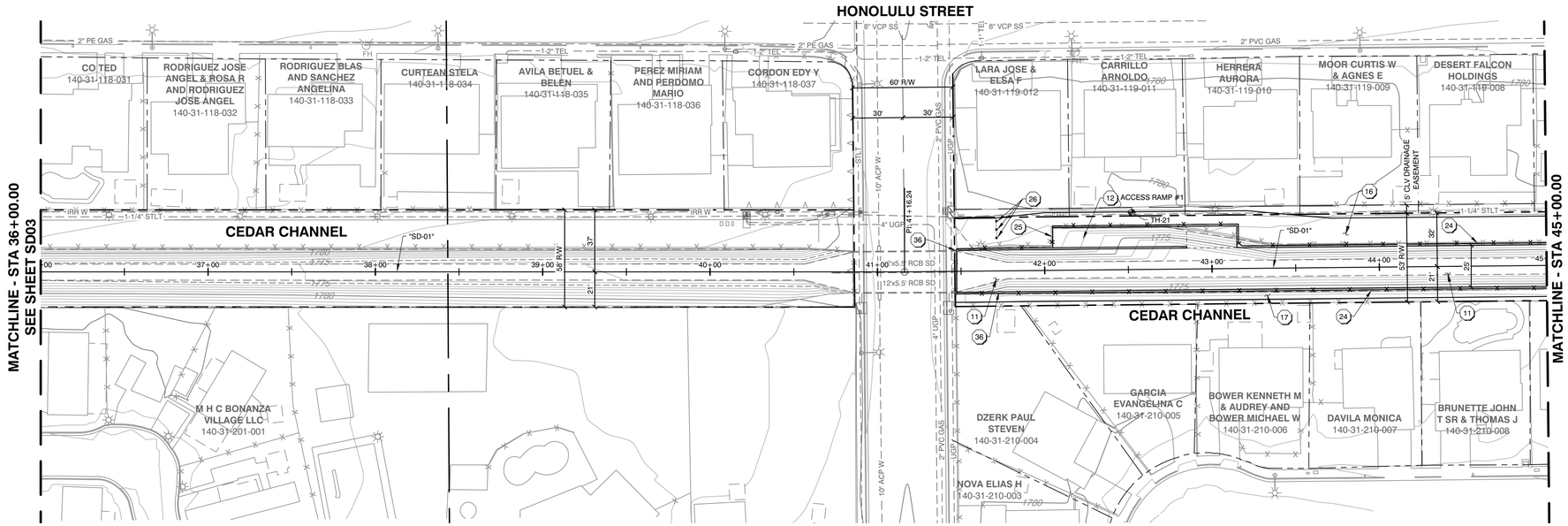
1# H49866
DATE: 11/18/2016
SUBMITTAL STAGE:
70% - PRELIMINARY

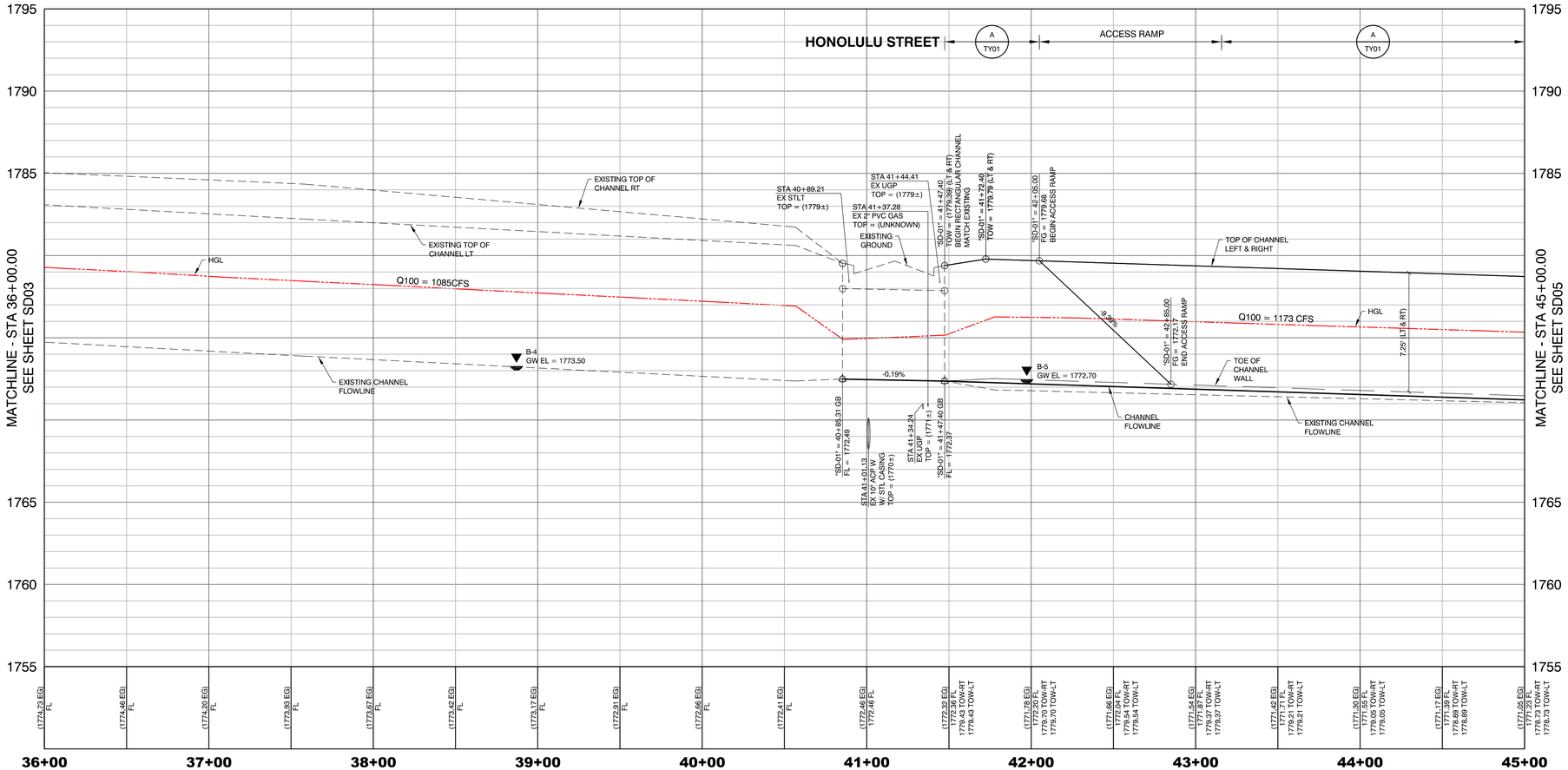
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 27+00 TO "SD01" 36+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALE R. MAHAN
No. 19685
CIVIL
NOT FOR CONSTRUCTION

SHEET
SD03
26 OF 55
DRAWING NO.
XXX-XXXX





GRAPHIC SCALE

20 0 10 20 40

(IN FEET)

NORTH

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
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TEST HOLE TABLE

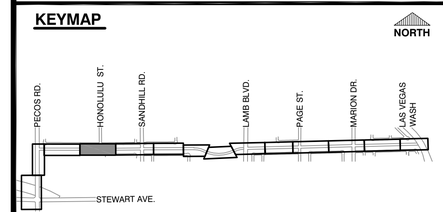
TEST HOLE #	DESCRIPTION
TH21	STLT

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

DATE: PROJECT# 123945

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR

CITY OF LAS VEGAS

BID# XX-XXXX	DESIGNED BY: KRM
DATE: 11/18/2016	DRAWN BY: MM
SUBMITTAL STAGE: 70% - PRELIMINARY	CHECKED BY: HB

1# H49866

TITLE

LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

STORM DRAIN PLAN AND PROFILE
"SD01" 36+00 TO "SD01" 45+00

PROFESSIONAL ENGINEER STATE OF NEVADA
KONDAL S. KORAD
No. 19685
CIVIL
EXPIRES 06-30-17
NOT FOR CONSTRUCTION

SHEET

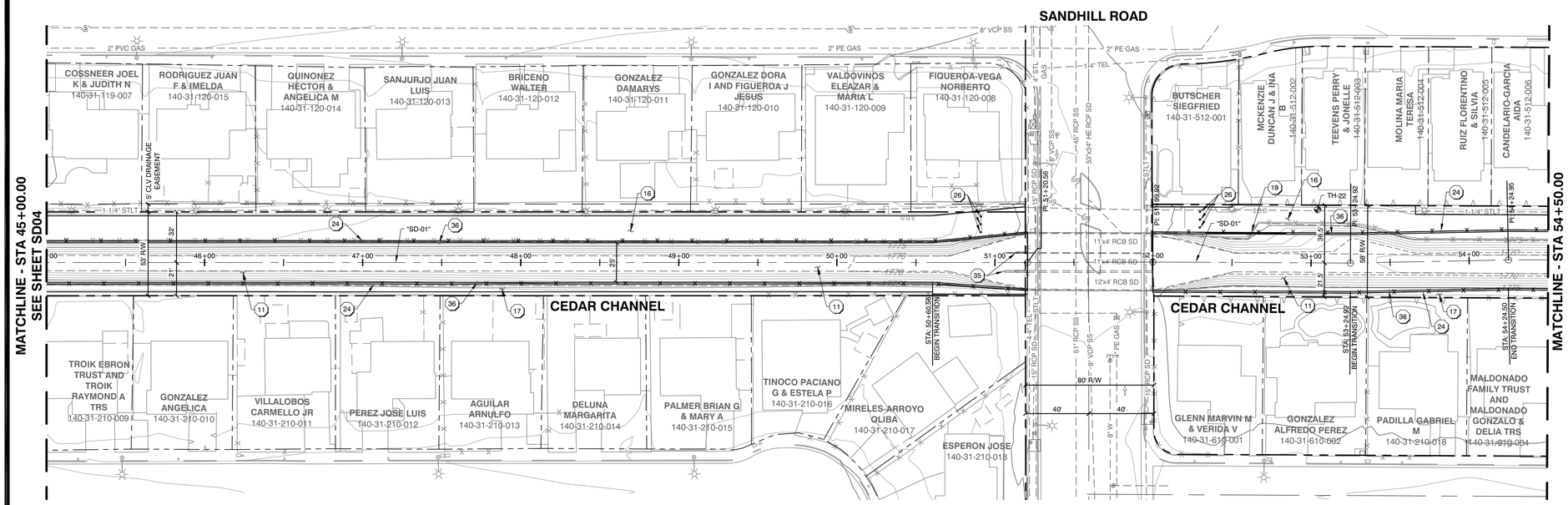
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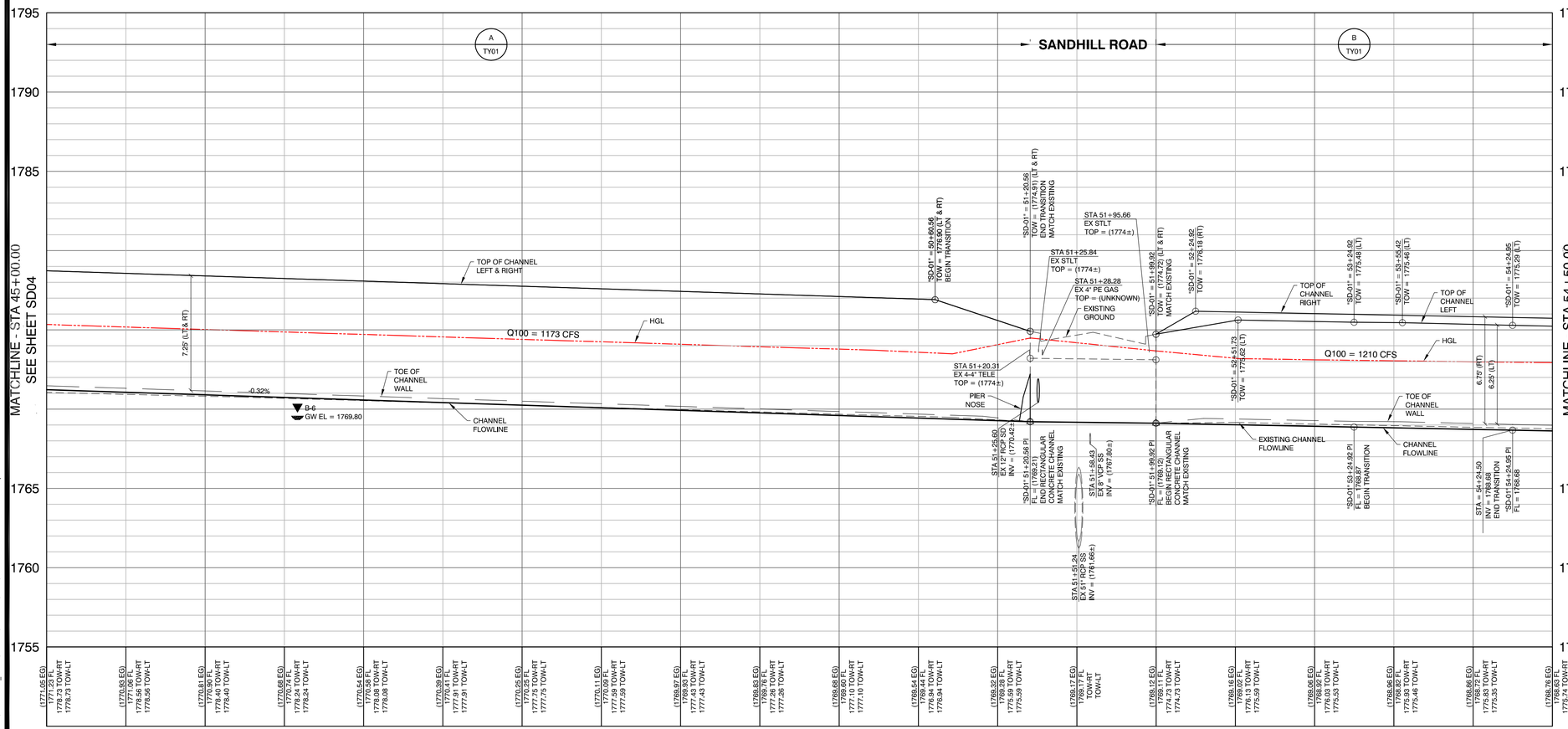
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XXX-XXXX

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NORTH

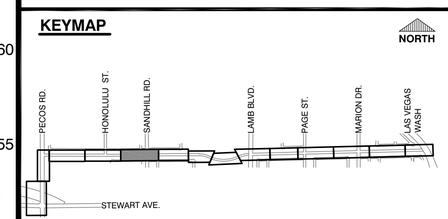
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. INSTALL 18" RCP SD AND CONNECT TO EXISTING PIPE AND PROPOSED RCBC
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3. INSTALL 5' X 3' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
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5. INSTALL 8' X 4' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
6. INSTALL 8' X 5' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
7. INSTALL 12' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
8. INSTALL 15' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
9. INSTALL 18' X 5' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
10. INSTALL RCB TRANSITION SEE DETAILS ON DRAWING ST01
11. CONSTRUCT RECTANGULAR CONCRETE CHANNEL PER DRAWINGS TY01 AND TY02
12. CONSTRUCT CHANNEL ACCESS RAMP, SEE DETAIL H DRAWING TY02
13. CONSTRUCT JUNCTION STRUCTURE, SEE STRUCTURAL DETAIL A ON DRAWING ST01
14. CONSTRUCT TYPE "C" MODIFIED DROP INLET PER USDCCA STD. DWG. NO. 412.1
15. CONSTRUCT TYPE I HEADWALL PER NDOT STD. DWG. B-20.15
16. CONSTRUCT AC TRAIL (2" AC OVER 4" TYPE II AGGREGATE BASE), PER TYPICAL SECTION DRAWINGS
17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY
18. INSTALL 48" ACCESS SDMH PER DETAIL 2 DRAWING SD17
19. CONSTRUCT ACCESS GATE PER DETAIL 1 DRAWING SD18
20. RELOCATE EXISTING UTILITY (BY OTHERS)
21. PIPE PENETRATION PER DETAIL XX DRAWING SD17
22. CONNECT EXISTING SD PIPE TO THE PROPOSED CHANNEL PER DETAIL XX, DRAWING SD17
23. PROTECT-IN-PLACE. CONTRACTOR TO SUPPORT UTILITY ACROSS THE TRENCH. ANY DESIGN REQUIRED TO SUPPORT THE UTILITY SHALL BE DONE BY THE CONTRACTOR'S ENGINEER AND SHALL BE LICENSED IN THE STATE OF NEVADA. (NO DIRECT PAYMENT)
24. CONSTRUCT POST AND CABLE FENCE PER DETAILS 4, 5, 6, AND 7, DRAWING SD19 (SEE TY DRAWINGS FOR FENCE HEIGHTS)
25. CONSTRUCT 12' WIDE CHANNEL ACCESS GATE PER DETAIL XX, DRAWING SDXX
26. CONSTRUCT COLLAPSIBLE BOLLARDS PER DETAIL 5, DRAWING ST02
27. CONSTRUCT TRANSITION FROM 12'X6' RCB TO THE EXISTING TRAPEZOIDAL CHANNEL PER DETAILS 1, 2, AND 3, DRAWING ST02
28. RELOCATE EXISTING 18" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
29. CONSTRUCT STORM DRAIN END CAP PER DETAIL 7, DRAWING SD17
30. INSTALL 48" SDMH WITH RCB JUNCTION STRUCTURE
31. RELOCATE EXISTING 36" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
32. REPROFILE EXISTING 12" SANITARY SEWER, SEE DRAWING SS01 FOR PLAN AND PROFILE
33. CONNECT EXISTING SD PIPE TO THE PROPOSED RCB PER DETAIL XX, DRAWING SD17
34. CONSTRUCT RCB CONNECTION STRUCTURE, SEE DETAILS 3, 4, 5, AND 6 ON DRAWING SD17
35. CONSTRUCT PIER NOSE PER DETAIL 4, DRAWING ST02
36. INSTALL ACCESS LADDER PER DETAILS 1, 2, AND 3, DRAWING SD19
37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

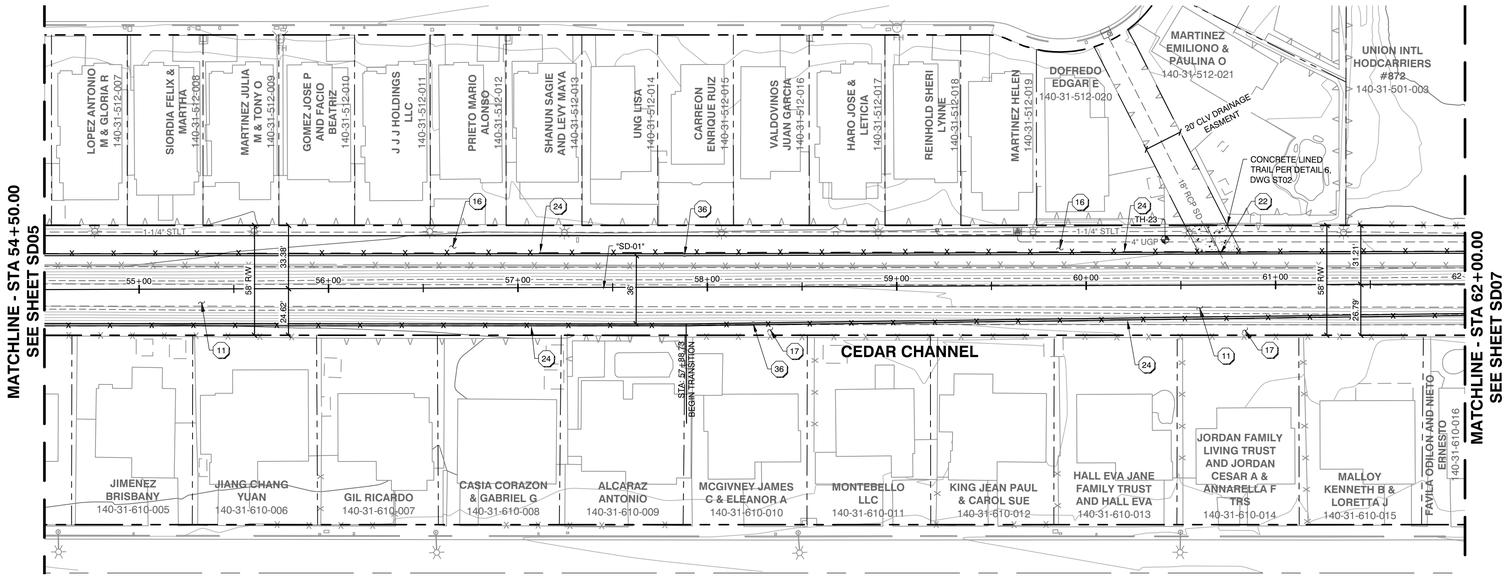
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DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	CHECKED BY: HB

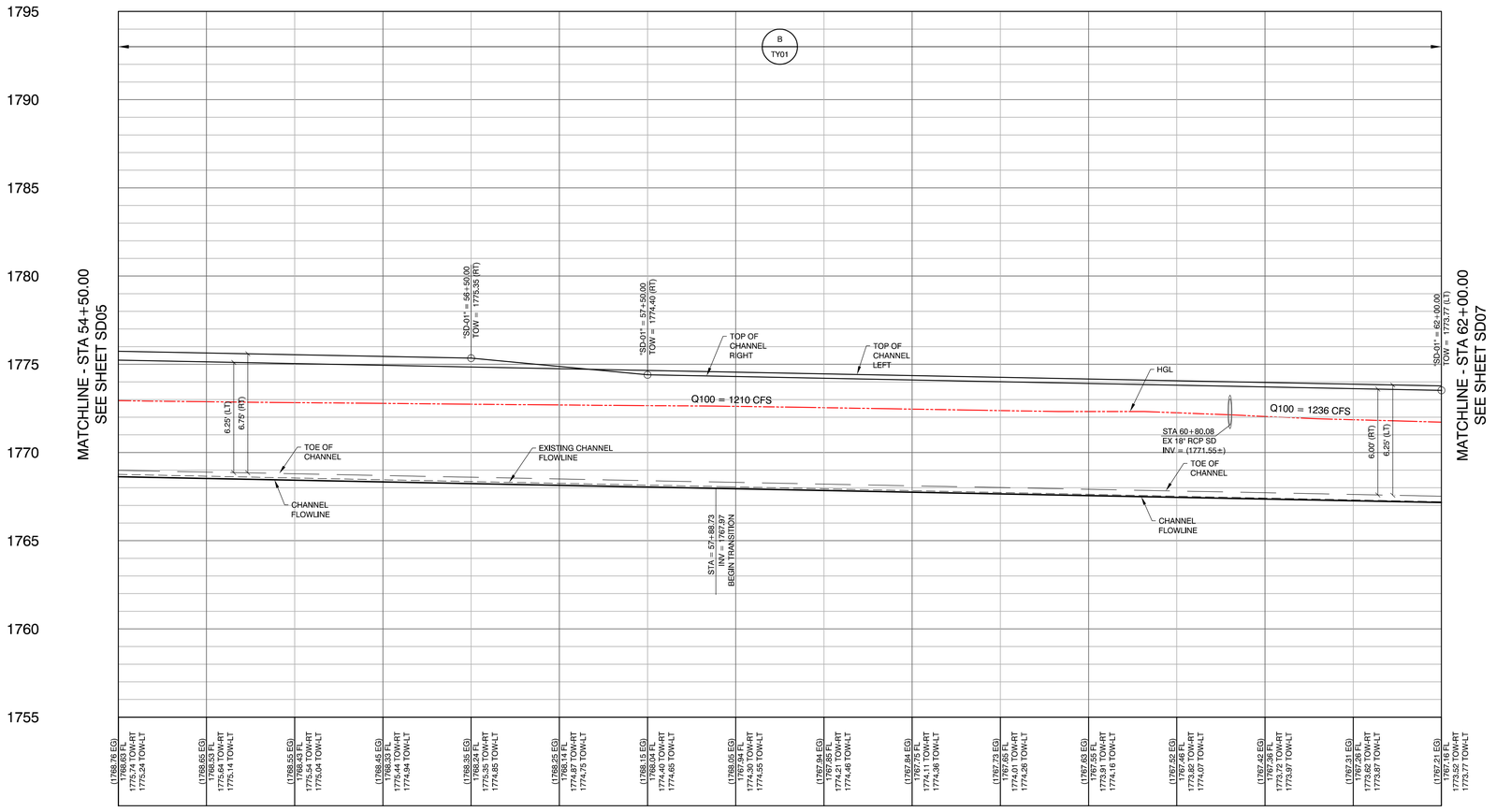
TITLE
LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE "SD01" 45+00 TO "SD01" 54+50

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALO RAMAKRISHNA MURTHY
No. 19685
CIVIL

SHEET
SD05
28 OF 55
DRAWING NO.
XXX-XXXX





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(IN FEET)

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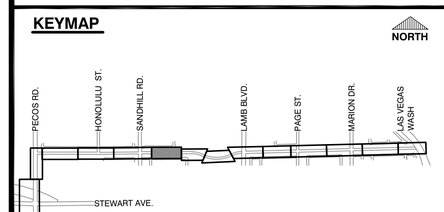
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

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19. CONSTRUCT ACCESS GATE PER DETAIL 1 DRAWING SD18
20. RELOCATE EXISTING UTILITY (BY OTHERS)
21. PIPE PENETRATION PER DETAIL XX DRAWING SD17
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26. CONSTRUCT COLLAPSIBLE BOLLARDS PER DETAIL 5, DRAWING ST02
27. CONSTRUCT TRANSITION FROM 12'X6' RCB TO THE EXISTING TRAPEZOIDAL CHANNEL PER DETAILS 1, 2, AND 3, DRAWING ST02
28. RELOCATE EXISTING 18" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
29. CONSTRUCT STORM DRAIN END CAP PER DETAIL 7, DRAWING SD17
30. INSTALL 48" SDMH WITH RCB JUNCTION STRUCTURE
31. RELOCATE EXISTING 36" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
32. REPROFILE EXISTING 12" SANITARY SEWER, SEE DRAWING SS01 FOR PLAN AND PROFILE
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36. INSTALL ACCESS LADDER PER DETAILS 1, 2, AND 3, DRAWING SD19
37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

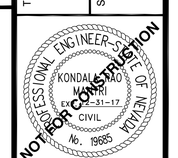
PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7290

