

DS #:

4976

APN:

138.08.401-013

PROJECT:

All Storage @Chuyenne & Fort Apache

SUBMITTAL:

1st

SCANNED BY/DATE:

CHECKED BY/DATE:



CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		April 25, 2018
TO: Land Development Services Department of Building & Safety		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Drainage Study for:	
	All Storage @ Cheyenne & Fort Apache	
Cross Streets:	NWC of Cheyenne Blvd. & Dapple Grey Av.	
File Number:	F:\Depot\DSMemos\DS4976A.doc	
Parcel Number:	138-08-401-013	
Zoning Action:	SDR-71559	
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES	NO X
		COPIES TO: Horrocks Engineers Cheyenne Investors, LLC Bart Anderson, P.E., DevCo

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	4/10/2018	4/25/2018	See Comments Below	\$400.00	495062: \$400
			TOTAL FEES (LDDRS):	\$400.00	----

REMARKS:

The Drainage Study for the subject project has been reviewed and:

	is approved subject to conformance to all City standards and the following conditions:
X	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. Provide a copy of the zoning/planning conditions associated with this site (**SDR-71559**) with the next submittal to verify compliance with conditions. *Flood Control* will not issue conditional approval of the drainage study without the associated zoning/planning conditions (issued by the *City Council*). Any associated conditions of approval that revise the site drainage parameters will require that the drainage study be revised and resubmitted.
2. The subject development accepts flows from the adjacent property through the northwest corner. Provide public drainage easement along the northern boundary of the site to perpetuate offsite flows. Public drainage easement must be recorded by separate document prior to the final acceptance of the improvement plans unless they are recorded by parcel map or final map.
3. The required public drainage easement must be 10'-wide minimum and is to be privately maintained. Clearly label as such in the grading plan and the recording documents. Concrete lined the easement so as to ease the burden of future maintenance by the property owner.
4. The proposed finished floor elevation of the new building is below the corresponding street grades in *Cheyenne Boulevard*. In *Detail Section 10/C6.0*, revise the height of the proposed berm to be 18" above the back of sidewalk at a minimum.

5. Label an existing drainage easement in the property on the east side of *Dapple Grey Avenue* with recorded document number on the grading plan.
6. Label the street names of the perimeter roadways in both of the Existing and Developed Conditions Basin Maps.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the *Nevada Division of Environmental Protection* a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see <http://ndep.nv.gov/bwpc/storm01.htm> or call (775) 687-9429.

END OF REMARKS

ays

T/R/S: T20S/R60E/08
AREA L-08

TECHNICAL DRAINAGE STUDY FOR
ALL STORAGE
@
CHEYENNE AND FORT APACHE
(APN 138-08-401-013)
IN
THE CITY OF LAS VEGAS, CLARK COUNTY, NEVADA

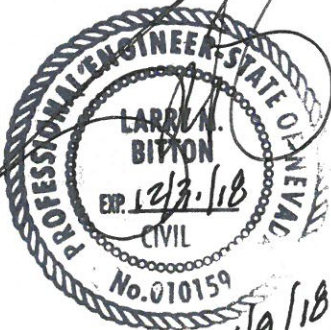
PREPARED FOR
Cheyenne Investors LLC
530 Lomas Santa Fe, Suite C
Solano Beach, CA 92075
Ph. (702) 348 5100

SUBMITTED TO
CITY OF LAS VEGAS

APRIL 2018

HORROCKS ENGINEERS PROJECT NV-1029-1801

Horrocks Engineers
1401 N Green Valley Pkwy, Suite 160
Henderson, NV 89074
702.966.4063



HORROCKS
ENGINEERS

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: All-Storage @ Cheyenne and Fort Apache Date: 04-05-2018
Location of Development: a) Descriptive (Cross Streets) North/South: Fort Apache
East/West: Cheyene Avenue
b) Section: 8 Township: 20S Range: 60E
c) APN: 138-08-401-013

Name of Owner: Cheyenne Investors LLC
Telephone No.: 702-348-5100 Fax No.: _____ E-Mail Address: blake@chaseconstruction@gmail.com
Address: 530 Lomas Santa Fem Solano Beach, CA 92075

Contact Person-Name: Larry Bitton Telephone No.: 702.966.4063
* E-Mail Address: larryb@horrocks.com Fax No.: _____
Firm: Horrocks Engineers
Address: 1401 N Green Valley Pkwy, Suite 160 Henderson, NV 89074

Type of Land Development/Land Disturbance Process:

☐ Rezoning	☐ Subdivision Map	☐ Clearing and Grading Only
☐ Parcel Map	☐ Planned Unit Development	☐ Other (Please specify below)
☐ Large Parcel Map	☒ Building Permit	

1. Total Owned Land Area: At Site: 2.1 acres Being Developed/Disturbed: 2.1 acres
2. Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? ☐ Yes** ☒ No
3. Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? ☐ Yes** ☒ No
4. Proposed type of development (Residential, Commercial, Etc.): Commercial
5. Approximate upstream land area which drains to the subject site: 3.5 acres
6. Has the site drainage been evaluated in the past? ☐ YES ☒ NO If yes, please identify documentation: _____
7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: At the northwest corner of the project site into Dapple Gray Road and east to Dapple Gray Road.
8. Briefly describe your proposed schedule for the subject project: ASAP



Engineer's Seal

Submit this form as part of the required drainage study to the local entity which has jurisdiction over the subject property. This form may provide sufficient information to serve as the Conceptual Drainage Study.

***New Required Field**

****Review and concurrence of the Clark County Regional Flood Control District is required.**

Local Entity File No.	Revision	Date

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

Project Name: All Storage @ Cheyenne	Map ID:	
Firm Name: Horrocks Engineers	Engineer: Larry Bitton	
Address: 1401 N Green Valley Pkwy, Suite 160		
City: Henderson,	State: NV	Zip: 89074
Phone Number: 702.966.4063	Fax Number:	
Property Owner: Cheyenne Investors LLC		
Address: 530 Lomas Santa Fe, Suite C		
City: Solano Beach	State: CA	Zip: 92075
Reviewed By:	Date Received:	Date Accepted for Review:

The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL).

This document is intended as an aid in preparing Technical Drainage Studies. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use.

If items are not applicable for the subject site, provide N/A.

I. GENERAL REQUIREMENT

Yes	No	
<u>X</u>	<u> </u>	Design Manual Standard Form 1 with the engineer's seal and signature.
<u>X</u>	<u> </u>	Design Manual Standard Form 4 .
<u>X</u>	<u> </u>	2 copies of the 24" x 36" Drainage Plan.
<u> </u>	<u>X</u>	A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

Yes	No	
<u>X</u>	<u> </u>	A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.
<u>X</u>	<u> </u>	A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:	STANDARD FORM 2
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HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

Yes	No	
<u>X</u>	<u> </u>	Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs.
<u>X</u>	<u> </u>	On-site drainage basin maps for existing and proposed conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs.
<u>X</u>	<u> </u>	Vicinity Map with local and major cross streets identified and a north arrow.

III. DRAINAGE PLAN

Yes	No	
<u>X</u>	<u> </u>	Sheet size: 24" x 36" sealed by a registered engineer in the State of Nevada.
<u>X</u>	<u> </u>	Minimum scale: 1" = 60'.
<u>X</u>	<u> </u>	Project name.
<u>X</u>	<u> </u>	Vicinity Map with local and major cross streets.
<u>X</u>	<u> </u>	Revision box.
<u>X</u>	<u> </u>	North arrow and bar scale.
<u>X</u>	<u> </u>	Engineer's/consultant's address and phone number.
<u>X</u>	<u> </u>	Elevation datum and benchmark.
<u>X</u>	<u> </u>	Legend for symbols and abbreviations.
<u>X</u>	<u> </u>	Cut/fill scarps, where applicable.
<u>X</u>	<u> </u>	Street names, grades, widths.
<u>X</u>	<u> </u>	Proposed future and existing spot grades for top of curbs and street crowns at lot lines, grade breaks, and along curb returns on both sides of the street.
<u>X</u>	<u> </u>	Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate.
<u>X</u>	<u> </u>	Minimum finish floor elevations with top-of-curb elevations at upstream end of lot.
<u>X</u>	<u> </u>	Proposed typical street sections.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
<u>X</u>	_____	Streets with off-set crowns.
<u>X</u>	_____	Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
<u>X</u>	_____	Property lines.
<u>X</u>	_____	Right-of-way lines and widths, existing and proposed.
<u>X</u>	_____	Existing improvements and their elevations.
<u>X</u>	_____	Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm peak flows at basin concentration points.
<u>X</u>	_____	Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
<u>X</u>	_____	Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
<u>X</u>	_____	Location and cross-section of street capacity calculations.
<u>X</u>	_____	Cross-sectional detail for channels, including cutoff wall locations.
<u>X</u>	_____	Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalk, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, material, shape, and slope with plan and profile and HGL calculations.
<u>X</u>	_____	Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
<u>X</u>	_____	Location and detail of existing, proposed, and future block wall openings. Minimum size is 16" x 48". Wrought iron gate is required for flows > 10 cfs.
_____	n/a	Location and detail of flood walls illustrating depth of flow, proposed grouting height, etc.
<u>X</u>	_____	Perimeter retaining wall locations. All existing and proposed walls (retaining screen and flood) must be shown with adjacent ground elevations. Flood walls with 8-inch concrete masonry unit.
<u>X</u>	_____	Building and/or lot numbers.
n/a	_____	Alignment of all existing, proposed, or future Regional Facilities adjacent to the site.
<u>X</u>	_____	Limits of existing floodplain based on current FIRM or best available information; limits of proposed floodplains based on best available information.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
☐	☒	n/a
☒	☐	For areas in Zone A, AE, AH, and AO, base flood elevations (BFEs) must be shown for each lot; BFEs may be listed on each lot, or in a table. Finish floor elevations must be a minimum of 18 inches above BFE.
☐	☐	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
☒	☐	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
☐	☐	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
☒	☐	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
☒	☐	Input and output information for existing conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	Input and output information for future conditions from computer models (HEC-1 or TR-55). The flow routing diagram must be provided with HEC-1 models.
☒	☐	Use of correct precipitation values in and around the McCarran Airport rainfall area.
☒	☐	A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
☒	☐	A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.
☐	☒	n/a
☒	☐	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
☐	☐	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
☒	☐	Calculation for impervious area for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

V. HYDRAULIC ANALYSIS

Yes	No	
☐	☒ n/a	Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
☒	☐	Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q_{100} and Q_{10} flows representing the worst case for interior and all perimeter streets. $Q_{100} d \times v \leq 8$. $Q_{10} d \times v \leq 6$ and 12 foot dry lane for rights-of-way ≥ 80 feet. Calculations must be labeled by street name as indicated on the Grading Plan.
☒	☐	A summary table of interior and exterior street capacity calculations showing the street name, Q_{100} flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
☒	☐	Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
☐	☒ n/a	Appropriate hydraulic calculations at drainage easement entrance and discharge locations to set finish floor elevations. Hydraulic calculations must include submerged weir, superelevation and tee intersection losses, where appropriate.
☒	☐	Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q_{100} weir height or flow depth, whichever is greater.
☐	☒ n/a	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
☒	☐	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
☒	☐	Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
☒	☐	The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
☒	☐	Provide BMP type, size and supporting calculations for parking lots and LIDs (if required).

REFERENCE:

STANDARD FORM 2

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APPENDICES

Appendix A – Hydrologic Data and Calculations

Appendix B – Hydraulic Sections and Calculations

Appendix C– Referenced Information

Appendix D – Grading Plan; Plan/Profiles; Sections/Details

I. INTRODUCTION

Cheyenne Investors, LLC is proposing to develop a 2.5 +/-acres commercial parcel located in the City of Las Vegas on Cheyenne Avenue and east of Fort Apache Road. (Assessor Parcel Numbers 138-08-401-013). The site will consist of one (1) storage building, parking stalls, landscaping and fencing/gates. This report presents the results of a technical drainage study consisting of hydrologic and hydraulic analysis for the site development as required in the Clark County Regional Flood Control District Hydrologic Criteria and Design Manual (hereinafter referred to as, "The Manual"). The purpose of the report is:

- To identify and evaluate previous drainage studies in the surrounding area
- To identify the flood zone status of the property
- To identify the existing and developed regional facilities adjacent to the site
- To quantify the 10-yr and 100-yr peak runoff impacting the site, and
- To present the appropriate mitigation for conveying the peak flows under the Proposed and Ultimate conditions through and around the development in accordance with local standards.

II. PROJECT LOCATION AND DESCRIPTION

The project is located in Section 8 Township 20 South, Range 60 East MDM in the City of Las Vegas, Clark County, Nevada. Refer to Figure 1 – Vicinity Map. Conditions surrounding the property are summarized in Table 1 below.

TABLE 1

Table 1 – Project Conditions

Frontage	Existing Condition	Proposed Condition	notes
Site	Undeveloped	Commercial – Storage	The site drains west to east and drops ~10' between existing developments from the west to the east
North	Developed – Public Utility Facility (LVVWD)	Unchanged	This site discharges flow away from the project site. The site does not affect the site drainage. Accepts flow from 7-11 Site.
West	Developed – Commercial	Unchanged	Discharges 1/3 cfs (10/100 yr) into the project site
South	Developed – 100' ROW Roadway	Unchanged	The site drains away from the roadway – The site does not discharge into Cheyenne Avenue
East	Developed - Commercial	Unchanged	Existing Commercial accepts the site discharge through the existing site via an existing drainage easement. Discharges flows into Campbell Road

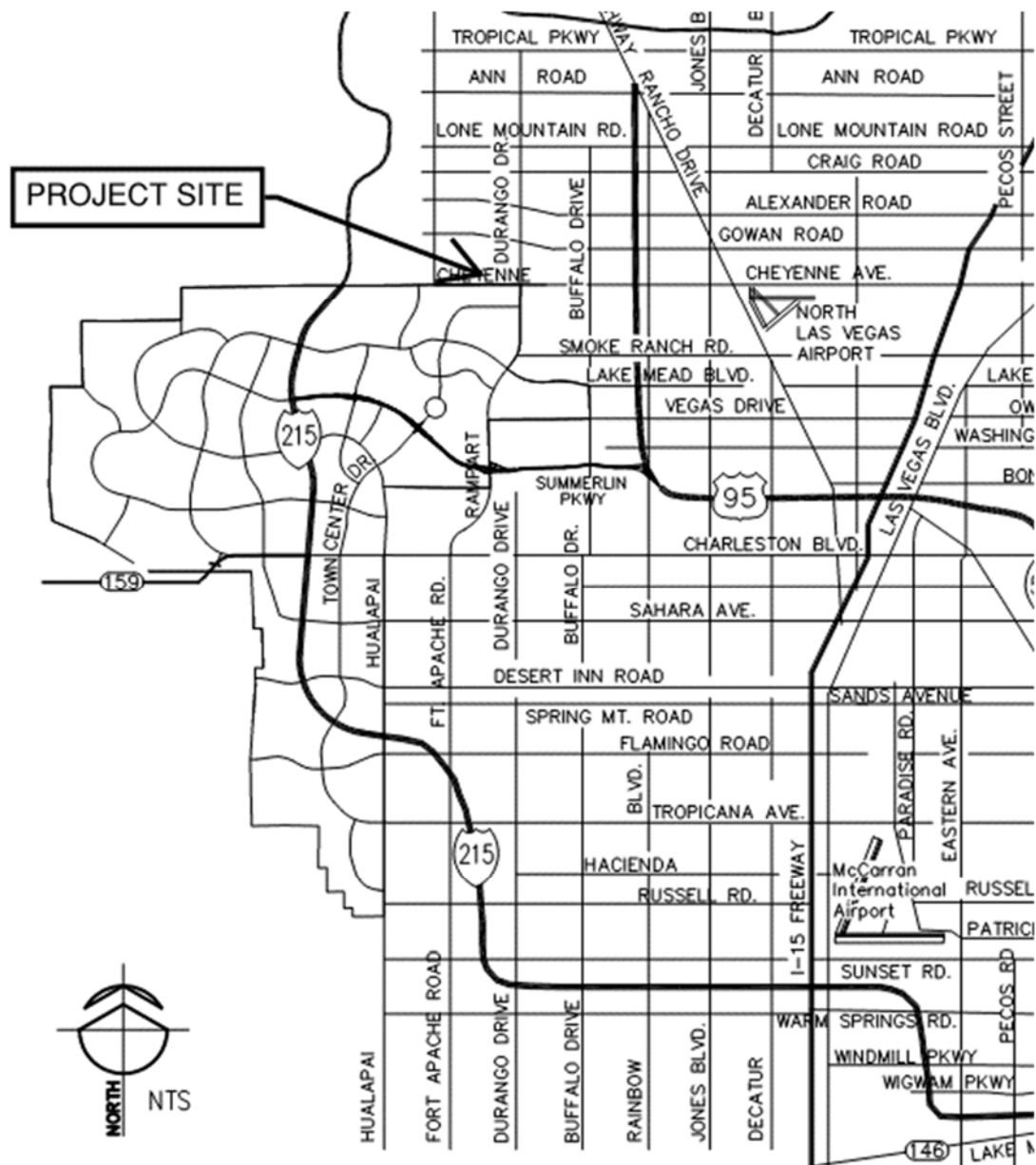


FIGURE 1 – VICINITY MAP

CCRFCD FACILITIES

There is an existing Clark County Regional Flood Control Facility (CCRFCD Facility GO02 0257 – GO02 0112) located south of Cheyenne Avenue along the Cheyenne alignment. The site and the north half of Cheyenne adjacent to the project site do not contribute flow to the CCRFCD Facility GO02 0257 – GO02 0112. It is defined as a 10' wide concrete channel with 1.5:1 side slopes. See Figures 4, 4A and 5 in Appendix A for reproductions of the MPU figures for the project site.

FEMA FLOOD ZONE

The project site is NOT located in a FEMA flood zone or special flood hazard area in accordance with Flood Insurance Rate Map 320032C2135F for the City of Las Vegas, dated November 16, 2011. See reference Appendix A for reproductions of the appropriate FIRM panels.

III. METHODOLOGY

The methodology for hydrologic and hydraulic analyses used in this study are in compliance with the Manual. The drainage models use unit hydrograph modeling methodology per the Manual. The (HEC-1) software package by USAC Water Resources Institute (Reference 3) as allowed per Clark County. Hydrologic methodologies used in this study are in accordance with Sections 500 and 600 of the Manual.

Hydraulic Methodology and Criteria

Hydraulic methodologies used in this study in accordance with the Manual. FlowMaster has been used to assist in hydraulic calculations. Excel spreadsheets have also been used for other necessary calculations. Hydraulic calculations can be found in Appendix B.

Topographic Information

Topographic information for this project was gathered from sources including:

1. Aerial and field topographic survey completed by at a 1-foot contour interval.
2. Two (2) foot contour data provided by Clark County around 2016.

HEC-1

The U.S. Army Corps of Engineers *HEC-1 Flood Hydrograph Package* was used to determine the peak runoff values generated by the 100-year, 6-hour storm event. The HEC-1 computer model has the ability to simulate the surface runoff response of a drainage basin to precipitation. The HEC-1 program represents the basin as an interconnected system of hydraulic components.

Rainfall

The project lies outside of the McCarran Rainfall Area as delineated in the Manual on Figures 501, 503, 506, and Tables 501 and 503 (included in Appendix A). The 6-hr rainfall depths were determined to be 0.85, 1.67 and 3.0 inches for the 2-yr, 10-yr, and 100-yr return periods, respectively. The site encompasses less than 8 square miles, therefore the Storm Distribution Number Three (SDN No. 3) was used for the HEC-1 Model. Since the total watershed studied consists of approximately 15 acres, the rainfall depths were not adjusted for depth area.

Table 2
6-Hour Rainfall Depths

Year	Rainfall Depth	Adjustment Ratio	Adjusted Rainfall Depth	Percentage of 100 Year
2	0.85	1	0.85	0.28
10	1.35	1.24	1.67	0.56
100	2.1	1.43	3.00	1.00

Curve Numbers

The soils for the drainage basins were determined using the digital map from the Las Vegas Valley Area, Nevada, Part of Clark County Soil Survey Area sourced from the Natural Resources Conservation Service (Reference 4). The drainage basins are comprised of soils classified as 502. These soils are classified as Hydrologic Soil Group: A. Soil descriptions, soils map, and associated soil properties/qualities are included in Appendix A. The Curve Numbers associated with the soils were determined using land use categories and methodology of the Manual and are summarized on Drainage Basin Curve Number Calculations in Appendix A.

Drainage Basins

Drainage basins were identified by field observations, aerial photography, surveyed topography, 2-ft contour topography from Clark County OpenWeb and referenced studies. The site has relatively small offsite basins contributing to Cheyenne Avenue. The other offsite basins consist of the commercial parcel to the west of the project site. The basins are described in the applicable sections below for each drainage condition. The drainage basins are shown on Figures 6 and 7.

Hydrologic Abstractions

Interception, infiltration, surface storage, evaporation, and evapotranspiration are regarded as hydrologic abstractions. The primary rainfall loss component in hydrologic models is infiltration.

The SCS curve number method was used to approximate the infiltration rates for the onsite watershed. Curve numbers are a function of the hydrologic soil group, vegetative cover and its hydrologic condition, land use, and the soil's antecedent soil moisture condition. Curve numbers are referenced from the CCRFCD's Hydrologic Criteria and Drainage Design Manual, Tables 602, pages 1 and 4 of 4.

Lag Time

Lag time (TLAG) is described as the time measured between the centroid of rainfall to the peak of the outflow hydrograph. It is a measure of the watershed's response time and is associated to basin length, slope, roughness characteristics, and land use.

Lag-times have been estimated by calculating the drainage basins' time of concentration, T_c . The time of concentration consists of two component times; the initial overland flow time, t_i , and the travel time for the flow within the gutter, swale, or channel, t_t . The equation for the time of concentration is as follows:

$$T_c = t_i + t_t$$

$$\text{Where, } t_i = 1.8(1.1-K)L_o^{1/2}/S^{1/3}$$

K = Flow Resistance Coefficient ($K = 0.0132CN - 0.39$)

CN = Curve Number

L_o = Length of the Overland Flow

S = Average Basin Slope

$$\text{And, } t_t = L/(60V)$$

L = Length of Gutter/Channel (ft)

V = Flow Velocity (ft/s) – Velocity is calculated from the Manning's Equation with $Q = 0.6Q_T$, where Q_T = Total Discharge

Lag-times are estimated with the following equation: $TLAG = 0.6T_c$.

IV. Drainage Summary

General Description

The project site is impacted by offsite runoff from the adjacent commercial parcel. The flow enters the northwest corner of the project site from the adjacent parcel to the west and will be

conveyed through the site in a proposed swale. The flow will be discharged into the LVVWD site north of the project site through existing block wall openings. These flow patterns match the existing flow patterns. The site itself will be developed as commercial landuse. There is one existing north-south street with half street improvements, Dapple Gray Road. It includes a slight existing highpoint north of its intersection with Cheyenne Avenue and is proposed to be fully developed with this project. Cheyenne Avenue borders the project site to the south, and is a 100' right-of-way road and slopes from west to east. The onsite basins will discharge to Dapple Gray Road.

Previous Drainage Studies

There were numerous Technical Drainage Studies that have been previously approved in the vicinity of the subject site. Although several studies were reviewed for general information, only the studies of which specific information was referenced are listed below. All reference material can be found in Appendix C.

Conceptual Drainage Study for Cheyenne/Campbell, DS 3582

The Technical Drainage Study for Cheyenne/Campbell (Conceptual) Study (Hereinafter referred to as the Cheyenne Conceptual Study) analyzed the site along with the parcels directly east of the project site. The Cheyenne Conceptual Study calculated the flows at the offsite basins in Cheyenne Avenue using the Rational Method. The parameters used in the rational method calculations were used for the HEC-1 input to calculate the flows upstream of the project site in Cheyenne Avenue for the Basin CHEY. The residential development proposed with the reference study was never constructed.