PREPARED FOR
CITY OF LAS VEGAS

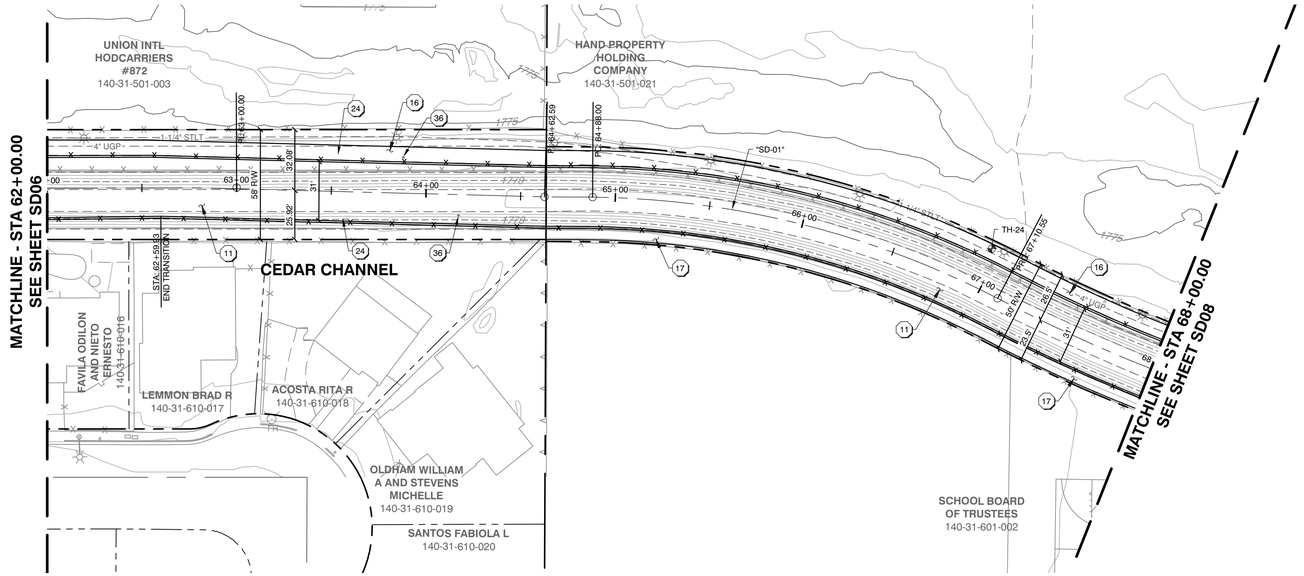
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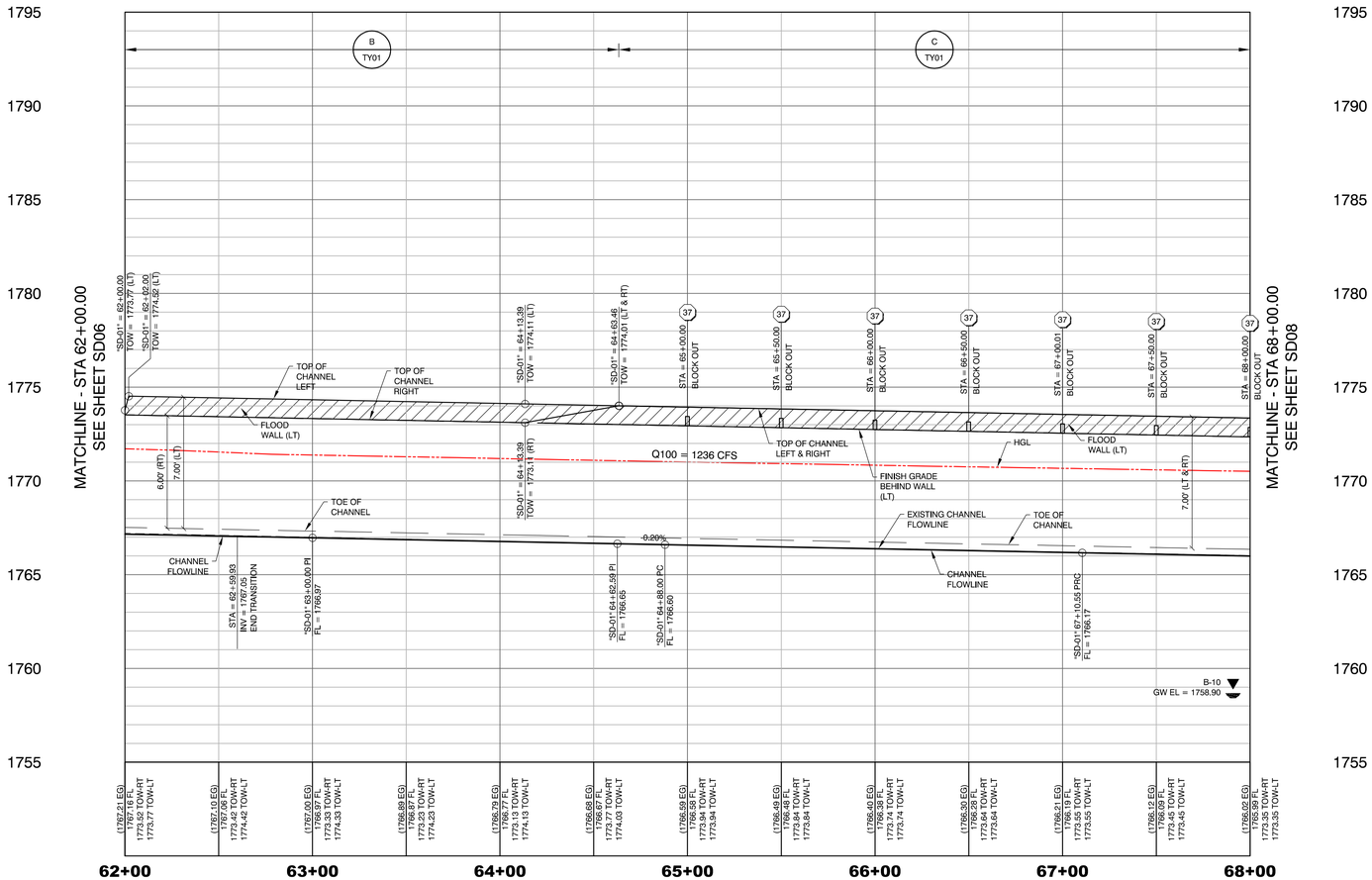
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 54+50 TO "SD01" 62+00



SHEET
SD06
29 OF 55
DRAWING NO
XXX-XXXX





GRAPHIC SCALE

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(IN FEET)

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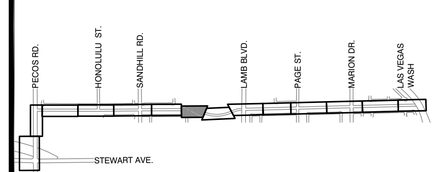
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7290

PREPARED FOR
CITY OF LAS VEGAS

1#	H49866
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

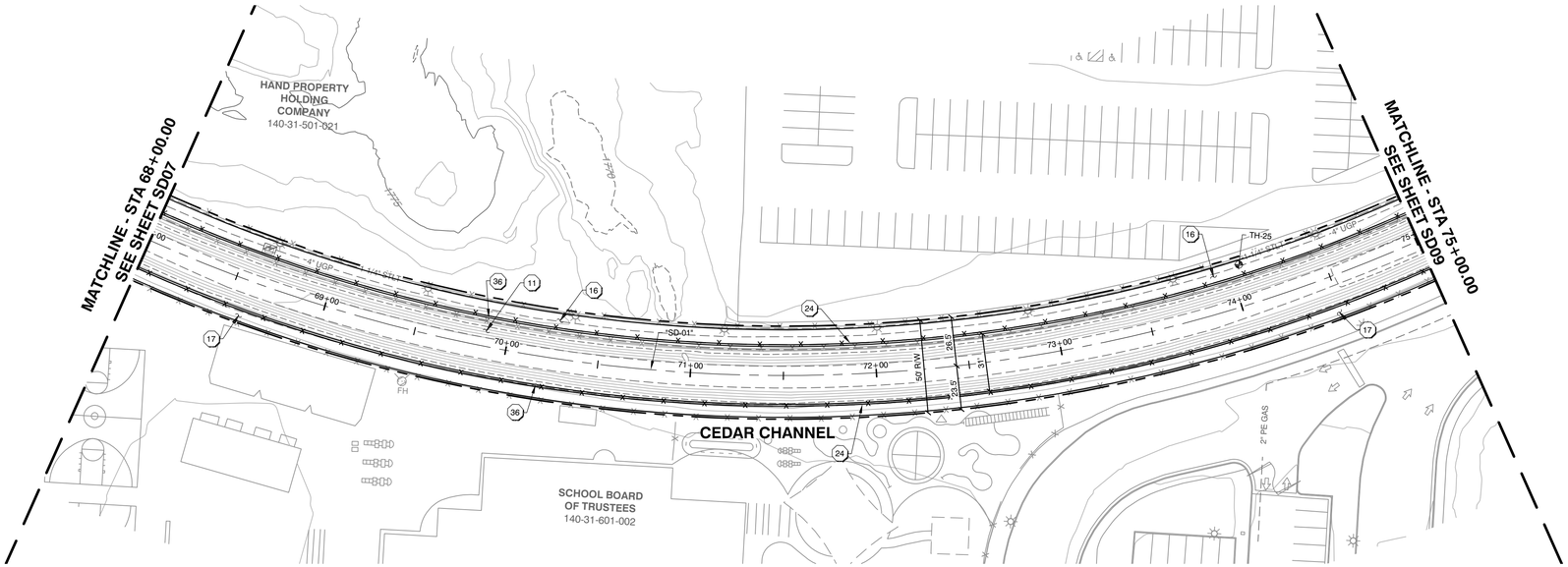
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STORM DRAIN PLAN AND PROFILE
"SD01" 62+00 TO "SD01" 68+00

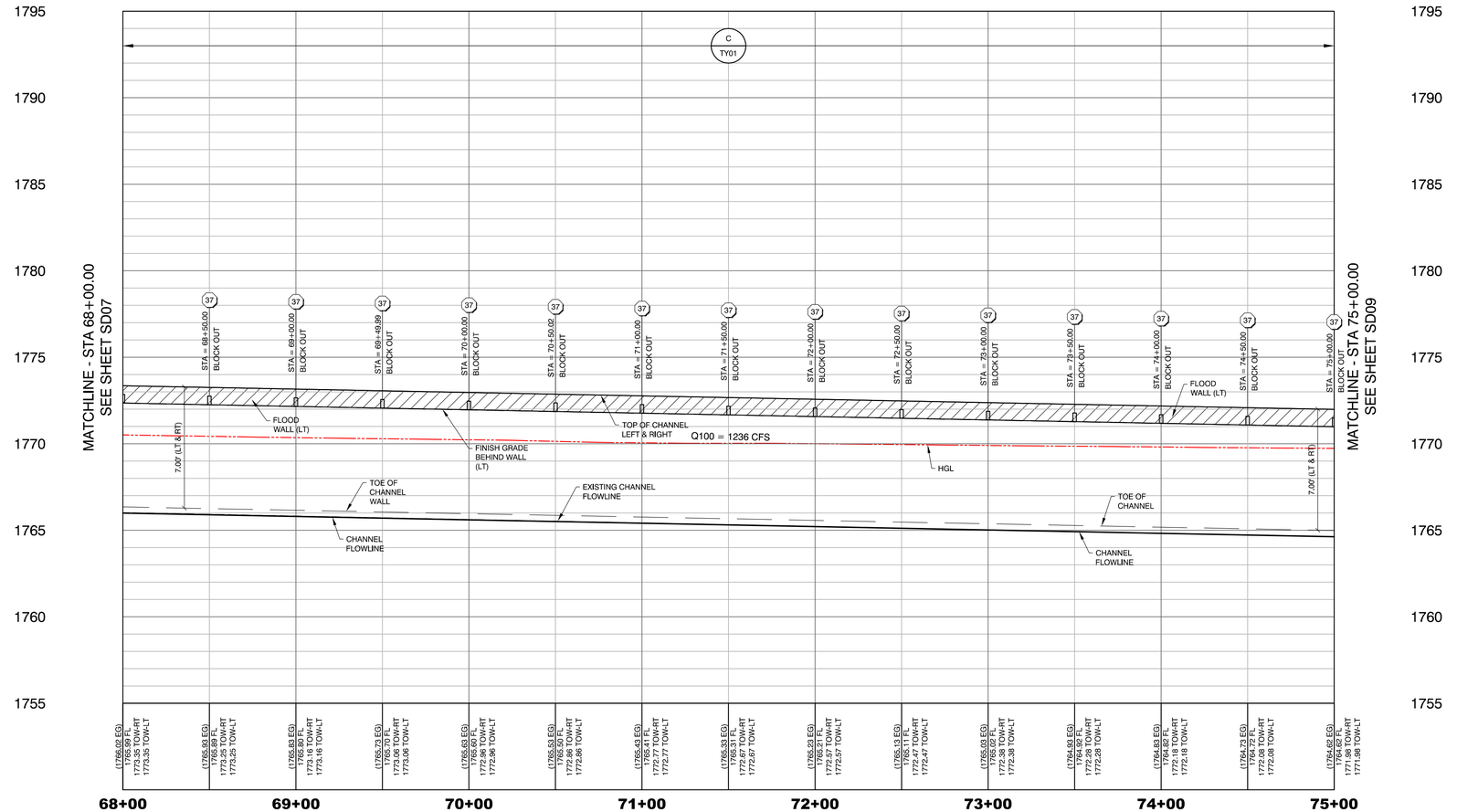
NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDAL RAO
VARMA
No. 19685
CIVIL

SHEET
SD07
30 OF 55

DRAWING NO.
XXX-XXXX

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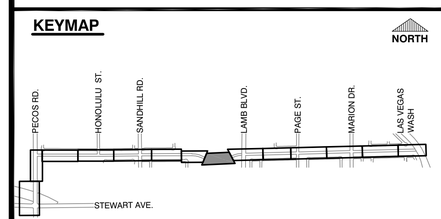
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
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BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
CITY OF LAS VEGAS NEVADA
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

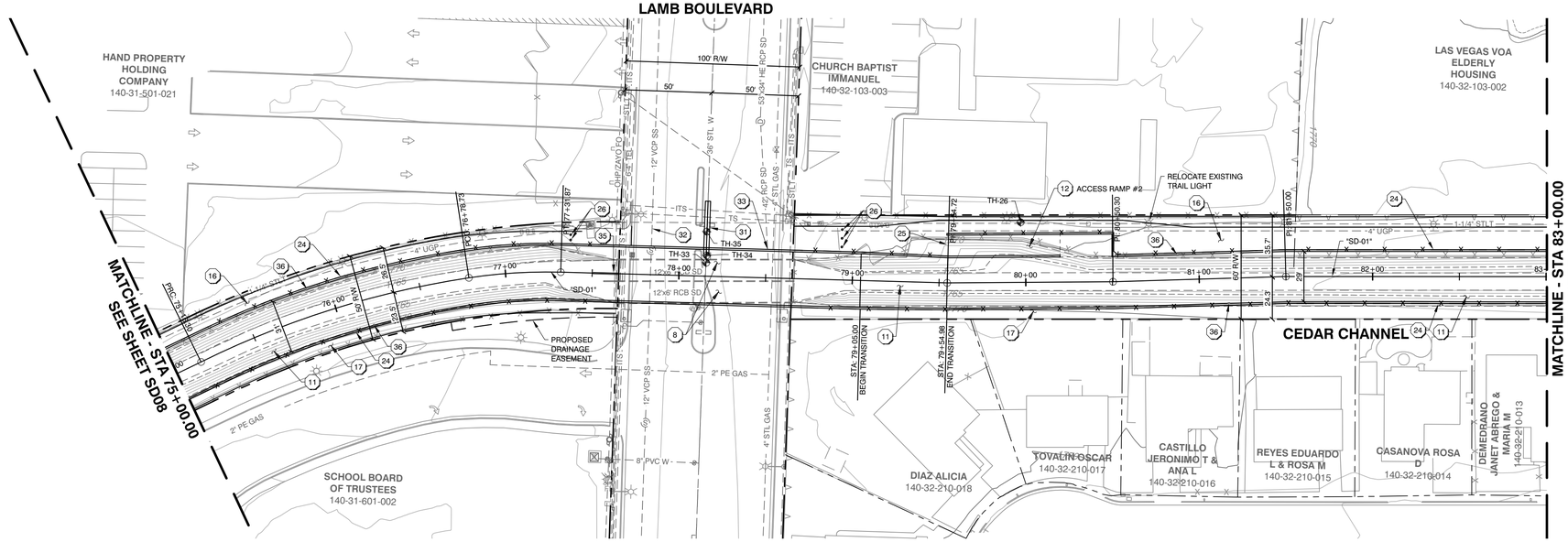
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DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	

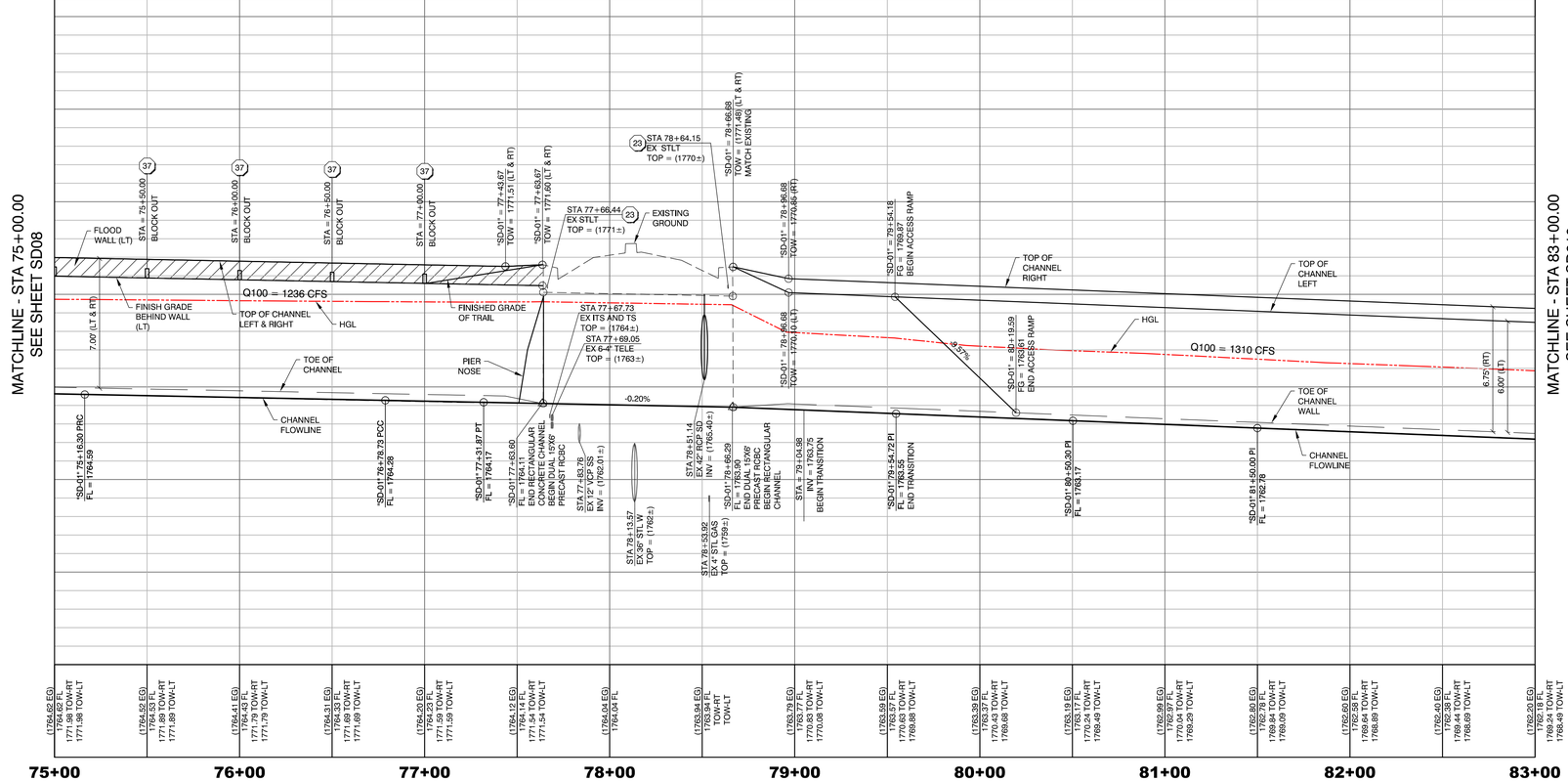
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 68+00 TO "SD01" 75+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALEE MARIE MAHAN
EXPIRES 11-30-17
CIVIL
No. 19685

SHEET
SD08
31 OF 55
DRAWING NO.
XXX-XXXX





GRAPHIC SCALE

NORTH

20 0 10 20 40

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

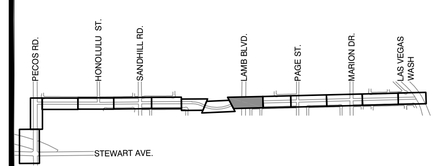
CONSTRUCTION KEY NOTES

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4. INSTALL 7' X 3' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
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6. INSTALL 8' X 5' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
7. INSTALL 12' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
8. INSTALL 15' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
9. INSTALL 18' X 5' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
10. INSTALL RCB TRANSITION SEE DETAILS ON DRAWING ST01
11. CONSTRUCT RECTANGULAR CONCRETE CHANNEL PER DRAWINGS TY01 AND TY02
12. CONSTRUCT CHANNEL ACCESS RAMP, SEE DETAIL H DRAWING TY02
13. CONSTRUCT JUNCTION STRUCTURE, SEE STRUCTURAL DETAIL A ON DRAWING ST01
14. CONSTRUCT TYPE "C" MODIFIED DROP INLET PER USDCCA STD. DWG. NO. 412.1
15. CONSTRUCT TYPE I HEADWALL PER NDOT STD. DWG. B-20.15
16. CONSTRUCT AC TRAIL (2" AC OVER 4" TYPE II AGGREGATE BASE), PER TYPICAL SECTION DRAWINGS
17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY
18. INSTALL 48" ACCESS SDMH PER DETAIL 2 DRAWING SD17
19. CONSTRUCT ACCESS GATE PER DETAIL 1 DRAWING SD18
20. RELOCATE EXISTING UTILITY (BY OTHERS)
21. PIPE PENETRATION PER DETAIL XX DRAWING SD17
22. CONNECT EXISTING SD PIPE TO THE PROPOSED CHANNEL PER DETAIL XX, DRAWING SD17
23. PROTECT-IN-PLACE. CONTRACTOR TO SUPPORT UTILITY ACROSS THE TRENCH. ANY DESIGN REQUIRED TO SUPPORT THE UTILITY SHALL BE DONE BY THE CONTRACTOR'S ENGINEER AND SHALL BE LICENSED IN THE STATE OF NEVADA. (NO DIRECT PAYMENT)
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25. CONSTRUCT 12' WIDE CHANNEL ACCESS GATE PER DETAIL XX, DRAWING SDXX
26. CONSTRUCT COLLAPSIBLE BOLLARDS PER DETAIL 5, DRAWING ST02
27. CONSTRUCT TRANSITION FROM 12'X6' RCB TO THE EXISTING TRAPEZOIDAL CHANNEL PER DETAILS 1, 2, AND 3, DRAWING ST02
28. RELOCATE EXISTING 18" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
29. CONSTRUCT STORM DRAIN END CAP PER DETAIL 7, DRAWING SD17
30. INSTALL 48" SDMH WITH RCB JUNCTION STRUCTURE
31. RELOCATE EXISTING 36" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
32. REPROFILE EXISTING 12" SANITARY SEWER, SEE DRAWING SS01 FOR PLAN AND PROFILE
33. CONNECT EXISTING SD PIPE TO THE PROPOSED RCB PER DETAIL XX, DRAWING SD17
34. CONSTRUCT RCB CONNECTION STRUCTURE, SEE DETAILS 3, 4, 5, AND 6 ON DRAWING SD17
35. CONSTRUCT PIER NOSE PER DETAIL 4, DRAWING ST02
36. INSTALL ACCESS LADDER PER DETAILS 1, 2, AND 3, DRAWING SD19
37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123945

KEYMAP



REVISIONS	DATE	NO.