Technical Drainage Study for Cheyenne/Campbell, DS 4106

The Technical Drainage Study for Cheyenne/Campbell (Hereinafter Referred to as the Cheyenne Study) proposed a drainage easement through the proposed parking lot that conveys the runoff from the project site from Dapple Gray Road to Campbell Road, downstream of the project site. The easement consists of a sidewalk underdrain and short concrete flume that conveys flows into the site from Dapple Gray Road. The easement was originally designed to run along the curb and gutter, but in subsequent updates was revised to be a 3' valley gutter that runs through the middle of the parking lot. The easement conveys flows east with a valley gutter and then discharges flow into Campbell Road. Normal depth calculations have been included that show that the flow through the 20' public drainage easement in the Cheyenne Study. See the Hydraulic calculations section below for further discussion.

Technical Hydrology Study for Cheyenne Campbell, DS 3971

The Technical Hydrology Study for Cheyenne/Campbell (Hereinafter Referred to as the Cheyenne Residential Study) includes the offsite basins map that illustrates the basin boundaries for the basin CHEY. The basins boundaries for the referenced Basin CHEY were reviewed and accepted using the 2-foot contours from Clark County flown in 2016. The offsite basin map has been included in Appendix C.

Technical Drainage Study for 7-11 at Northeast Corner Cheyenne/Fort Apache 7-11, HTE 98-8063

The Technical Drainage Study for Cheyenne/Fort Apache 7-11 (Hereinafter referred to as the 7-11 Study) proposed to discharge runoff to the project site through block wall openings at the northwest corner of the site. This study assumes that the entire runoff from referenced basin ON-2 from the 7-11 Study is conveyed into the project site. This assumption is conservative

because there is also a blockwall opening that convey flow north from the 7-11 Study site. However, with the propensity with which block wall openings can clog, it is reasonable to assume the entire flow from referenced basin ON-2 is discharged into the project site. The flows for ON-1 and ON-2 have been revised with this study. The curve number calculations have been updated with a current soils map and revised flows have been calculated with HEC-1. The revised flows are 1/3 cfs in the 10-year and 100-year events, respectively.

The previously mentioned flows and information have been accepted and referenced for use as presented in this study.

V. EXISTING CONDITIONS DRAINAGE

The site exists in a natural desert condition and generally slopes to the northeast corner of the site at Dapple Gray Road. Offsite flow impacts the project site from the 7-11 Study site to the west. Referenced Basin ON-2 is conveyed into the site through a wall opening at the northwest corner of the project site and then discharges into the adjacent parcel to the north of the project site through three (3) existing block wall openings. The southern portion of the 7-11 Study is conveyed into Cheyenne Avenue and does not enter the project site, but affects the total flows in Cheyenne Avenue. Refer to the Figure 5 in Appendix A, Existing Basin Map, for basin boundaries and flow paths. Refer to Appendix C for a referenced offsite basin map that shows the basin boundaries for Basin CHEY. See Table 3 for a summary of existing and proposed flows.

Offsite basin CHEY combines with basin ST1 and referenced basin ON-1 at concentration point CE1 near the intersection of Cheyenne Avenue and Dapple Gray Road. On the north side of Cheyenne Avenue there is a valley gutter and high point located in Dapple Gray Road that contains the 100-year flow in Cheyenne Avenue. The flow then continue east in Cheyenne Avenue. Runoff from the referenced basin ON-2 enters the site at the northwest corner of the site and is conveyed to the north through block wall openings to the existing parcel north of the project site. Onsite basin ON-E and ST2 combine in Dapple Gray Road at concentration point CE2. The flow from CE2 is then conveyed east to Campbell Road through the existing public drainage easement. Dapple Gray is currently only developed as a half street.

The referenced basins ON-1 and ON-2 from the 7-11 Study have been updated with a current soils map and the resulting flows have been recalculated using HEC-1. See the hydrologic calculations in Appendix A for updated calculations and Table 3 for a summary of the revised flows for basins ON-1 and ON-2.

VI. INTERIM/ULTIMATE CONDITIONS

The surrounding areas are fully developed. The interim/ultimate condition assumes that the project site is fully developed and the offsite areas are fully developed. The interim and ultimate conditions are considered the same. Refer to Figure 6, Developed Basin Map, for basin boundaries and flow paths. See Table 3 for a summary of existing and proposed flows. The offsite runoff from basin ON-2 along the northern portion of the site and through the existing block wall openings to the parcel north of the project site. Once in the northern parcel, flow is conveyed through an existing swale to an existing detention basin as in the existing conditions.

The interim/ultimate conditions flow patterns match the existing condition flow patterns. Offsite basin CHEY combines in Cheyenne Avenue with street basin ST1 and referenced offsite basin ON-1 at concentration point CD1 near the intersections of Cheyenne Avenue and Dapple Gray Road. Runoff from the referenced basin ON-2 enters the project site at the northwest corner, is conveyed through a proposed landscape swale along the north wall and then is discharged to the parcel north of the project site through existing block wall openings. Onsite runoff combines with

street basin ST2 at concentration point CD2. The flow from CD2 is then conveyed east to Campbell Road through the existing public drainage easement.

There is a proposed highpoint near the northwest corner of the site and onsite basin ON-D is prorated into OND1 and OND2 to account for the flow that is directed to the south then east and discharges through a swale at the proposed driveway in Dapple Gray Road. Prorated subbasin OND2 is conveyed east along the north portion of the site and discharges through a BMP swale at the northeastern corner of the project site. Runoff from prorated subbasin OND1 is conveyed counter clockwise around the proposed building from the northwest corner of the site and is discharged to Dapple Gray Road through a BMP swale near the project site driveway.

Hydraulic calculations for the proposed streets have been provided in Appendix B and are further discussed later in the report.

VII. WATER QUALITY BEST MANAGEMENT PRACTICES

The site is largely comprised of impervious areas similar to a parking lot. In accordance with Section 1502 of the Manual, Parking Lot Low Impact Development (LID) Best Management Practices (BMP) measures have been integrated into the site design to help control surface water quality exiting the site. The parking lot LID BMP features were implemented to capture the first flush of surface water to help reduce sediment and pollutants discharged during minor (2-yr) frequency storm events per Section 1502.3 of the Manual. The drainage plan incorporates BMP swales that will treat the impervious areas for at least 75% of the parking lot and impervious area from the onsite drainage network. This is accomplished by directing runoff to pervious areas that will convey the 2-year event storm via rock-lined swales designed as specified in the Manual. Per Chapter 15 of the manual, the project site is considered a large site. The BMP–LID Drainage Plan in Appendix B depicts the BMP facilities and the contributing areas. The proposed facilities will disconnect storm water runoff from more than 75% of the parking lot.

VIII. HYDRAULICS

Street Hydraulics

Hydraulic calculations have been provided for all streets in the developed conditions. See Table 4 for a summary of results; calculations can be found in Appendix B. The location of the hydraulic cross sections can be found on Figure 6. All street sections meet VxD and depth requirements for the 10-year and 100-year storm events. Dry lane requirements are also met for Cheyenne Avenue.

Cheyenne Avenue is a 100' ROW Street section with a median. The normal depth calculations for section 1 shows that Cheyenne Avenue meets 10 year and 100 year criteria including 10-year, 12-foot dry-lane criteria. Dapple Gray is a 60' ROW street section with 2% cross fall from west to east. The section slopes at 2% from the curb and gutter on the west side of the street to the curb and gutter on the east side of the street. Per chapter 9 of the Manual, the concerns associated with a cross fall street section have been considered. The engineer considers the 2% cross fall street section an acceptable design given the low amount of traffic, relatively short longitudinal length of Dapple Gray Road and the low speeds of the roadway. An administrative waiver will be sought if required as a variance from design standards.

There is a highpoint just north of the intersection of Cheyenne Avenue and Dapple Gray Road. The normal depth calculations for Cheyenne Avenue shows that the flows will be contained within Cheyenne Avenue.

Finished Floor Elevations

The proposed finished floors have been set at a minimum vertical distance above the gutter flowline of at least twice the depth of flow in the gutter flowline up to a maximum of 18 inches above the water surface elevation in the perimeter streets or have been protected up to at least twice the depth of flow in the gutter flowline up to a maximum of 18 inches above the water surface elevation in the perimeter streets. The proposed finished floors are set at least twice the depth of flow above the flowline in the parking lot and in Dapple Gray Road. Cheyenne Avenue is set above the site and the proposed finished floor elevations are below the flowline in the street. There is a proposed berm located in the landscaping area along Cheyenne Avenue that will provide protection of at least twice the depth of flow from the flows in Cheyenne Avenue.

Easements

The project includes one public easement. There is an existing 15' public sewer easement that runs along the north border of the project site, and will be revised to a 20' public sewer easement. Cross section 5 provided hydraulic calculations for this easement. There is a proposed landscaped swale that will contain the offsite flow that enters the site until it discharges from the site through one of the existing block wall openings in the northern wall. A 1' berm is proposed downstream of the second block wall opening that will direct the flows in the swale through the existing block wall opening to the parcel north of the project site. Calculations for the landscaped swale and block wall openings have been included in Appendix B. The finished floors are protected in the worst-case scenario regarding the flows through the proposed drainage easement.

IX. Summary Tables

Table 3: Basin Summary

Existing Condition				Developed Condition			
Basin	Area (acres)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)	Basin	Area (acres)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
CE1	-	14	25	CD1	-	14	25
CE2	-	1	3	CD2	-	4	8
CHEY*	7.0	12	21	CHEY*	7.0	12	21
ON-1**	1.0	1	3	ON-1**	1.0	1	3
ON-2**	1.0	1	3	ON-2**	1.0	1	3
ON-E	2.1	0	1	ON-D	2.1	2	6
ST1	0.7	2	3	ST1	0.7	2	3
ST2	0.5	1	2	ST2	0.5	1	2

*HEC-1 parameters taken from referenced rational method calculations and referenced figures. See Cheyenne/Campbell Study

**Basins referenced from the 7-11 Study. Curve number calculations have been updated with a current soils map. The flows have been re-calculated using HEC-1.

*HEC-1 parameters taken from referenced rational method calculations and referenced figures. See Cheyenne/Campbell Study

**Basins referenced from the 7-11 Study. Curve number calculations have been updated with a current soils map. The flows have been re-calculated using HEC-1.

Table 4: Cross Section Summary

Cross Section Summary						
Cross Section	Description	Q (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	DxV
Section 1 - Cheyenne 100 - YR	CD1	25	3.0	0.45	4.84	2.18
Section 1 - Cheyenne 10 - YR	CD1	14	3.0	0.39	4.23	1.65
Section 2 - Dapple Gray 100 - YR	CD2	8	0.7	0.41	2.07	0.85
Section 2 - Dapple Gray 100 - YR - Sloped	CD2	8	0.7	0.50	2.44	1.22
Section 3 - Onsite 100 - YR	OND2	2	2.0	0.32	4.13	1.32
Section 4 - Onsite 100 - YR	OND1	5	0.5	0.51	2.22	1.13
Section 5 - EASEMENT - 100 - YR - Max Slope	ON-2**	3	7.3	0.45	4.15	1.87
Section 5 - EASEMENT - 100 - YR - Min Slope	ON-2**	3	1.6	0.56	2.76	1.55
Section 6 - BMP SWALE - 100 - YR - Max Slope	OND1	4.59	3.4	0.55	3.79	2.08
Section 6 - BMP SWALE - 100 - YR - Min Slope	OND1	4.59	0.5	0.78	1.88	1.47
Section 7 - BMP SWALE - 100 - YR - Max Slope	OND2	1.41	4.4	0.34	3.11	1.06
Section 7 - BMP SWALE - 100 - YR - Min Slope	OND2	1.41	1.1	0.44	1.85	0.81
Section 8 - DOWNSTREAM ESMNT - 100 - YR	CD2 + 6/12***	20	2.5	0.30	4.72	1.42

**Referenced from the 7-11 Study HTE: 98-8063

***6/12 cfs is referenced from basin N from the Cheyenne/Campbell Study. DS4106

X. CONCLUSIONS & RECOMMENDATIONS

As detailed in this study, the All Storage – Cheyenne and Dapple Gray project is in compliance with the Manual. No adverse effects are expected either upstream or downstream of the subject site. Street criteria will be met. Proposed finished floor elevations are adequately protected a minimum vertical distance above the adjacent gutter flowline of at least twice the depth of flow up to a maximum of 18 inches above the water surface elevation in the street.