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY

TITLE

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

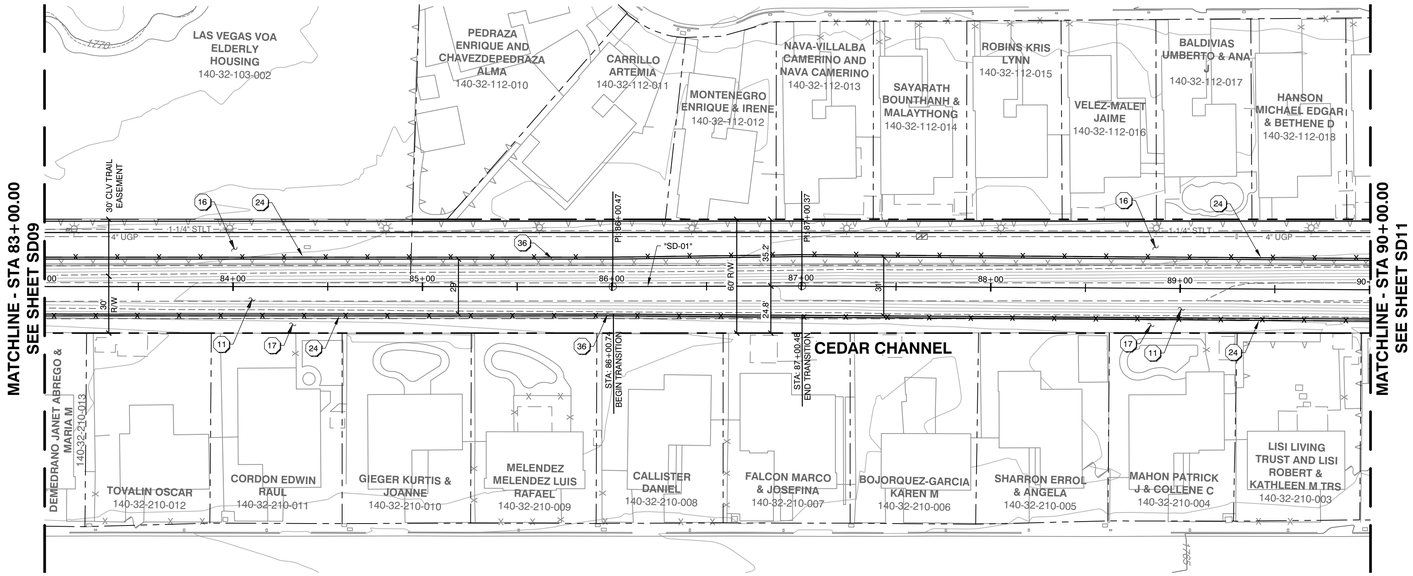
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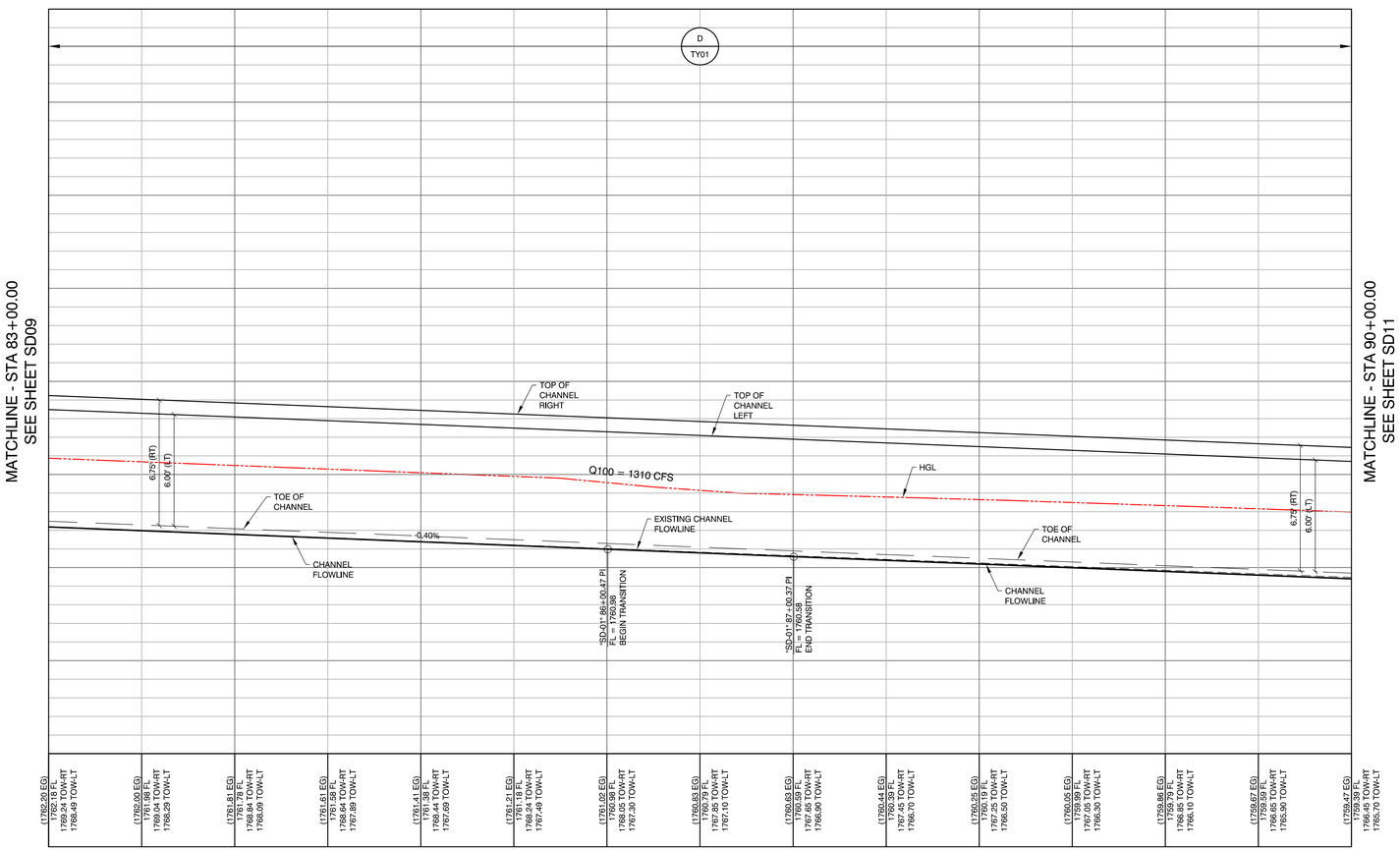
STORM DRAIN PLAN AND PROFILE "SD01" 75+00 TO "SD01" 83+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALE MAHAD
EXPIRES 06-30-17
CIVIL
No. 19685

SHEET
SD09
32 OF 55
DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE
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(IN FEET)

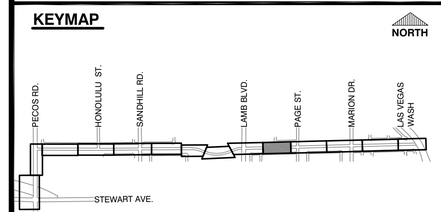
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	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7290

PREPARED FOR
CITY OF LAS VEGAS

BID#	XX.XXXX	DESIGNED BY:	KRM
H#	H49866	DRAWN BY:	MM
DATE:	11/18/2016	CHECKED BY:	HD

SUBMITTAL STAGE: 70% - PRELIMINARY

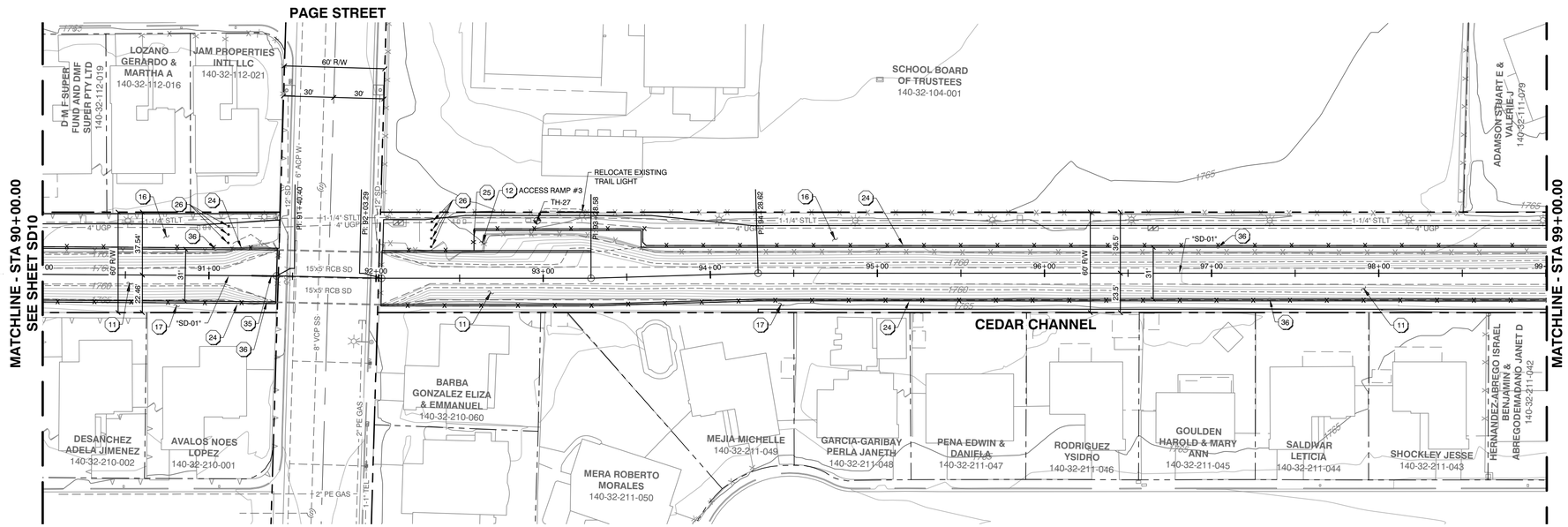
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

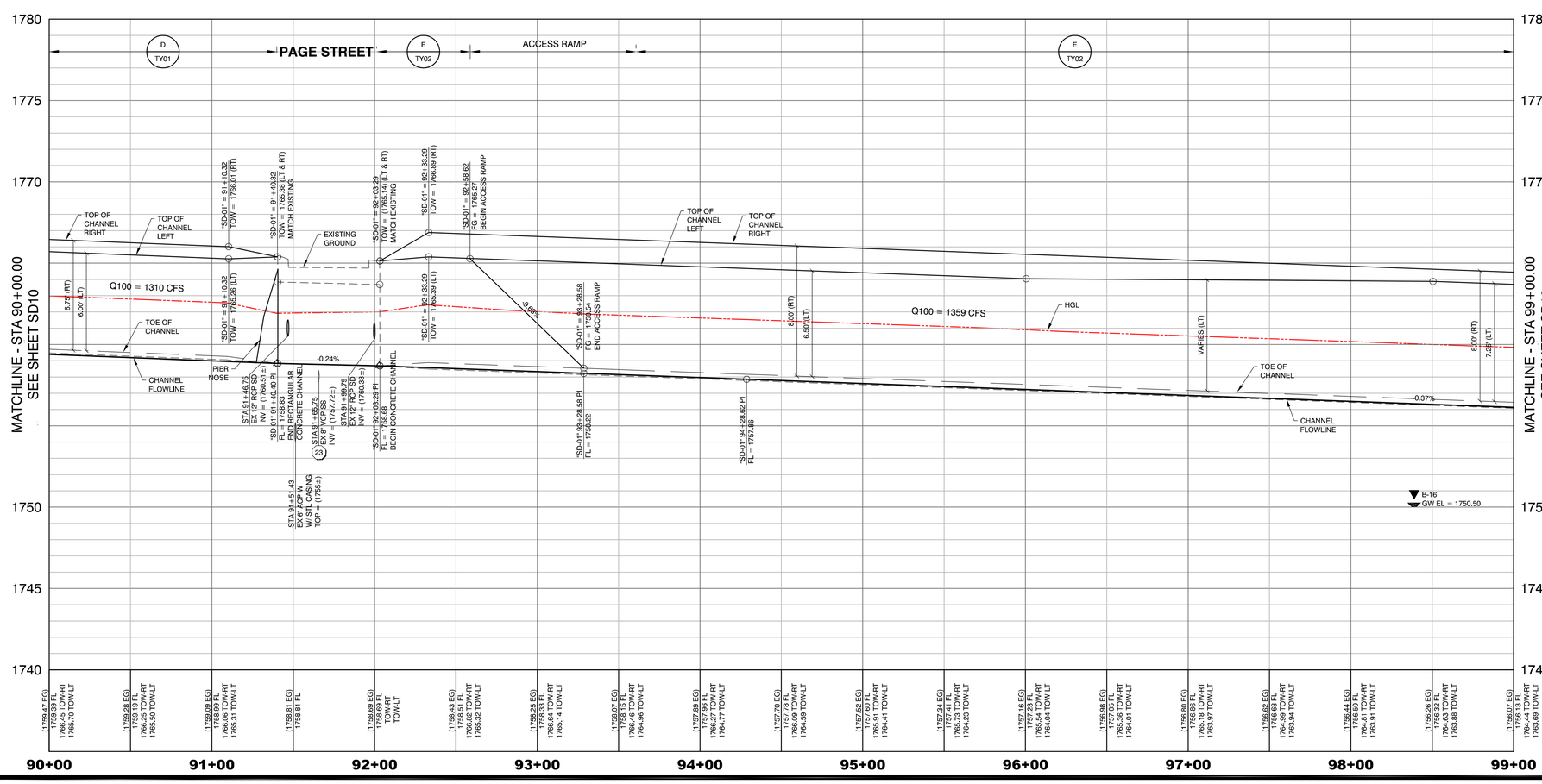
SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 83+00 TO "SD01" 90+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDAL S. MADAKA
Exp. 06-30-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
SD10
33 OF 55

DRAWING NO.
XXX-XXXX





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GRAPHIC SCALE

20 0 10 20 40

(IN FEET)

NORTH

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123945

KEYMAP

NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7274
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

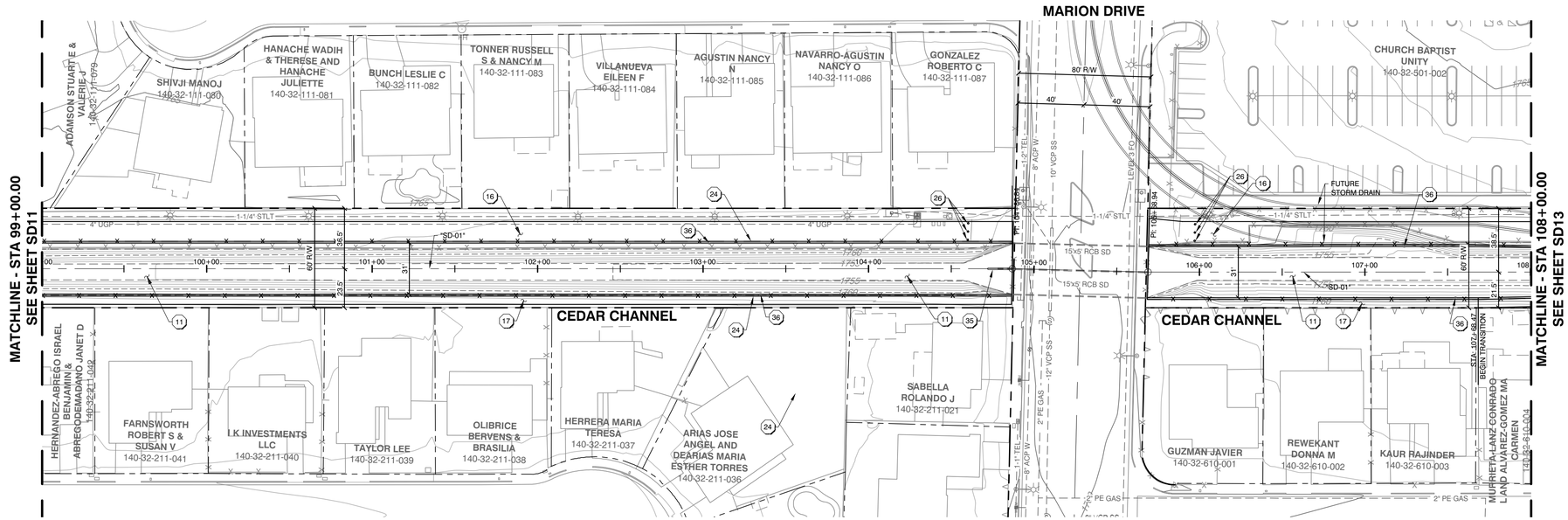
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DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	
		CHECKED BY: HD	

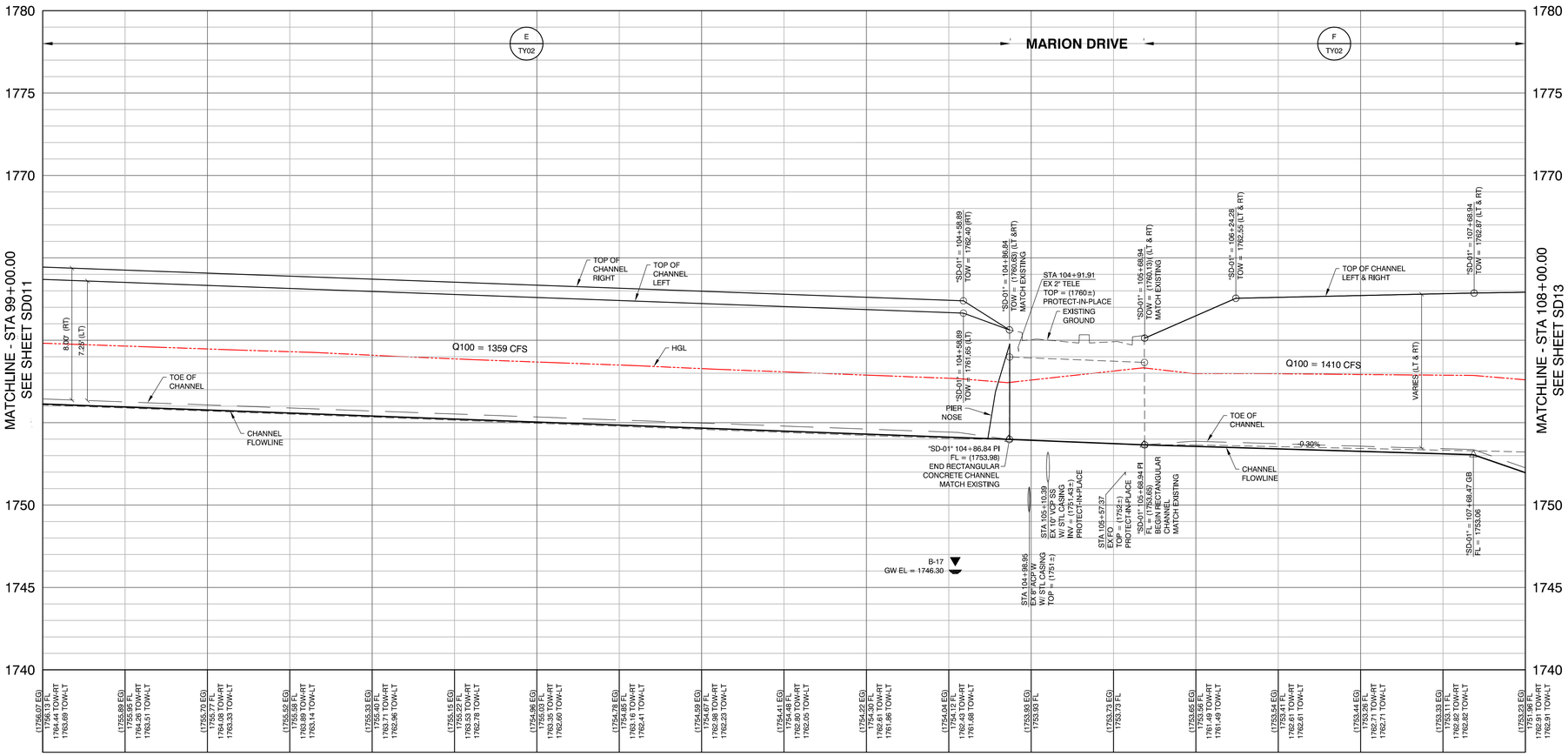
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 90+00 TO "SD01" 99+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER
STATE OF NEVADA
KONDALRAO MUTHYALA
12-31-17
CIVIL
No. 19685

SHEET
SD11
34 OF 55
DRAWING NO
XXX-XXXX





GRAPHIC SCALE

NORTH

20 0 10 20 40

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
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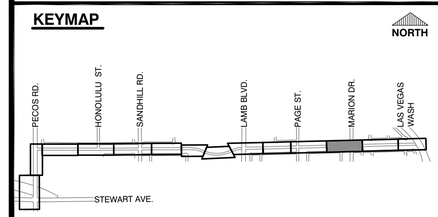
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APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123945

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7274
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID# XX.XXXX	DESIGNED BY: KRM
#: H49866	DRAWN BY: MM
DATE: 11/18/2016	CHECKED BY: HD
SUBMITTAL STAGE: 70% - PRELIMINARY	

TITLE
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CEDAR AVENUE CHANNEL

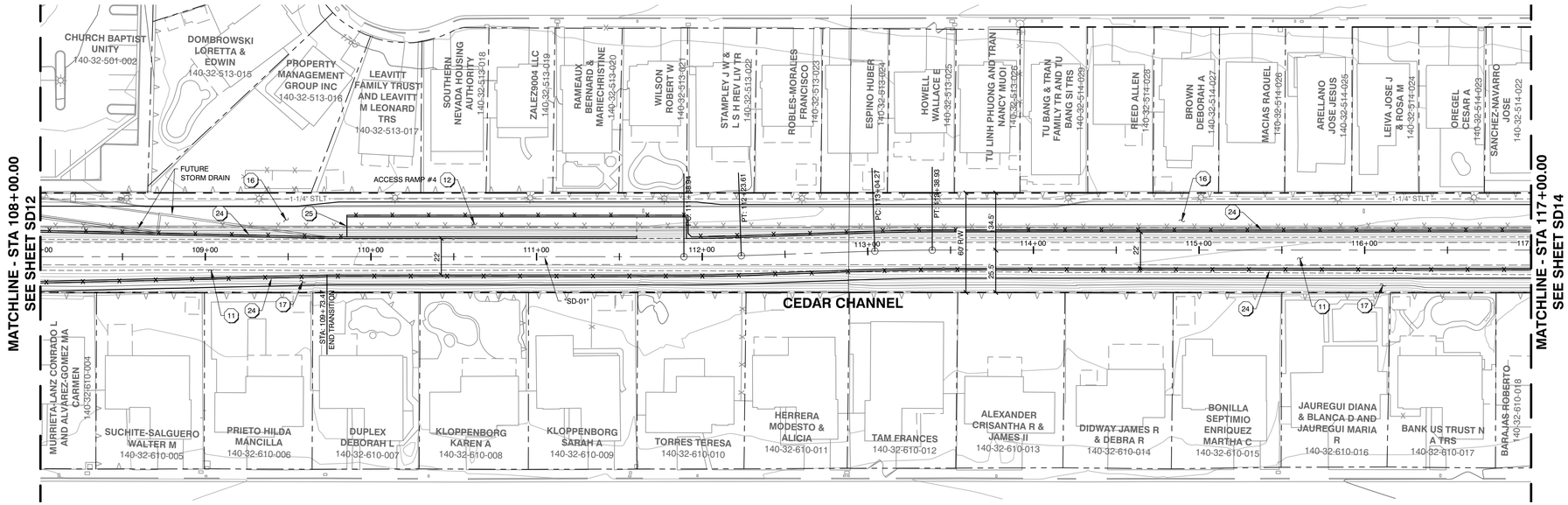
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STORM DRAIN PLAN AND PROFILE
"SD01" 99+00 TO "SD01" 108+00

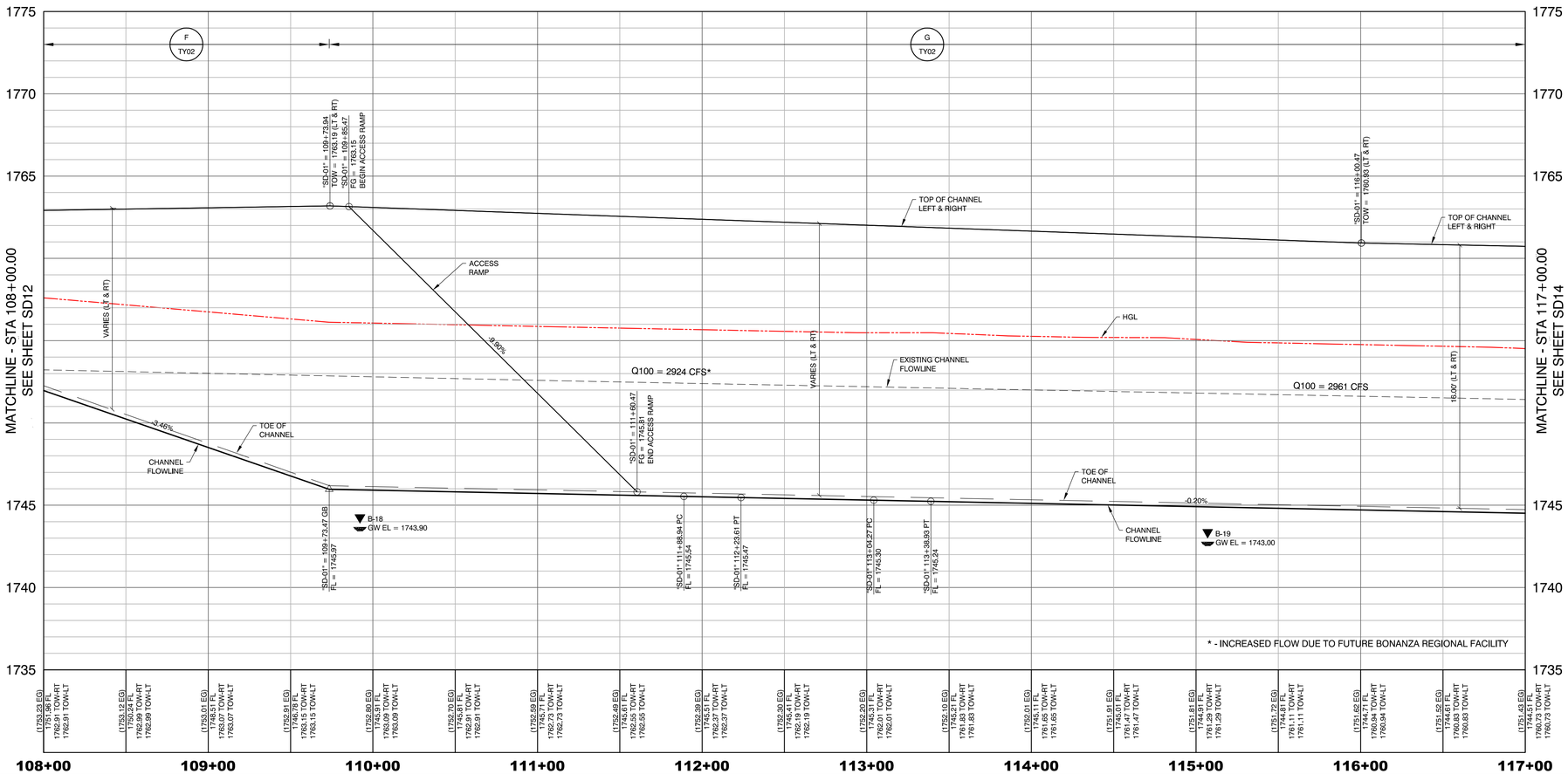
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDAL S. MAGAM
EXP. 06-30-17
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NOT FOR CONSTRUCTION

SHEET
SD12
35 OF 55

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

NORTH

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(IN FEET)

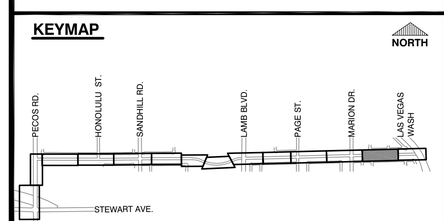
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. INSTALL 18" RCP SD AND CONNECT TO EXISTING PIPE AND PROPOSED RCBC
2. INSTALL 24" RCP SD AND CONNECT TO EXISTING DROP INLET AND PROPOSED RCBC
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5. INSTALL 8' X 4' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
6. INSTALL 8' X 5' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
7. INSTALL 12' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
8. INSTALL 15' X 6' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
9. INSTALL 18' X 5' RCB SD PER RCB TRENCH DETAIL 1, DRAWING SD17
10. INSTALL RCB TRANSITION SEE DETAILS ON DRAWING ST01
11. CONSTRUCT RECTANGULAR CONCRETE CHANNEL PER DRAWINGS TY01 AND TY02
12. CONSTRUCT CHANNEL ACCESS RAMP, SEE DETAIL H DRAWING TY02
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17. CONSTRUCT 5' TYPE II AGGREGATE BASE MANWAY
18. INSTALL 48" ACCESS SDMH PER DETAIL 2 DRAWING SD17
19. CONSTRUCT ACCESS GATE PER DETAIL 1 DRAWING SD18
20. RELOCATE EXISTING UTILITY (BY OTHERS)
21. PIPE PENETRATION PER DETAIL XX DRAWING SD17
22. CONNECT EXISTING SD PIPE TO THE PROPOSED CHANNEL PER DETAIL XX, DRAWING SD17
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25. CONSTRUCT 12' WIDE CHANNEL ACCESS GATE PER DETAIL XX, DRAWING SDXX
26. CONSTRUCT COLLAPSIBLE BOLLARDS PER DETAIL 5, DRAWING ST02
27. CONSTRUCT TRANSITION FROM 12'X6' RCB TO THE EXISTING TRAPEZOIDAL CHANNEL PER DETAILS 1, 2, AND 3, DRAWING ST02
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29. CONSTRUCT STORM DRAIN END CAP PER DETAIL 7, DRAWING SD17
30. INSTALL 48" SDMH WITH RCB JUNCTION STRUCTURE
31. RELOCATE EXISTING 36" WATERLINE, SEE DRAWING WT01 FOR PLAN AND PROFILE
32. REPROFILE EXISTING 12" SANITARY SEWER, SEE DRAWING SS01 FOR PLAN AND PROFILE
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36. INSTALL ACCESS LADDER PER DETAILS 1, 2, AND 3, DRAWING SD19
37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, NV 89074
Tel: +1 (702) 263 7274
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1# H49866 | BID# XX-XXXX | DESIGNED BY: KRM
DATE: 11/18/2016 | SUBMITTAL STAGE: 70% - PRELIMINARY | DRAWN BY: MM | CHECKED BY: HD

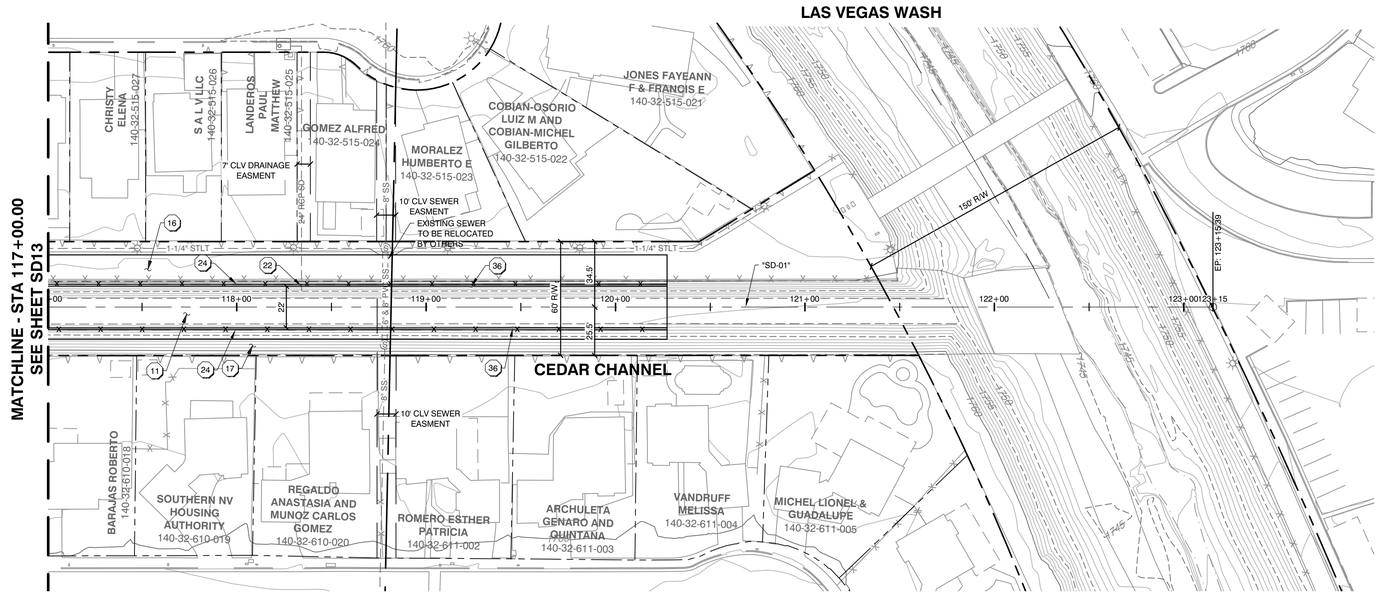
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

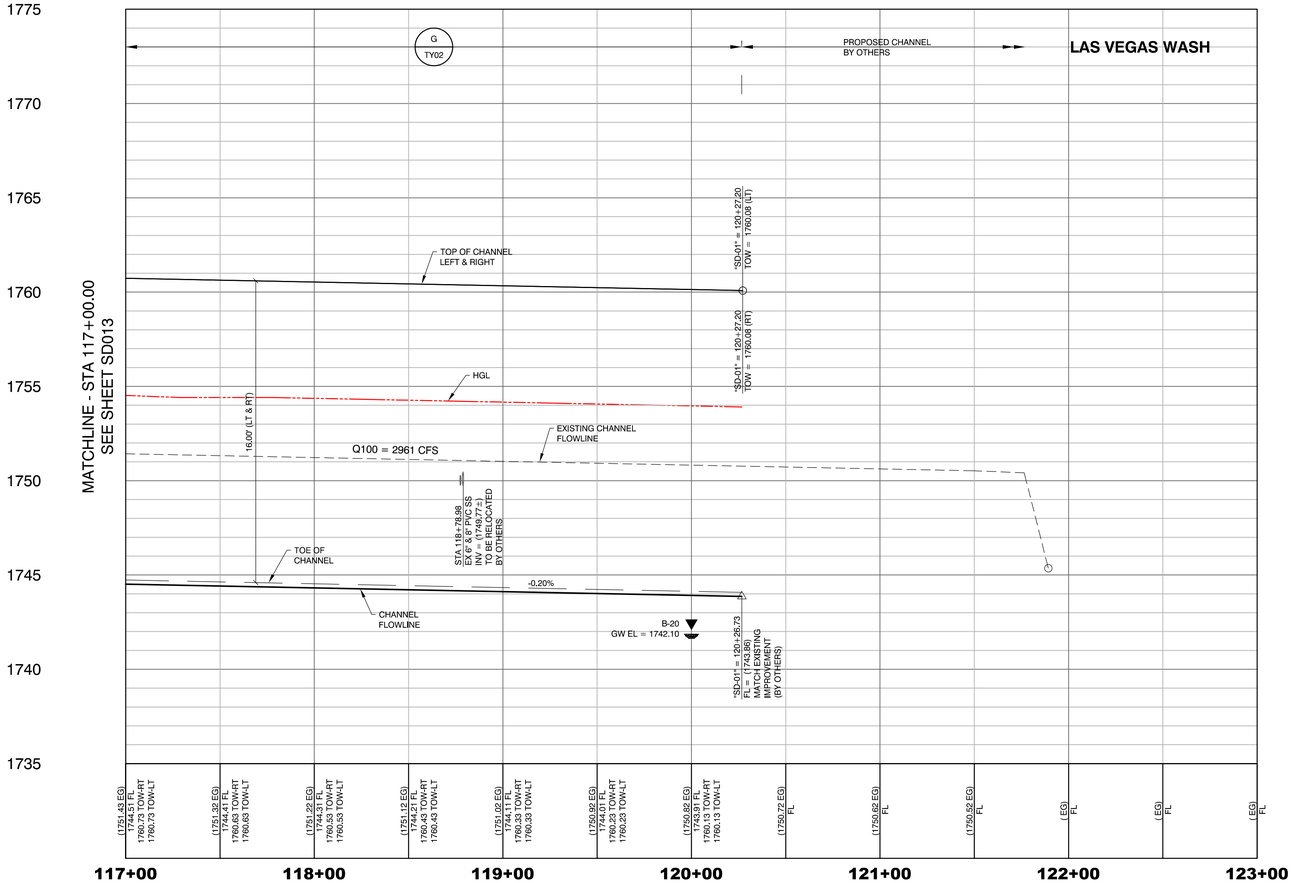
SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 108+00 TO "SD01" 117+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALAH NAIDU
No. 19685
CIVIL

SHEET
SD13
36 OF 55

DRAWING NO.
XXX-XXXX





GRAPHIC SCALE
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(IN FEET)

NORTH

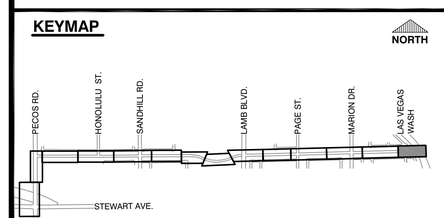
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BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

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37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7274
Fax: +1 (702) 263 7290

PREPARED FOR
CITY OF LAS VEGAS

BID#	XX-XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD
#:	H49866
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY

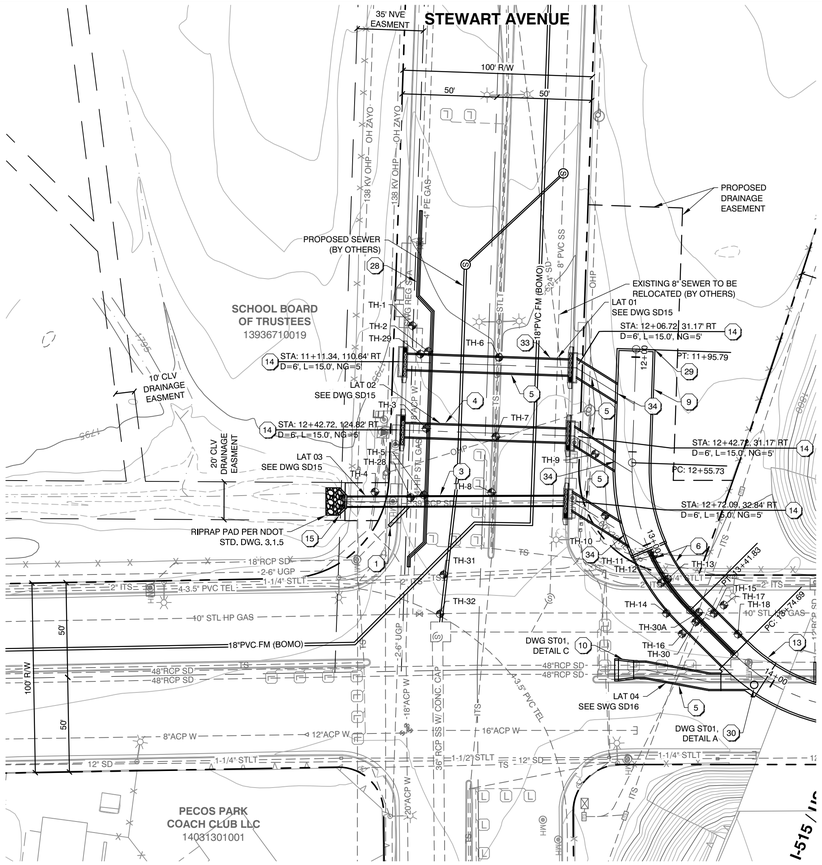
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

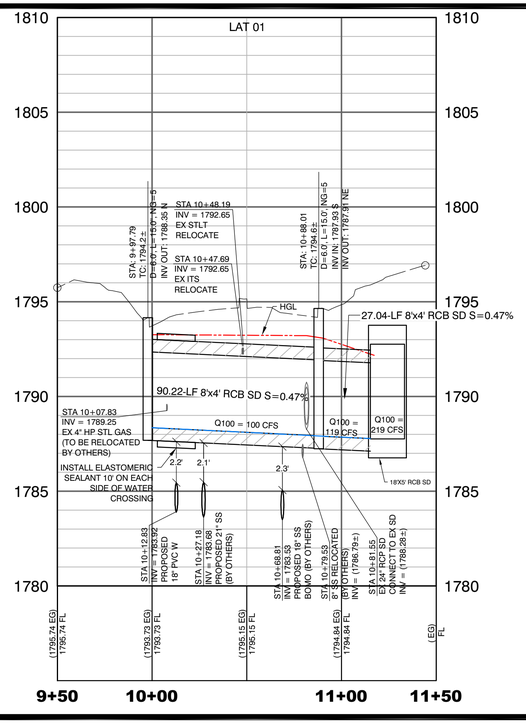
SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 117+00 TO "SD01" 123+00

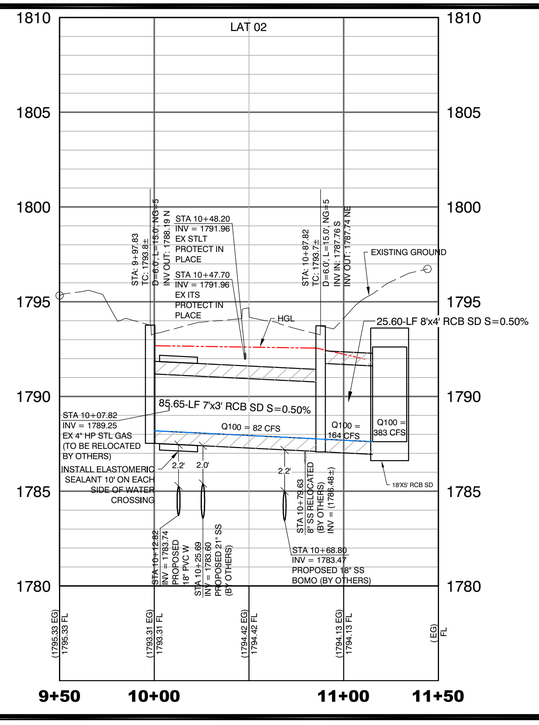
NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALAHO
WARREN
No. 19685
CIVIL

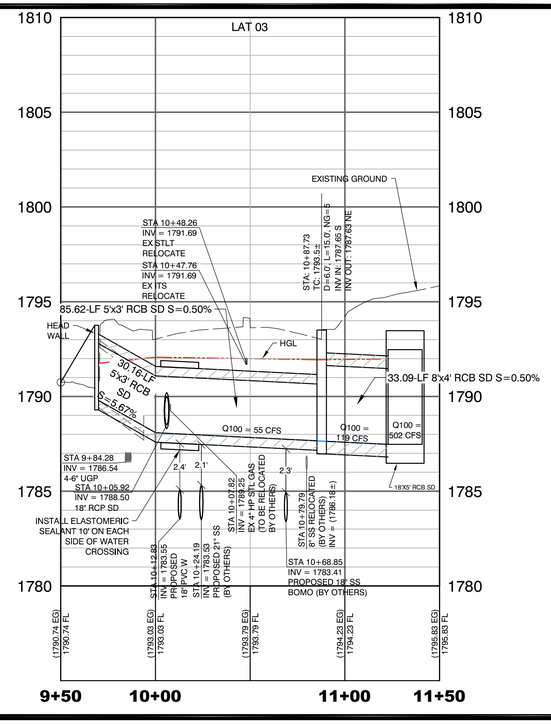
SHEET
SD14
37 OF 55
DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE
20 0 10 20 40
(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

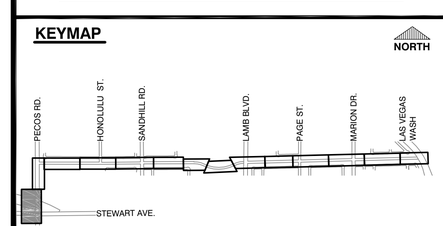
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37. CONSTRUCT FLOOD WALL BLOCK OUT PER DETAIL 8, DRAWING SD 17

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER
DATE: PROJECT# 123945

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY
CITY OF LAS VEGAS NEVADA
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

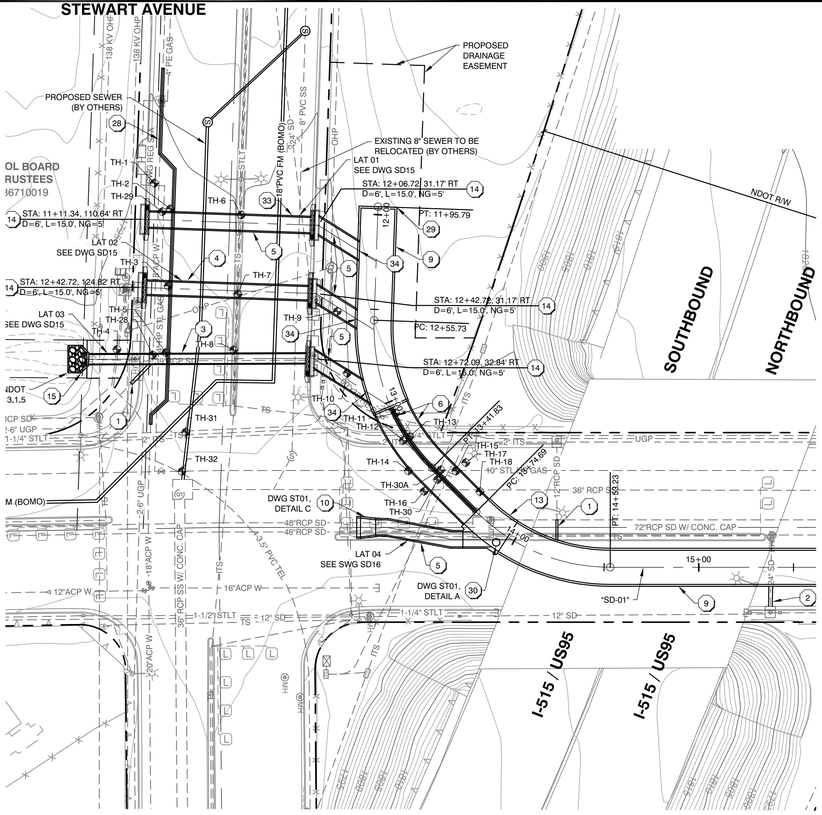
PREPARED FOR
CITY OF LAS VEGAS

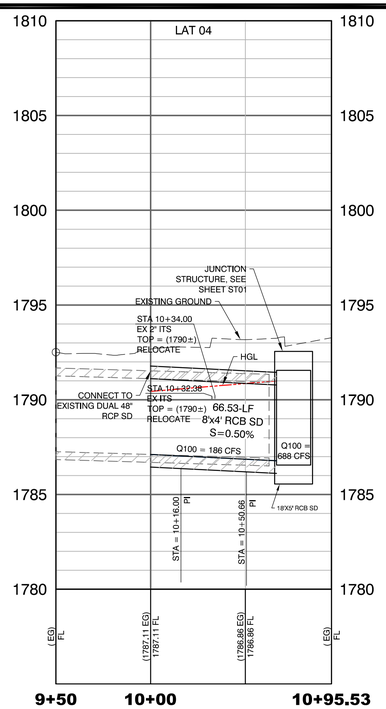
I#: H49866	BID# XX-XXXX	DESIGNED BY: KRM	CHECKED BY: HB
DATE: 11/18/2016	SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM	

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL
STORM DRAIN LATERAL
PLAN AND PROFILE

SHEET
SD15
38 OF 55
DRAWING NO.
XXX-XXXX

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALRAO MANGIPUDI
No. 19685
CIVIL
6-30-17
NOT FOR CONSTRUCTION





GRAPHIC SCALE

20 0 10 20 40

(IN FEET)

NORTH

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

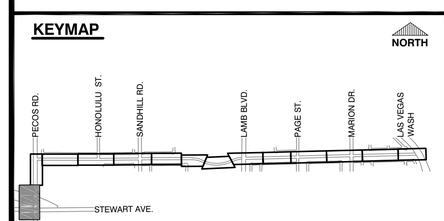
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APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

DATE: PROJECT# 123945

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID# XX-XXXX
DESIGNED BY: KRM
DRAWN BY: MM
CHECKED BY: HB

I# H49866
DATE: 11/18/2016
SUBMITTAL STAGE:
70% - PRELIMINARY

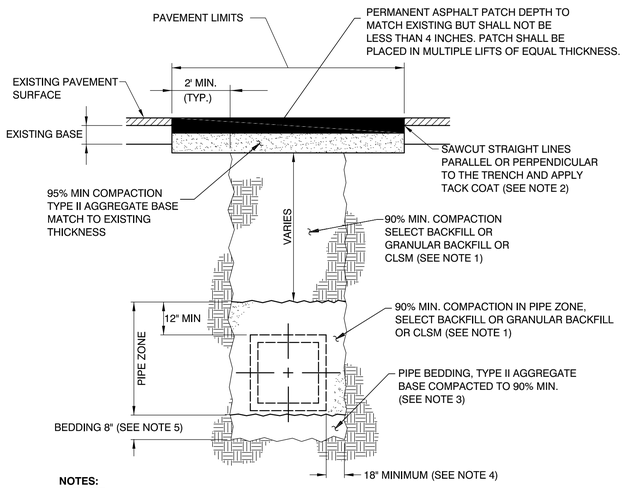
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN PLAN AND PROFILE
"SD01" 10+00 TO "SD01" 19+00

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER-SEAL
KONDALRAO VARANI
No. 19685
CIVIL
STATE OF NEVADA

SHEET
SD16
39 OF 55
DRAWING NO.
XXX-XXXX

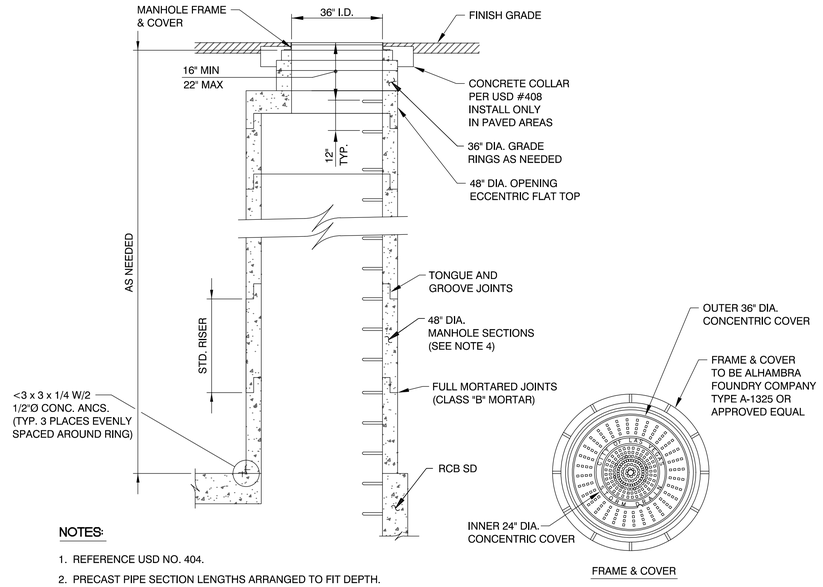
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NOTES:

1. NO STONES OR LUMPS GREATER THAN 3" PERMITTED IN TRENCH 2' OR LESS IN WIDTH.
2. IF SAWCUT IS WITHIN THREE FEET OF EDGE OF EXISTING ASPHALT CONCRETE SURFACE OR OTHER PATCH, REMOVE EXISTING PAVEMENT TO THAT EDGE AND REPLACE ENTIRE SECTION.
3. NATIVE SOILS BELOW PIPE BEDDING SHALL BE MOISTURE CONDITIONED, AND, COMPACTED TO 90% RELATIVE COMPACTION, AS EVALUATED BY ASTM D1557, UNLESS EXPOSED SOILS AT THE BASE OF THE TRENCH ARE LOOSE, SOFT, OR DISTURBED BY EXCAVATION OPERATIONS IN WHICH CASE THESE SOILS SHALL BE SCARIFIED TO A DEPTH OF 6-INCHES, MOISTURE CONDITIONED, AND COMPACTED TO 95 PERCENT RELATIVE COMPACTION, AS EVALUATED BY ASTM D1557.
4. IF CLSM IS USED FOR THE PIPE ZONE THEN THE MINIMUM WIDTH CAN BE REDUCED TO 8".
5. AT THE CONTRACTORS OPTION A 2" LEVELING COARSE OF CRUSHED ROCK CAN BE PLACED ABOVE THE RCB BEDDING.

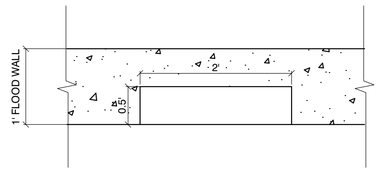
TYPICAL RCB TRENCH SECTION
SCALE: NTS — 1 / SD17



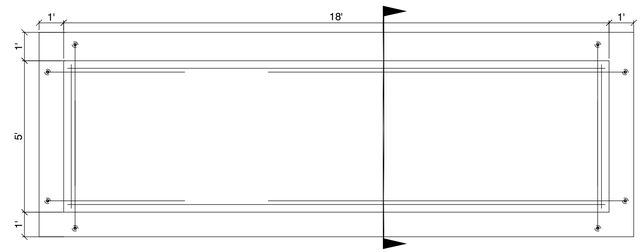
NOTES:

1. REFERENCE USD NO. 404.
2. PRECAST PIPE SECTION LENGTHS ARRANGED TO FIT DEPTH.
3. MANHOLE STEPS PER USD NO. 410.
4. PRECAST MANHOLE SECTIONS SHALL HAVE LONGITUDINAL REINFORCEMENT GREATER THAN OR EQUAL TO .0018 TIMES THE GROSS AREA OF THE RING.
5. STEPS SHALL BE EVENLY SPACED FROM 12" TO 16". VERTICAL DISTANCE BETWEEN THE TOP OF MANHOLE AND FIRST STEP SHALL BE A MAXIMUM OF 16". STEPS TO BE INSTALLED DOWN RCB WALL. VERTICAL DISTANCE BETWEEN THE INVERT OF RCB AND LAST STEP SHALL BE A MAXIMUM OF 16".