As a result of completing the analysis of the drainage conditions associated with the development, Horrocks Engineers concludes the following:

1. The analysis used in this study is in compliance with the Clark County Regional Flood Control District Criteria.
2. The proposed project is not located within a FEMA flood zone.
3. Peak flows can be safely routed through and around the proposed development to return to the natural flow path in accordance with the criteria of the Manual
4. Adjacent finished floor elevations are established in accordance with the Manual and are protected to at least twice the depth of flow or 18 inches above the water surface elevation.

XI. REFERENCES

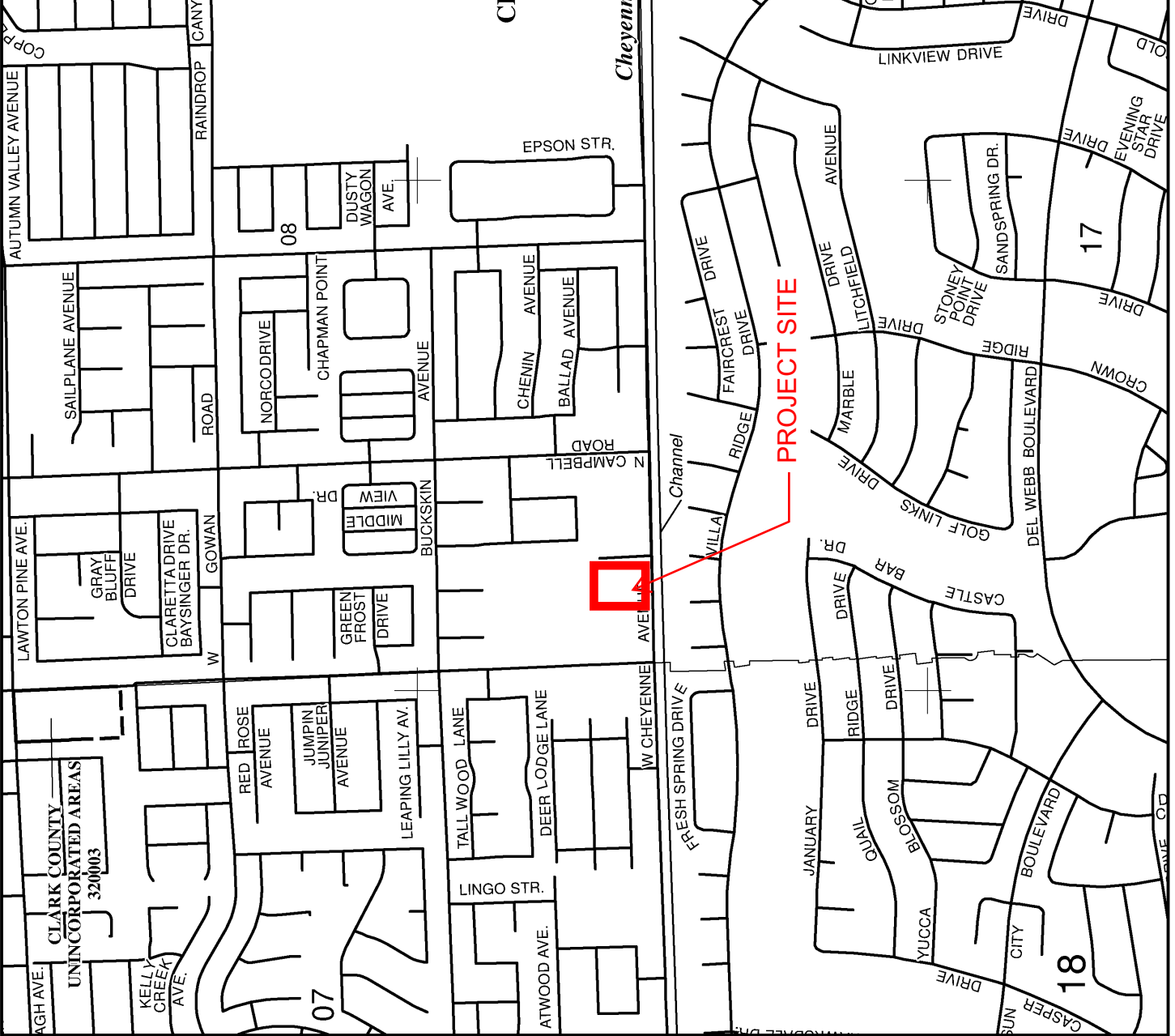
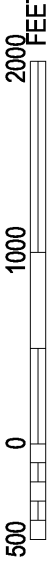
1. *2013 Clark County Regional Flood Control District Master Plan Update – September 2008* by PBS&J, Louis Berger Group & Parsons Brinkerhoff
2. *Clark County Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual* – Adopted August 12, 1999
3. HEC-1: U.S. Army Corps of Engineers Institute for Water Resources
4. Las Vegas Valley Area, Nevada, Part of Clark County Soil Survey Area sourced from the Natural Resources Conservation Service – Online Resource <http://websoilssurvey.nrcs.sda.gov>. Version 11, Sept 2016
5. Flowmaster Version 8i, Bentley Systems, Inc. Haestad Methods Solution Center, Watertown CT
6. Conceptual Drainage Study for Cheyenne/Campbell. LR Nelson, 2004
7. Technical Drainage Study for Cheyenne / Campbell. LR Nelson Consulting Engineers, 2016
8. Technical Hydrology Study for Cheyenne/Campbell. Thomason Consulting Engineers. March 2006
9. Technical Drainage Report for 7-11 at Northeast Corner Cheyenne and Fort Apache. AGRA Infrastructure, Inc. July 1998

APPENDIX A. Hydrologic Data and Calculations

- FIRM – Panel 2135F
- CCRFCD Figure F-25
- CCRFCD Figure H-25
- SCS Soil Report
- Curve Number Calculations
- Rainfall / Precipitation Data
- Standard Form 4 (All Conditions)
- HEC-1 Existing
- HEC-1 Developed
- Figure 5 - Existing Basin Map
- Figure 6 – Interim/Ultimate Basin Map



MAP SCALE 1" = 1000'



NFIP

PANEL 2135F

FIRM
FLOOD INSURANCE RATE MAP
CLARK COUNTY,
NEVADA
AND INCORPORATED AREAS

PANEL 2135 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CLARK COUNTY	320003	2135	F
LAS VEGAS, CITY OF	325276	2135	F

Notice to User: The Map Number shown below should be used when ordering map prints. The Community Number shown above should be used on insurance applications for the subject community.

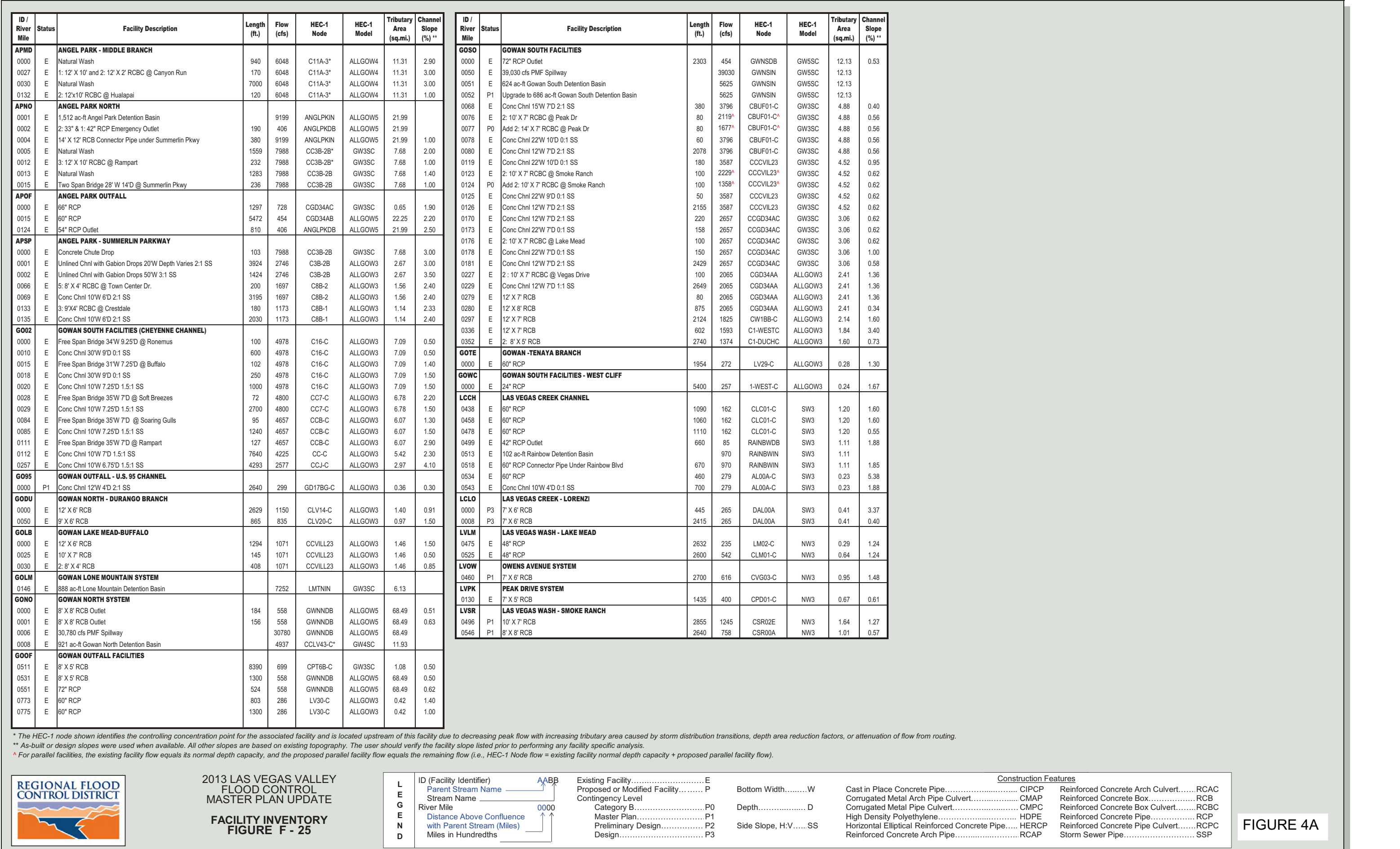


MAP NUMBER
32003C2135F
MAP REVISED
NOVEMBER 16, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov







United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for Las Vegas Valley Area, Nevada, Part of Clark County



February 8, 2018

Las Vegas Valley Area, Nevada, Part of Clark County

502—Canutio-Cave gravelly fine sandy loams, 2 to 8 percent slopes

Map Unit Setting

National map unit symbol: hrcf
Elevation: 1,700 to 4,800 feet
Mean annual precipitation: 4 to 12 inches
Mean annual air temperature: 57 to 70 degrees F
Frost-free period: 180 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

Canutio and similar soils: 55 percent
Cave and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Canutio

Setting

Landform: Inset fans
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 9 inches: gravelly fine sandy loam
H2 - 9 to 60 inches: stratified extremely gravelly loamy coarse sand to gravelly loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 10 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 7c
Hydrologic Soil Group: A
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)
Hydric soil rating: No

Description of Cave

Setting

Landform: Fan remnants

Custom Soil Resource Report

Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Mixed alluvium

Typical profile

H1 - 0 to 16 inches: gravelly fine sandy loam
H2 - 16 to 30 inches: indurated
H3 - 30 to 60 inches: very gravelly sandy loam

Properties and qualities

Slope: 2 to 8 percent
Depth to restrictive feature: 4 to 20 inches to petrocalcic
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 40 percent
Gypsum, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 12.0
Available water storage in profile: Very low (about 1.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Other vegetative classification: LIMY 3-5" P.Z. (030XB019NV_3)
Hydric soil rating: No

Minor Components

Arizo

Percent of map unit: 5 percent
Landform: Channels
Down-slope shape: Linear
Across-slope shape: Concave
Ecological site: VALLEY WASH (R030XB028NV)
Hydric soil rating: No

Custom Soil Resource Report Map—Hydrologic Soil Group



Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
502	Canutio-Cave gravelly fine sandy loams, 2 to 8 percent slopes	A	19.6	100.0%
Totals for Area of Interest			19.6	100.0%

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Composite Curve Number Calculations

Proj. No: NV-1029-1801

Project Name: CHEYENNE MINI STORAGE

Date: 4/2/2018

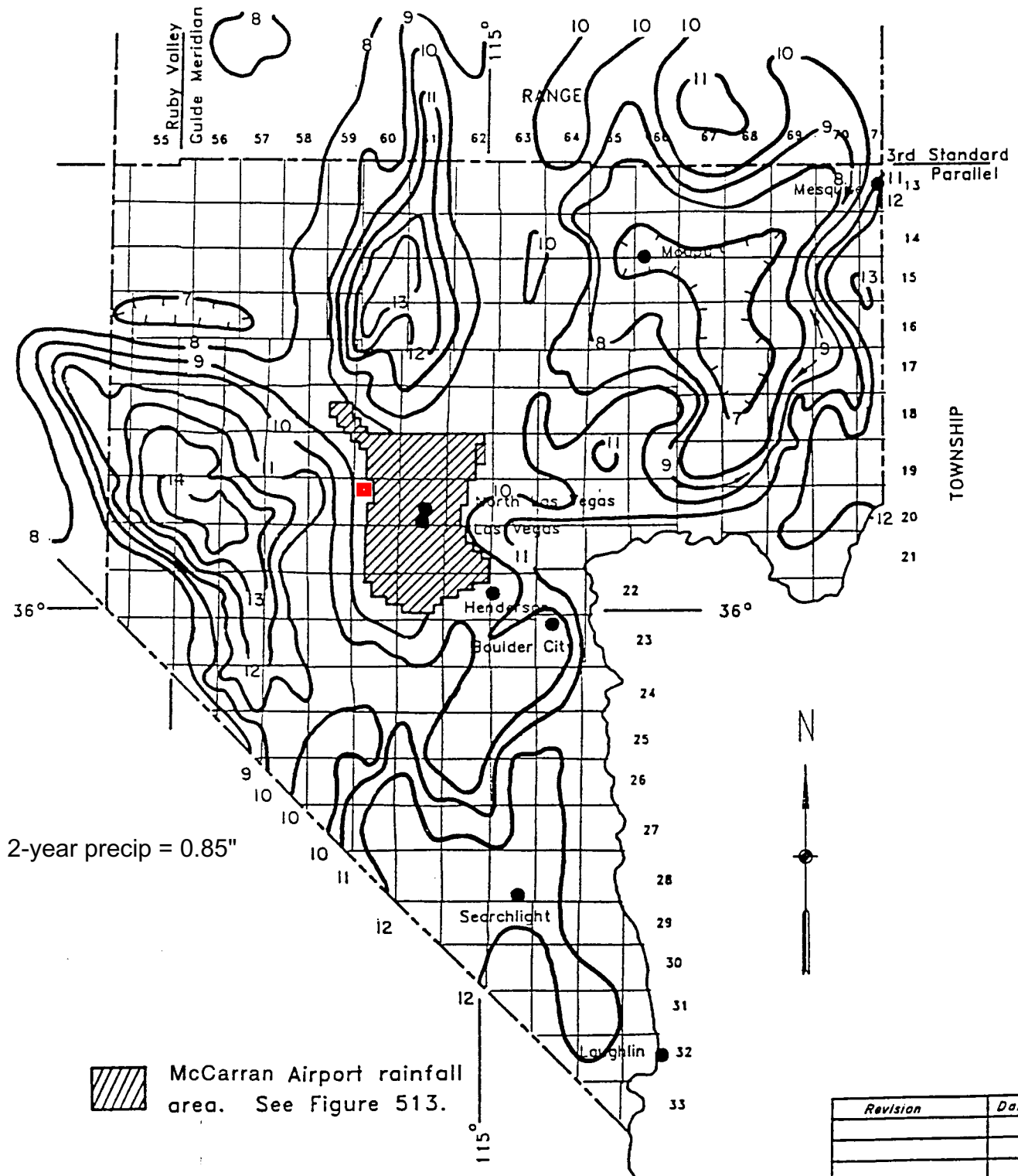
Designed By: dbc

Basin	Basin Area (ac)	Sub-region Cover Type	Sub-region Soil Type	Sub-region CN	Sub-region Area (ac)	Percent of Basin	Cumulative Percent	Areal Weighted CN	Cumulative CN	Composite CN
ON-E	2.08	Desert Shrub, Poor	A	63	2.08	100.0%	100.0%	63.0	63.0	63.0
ON-D	2.08	Commercial	A	89	2.08	100.0%	100.0%	89.0	89.0	89.0
ON-2**	1.00	Commercial	A	89	1.00	100.0%	100.0%	89.0	89.0	89.0
ON-1**	1.00	Commercial	A	89	1.00	100.0%	100.0%	89.0	89.0	89.0
CHEY*	7.00	Impervious	A	98	7.00	100.0%	100.0%	98.0	98.0	98.0
ST1	0.74	Impervious	A	98	0.74	100.0%	100.0%	98.0	98.0	98.0
ST2	0.49	Impervious	A	98	0.49	100.0%	100.0%	98.0	98.0	98.0

*Area referenced from the Rational Method Calculations from the Cheyenne/Campbell Residential Study study

**Basins referenced from the 7-11 Study. The Curve Number calculations and flows are updated with this study using a current soils map and HEC-1 model

RAINFALL DEPTH-DURATION-FREQUENCY 2-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



$$1.35" \times 1.24 = 1.67"$$

$$2.1" \times 1.43 = 3.0"$$

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL - STANDARD FORM 4

PROJECT NO. : NV-1029-1801

PROJECT: CHEYENNE MINI STORAGE

FILE : STD_FRM4

CALCULATED BY: dbc

DATE : 03/14/18

Sub-Basin Data					Initial/Overland Time (T _i)			Travel Time (T _t)					T _c	T _c Check (Urbanized Basins)		Final T _c	T _{lag}	Remarks
DESIG (1)	CN (2)	K (3)	AREA (acres) (4)	AREA (mi^2) (5)	LENGTH (ft) (6)	SLOPE (%) (7)	T _i (min) (8)	LENGTH (ft) (9)	SLOPE (%) (10)	V ₁ (fps) (11)	V ₂ (fps) (12)	T _t (min) (13)	T _c =T _i +T _t (min) (14)	TOTAL (ft) (15)	T _c (min) (16)	T _c (min) (17)	T _{lag} (hrs) (18)	Remarks (19)

EXISTING CONDITION

ON-E	63	0.442	2.1	0.0033	60	1.9	7.4	430	3.3	2.69	N/A	2.7	10.1	N/A	N/A	10.08	0.101	
ON-2**	89	0.785	1.0	0.0016	100	1.0	5.7	300	3.0	3.50	N/A	1.4	7.1	400	12.2	7.10	0.071	
ON-1**	89	0.785	1.0	0.0016	100	1.0	5.7	250	2.0	2.86	N/A	1.5	7.1	350	11.9	7.13	0.071	
ST1	98	0.904	0.7	0.0012	50	2.0	2.0	300	3.0	3.50	N/A	1.4	3.4	350	11.9	3.41	0.050	
ST2	98	0.904	0.5	0.0008	50	2.0	2.0	300	1.3	2.30	N/A	2.2	4.2	350	11.9	4.15	0.050	
CHEY*	98	0.904	7.00	0.0109	50	2.0	2.0	5700	5.3	4.65	7.04	14.1	16.1	N/A	N/A	16.08	0.161	

DEVELOPED CONDITION

ON-D	89.0	0.785	2.1	0.0033	100	1.0	5.7	800	1.6	2.56	3.87	4.6	10.2	900.0	15.0	10.2	0.102	
------	------	-------	-----	--------	-----	-----	-----	-----	-----	------	------	-----	------	-------	------	------	-------	--

$T_i=(1.8(1.1-K)L^{1/2})/(S^{1/3})$ $T_c=T_i+T_t$ $K=0.0132(CN)-.39$ $T_{lag} = 0.6T_c$		For the travel time (T_t) calculations, V_1 applies to the first 500 feet of travel distance; V_2 applies to the remaining travel distance.		Travel Time Velocity Formulas		All basins over one square mile are calculated by the equation $T_{lag}=20Kn(L \cdot L_c/S^{0.5})^{0.33}$ and denoted by shaded gray (See Worksheet).
				Existing	Developed	
				$V_1 = 14.8 \cdot (S/100)^{1/2}$ $V_2 = 29.4 \cdot (S/100)^{1/2}$	$V_1 = 20.2 \cdot (S/100)^{1/2}$ $V_2 = 30.6 \cdot (S/100)^{1/2}$	

REFERENCE:								CCRFCD HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL											STANDARD FORM 4
------------	--	--	--	--	--	--	--	---	--	--	--	--	--	--	--	--	--	--	-----------------

*HEC-1 parameters taken from referenced rational method calculations and referenced figures. See Cheyenne/Campbell Residential Study

**Basins referenced from the 7-11 Study

```
*****
*
*      U.S. ARMY CORPS OF ENGINEERS      *
*      HYDROLOGIC ENGINEERING CENTER    *
*      609 SECOND STREET                 *
*      DAVIS, CALIFORNIA 95616          *
*      (916) 756-1104                   *
*
*****
```

Page 1

46	KK	CE1	
47	HC	COMBINES ST1, ON1, AND CHEY	
48	*	3	
49	KK	ON-2**	
50	KM	BASIN REFERENCED FROM THE 7/11 CHEYENNE STUDY	
51	BA	.0016	
52	LS	0	89
53	UD	.071	
	*		
54	KK	ON-E	
55	KM	ONSITE BASIN IN THE EXISTING CONDITION	
56	BA	.0033	
57	LS	0	63
58	UD	.101	
	*		
59	KK	ST2	
60	KM	STREET BASIN IN DAPPLE GRAY ROAD	
61	BA	.0008	
62	LS	0	98
63	UD	.050	
	*		
64	KK	CE2	
65	KM	COMBINES ON-E AND ST2	
66	HC	2	
	*		
67	ZZ		

INPUT LINE	(V) ROUTING	(---) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW

22 ST1 .
35 . ON-1** .
40 . . CHEY .
46 CE1
49 . ON-2** .
54 . . ON-E .
59 . . ST2 .
64 . CE2

```

1*****
*
*   FLOOD HYDROGRAPH PACKAGE   (HEC-1)
*           JUN 1998
*           VERSION 4.1
*
*   RUN DATE   14MAR18   TIME   15:03:10
*
*****

```

```
*****
*
*      U.S. ARMY CORPS OF ENGINEERS      *
*      HYDROLOGIC ENGINEERING CENTER      *
*      609 SECOND STREET                  *
*      DAVIS, CALIFORNIA 95616           *
*      (916) 756-1104                    *
*
*****
```

TANEY ENGINEERING
EXISTING CONDITION
FILE: EX.DAT
PROJECT No: NV-1029-1801
DATE: MAR 2018

Page 2

EX

19 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
 .56 1.00

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	RATIO 2
					.56	1.00
HYDROGRAPH AT						
+	ST1	.00	1	FLOW	2.	3.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	ON-1**	.00	1	FLOW	1.	3.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	CHEY	.01	1	FLOW	12.	21.
				TIME	3.58	3.58
3 COMBINED AT						
+	CE1	.01	1	FLOW	14.	25.
				TIME	3.58	3.50
HYDROGRAPH AT						
+	ON-2**	.00	1	FLOW	1.	3.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	ON-E	.00	1	FLOW	0.	1.
				TIME	4.83	3.58
HYDROGRAPH AT						
+	ST2	.00	1	FLOW	1.	2.
				TIME	3.50	3.50
2 COMBINED AT						
+	CE2	.00	1	FLOW	1.	3.
				TIME	3.50	3.50