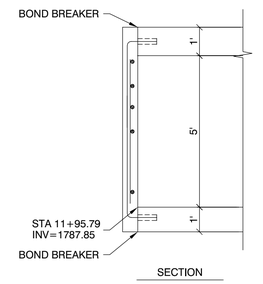
48" MANHOLE RISER DETAIL
SCALE: NTS — 2 / SD17



FLOOD WALL BLOCKOUTS
SCALE: NTS — 8 / SD17

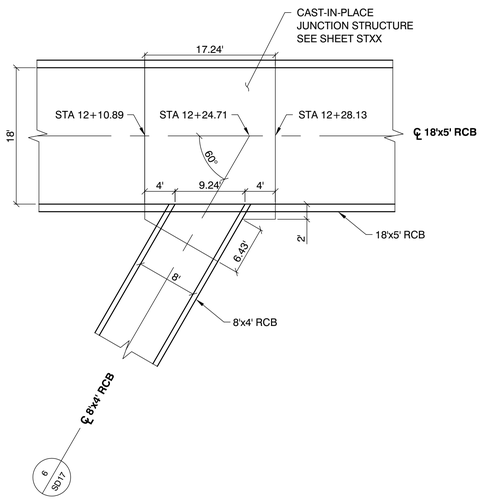


ELEVATION

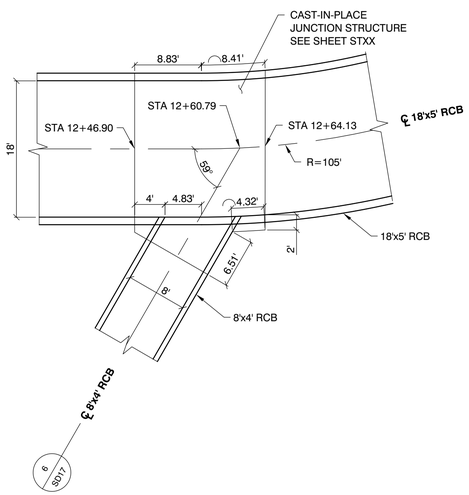


SECTION

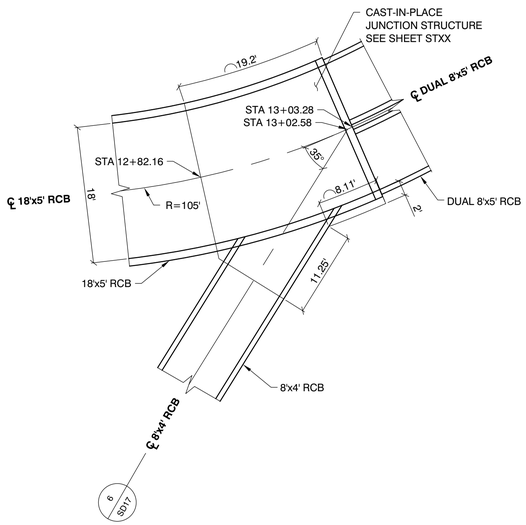
END CAP STA 11+95.79
SCALE: NTS — 7 / SD17



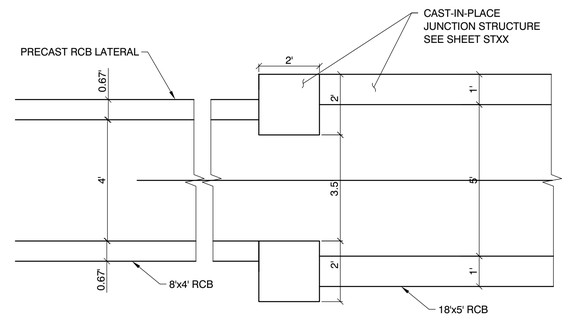
RCB CONNECTION DETAIL
SCALE: NTS — 3 / SD17



RCB CONNECTION DETAIL
SCALE: NTS — 4 / SD17



RCB CONNECTION DETAIL
SCALE: NTS — 5 / SD17



RCB CONNECTION SECTION
SCALE: NTS — 6 / SD17

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NO.	DATE	REVISIONS

PREPARED BY

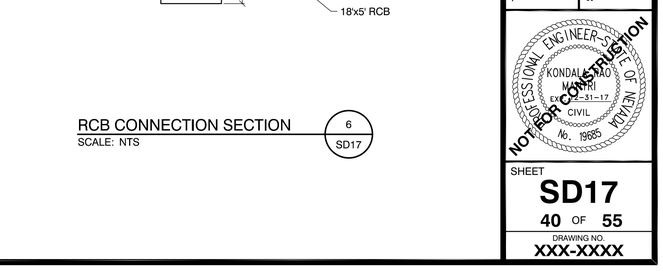
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

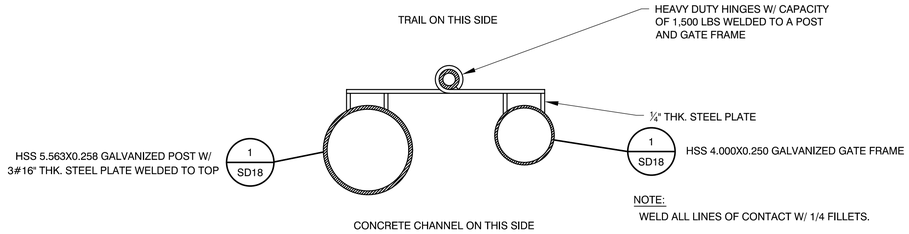
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DATE:	11/18/2016
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD
SUBMITTAL STAGE:	70% - PRELIMINARY

TITLE: **LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL**

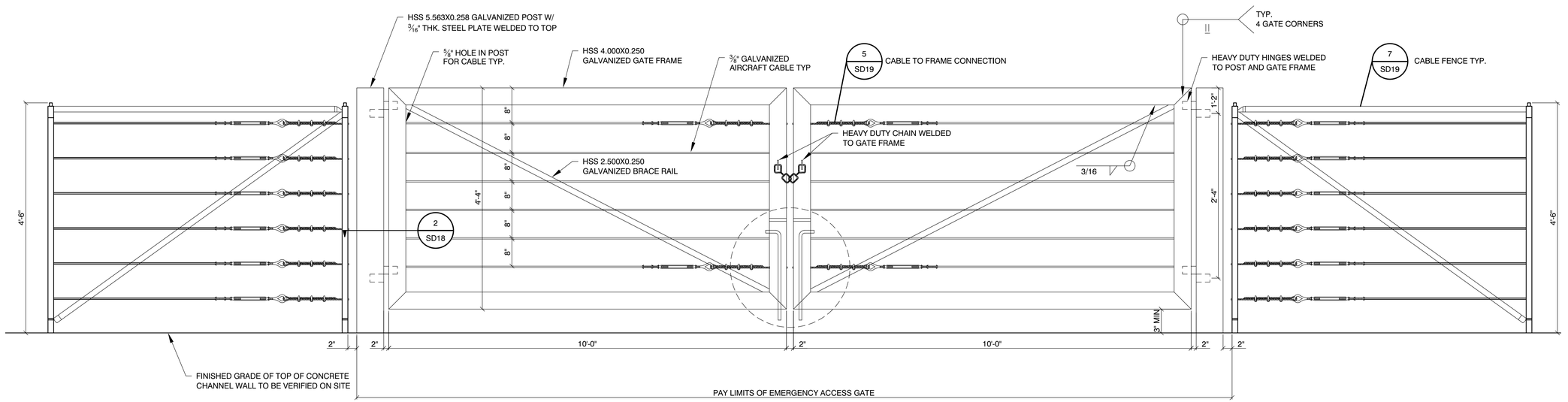
SHEET: **STORM DRAIN DETAILS**



SHEET **SD17**
40 OF 55
DRAWING NO. XXX-XXXX



HINGES MOUNT
SCALE: NTS
2
SD18



NOTE:
GATE TO SWING INTO ACCESS ROAD ONLY
GATE SHOULD BE CAPABLE TO SWING OUT FULL 180°

EMERGENCY ACCESS GATE
SCALE: NTS
1
SD18

M:\Projects\100039014_Cedar\H49866\Sheet Set\DWG\H49866-SD18 *11-21-16 03:0 pm

NO.	DATE	REVISIONS

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ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

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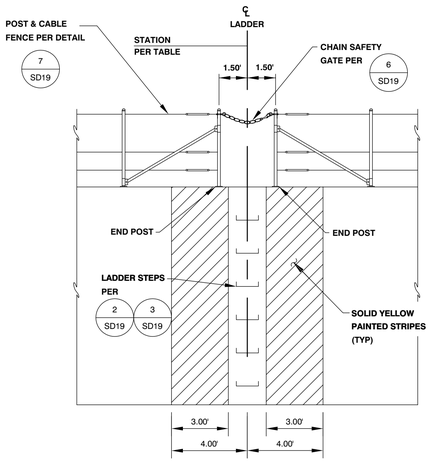
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DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: **70% - PRELIMINARY**		CHECKED BY: HD	

TITLE
LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN DETAILS

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDAL RAO MANNEM
EXP. 6-30-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
SD18
41 OF **55**
DRAWING NO.
XXX-XXXX

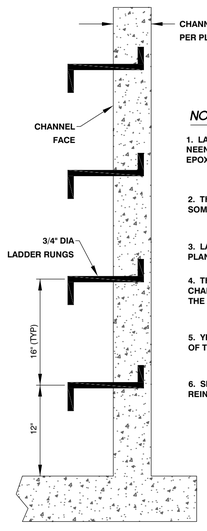


LADDER LOCATION TABLE

STA	OFFSET	STA	OFFSET
41+48.50	LT	81+17.00	RT
42+72.50	RT	85+69.00	LT
47+48.50	LT	85+98.00	RT
47+72.50	RT	91+04.00	LT
53+13.00	LT	91+35.00	RT
53+49.00	RT	97+04.00	LT
57+88.00	LT	97+35.00	RT
58+24.00	RT	103+04.00	LT
63+88.00	LT	103+35.00	RT
64+19.00	RT	107+24.00	LT
69+88.00	LT	107+55.00	RT
70+19.00	RT	113+24.00	LT
75+88.00	LT	113+46.00	RT
76+19.00	RT	119+24.00	LT
80+88.00	LT	119+46.00	RT

ACCESS LADDER WITH POST & CABLE FENCE

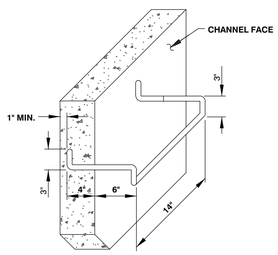
CHANNEL ACCESS LADDER — 1 / SD19
SCALE: NTS



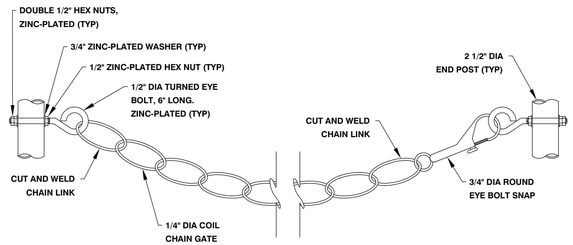
NOTES:

1. LADDER RUNGS TO BE CAST-IN-PLACE PER DETAIL 2, DWG C13 OR NEENAH FOUNDRY R-1982-F MANHOLE STEP OR EQUAL DRILLED AND EPOXIED IN PLACE WITH 4" EMBEDMENT.
2. THE LADDER SHALL BE MADE OF EITHER GALVANIZED STEEL OR SOME OTHER UV-RESISTANT MATERIAL.
3. LADDERS SHALL BE PLACED IN PAIRS AND ARE SHOWN PER PLAN SHEETS.
4. THE PAIRS SHALL BE LOCATED ON OPPOSITE SIDES OF THE CHANNEL AND WILL BE OFFSET BY APPROXIMATELY THE WIDTH OF THE CHANNEL BOTTOM
5. YELLOW STRIPES 36" WIDE SHALL BE PAINTED ON BOTH SIDES OF THE LADDER FROM BOTTOM OF CHANNEL TO TW
6. SEE STRUCTURAL SECTIONS FOR CHANNEL WALL AND SLAB REINFORCEMENT REQUIREMENTS

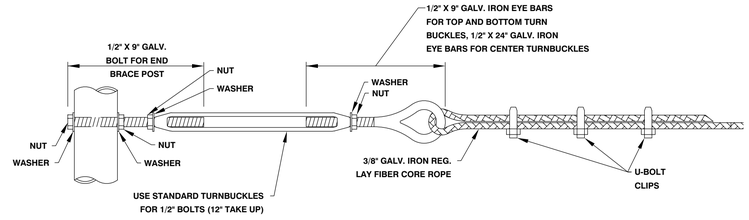
LADDER DETAILS — 2 / SD19
SCALE: NTS



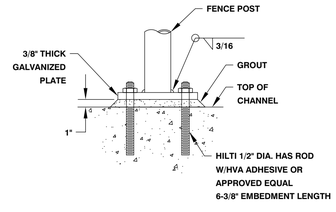
STEP DETAIL — 3 / SD19
SCALE: NTS

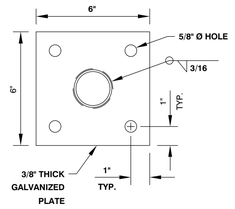


CHAIN SAFETY GATE DETAIL — 4 / SD19
SCALE: NTS

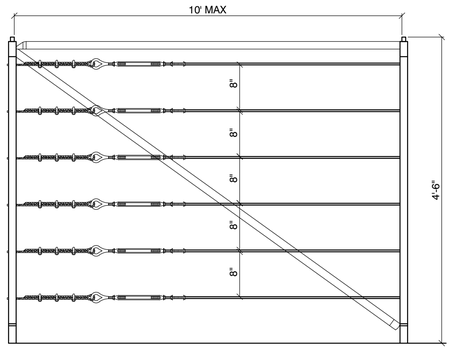


TURNBUCKLE @ END POST DETAIL — 5 / SD19
SCALE: NTS

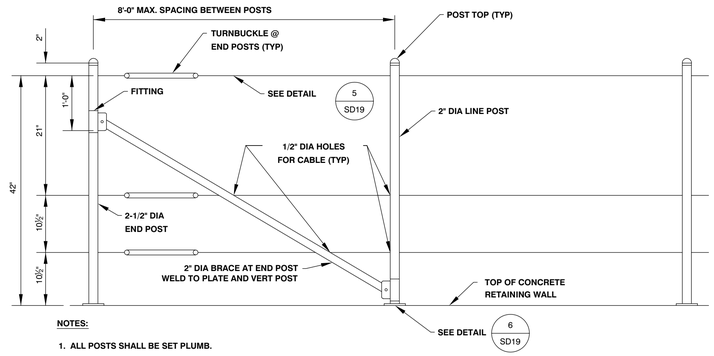




MOUNTING DETAIL — 6 / SD19
SCALE: NTS



54" FENCE



NOTES:

1. ALL POSTS SHALL BE SET PLUMB.
2. RAILING POSTS AND FITTINGS SHALL BE HOT DIPPED GALVANIZED MALLEABLE, CAST IRON, OR PRESSED STEEL.
3. CHAIN SAFETY GATES SHALL BE PROVIDED AT LADDER LOCATIONS. SEE DETAIL 1, DWG C13 FOR DETAILS & LOCATIONS.
4. ATTACH TO TOP OF CONCRETE WALL PER DETAIL 4, DWG C13 AS SHOWN ABOVE.
5. BRACE POST ARE NOT TO BE INSTALLED ACROSS EXPANSION JOINTS.
6. WHEN AN EXPANSION JOINT OCCURS AT A HORIZONTAL ANGLE POINT THE CONCTRACTOR SHALL INSTALL TWO END POSTS, ONE ON EACH SIDE OF EXPANSION JOINT, WITH A MAX. 6" GAP BETWEEN THE POSTS.
7. BRACE POSTS SHALL BE PLACED AT A MAXIMUM OF 250' INTERVALS AND AT END POSTS.

42" FENCE

POST AND CABLE FENCE ELEVATION VIEW — 7 / SD19
SCALE: NTS

NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

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CITY OF LAS VEGAS

1# H49866	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: **70% - PRELIMINARY**		CHECKED BY: HD	

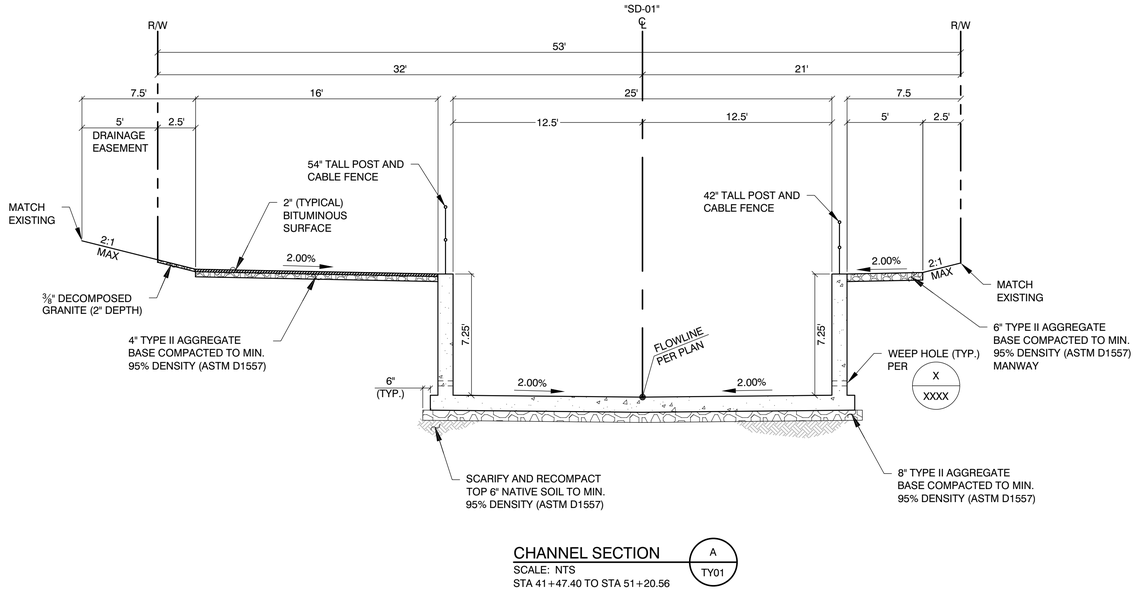
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LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN DETAILS

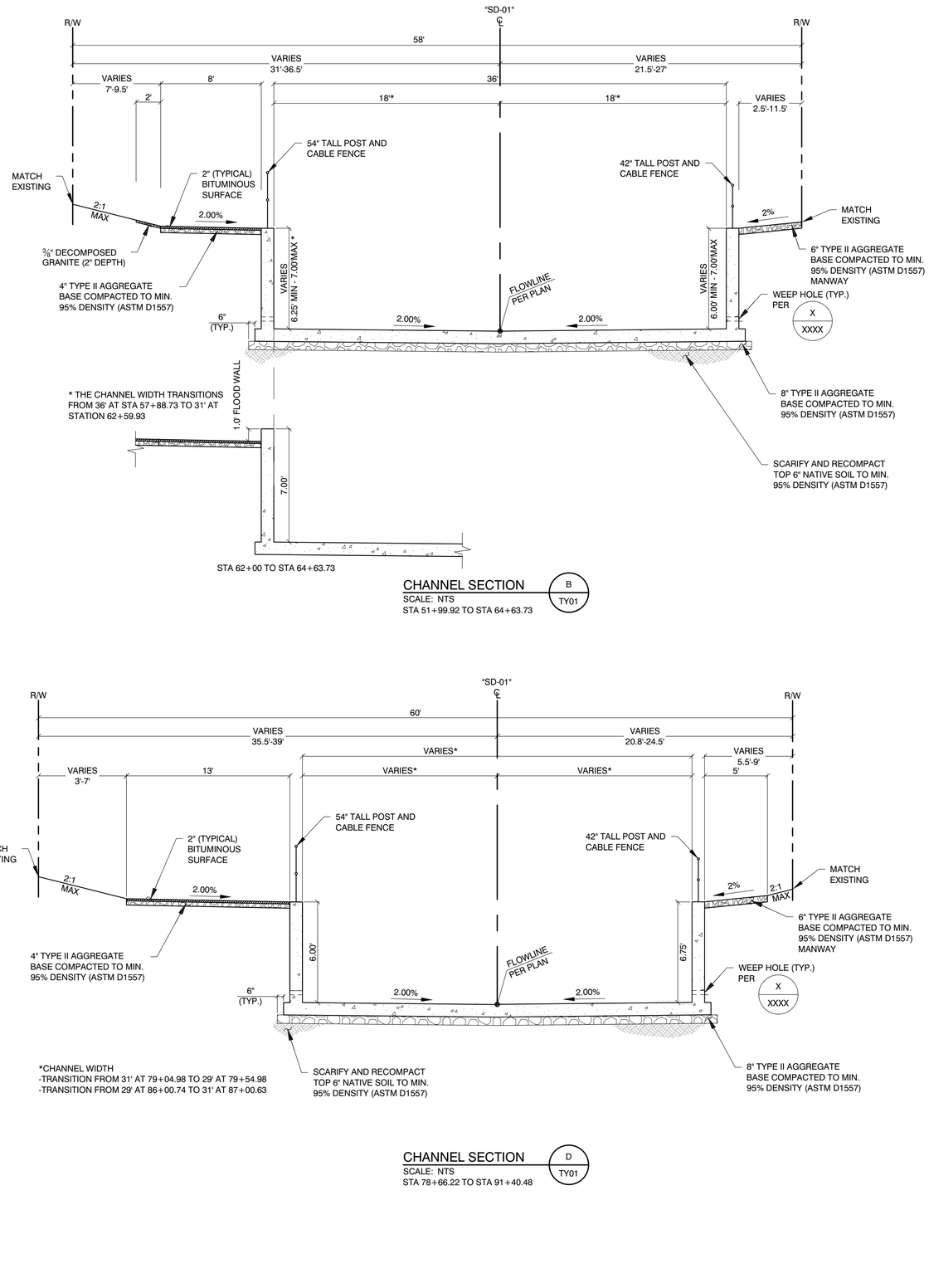
PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALRAO MANNI
EXP. 12-31-17
CIVIL
No. 19665
NOT FOR CONSTRUCTION

SHEET
SD19
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DRAWING NO.
XXX-XXXX

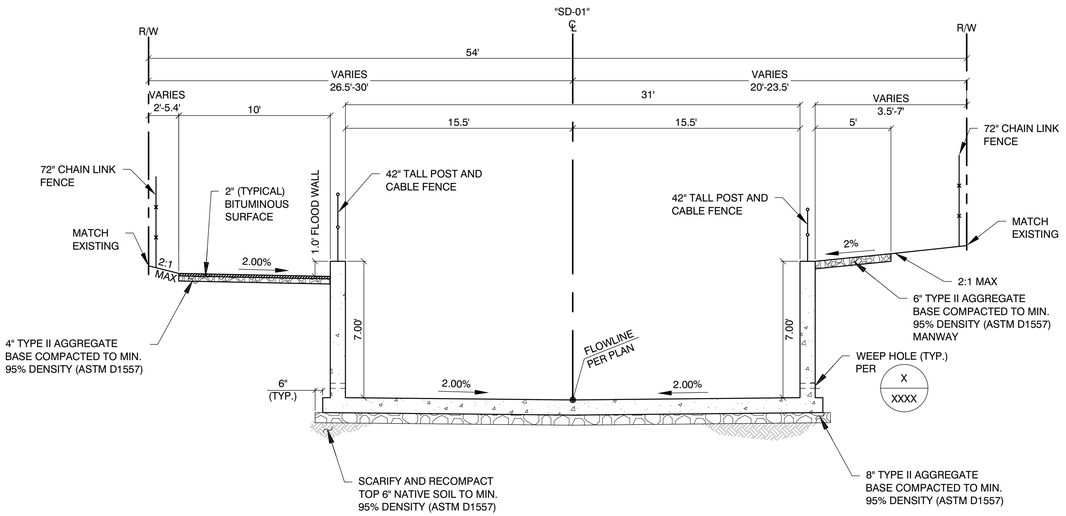
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CHANNEL SECTION — A / TY01
SCALE: NTS
STA 41+47.40 TO STA 51+20.56



CHANNEL SECTION — B / TY01
SCALE: NTS
STA 51+99.92 TO STA 64+63.73



CHANNEL SECTION — C / TY01
SCALE: NTS
STA 64+63.73 TO STA 77+63.94

*CHANNEL WIDTH
-TRANSITION FROM 31' AT 79+04.98 TO 29' AT 79+54.98
-TRANSITION FROM 29' AT 86+00.74 TO 31' AT 87+00.63

CHANNEL SECTION — D / TY01
SCALE: NTS
STA 78+66.22 TO STA 91+40.48

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ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

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CITY OF LAS VEGAS

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DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD

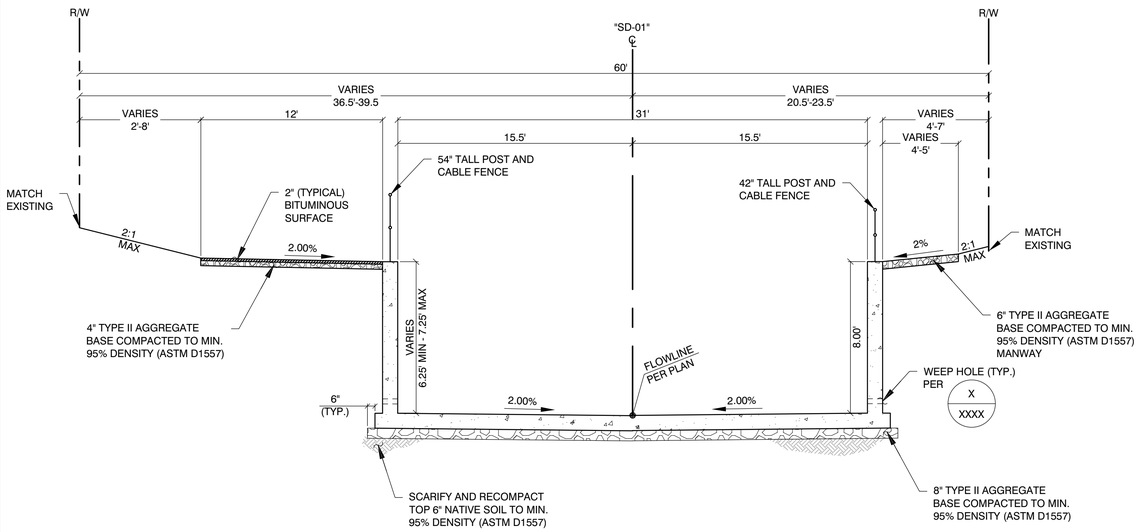
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CEDAR AVENUE CHANNEL

SHEET
CHANNEL TYPICAL SECTIONS

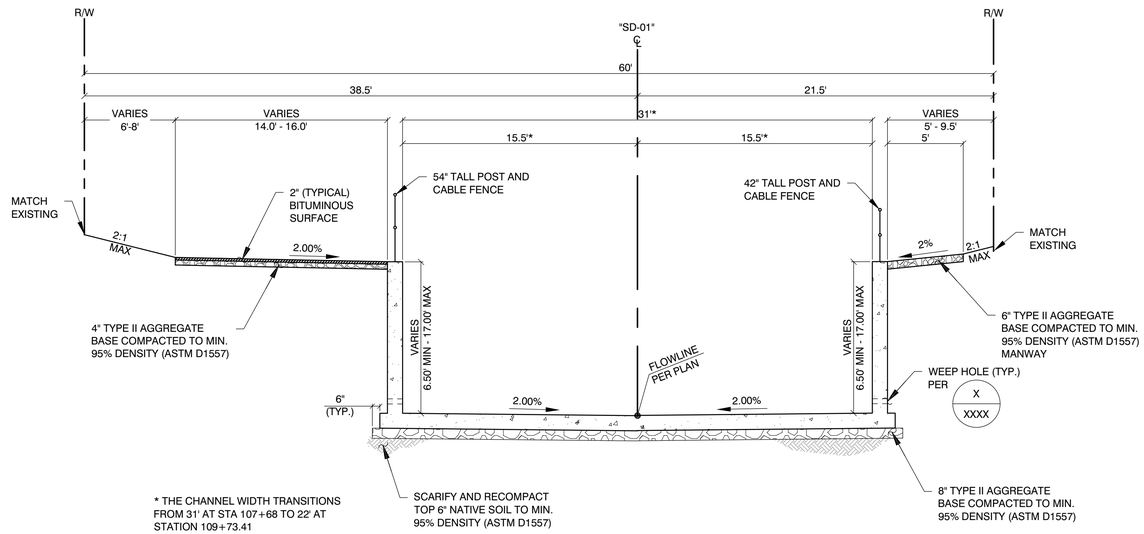
KONDAL R. MANTRI — 12-31-17 — CIVIL — No. 19655 — STATE OF NEVADA — PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

SHEET
TY01
43 OF 55
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XXX-XXXX