*** NORMAL END OF HEC-1 ***

46	KK	CD1		
47	KM	COMBINES ST1, ON1, AND CHEY		
48	HC	3		
	*			
49	KK	ON-2**		
50	KM	BASIN REFERENCED FROM THE 7/11 CHEYENNE STUDY		
51	BA	.0016		
52	LS	0	89	
53	UD	.071		
	*			
54	KK	ON-D		
55	KM	ONSITE BASIN IN THE DEVELOPED CONDITION		
56	BA	.0033		
57	LS	0	89	
58	UD	.092		
	*			
59	KK	ST2		
60	KM	STREET BASIN IN DAPPLE GRAY ROAD		
61	BA	.0008		
62	LS	0	98	
63	UD	.050		
	*			
64	KK	CD2		
65	KM	COMBINES ON-D AND ST2		
66	HC	2		
	*			
67	ZZ			

ST1

ON-1**

CHEY

CD1

ON-2**

ON-D

ST2

CD2

```
*****
*
*      U.S. ARMY CORPS OF ENGINEERS      *
*      HYDROLOGIC ENGINEERING CENTER    *
*      609 SECOND STREET                 *
*      DAVIS, CALIFORNIA 95616          *
*      (916) 756-1104                   *
*
*****
```

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                                DEV
19 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
            .56      1.00      .28
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  RATIO 2  RATIO 3
                                .56      1.00      .28

HYDROGRAPH AT
+              ST1          .00      1  FLOW
                                2.        3.        1.
                                3.50     3.50     3.50
                                TIME

HYDROGRAPH AT
+              ON-1**       .00      1  FLOW
                                1.        3.        0.
                                3.50     3.50     3.50
                                TIME

HYDROGRAPH AT
+              CHEY         .01      1  FLOW
                                12.       21.       5.
                                3.58     3.58     3.58
                                TIME

3 COMBINED AT
+              CD1          .01      1  FLOW
                                14.       25.       6.
                                3.58     3.50     3.58
                                TIME

HYDROGRAPH AT
+              ON-2**       .00      1  FLOW
                                1.        3.        0.
                                3.50     3.50     3.50
                                TIME

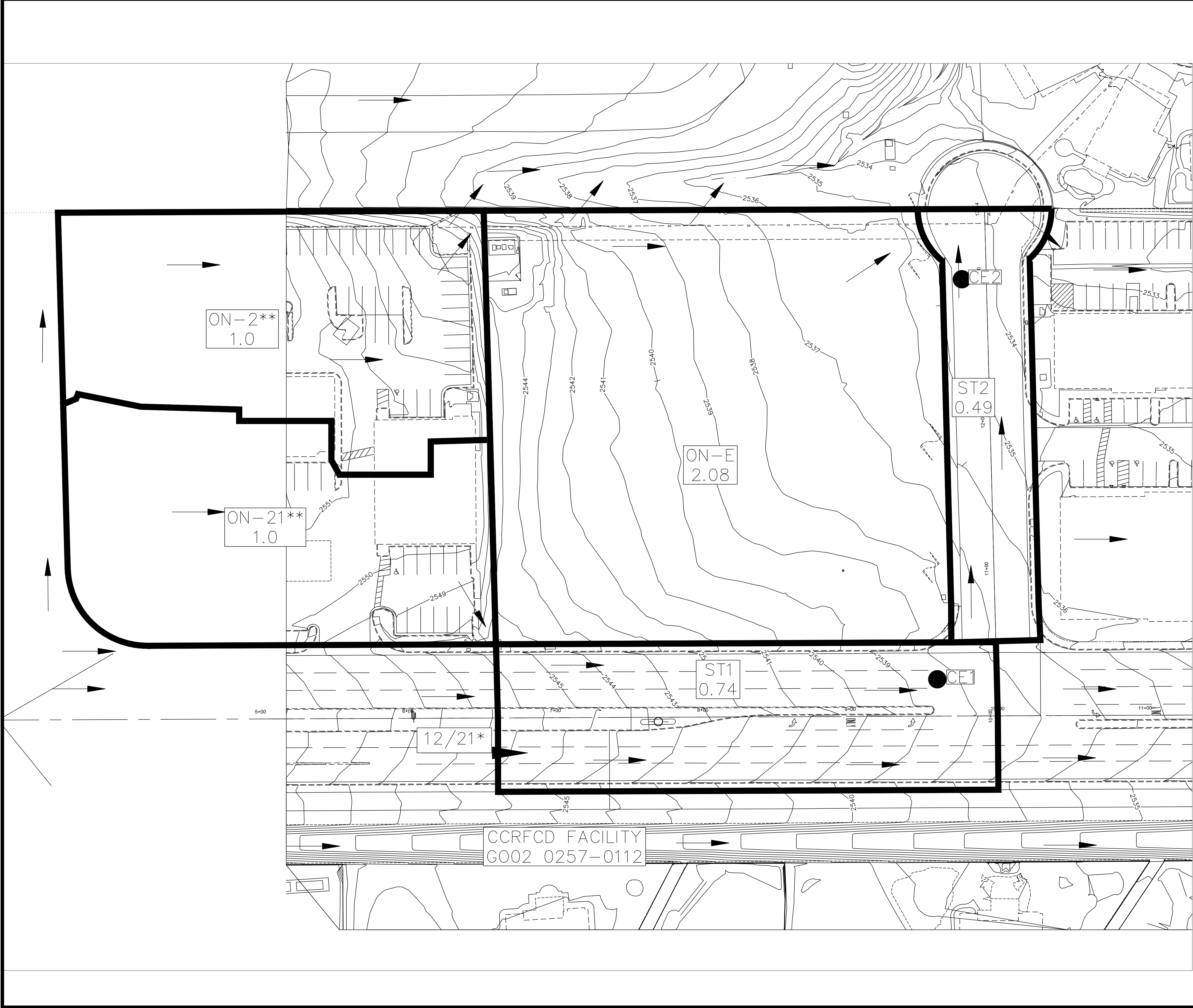
HYDROGRAPH AT
+              ON-D         .00      1  FLOW
                                2.        6.        1.
                                3.50     3.50     3.58
                                TIME

HYDROGRAPH AT
+              ST2          .00      1  FLOW
                                1.        2.        1.
                                3.50     3.50     3.50
                                TIME

2 COMBINED AT
+              CD2          .00      1  FLOW
                                4.        8.        1.
                                3.50     3.50     3.50
                                TIME

*** NORMAL END OF HEC-1 ***

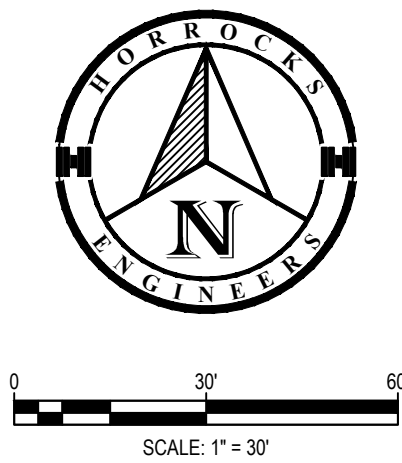
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Existing Condition			
Basin	Area (acres)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
CE1	-	14	25
CE2	-	1	3
CHEY*	7.0	12	21
ON-1**	1.0	1	3
ON-2**	1.0	1	3
ON-E	2.1	0	1
ST1	0.7	2	3
ST2	0.5	1	2

*HEC-1 parameters taken from referenced rational method calculations and referenced figures.
**Basins referenced from the 7-11 Study

* BASIN PARAMETERS REFERENCED FROM THE CHEYENNE/CAMPBELL STUDY. DS# 3971
** REFERENCED FROM THE 7-11 CHEYENNE STUDY. HTE: 98-8063



KEY:

- ST1 0.74 BASIN NAME/AREA
- OND2 0.49 PRORATE BASIN NAME/AREA
- CE1 CONCENTRATION POINT
- Flow arrow FLOW DIRECTION
- Cross section symbol CROSS SECTION
- Solid line BASIN BOUNDARY
- Dashed line PRORATE BASIN BOUNDARY

WARNING

0 1 2

IF THIS BAR DOES NOT MEASURE 2" THEN DRAWING IS NOT TO SCALE

DRAWING INFO		REVISIONS	
DATE	03/27/2018	REV #	DATE
DESIGNED			
DRAWN			
CHECKED			
PROJECT	NV-1029-1801	*SEE GENERAL NOTES SHEET	

PRELIMINARY

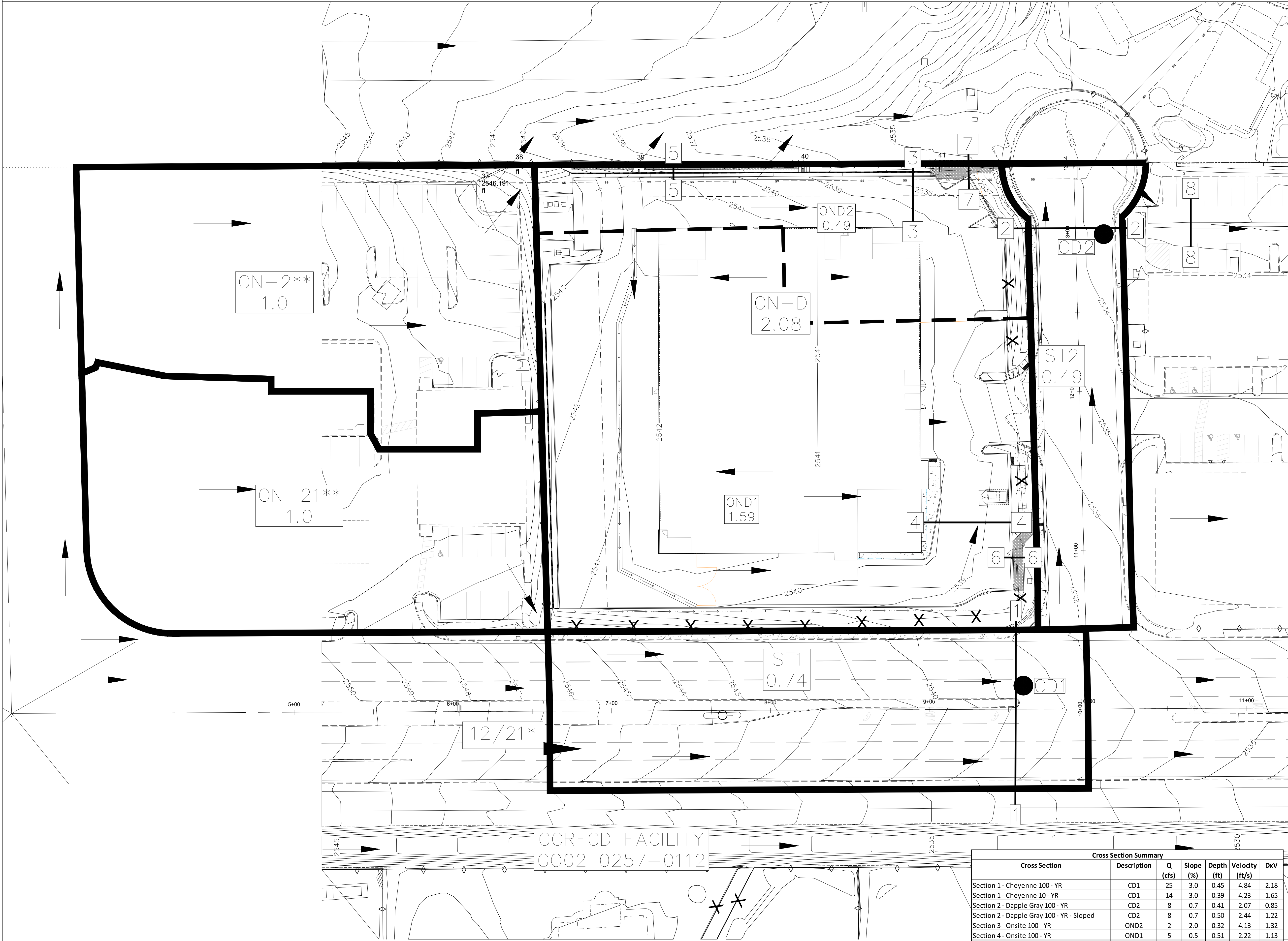
NOT FOR CONSTRUCTION

ALL-STORAGE

@ CHEYENNE AND DAPPLE GRAY
LAS VEGAS, NEVADA

EXISTING CONDITIONS BASIN MAP

138-08-401-013



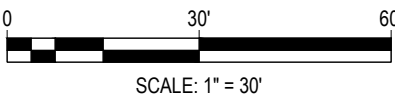
Cross Section Summary						
Cross Section	Description	Q (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	DxV
Section 1 - Cheyenne 100 - YR	CD1	25	3.0	0.45	4.84	2.18
Section 1 - Cheyenne 10 - YR	CD1	14	3.0	0.39	4.23	1.65
Section 2 - Dapple Gray 100 - YR	CD2	8	0.7	0.41	2.07	0.85
Section 2 - Dapple Gray 100 - YR - Sloped	CD2	8	0.7	0.50	2.44	1.22
Section 3 - Onsite 100 - YR	OND2	2	2.0	0.32	4.13	1.32
Section 4 - Onsite 100 - YR	OND1	5	0.5	0.51	2.22	1.13
Section 5 - EASEMENT - 100 - YR - Max Slope	ON-2**	3	7.3	0.45	4.15	1.87
Section 5 - EASEMENT - 100 - YR -Min Slope	ON-2**	3	1.6	0.56	2.76	1.55
Section 6 - BMP SWALE - 100 - YR - Max Slope	OND1	4.59	3.4	0.55	3.79	2.08
Section 6 - BMP SWALE - 100 - YR - Min Slope	OND1	4.59	0.5	0.78	1.88	1.47
Section 7 - BMP SWALE - 100 - YR - Max Slope	OND2	1.41	4.4	0.34	3.11	1.06
Section 7 - BMP SWALE - 100 - YR - Min Slope	OND2	1.41	1.1	0.44	1.85	0.81
Section 8 - DOWNSTREAM ESMINT - 100 - YR	CD2 + 6/12***	20	2.5	0.30	4.72	1.42

**Referenced from the 7-11 Study HTE: 98-8063
***6/12 cfs is referenced from basin N from the Cheyenne/Campbell Study. DS4106

Developed Condition			
Basin	Area (acres)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
CD1	-	14	25
CD2	-	4	8
CHEY*	7.0	12	21
ON-1**	1.0	1	3
ON-2**	1.0	1	3
ON-D	2.1	2	6
ST1	0.7	2	3
ST2	0.5	1	2

*HEC-1 parameters taken from referenced rational method calculations and referenced figures.
**Basins referenced from the 7-11 Study

Prorate Calculations			
Basin	Area (acres)	Q ₁₀₀ (cfs)	CFS/AC
ON-D	2.08	6	2.88
OND1	1.59	4.59	2.88
OND2	0.49	1.41	2.88
Parking	2.08	6.00	N/A



* BASIN PARAMETERS REFERENCED FROM THE CHEYENNE/CAMPBELL STUDY. DS# 3971
** REFERENCED FROM THE 7-11 CHEYENNE STUDY. HTE: 98-8063

KEY:

ST1
0.74

BASIN NAME/AREA

OND2
0.49

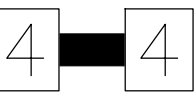
PROROATE BASIN
NAME/AREA



CONCENTRATION POINT



FLOW DIRECTION



CROSS SECTION



BASIN BOUNDARY



PRORATE BASIN
BOUNDARY

WARNING

0 1 2
IF THIS BAR DOES NOT
MEASURE 2" THEN
DRAWING IS NOT TO SCALE

REVISIONS

REV #

DATE

DESIGNED

DRAWN

CHECKED

PROJECT

NV-1029-1801

*SEE GENERAL NOTES SHEET

DATE

03/27/2018

DATE

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*SEE GENERAL NOTES SHEET

DATE

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PROJECT

APPENDIX B. Hydraulic Data and Calculations

- Normal Depth Calculations
- Riprap Calculations
- Block Wall Opening
- Weir Calculations
- BMP Normal Depth Calculations
- BMP Figure

Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

Bentley Systems, Inc. Haestad Methods Software Center Master V8i (SELECTseries 1) [08.11.01.03]
3/29/2018 12:06:57 PM 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

Worksheet for Section 1 - Cheyenne 10 - YR

Options

Current Roughness weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.39	ft
Elevation Range	0.00 to 1.39 ft		
Flow Area		3.31	ft ²
Wetted Perimeter		25.53	ft
Hydraulic Radius		0.13	ft
Top Width		24.66	ft
Normal Depth		0.39	ft
Critical Depth		0.48	ft
Critical Slope		0.00658	ft/ft
Velocity		4.23	ft/s
Velocity Head		0.28	ft
Specific Energy		0.66	ft
Froude Number		2.03	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.39	ft
Critical Depth	0.48	ft
Channel Slope	3.00	%
Critical Slope	0.00658	ft/ft

Cross Section for Section 1 - Cheyenne 10 - YR

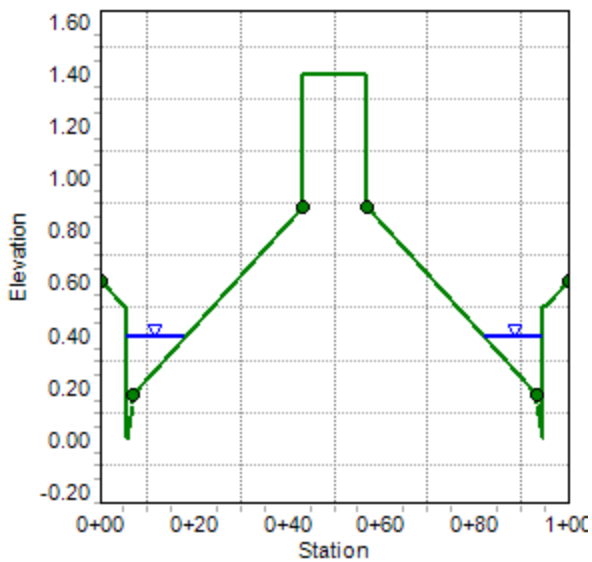
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.00	%
Normal Depth	0.39	ft
Discharge	14.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

Bentley Systems, Inc. Haestad Methods Soildyne Center Master V8i (SELECTseries 1) [08.11.01.03]

Worksheet for Section 1 - Cheyenne 100 - YR

Options

Current Roughness weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth		0.45	ft
Elevation Range	0.00 to 1.39 ft		
Flow Area		5.16	ft ²
Wetted Perimeter		32.28	ft
Hydraulic Radius		0.16	ft
Top Width		31.27	ft
Normal Depth		0.45	ft
Critical Depth		0.57	ft
Critical Slope		0.00635	ft/ft
Velocity		4.84	ft/s
Velocity Head		0.36	ft
Specific Energy		0.82	ft
Froude Number		2.10	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.45	ft
Critical Depth	0.57	ft
Channel Slope	3.00	%
Critical Slope	0.00635	ft/ft

Cross Section for Section 1 - Cheyenne 100 - YR

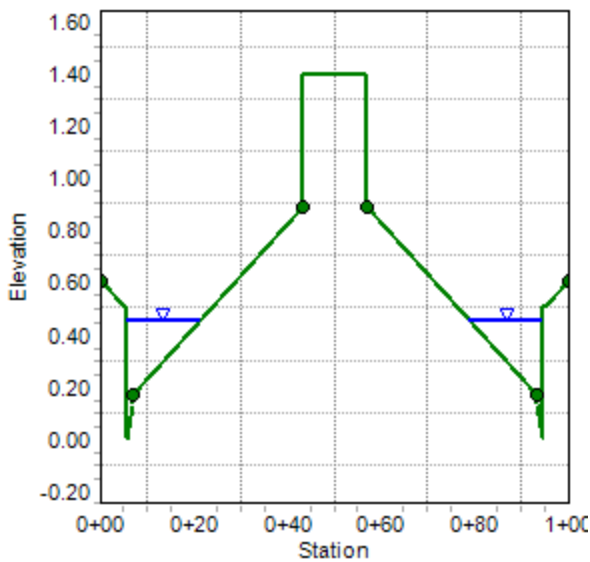
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	3.00	%
Normal Depth	0.45	ft
Discharge	25.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

Options

Bentley Systems, Inc. Haestad Methods Software Bentley Master V8i (SELECTseries 1) [08.11.01.03]
3/29/2018 1:07:59 PM 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

Worksheet for Section 2 - Dapple Gray 100 - YR - Sloped

Results

Normal Depth		0.50	ft
Elevation Range	0.00 to 1.52 ft		
Flow Area		3.28	ft ²
Wetted Perimeter		18.33	ft
Hydraulic Radius		0.18	ft
Top Width		17.82	ft
Normal Depth		0.50	ft
Critical Depth		0.50	ft
Critical Slope		0.00655	ft/ft
Velocity		2.44	ft/s
Velocity Head		0.09	ft
Specific Energy		0.59	ft
Froude Number		1.00	
Flow Type	Supercritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.50	ft
Critical Depth	0.50	ft
Channel Slope	0.66	%
Critical Slope	0.00655	ft/ft

Cross Section for Section 2 - Dapple Gray 100 - YR - Sloped

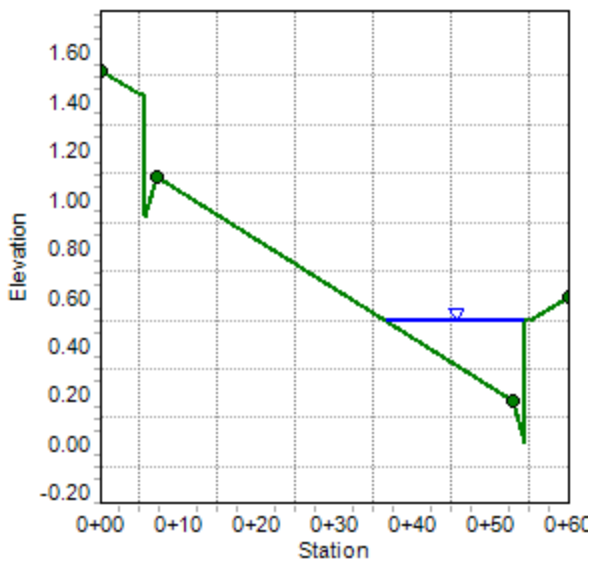
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.66	%
Normal Depth	0.50	ft
Discharge	8.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

Options

Bentley Systems, Inc. Haestad Methods Software Center Master V8i (SELECTseries 1) [08.11.01.03]
3/29/2018 12:08:34 PM 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

Worksheet for Section 2 - Dapple Gray 100 - YR

Results

Normal Depth		0.41	ft
Elevation Range	0.00 to 0.63 ft		
Flow Area		3.87	ft ²
Wetted Perimeter		27.90	ft
Hydraulic Radius		0.14	ft
Top Width		27.05	ft
Normal Depth		0.41	ft
Critical Depth		0.41	ft
Critical Slope		0.00712	ft/ft
Velocity		2.07	ft/s
Velocity Head		0.07	ft
Specific Energy		0.48	ft
Froude Number		0.96	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.41	ft
Critical Depth	0.41	ft
Channel Slope	0.66	%
Critical Slope	0.00712	ft/ft