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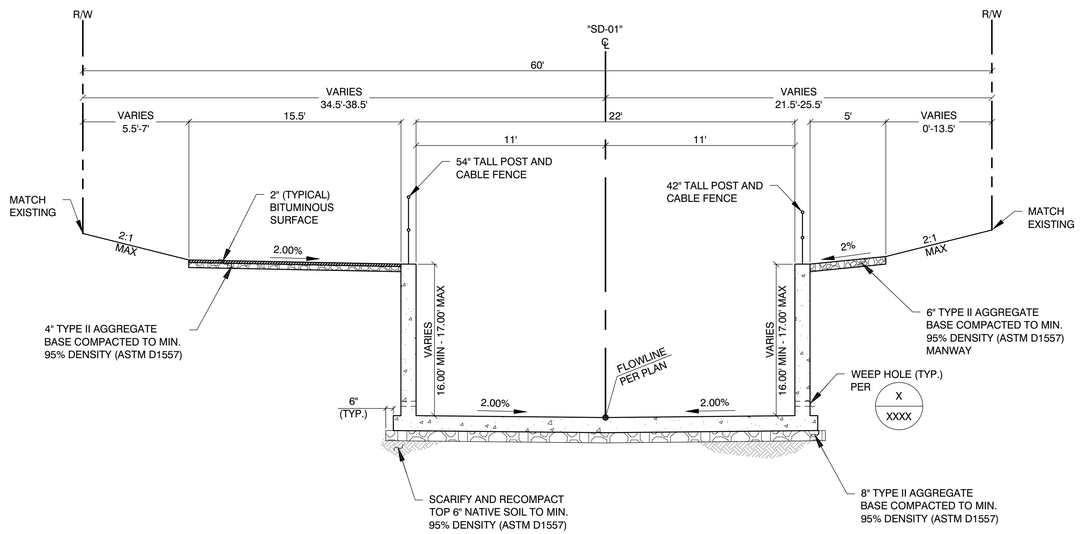


CHANNEL SECTION (E / TY02)
SCALE: NTS
STA 92+03.44 TO STA104+86.99

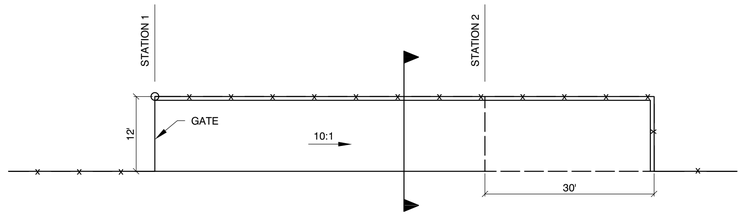


* THE CHANNEL WIDTH TRANSITIONS FROM 31' AT STA 107+68 TO 22' AT STATION 109+73.41

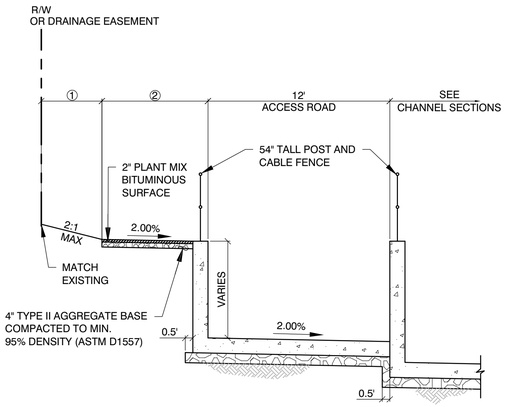
CHANNEL SECTION (F / TY02)
SCALE: NTS
STA 105+69.09 TO STA 109+73.47



CHANNEL SECTION (G / TY02)
SCALE: NTS
STA 109+73.47 TO STA 121+26.63



PLAN



SECTION

CHANNEL PLAN AND SECTION (H / TY02)
SCALE: NTS

ACCESS RAMP STATION TABLE

ACCESS RAMP NO.	STATION 1	STATION 1
1	45+05.00	42+85.00
2	79+55.15	80+19.83
3	92+58.58	93+29.07
4	109+85.47	111+60.47

ACCESS RAMP DIMENSION TABLE

ACCESS RAMP NO.	SECTION 1 (FEET)	SECTION 2 (FEET)
1	2.5	8
2	3	10
3	2	8
4	5.5	8

NO.	DATE	REVISIONS

PREPARED BY
ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: 70% - PRELIMINARY		CHECKED BY: HD	

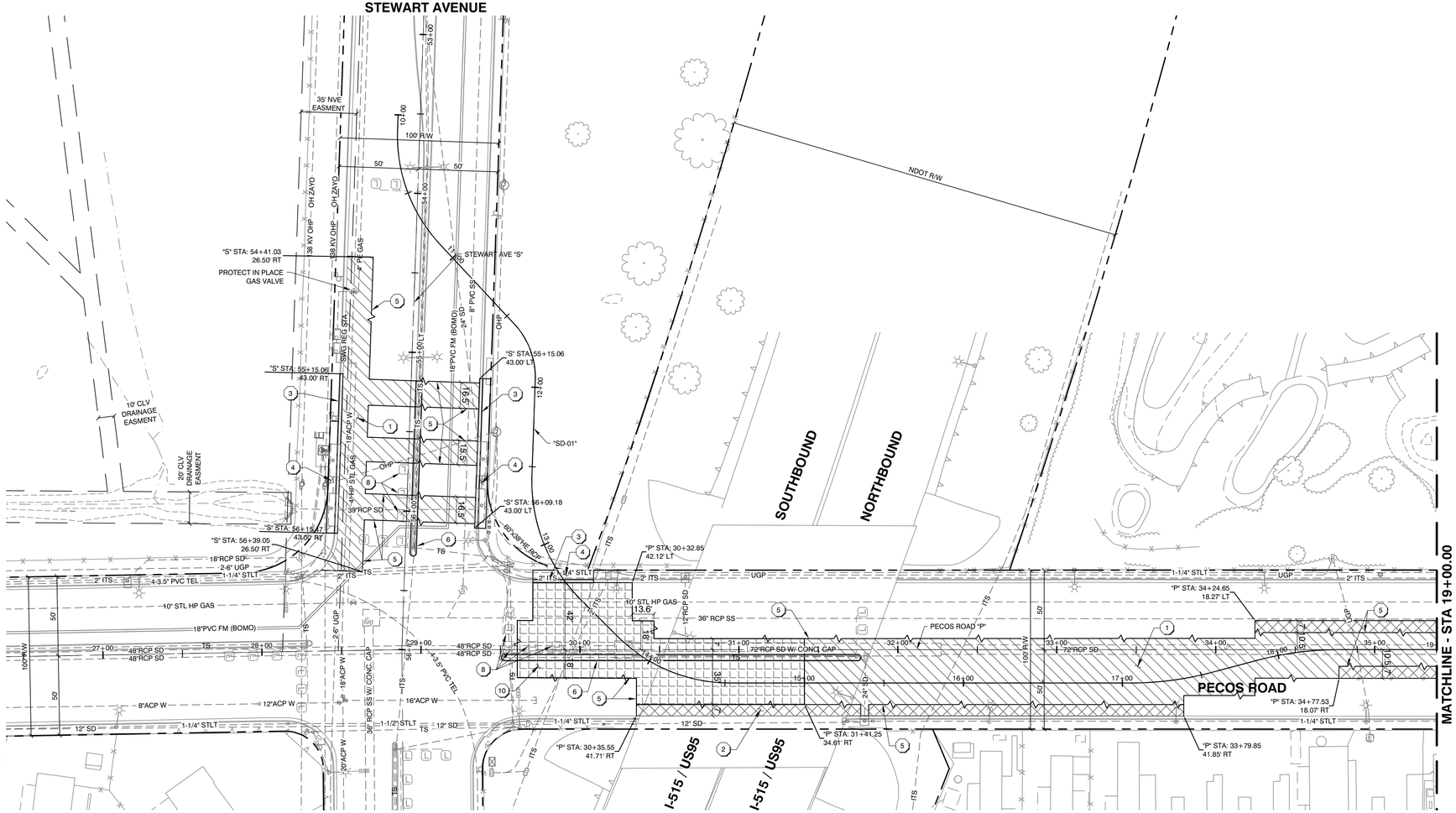
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
CHANNEL TYPICAL SECTIONS

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER - STATE OF NEVADA
KONDAL RAO MOTKURI
12-31-17
CIVIL
No. 19655

SHEET
TY02
44 OF 55
DRAWING NO.
XXX-XXXX

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NORTH

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. CONSTRUCT PLANTMIX BITUMINOUS PAVEMENT SURFACE WITH TYPE II AGGREGATE BASE (SEE DETAIL 1, DRAWING RD03)
2. CONSTRUCT 2" PLANTMIX BITUMINOUS PAVEMENT
3. CONSTRUCT "L" TYPE CURB AND GUTTER PER USD #216
4. CONSTRUCT CONCRETE SIDEWALK PER USD #234
5. SAWCUT AND MATCH EXISTING PAVEMENT
6. CONSTRUCT TACK ON MEDIAN PER USD #220.1.S1
7. CONSTRUCT CONCRETE SIDEWALK RAMP PER USD #235 (CASE III)
8. INSTALL 6'x6' PREFORMED LOOP DETECTORS (SEE DETAIL 2, DRAWING RD03 FOR INSTALLATION DETAILS)
9. REMOVE AND REPLACE EXISTING STREETLIGHT POLE
10. CONSTRUCT CONCRETE PAVEMENT MONOLITHIC WITH THE RCB ROOF SLAB

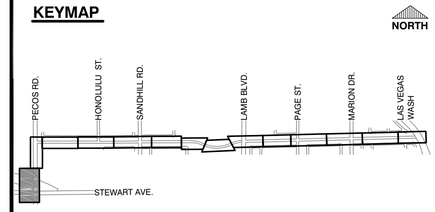
NOTES

1. THE ACTUAL LOCATION OF SAWCUT LINES AND LIMITS OF MILLING SHALL BE DETERMINED IN THE FIELD BY THE RESIDENT PROJECT REPRESENTATIVE.

LEGEND

- PLANTMIX BITUMINOUS PAVEMENT
- CONCRETE PAVEMENT (SEE DETAIL SHEETS)
- 2" PLANTMIX BITUMINOUS MILL & OVERLAY

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I.#:	H49866
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY
BID#:	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

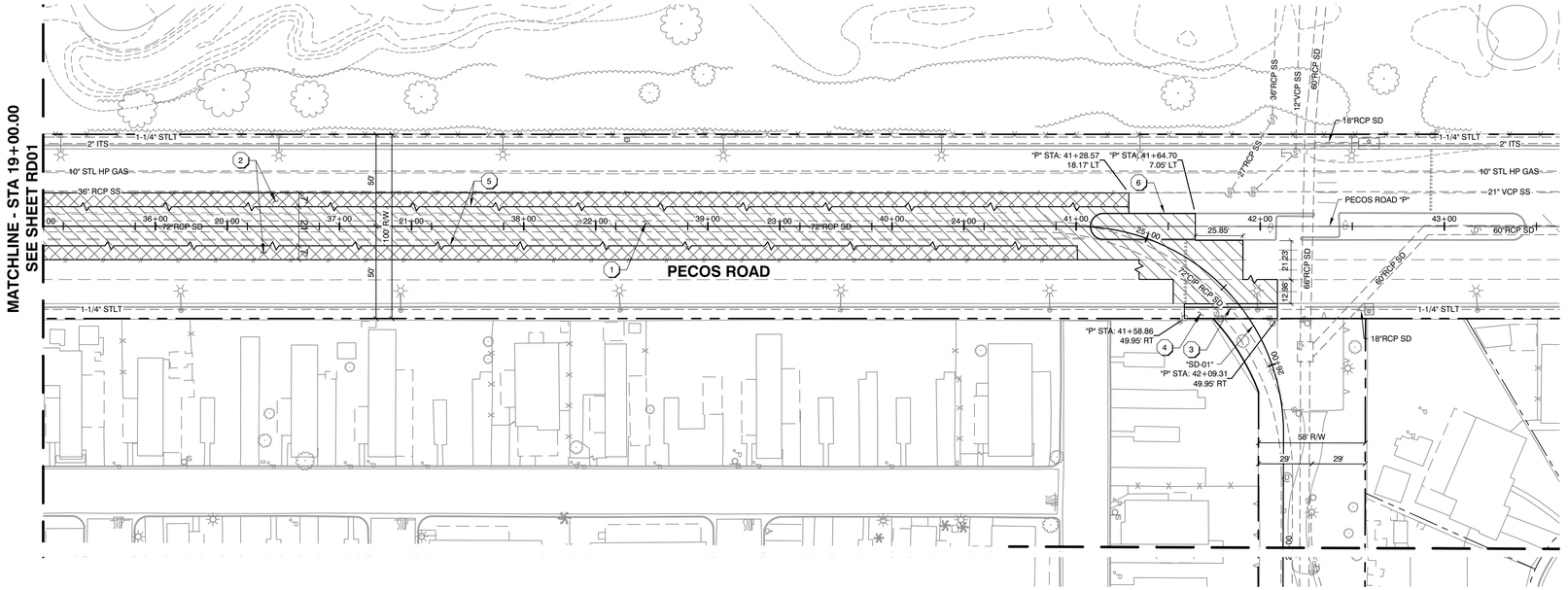
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ROADWAY PLAN
"SD01" 10+00 TO "SD01" 19+00

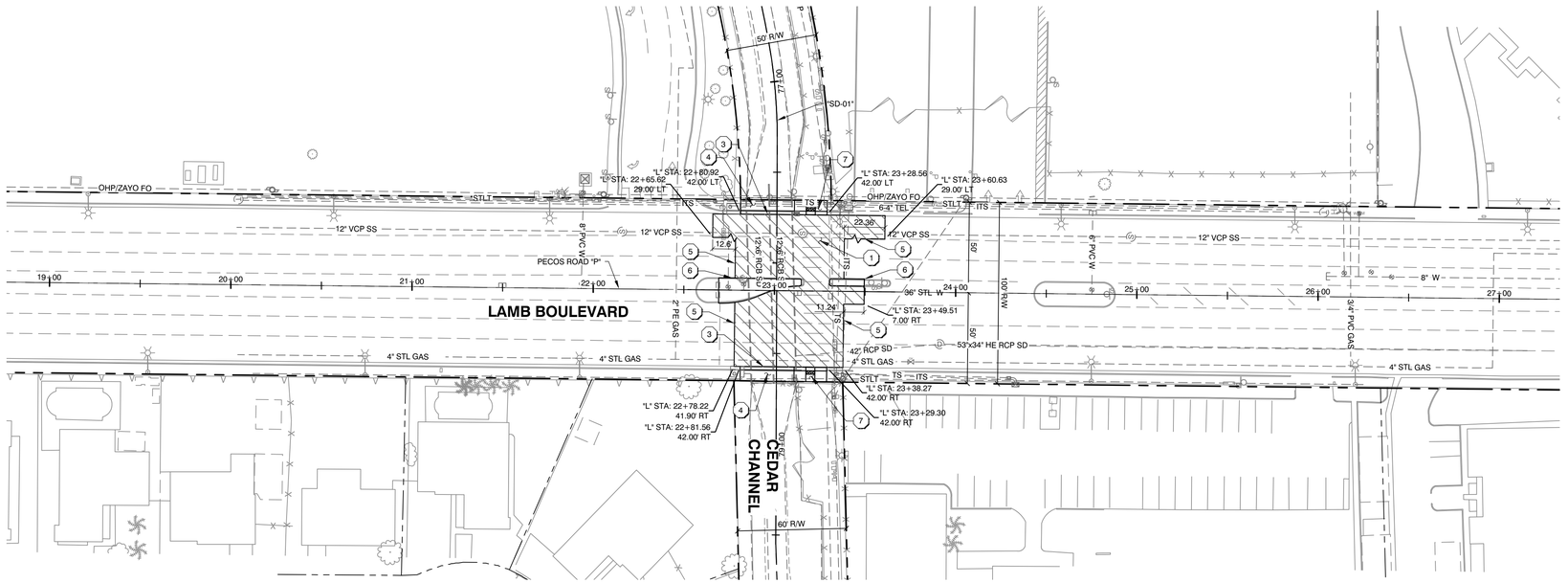
NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER STATE OF NEVADA
KONDAL RAO MURRI
12-31-17
CIVIL
No. 19685

SHEET
RD01
45 OF 55

DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

40 0 20 40 80

(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

CONSTRUCTION KEY NOTES

1. CONSTRUCT PLANTMIX BITUMINOUS PAVEMENT SURFACE WITH TYPE II AGGREGATE BASE (SEE DETAIL 1, DRAWING RD03)
2. CONSTRUCT 2" PLANTMIX BITUMINOUS PAVEMENT
3. CONSTRUCT "L" TYPE CURB AND GUTTER PER USD #216
4. CONSTRUCT CONCRETE SIDEWALK PER USD #234
5. SAWCUT AND MATCH EXISTING PAVEMENT
6. CONSTRUCT TACK ON MEDIAN PER USD #220.1.S1
7. CONSTRUCT CONCRETE SIDEWALK RAMP PER USD #235 (CASE III)
8. INSTALL 6'x6' PREFORMED LOOP DETECTORS (SEE DETAIL 2, DRAWING RD03 FOR INSTALLATION DETAILS)
9. REMOVE AND REPLACE EXISTING STREETLIGHT POLE
10. CONSTRUCT CONCRETE PAVEMENT MONOLITHIC WITH THE RCB ROOF SLAB

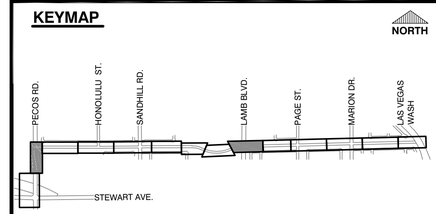
NOTES

1. THE ACTUAL LOCATION OF SAWCUT LINES AND LIMITS OF MILLING SHALL BE DETERMINED IN THE FIELD BY THE RESIDENT PROJECT REPRESENTATIVE.

LEGEND

- PLANTMIX BITUMINOUS PAVEMENT
- CONCRETE PAVEMENT (SEE DETAIL SHEETS)
- 2" PLANTMIX BITUMINOUS MILL & OVERLAY

KEYMAP



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PREPARED BY

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2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1#	H49866
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SUBMITTAL STAGE:	70% - PRELIMINARY
BID#	XX.XXXX
DESIGNED BY:	KRM
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CHECKED BY:	HB

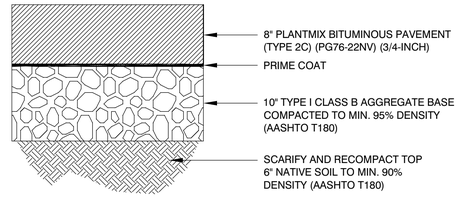
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
ROADWAY PLAN
"SD01" 19+00 TO "SD01" 27+00

PROFESSIONAL ENGINEER - STATE OF NEVADA
KONDALARAO MOTURI
12-31-17
CIVIL
No. 19655
NOT FOR CONSTRUCTION

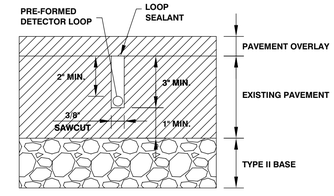
SHEET
RD02
46 OF 55
DRAWING NO.
XXX-XXXX

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PAVEMENT SECTION
SCALE: NTS

1
RD03



PRE-FORMED DETECTOR LOOP INSTALLATION
PAVEMENT REHABILITATION

CONSTRUCTION NOTES:

1. DETECTOR LOOPS SHALL BE PRE-FORMED PER SPECIAL PROVISION 623.02.04.
2. LOOP LEAD-IN CABLE SHALL BE PER SPECIAL PROVISION 623.02.04.
3. FOR FULL-DEPTH PAVEMENT CONSTRUCTION, EMBED OR PLACE PRE-FORMED LOOP DETECTORS ON TOP OF AGGREGATE BASE MATERIAL PER MANUFACTURER'S RECOMMENDATIONS OR AS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL ENSURE THAT THE LOOP DETECTORS ARE PROPERLY SECURED IN PLACE TO PREVENT MOVEMENT PRIOR TO AND DURING THE INSTALLATION OF PAVING MATERIAL.
4. LOOP DETECTORS SHALL BE CENTERED IN TRAVEL LANES.
5. ALL LOOP DETECTOR LOCATIONS SHALL BE APPROVED BY THE CLV TRAFFIC ENGINEER PRIOR TO INSTALLATION.

PRE-FORMED LOOP DETECTOR
SCALE: NTS

2
RD03

PREPARED FOR
CITY OF LAS VEGAS

I/# H49866
DATE: 11/18/2016
SUBMITTAL STAGE:
70% - PRELIMINARY

BID# XX.XXXX
DESIGNED BY: KRM
DRAWN BY: MM
CHECKED BY: HD

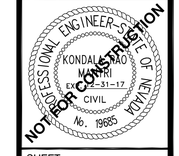
PREPARED BY
CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

NO.	DATE	REVISIONS

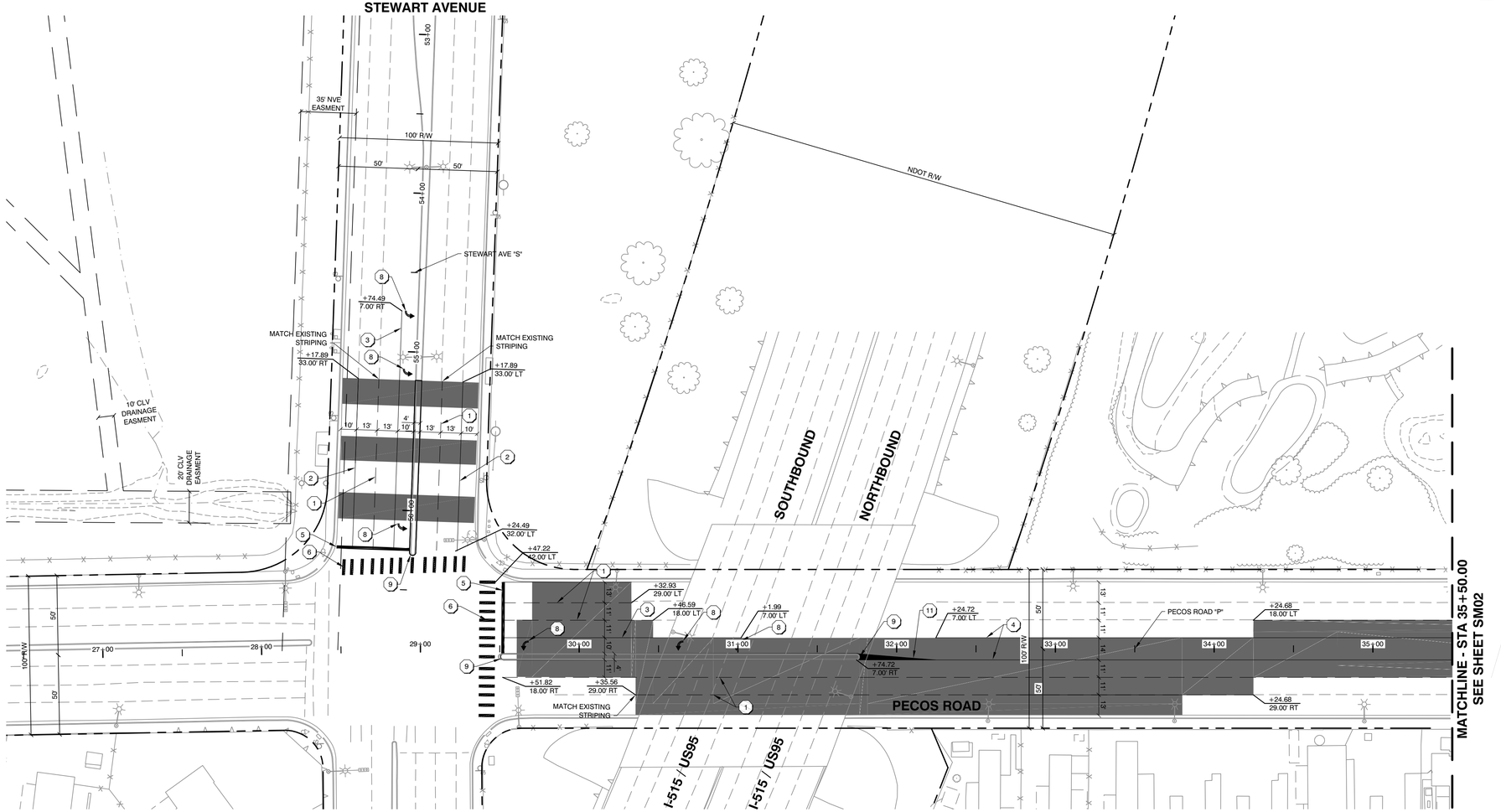
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
ROADWAY DETAILS



SHEET
RD03
47 OF **55**
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

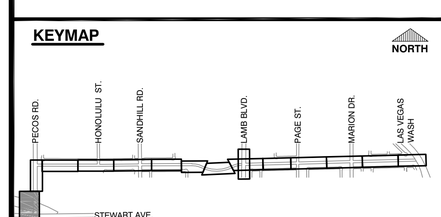
TRAFFIC NOTES

1. INSTALL TYPE 4 LANE LINE (RPM) PER USD #244.1
2. INSTALL 6" SOLID WHITE LINE (POLYUREA)
3. INSTALL STORAGE LANE LINE PER USD #246
4. INSTALL TYPE 2 CENTERLINE (RPM) PER USD #244
5. INSTALL 24" STOP BAR PER USD #254 (TYPE 2 PMF)
6. INSTALL 24" CROSSWALK MARKINGS PER USD #254 (TYPE 2 PMF)
7. INSTALL YIELD BAR PER NDOT STD. DWG. T-38.1.3
8. INSTALL WHITE TURN ARROW (TYPE 2 PMF) PER USD #246
9. INSTALL MEDIAN NOSE MARKINGS PER USD #248
10. EXISTING STREETLIGHT TO BE REMOVED AND REPLACED
11. INSTALL TRANSITION PER USD #245.2 (2 OF 2) (FILM) (YELLOW)

LEGEND

PAVEMENT REPLACEMENT AND MILL AND OVERLAY LIMITS

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I.# H49866	BID# XX.XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: 70% - PRELIMINARY		CHECKED BY: HB	

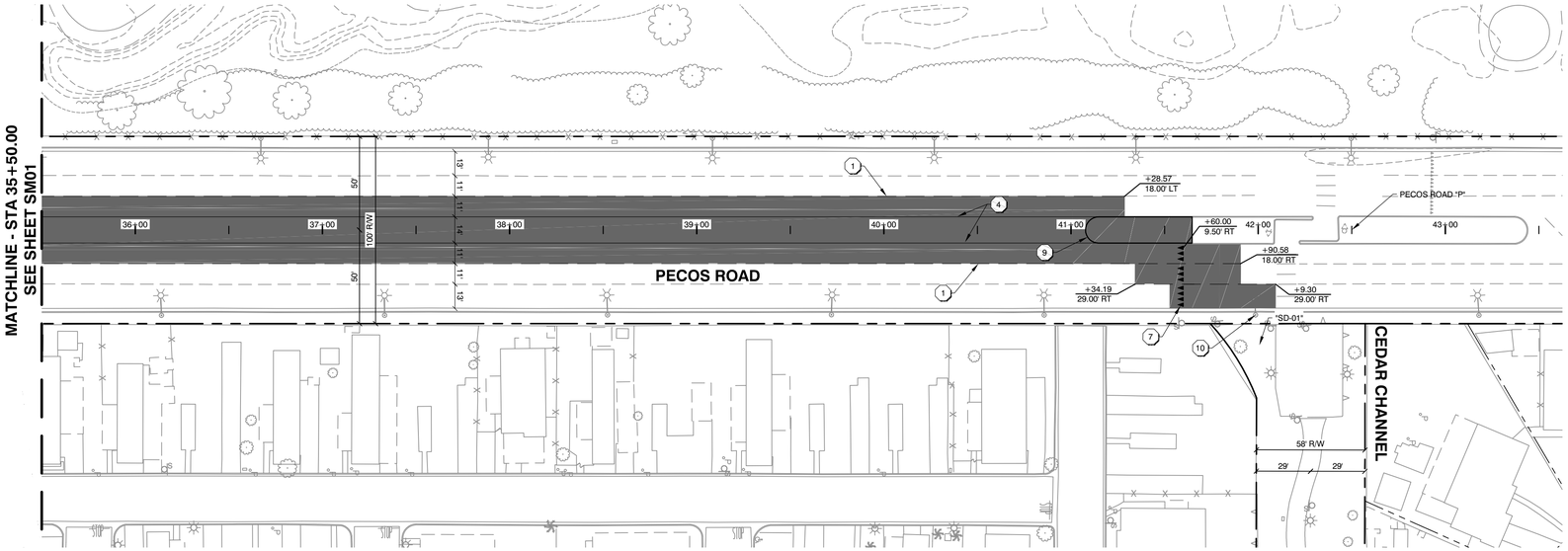
TITLE
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CEDAR AVENUE CHANNEL

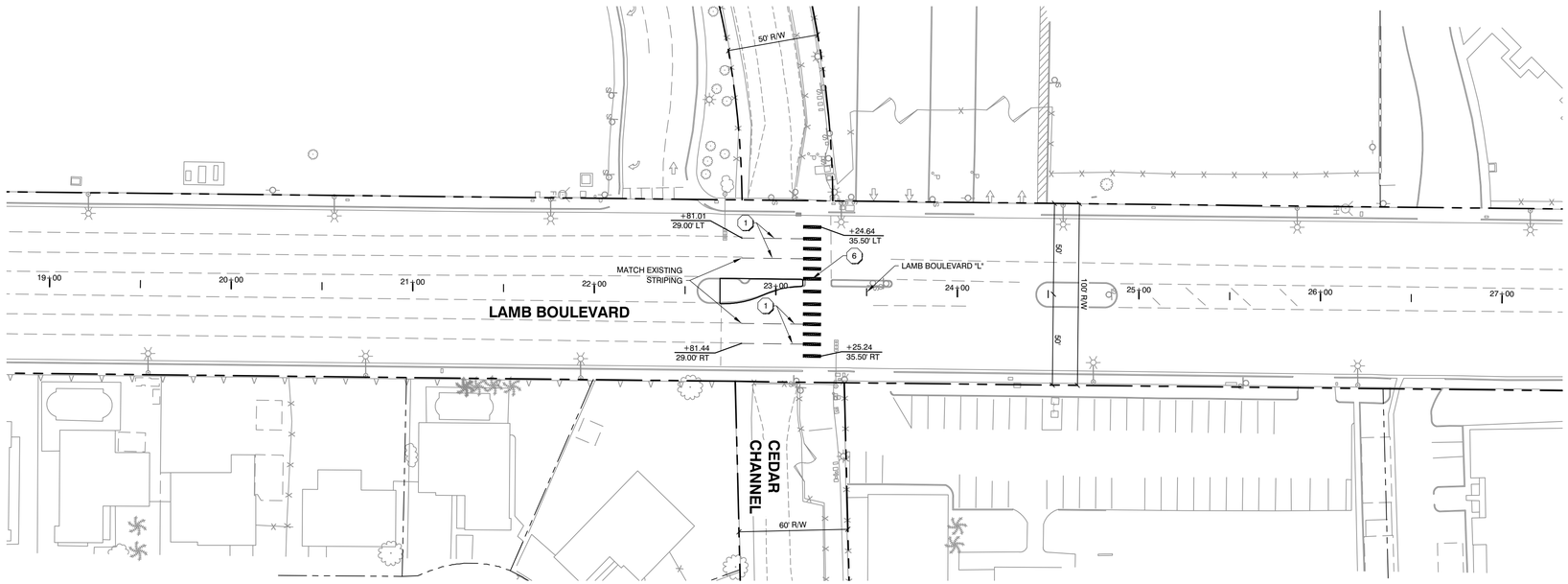
SHEET
SIGNING AND STRIPING PLAN
"SD01" 10+00 TO "SD01" 19+00

PROFESSIONAL ENGINEER-STATE OF NEVADA
KONDALA R. MADDU
No. 19685
CIVIL
NOT FOR CONSTRUCTION

SHEET
SM01
48 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

20 0 10 20 40

(IN FEET)

CALL BEFORE CONSTRUCTION ⚠		
BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

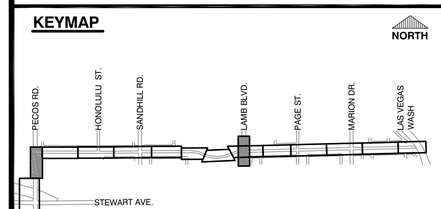
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11. INSTALL TRANSITION PER USD #245.2 (2 OF 2) (FILM) (YELLOW)

LEGEND

PAVEMENT REPLACEMENT AND MILL AND OVERLAY LIMITS

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866 | BID# XX.XXXX | DESIGNED BY: KRM
DATE: 11/18/2016 | DRAWN BY: MM
SUBMITTAL STAGE: 70% - PRELIMINARY | CHECKED BY: HB

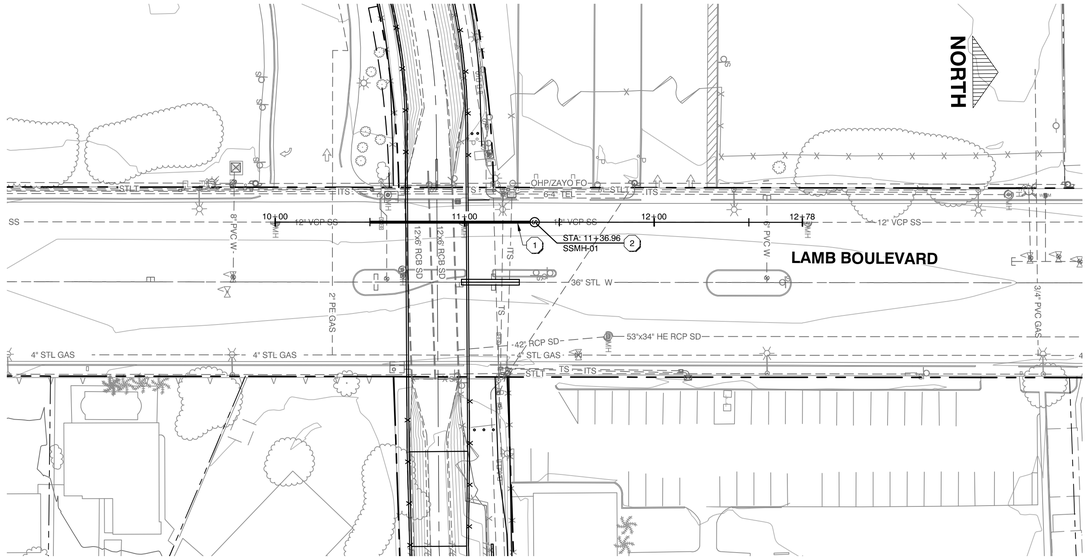
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CEDAR AVENUE CHANNEL

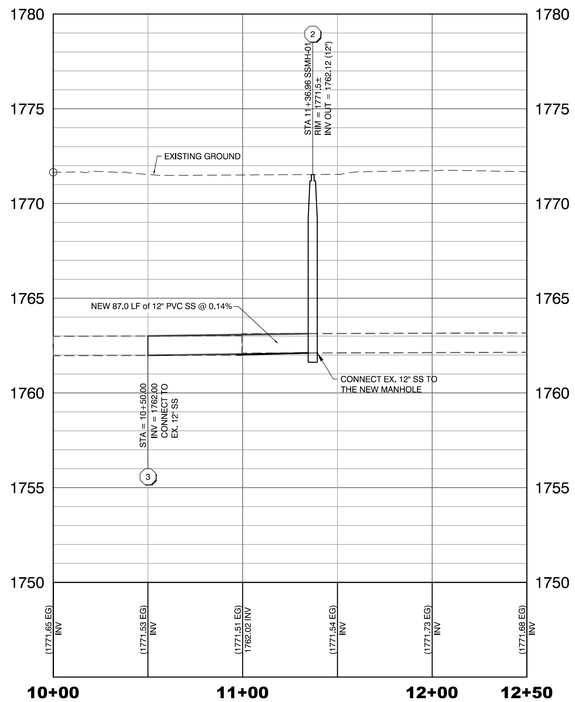
SHEET
SIGNING AND STRIPING PLAN
"SD01" 19+00 TO "SD01" 27+00

KONDALA RAO MOTURI
12-31-17
CIVIL
No. 19685
STATE OF NEVADA
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

SHEET
SM02
49 OF 55
DRAWING NO.
XXX-XXXX

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GRAPHIC SCALE

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(IN FEET)

CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

SEWER CONSTRUCTION KEY NOTES

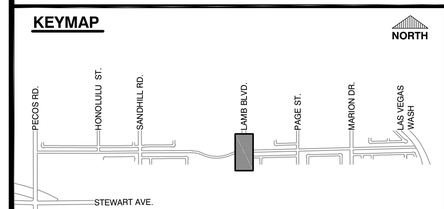
1. INSTALL 12" SDR-35 PVC SS PER DCSWCS SD-18
2. INSTALL 48" SSMH PER DCSWCS SD-1A
3. CONNECT TO EXISTING 12" VCP SS WITH A FLEXIBLE COUPLING

APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

DATE: PROJECT# XXXXX

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7272
Fax: +1 (702) 263 7200

PREPARED FOR

CITY OF LAS VEGAS

I# H49866 | BID# XX.XXXX | DESIGNED BY: KRM | DRAWN BY: MM | CHECKED BY: HB

DATE: 11/18/2016

SUBMITTAL STAGE:

70% - PRELIMINARY

NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER
KONDAL R. NAO
Vol. 31 - 17
CIVIL
No. 19685
STATE OF NEVADA

TITLE

LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

SHEET

SANITARY SEWER RELOCATION PLAN

SHEET

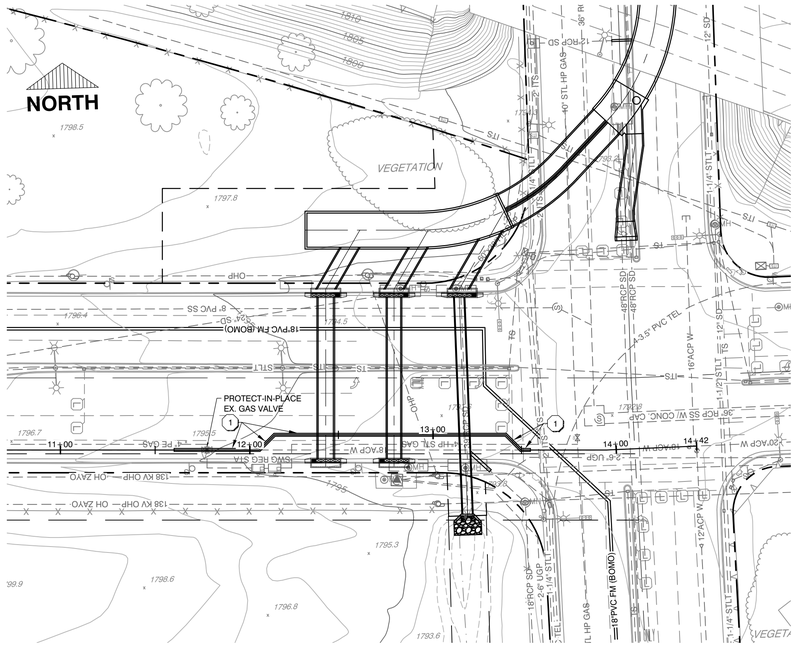
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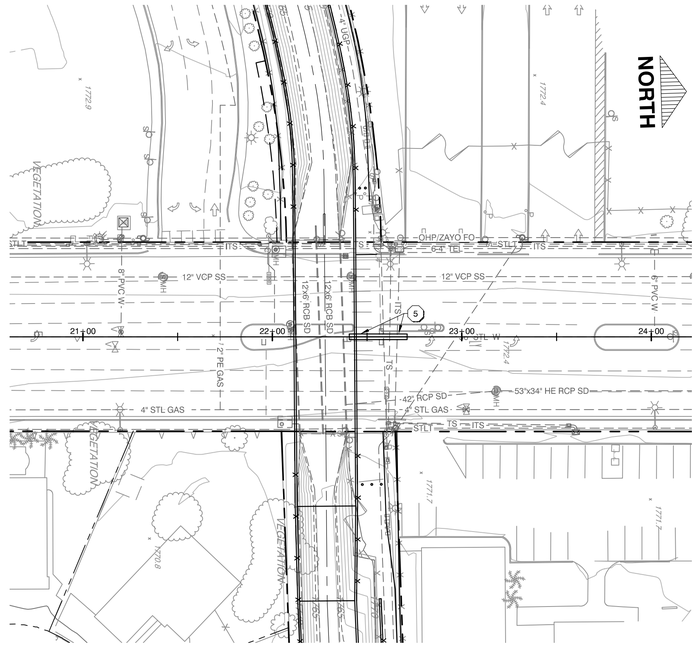
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DRAWING NO.

XXX-XXXX

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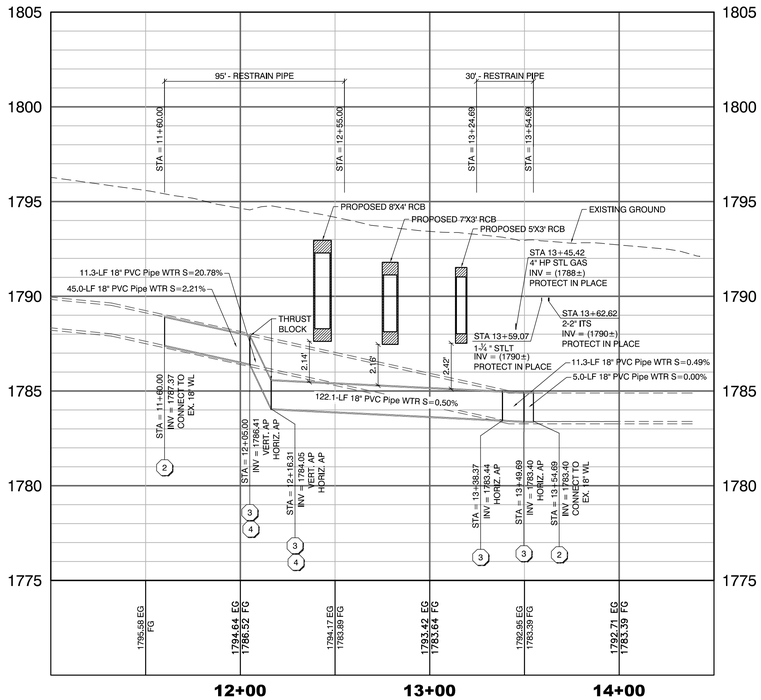
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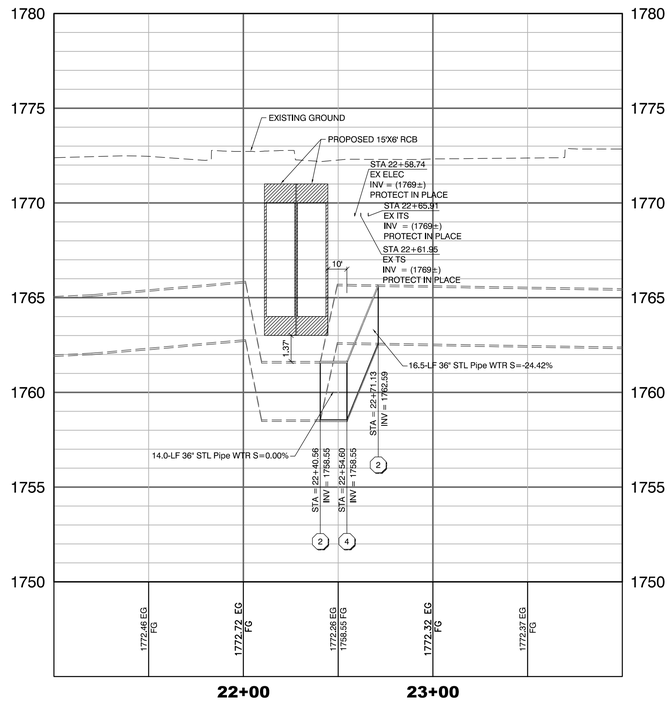
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

WATER CONSTRUCTION KEY NOTES

1. INSTALL 18" PVC C905 WATERLINE PER UDACS PLATE #17
2. CONNECT TO EXISTING WATERLINE WITH TRANSITION COUPLING
3. INSTALL HORIZONTAL 45° ELBOW
4. INSTALL VERTICAL 45° ELBOW
5. INSTALL 36" STL WATERLINE PER UDACS PLATE #17



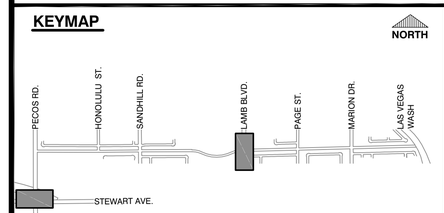


APPROVED FOR CONSTRUCTION

LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES MANAGER

DATE: PROJECT# XXXXX

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

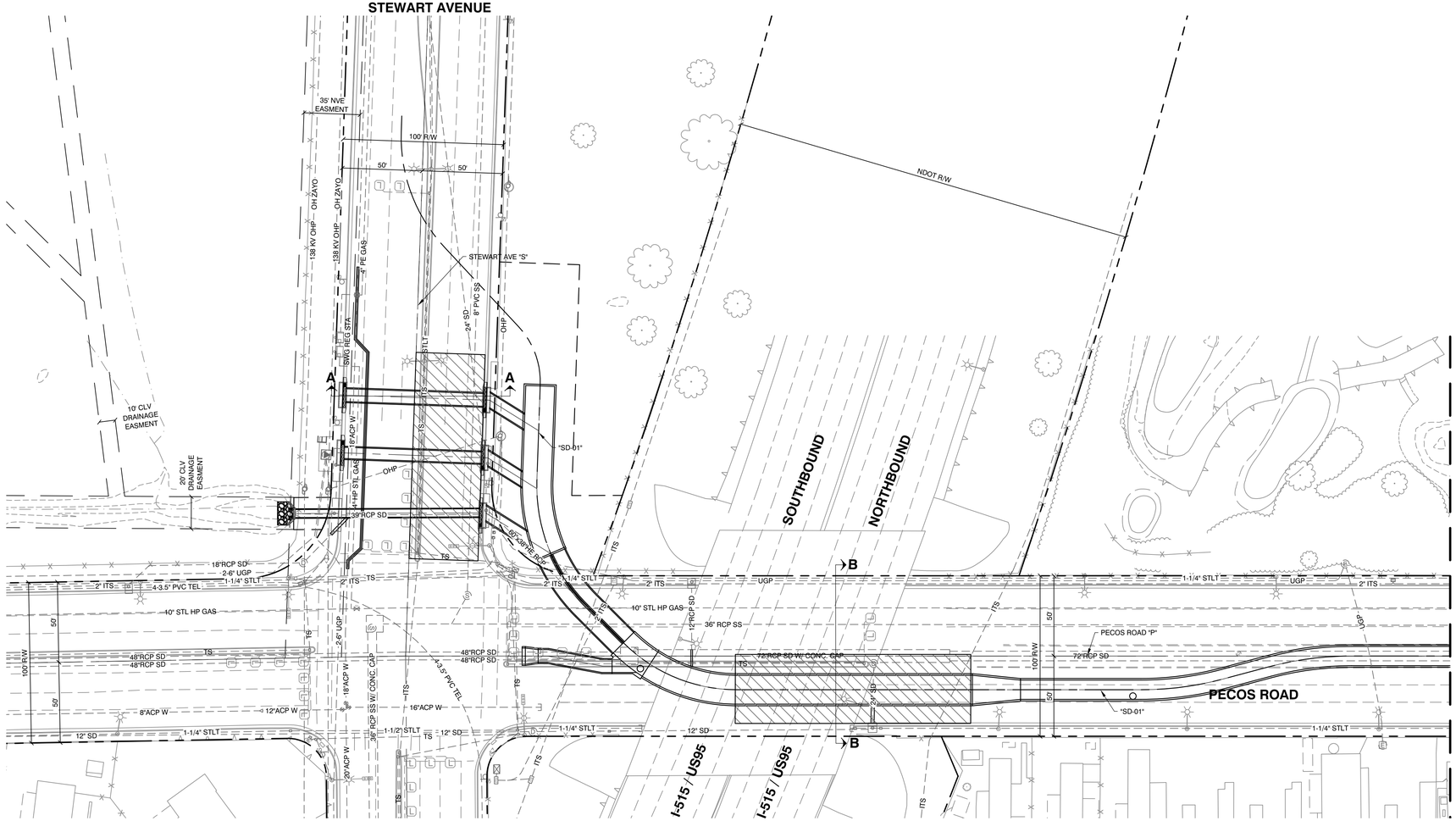
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DATE: 11/18/2016	DESIGNED BY: KRM
SUBMITTAL STAGE: 70% - PRELIMINARY	DRAWN BY: MM
	CHECKED BY: HB

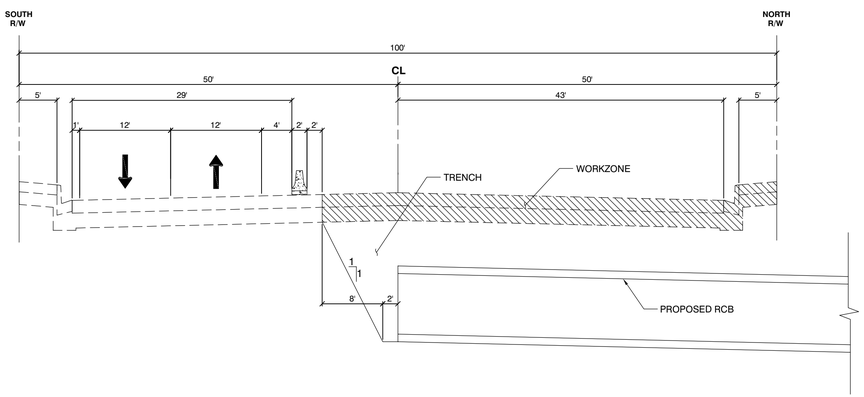
TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL
WATER RELOCATION
PLAN

PROFESSIONAL ENGINEER
KONDALARAO KANTI
51-17
CIVIL
No. 19685
STATE OF NEVADA
NOT FOR CONSTRUCTION

SHEET
WT01
51 OF 55
DRAWING NO.
XXX-XXXX

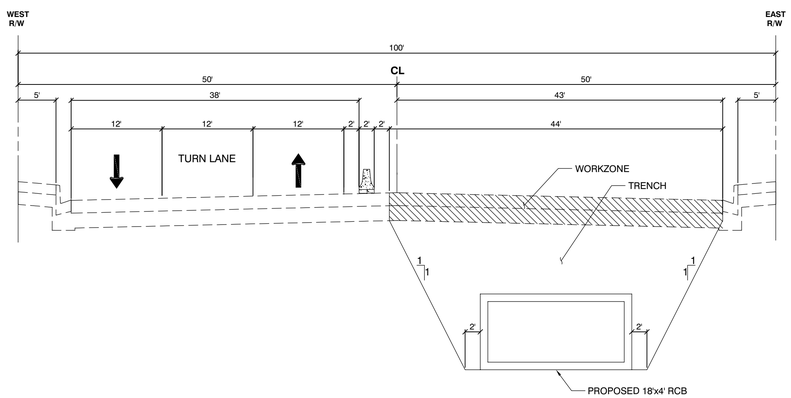
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SECTION A - A
SCALE: NTS

1
TC01



SECTION B - B
SCALE: NTS

2
TC01

GRAPHIC SCALE
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(IN FEET)

NORTH

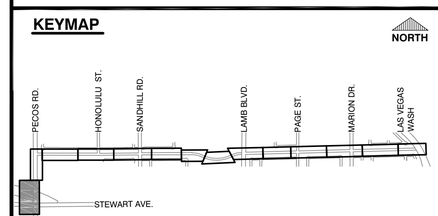
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- WORK ZONE
- DIRECTION OF TRAFFIC FLOW

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

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BID#	XX-XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HB

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

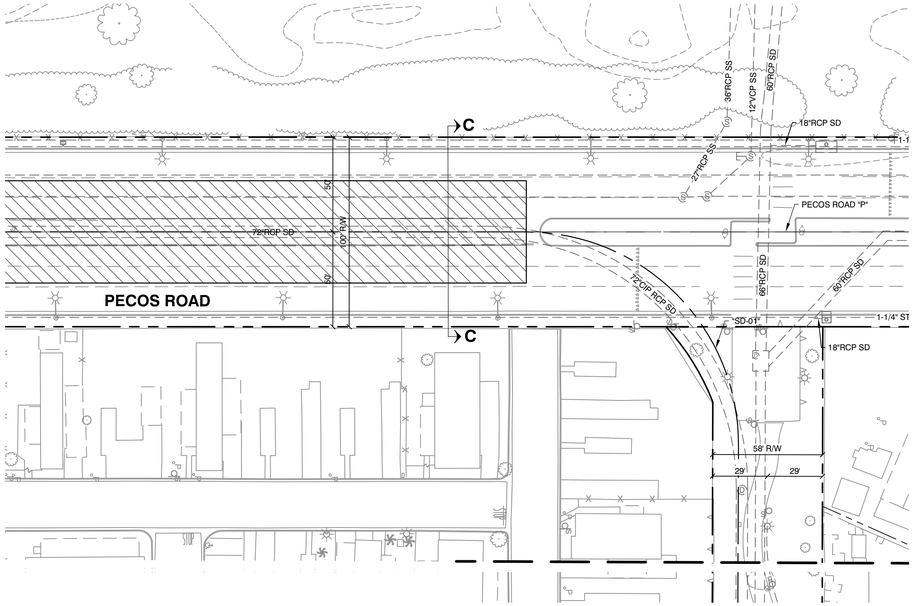
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"SD01" 10+00 TO "SD01" 19+00

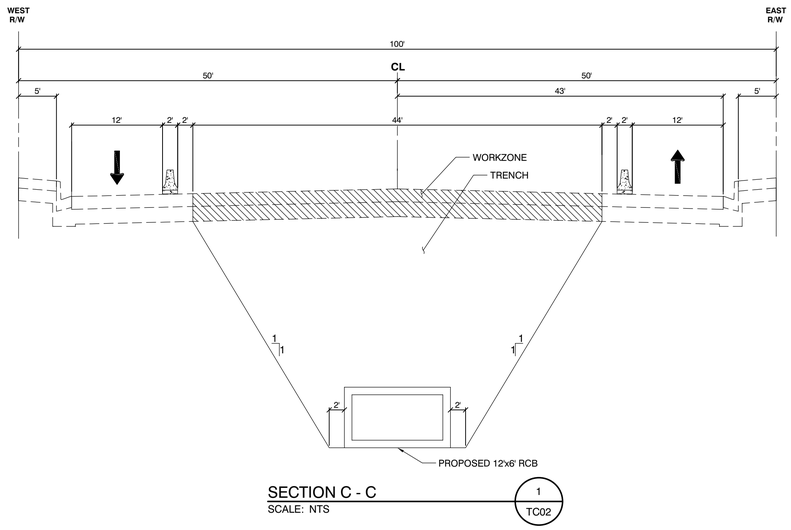
PROFESSIONAL ENGINEER STATE OF NEVADA
KONDAL RAO MADIRI
12-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
TC01
52 OF 55

DRAWING NO.
XXX-XXXX

M:\Projects\10003901_Cedar\H49866\Sheet Set\DWG\H49866 TC01 11-21-16 04:04pm





SECTION C - C
SCALE: NTS

1
TC02

NORTH

GRAPHIC SCALE

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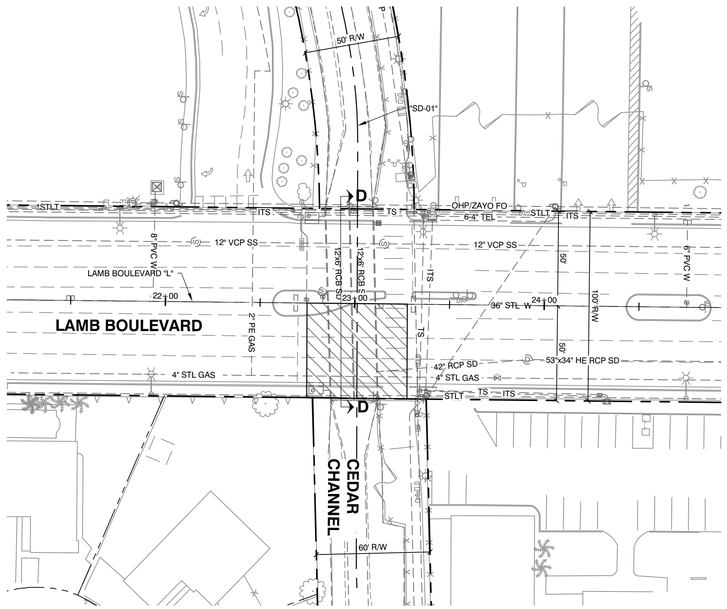
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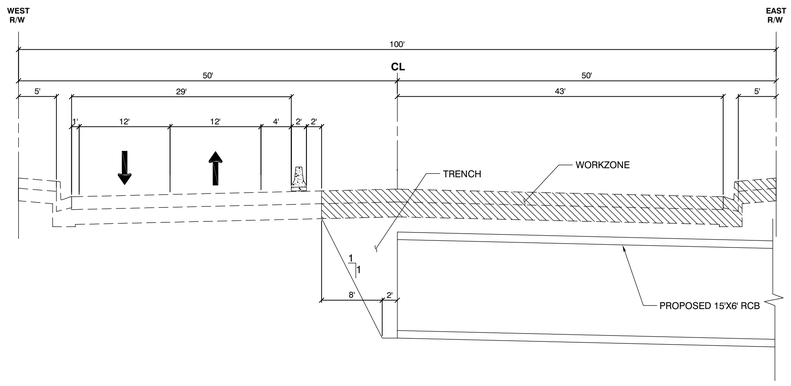
CALL BEFORE CONSTRUCTION

BEFORE YOU DIG	USA NORTH	811 OR 800-227-2600
BEFORE YOU UNDERGROUND	F.A.S.T.	702-432-5300
	CLARK COUNTY TRAFFIC OPERATIONS	702-455-7511
	CITY OF LAS VEGAS T.E.F.O.	702-229-6611
BEFORE YOU OVERHEAD	NV ENERGY	702-227-2929

LEGEND

- WORK ZONE
- DIRECTION OF TRAFFIC FLOW



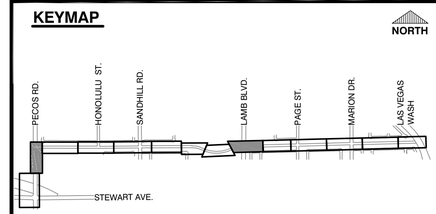


SECTION D - D
SCALE: NTS

2
TC02

NORTH

KEYMAP



NO.	DATE	REVISIONS

PREPARED BY

CITY OF LAS VEGAS NEVADA

ATKINS

2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

I# H49866	BID# XX-XXXX	DESIGNED BY: KRM	
DATE: 11/18/2016		DRAWN BY: MM	
SUBMITTAL STAGE: **70% - PRELIMINARY**		CHECKED BY: HB	

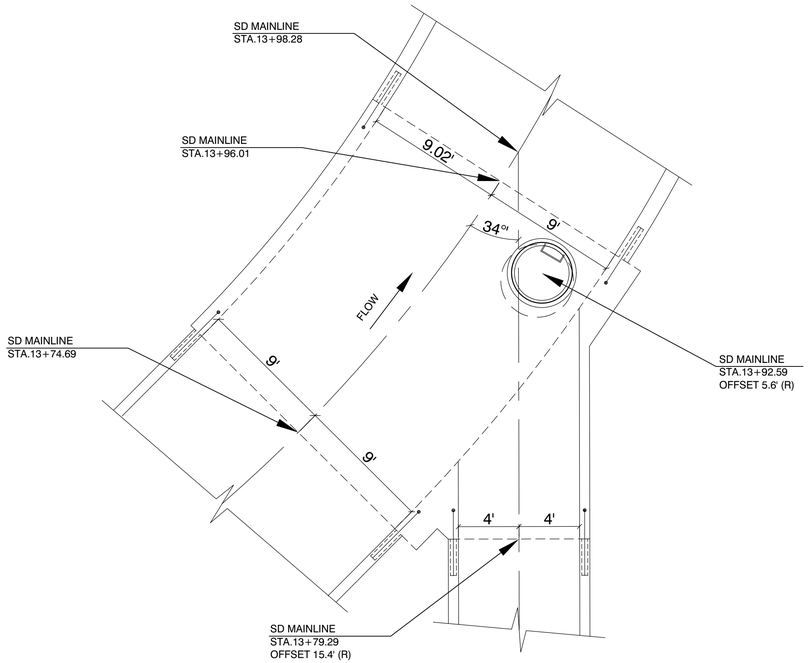
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LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

SHEET
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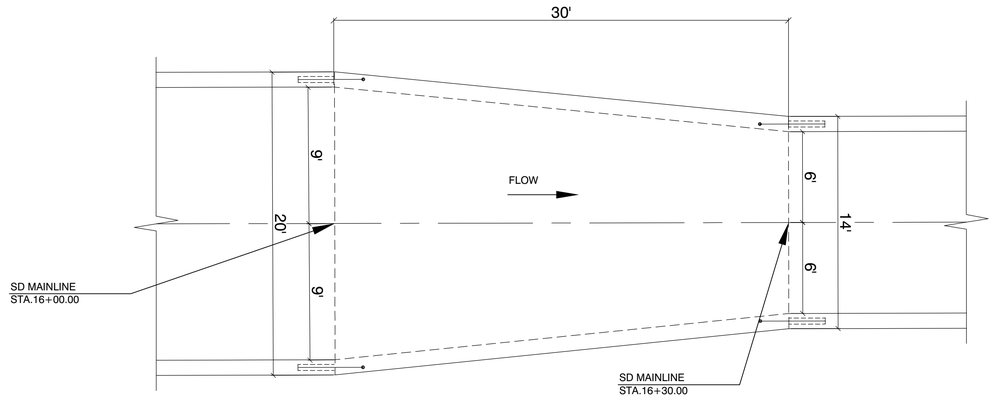
KONDALA M. NAO
Vol. 17
12-31-17
CIVIL
No. 19685
STATE OF NEVADA
PROFESSIONAL ENGINEER
NOT FOR CONSTRUCTION

SHEET
TC02
53 OF 55
DRAWING NO.
XXX-XXXX

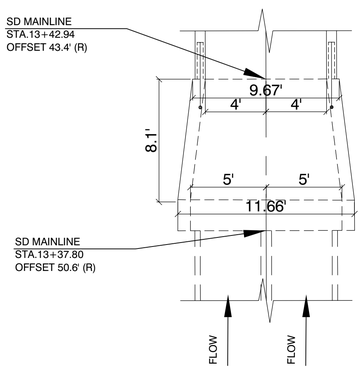
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JUNCTION STRUCTURE (A / ST01)
SCALE: NTS



TRANSITION STRUCTURE (B / ST01)
SCALE: NTS



TRANSITION STRUCTURE (C / ST01)
SCALE: NTS

GENERAL STRUCTURAL NOTES

GENERAL

STRUCTURES HAVE BEEN DESIGNED FOR OPERATIONAL LOADS ON THE COMPLETED STRUCTURES. DURING CONSTRUCTION, THE STRUCTURES SHALL BE PROTECTED BY BRACING AND BALANCING WHEREVER EXCESSIVE CONSTRUCTION LOADS MAY OCCUR.

UNLESS OTHERWISE SHOWN ON ALL STRUCTURAL DRAWINGS THE FINISH GRADE AROUND STRUCTURES IS SHOWN THUS ~~~~~ INDICATING EITHER GROUND SURFACE, TOP OF CONCRETE SLAB OR AC PAVEMENT. FOR DETAILS OF FINISH SURFACES SEE CIVIL AND ARCHITECTURAL DRAWINGS.

FOR PROJECT CONTROL POINTS REFER TO PLAN SHEET C1.06

STRUCTURAL

DESIGN IN ACCORDANCE WITH IBC 2009 AND CCRFCD "HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL".

LOCATION OF ALL CONSTRUCTION JOINTS SHALL BE AS SHOWN ON THE DRAWINGS OR APPROVED BY THE ENGINEER.

LOADING:
LIVE LOAD: 100 PSF

CONCRETE

UNLESS OTHERWISE NOTED OR SPECIFIED, ALL STRUCTURAL CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4500 PSI IN 28 DAYS. CEMENT SHALL BE TYPE V FOR ALL CONCRETE.

FILLET FORMS AT ALL EXPOSED CORNERS USING TRIANGULAR MOLDING WITH 2 EQUAL SIDES OF 3/4" IN SIZE.

REINFORCEMENT STEEL SHALL BE DEFORMED BARS CONFORMING IN QUALITY TO THE REQUIREMENTS OF ASTM A-615 "SPECIFICATIONS FOR DEFORMED BILLET-STEEL BARS FOR CONCRETE REINFORCEMENT". GRADE 60.

ALL DETAILING, FABRICATION AND PLACING OF REINFORCING BARS, UNLESS OTHERWISE INDICATED, SHALL BE IN ACCORDANCE WITH ACI-315, "MANUAL OF STANDARD PRACTICE FOR DETAILING REINFORCED CONCRETE STRUCTURES" LATEST EDITION.

TOLERANCES IN PLACING REINFORCEMENT SHALL BE:

± 3/8 INCH FOR MEMBERS WITH D ≤8 INCHES

± 1/2 INCH FOR MEMBERS WITH D > 8 INCHES

CONCRETE CONT.

ALL KEYWAYS IN CONSTRUCTION JOINTS, WHERE SHOWN, SHALL BE ROUGH AND THOROUGHLY CLEANED FOR BOND.

DOWELS, WATERSTOPS AND OTHER INSTALLED MATERIALS AND ACCESSORIES SHALL BE HELD SECURELY IN POSITION WHILE CONCRETE IS BEING PLACED.

UNLESS OTHERWISE INDICATED, ASIDE FROM NORMAL ACCESSORIES USED TO HOLD REINFORCING BARS FIRMLY IN POSITION, THE FOLLOWING SHALL BE ADDED:

A) IN SLABS #5 RISER BARS AT 36 INCHES O.C. MAXIMUM TO SUPPORT TOP REINFORCING BARS.

B) IN WALLS WITH 2 CURTAINS #3 U OR Z SHAPE SPACERS AT 6 FEET O.C. EACH WAY.

METAL CLIPS OR SUPPORTS SHALL NOT BE PLACED IN CONTACT WITH THE FORMS OR THE SUBGRADE. CONCRETE BLOCKS (OR DOBIES) SUPPORTING BARS ON SUBGRADE SHALL BE IN SUFFICIENT NUMBERS TO SUPPORT THE BARS WITHOUT SETTLEMENT, BUT IN NO CASE SHALL SUCH SUPPORT BE CONTINUOUS.

DOWELS SHALL BE WIRED OR OTHERWISE HELD IN POSITION. THEY SHALL NOT BE PLACED AFTER CONCRETE HAS BEEN POURED.

UNLESS OTHERWISE INDICATED ON THE DRAWINGS, LAPS OF REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE LATEST VERSION OF ACI-318.

REINFORCING BARS AND ACCESSORIES SHALL NOT BE IN CONTACT WITH METAL PARTS EMBEDDED IN CONCRETE. A MINIMUM OF 2 INCHES CLEARANCE SHALL BE PROVIDED AT ALL TIMES.

UNLESS OTHERWISE SHOWN ON THE DRAWINGS CONCRETE COVER FOR REINFORCING BARS SHALL BE AS FOLLOWS:

FOR CONCRETE PLACED AGAINST EARTH ——— 3"

FOR SURFACES IN CONTACT WITH WATER OR WEATHER AND FORMED SURFACES IN CONTACT WITH EARTH ——— 2"

FOR CONCRETE NOT EXPOSED TO WEATHER. OR IN CONTACT WITH WATER OR EARTH ——— 1-1/2"

UNLESS OTHERWISE NOTED, WALLS AND SLABS SHOWN WITH A SINGLE LAYER OF REINFORCEMENT SHALL HAVE THAT REINFORCEMENT CENTERED.

EXCAVATION AND BACKFILL

PREPARATION OF FOUNDATION MATERIAL LOCATED BELOW THE BOTTOM OF WALL FOOTINGS AND BACKFILL SHALL BE PERFORMED PER SPECIFICATIONS.

SOIL PARAMETERS USED FOR DESIGN:
(A) ALLOWABLE NET SOIL BEARING PRESSURE: 140 PSF.
(B) ACTIVE PRESSURE: 40 PCF (LEVEL BACKFILL)
(C) DYNAMIC PRESSURE: 8.9 PCF (LEVEL BACKFILL)
(D) ALLOWABLE COEFFICIENT OF FRICTION: 0.40
(E) SOIL WEIGHT: 125 PCF

THE FOOTINGS SHALL BE CAST AGAINST NATIVE MATERIAL FOR THE FULL DEPTH OF THE FOOTING OR FOOTING SHALL BE COMPLETELY BACKFILLED AND COMPACTED PER SPECIFICATIONS PRIOR TO PLACING ANY BACKFILL BEHIND THE WALL.

CONTRACTOR SHALL EXERCISE CARE DURING BACKFILL OPERATIONS TO ASSURE THAT WALLS ARE NOT DAMAGED. REFER TO EARTH WORK SPECIFICATIONS FOR BACKFILL PLACEMENT PROCEDURES AND LIMITATIONS ON EQUIPMENT WEIGHT.

TRENCH EXCAVATION AND SHORING SHALL CONFORM TO OSHA REGULATIONS 29 CFR PART 1926, SUBPART C.

MISCELLANEOUS

JOINT MATERIALS SHALL BE FURNISHED AND INSTALLED IN ACCORDANCE WITH CONCRETE SPECIFICATIONS.

SPECIAL INSPECTION IS REQUIRED FOR THE WORK. REFER TO IBC 2009 SECTION 1704.

DOWELS SHALL BE EPOXY TYPE. THE FOLLOWING PRODUCTS SATISFY THE REQUIREMENTS FOR THIS PROJECT: HIT RE 500 BY HILTI INCORPORATED.

THE INSTALLATION OF EPOXY DOWELS SHALL FOLLOW THE RECOMMENDATIONS OF THE SELECTED MANUFACTURER.

NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

1#	H49866
DATE:	11/18/2016
BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD

SUBMITTAL STAGE:
70% - PRELIMINARY

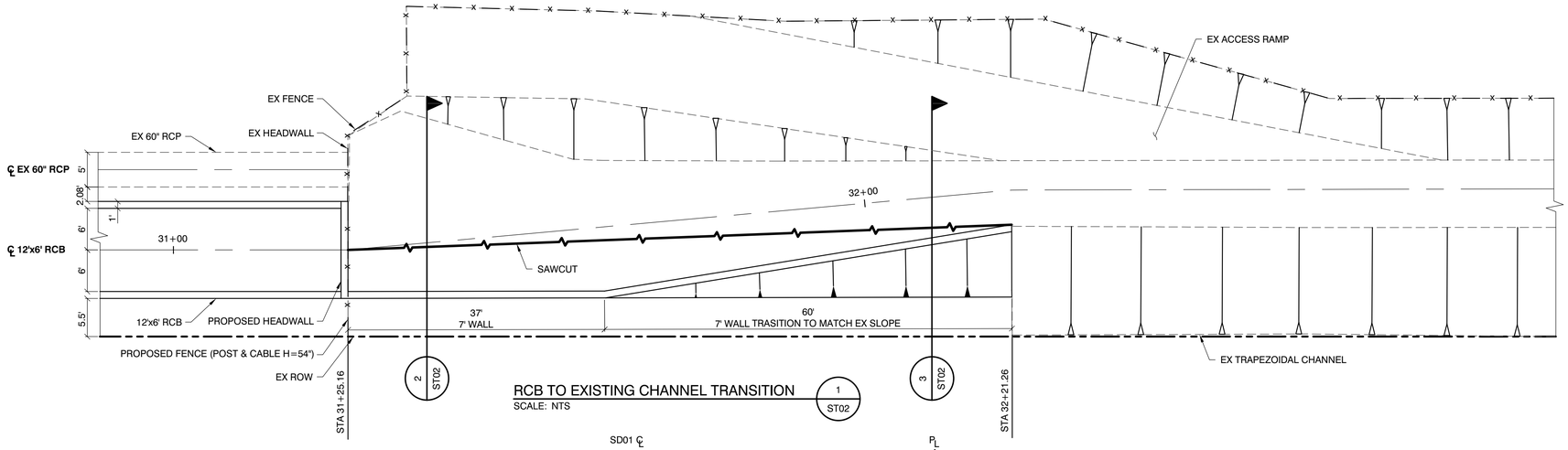
NOT FOR CONSTRUCTION
PROFESSIONAL ENGINEER - STATE OF NEVADA
KONDAL NAO
MUKTRI
12-31-17
CIVIL
No. 19655

TITLE
LAS VEGAS WASH CENTRAL CEDAR AVENUE CHANNEL

SHEET
STRUCTURAL SECTIONS

SHEET
ST01
54 OF 55
DRAWING NO.
XXX-XXXX

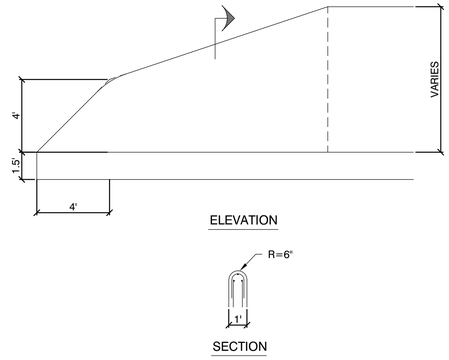
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RCB TO EXISTING CHANNEL TRANSITION

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1 / ST02



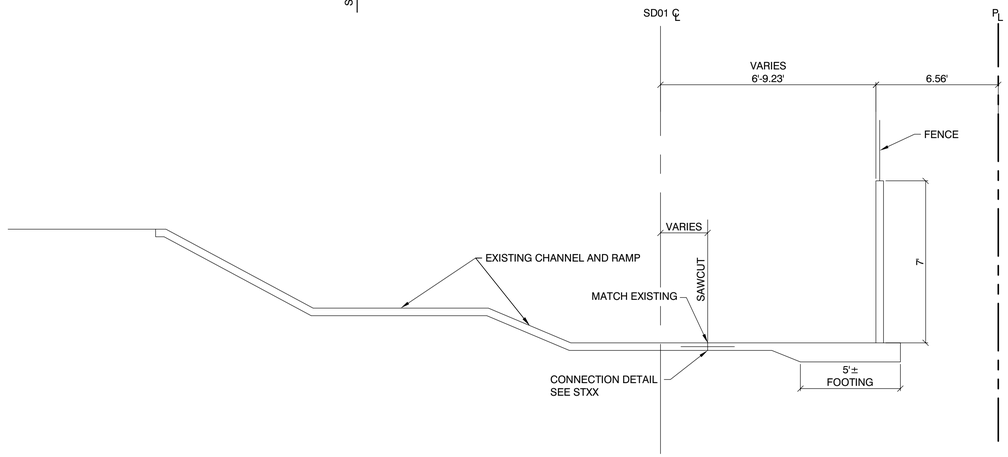
ELEVATION

SECTION

PIER NOSE

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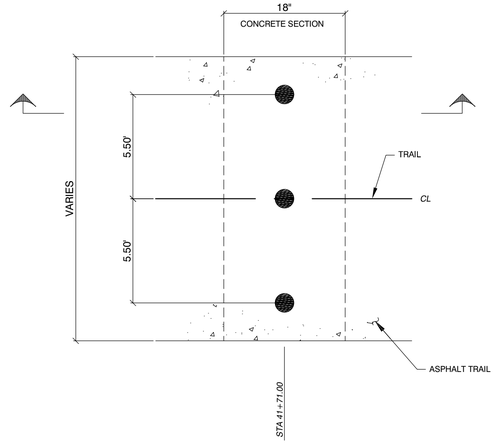
4 / ST02



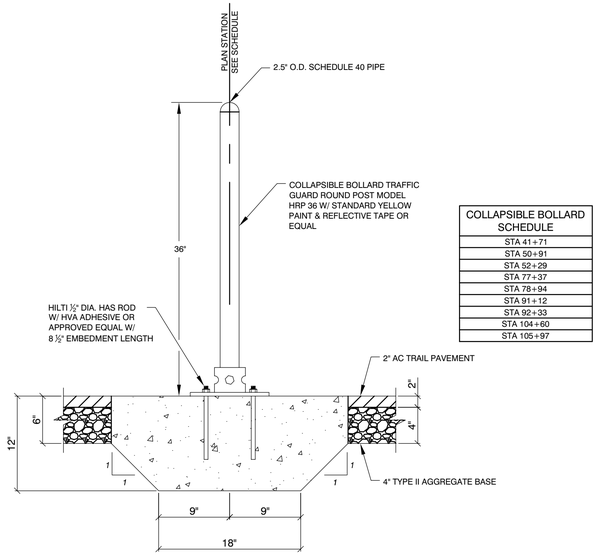
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2 / ST02



PLAN



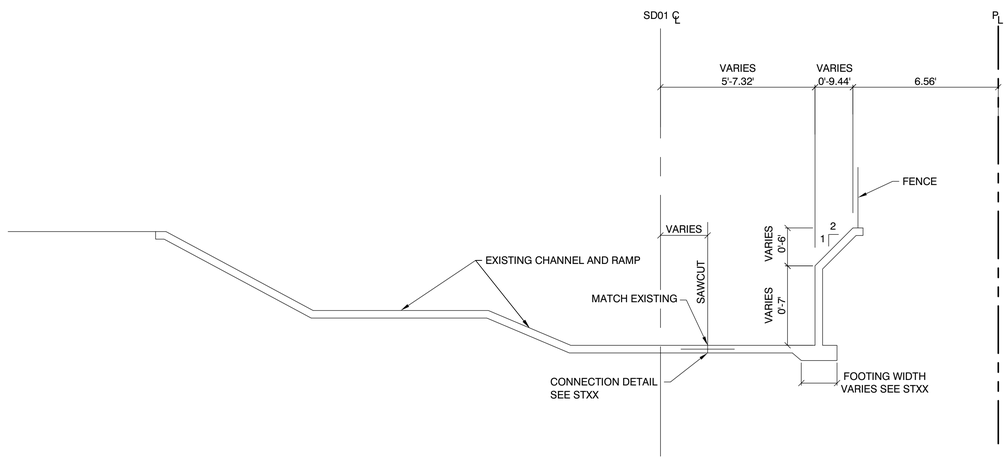
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COLLAPSIBLE BOLLARD SCHEDULE
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STA 50+91
STA 52+29
STA 77+37
STA 78+94
STA 91+12
STA 92+33
STA 104+60
STA 105+97

COLLAPSIBLE BOLLARD

SCALE: NTS

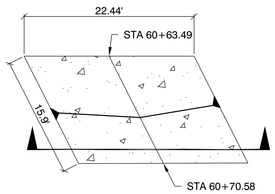
5 / ST02



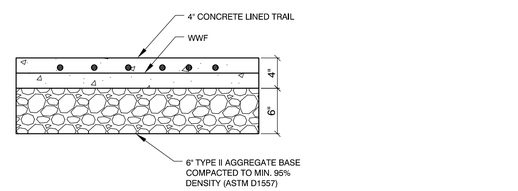
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SCALE: NTS

3 / ST02



PLAN



SECTION

CONCRETE LINED TRAIL

SCALE: NTS

6 / ST02

NO.	DATE	REVISIONS

PREPARED BY

ATKINS
2270 Corporate Circle, Suite 200
Henderson, Nevada 89074
Tel: +1 (702) 263 7273
Fax: +1 (702) 263 7200

PREPARED FOR
CITY OF LAS VEGAS

BID#	XX.XXXX
DESIGNED BY:	KRM
DRAWN BY:	MM
CHECKED BY:	HD
#:	H49866
DATE:	11/18/2016
SUBMITTAL STAGE:	70% - PRELIMINARY

TITLE
LAS VEGAS WASH CENTRAL
CEDAR AVENUE CHANNEL

SHEET
STORM DRAIN DETAILS

PROFESSIONAL ENGINEER – STATE OF NEVADA
KONDALA RAO MANTRI
12-31-17
CIVIL
No. 19685
NOT FOR CONSTRUCTION

SHEET
ST02
55 OF **55**

DRAWING NO.
XXX-XXXX

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