Cross Section for Section 2 - Dapple Gray 100 - YR

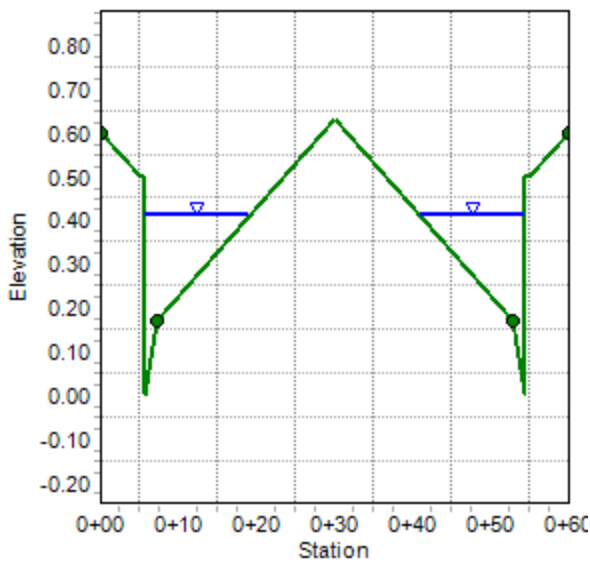
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.66	%
Normal Depth	0.41	ft
Discharge	8.00	ft ³ /s

Cross Section Image



Worksheet for Section 3 - Onsite 100 - YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00	%
Discharge	2.00	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.50
0+00.5	0.50
0+00.5	0.00
0+02.0	0.17
0+25.0	1.92
0+30.0	2.02

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.50)	(0+02.0, 0.17)	0.013
(0+02.0, 0.17)	(0+30.0, 2.02)	0.013

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.32	ft
Elevation Range	0.00 to 2.02 ft	
Flow Area	0.48	ft ²
Wetted Perimeter	3.74	ft
Hydraulic Radius	0.13	ft
Top Width	3.41	ft

Worksheet for Section 3 - Onsite 100 - YR

Results

Normal Depth	0.32	ft
Critical Depth	0.40	ft
Critical Slope	0.00489	ft/ft
Velocity	4.13	ft/s
Velocity Head	0.27	ft
Specific Energy	0.58	ft
Froude Number	1.93	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.32	ft
Critical Depth	0.40	ft
Channel Slope	2.00	%
Critical Slope	0.00489	ft/ft

Cross Section for Section 3 - Onsite 100 - YR

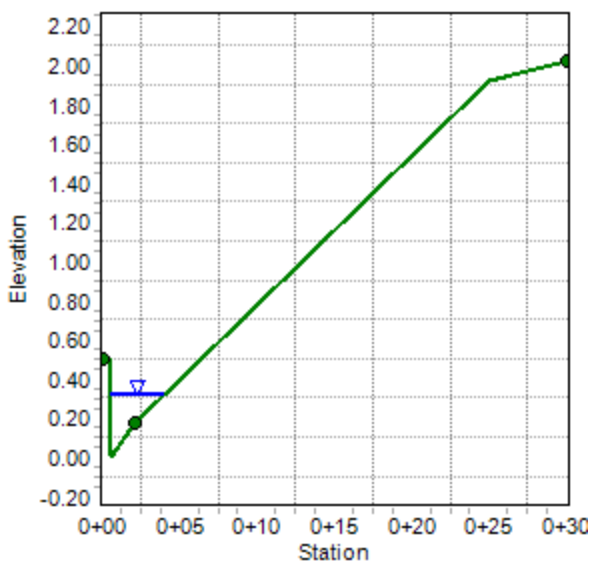
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.00	%
Normal Depth	0.32	ft
Discharge	2.00	ft ³ /s

Cross Section Image



Project Description

Input Data

0+00.0	1.98
0+00.5	1.98
0+00.5	1.48
0+38.0	0.17
0+39.5	0.00
0+39.5	0.50
0+40.0	0.50

(0+00.0, 1.98)	(0+00.5, 1.48)	0.013
(0+00.5, 1.48)	(0+38.0, 0.17)	0.016
(0+38.0, 0.17)	(0+40.0, 0.50)	0.013

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Normal Depth		0.51	ft
Elevation Range	0.00 to 1.98 ft		
Flow Area		2.26	ft²
Wetted Perimeter		12.15	ft

Worksheet for Section 4 - Onsite 100 - YR

Results

Hydraulic Radius	0.19	ft
Top Width	11.63	ft
Normal Depth	0.51	ft
Critical Depth	0.48	ft
Critical Slope	0.00640	ft/ft
Velocity	2.22	ft/s
Velocity Head	0.08	ft
Specific Energy	0.58	ft
Froude Number	0.89	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.51	ft
Critical Depth	0.48	ft
Channel Slope	0.50	%
Critical Slope	0.00640	ft/ft

Cross Section for Section 4 - Onsite 100 - YR

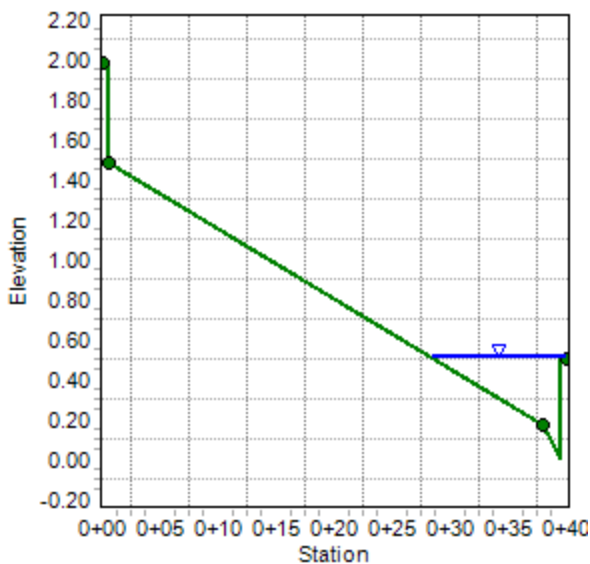
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	0.50	%
Normal Depth	0.51	ft
Discharge	5.00	ft ³ /s

Cross Section Image



Project Description

Input Data

Station (ft)	Elevation (ft)
--------------	----------------

Roughness Segment Definitions

(0+00.0, 1.50)	(0+00.0, 0.50)	0.025
(0+00.0, 0.50)	(0+07.5, 2.50)	0.013

Options

Results

Bentley Systems, Inc. Haestad Methods Software Center Master V8i (SELECTseries 1) [08.11.01.03]

Worksheet for Section 5 - EASEMENT - 100 - YR

Results

Critical Depth	0.60	ft
Critical Slope	0.00391	ft/ft
Velocity	9.25	ft/s
Velocity Head	1.33	ft
Specific Energy	1.68	ft
Froude Number	3.89	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.35	ft
Critical Depth	0.60	ft
Channel Slope	7.00	%
Critical Slope	0.00391	ft/ft

Cross Section for Section 5 - EASEMENT - 100 - YR

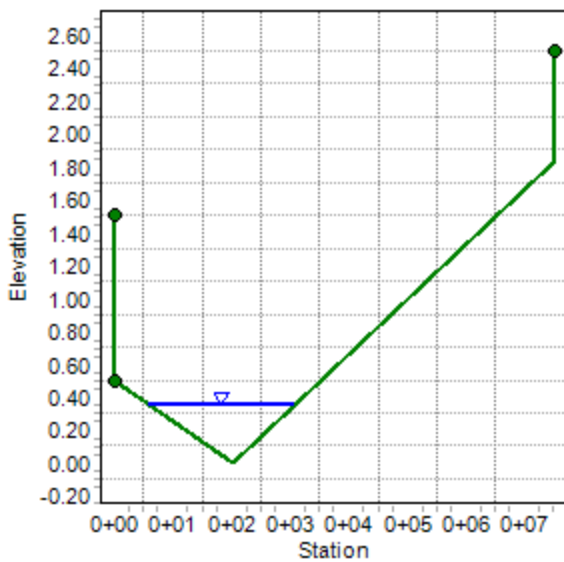
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	7.00	%
Normal Depth	0.35	ft
Discharge	4.00	ft ³ /s

Cross Section Image



Project Description

Input Data

0+00.0	0.75
0+03.0	0.00
0+06.0	0.75

(0+00.0, 0.75)	(0+06.0, 0.75)	0.030
----------------	----------------	-------

Results

3/29/2018 12:37:41 PM 27 Siemens Company Drive Suite 200 W Watertown, CT 06795 USA +1-203-755-1666 Page 1 of 2

Worksheet for Section 6 - BMP SWALE - 100 - YR

Results

Velocity Head	0.09	ft
Specific Energy	0.78	ft
Froude Number	0.72	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.69	ft
Critical Depth	0.61	ft
Channel Slope	1.00	%
Critical Slope	0.02033	ft/ft

Cross Section for Section 6 - BMP SWALE - 100 - YR

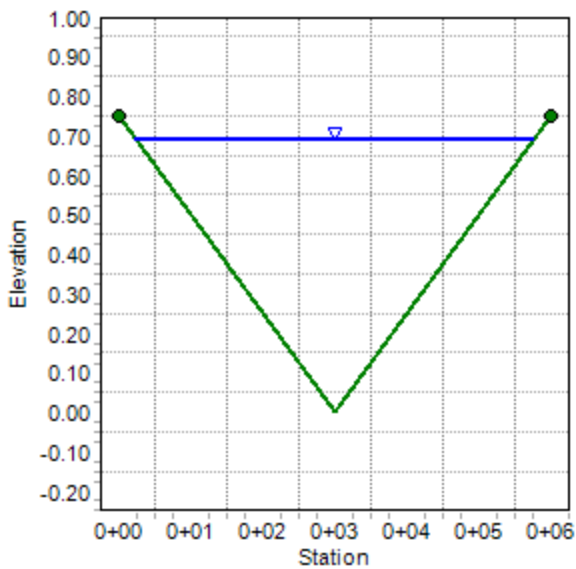
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00	%
Normal Depth	0.69	ft
Discharge	4.59	ft ³ /s

Cross Section Image



Worksheet for Section 7 - BMP SWALE - 100 - YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00	%
Discharge	1.41	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.75
0+03.0	0.00
0+06.0	0.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.75)	(0+06.0, 0.75)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.44	ft
Elevation Range	0.00 to 0.75 ft	
Flow Area	0.79	ft ²
Wetted Perimeter	3.67	ft
Hydraulic Radius	0.22	ft
Top Width	3.56	ft
Normal Depth	0.44	ft
Critical Depth	0.38	ft
Critical Slope	0.02380	ft/ft
Velocity	1.78	ft/s

Worksheet for Section 7 - BMP SWALE - 100 - YR

Results

Velocity Head	0.05	ft
Specific Energy	0.49	ft
Froude Number	0.67	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.44	ft
Critical Depth	0.38	ft
Channel Slope	1.00	%
Critical Slope	0.02380	ft/ft

Cross Section for Section 7 - BMP SWALE - 100 - YR

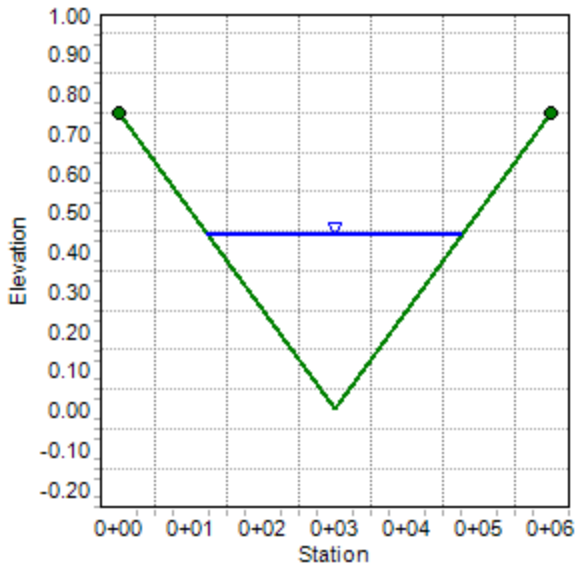
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00	%
Normal Depth	0.44	ft
Discharge	1.41	ft ³ /s

Cross Section Image



Project Description

Input Data

0+00.0	0.74
0+00.0	0.24
0+10.5	0.03
0+12.0	0.00
0+13.5	0.03
0+24.0	0.24
0+24.0	0.74

(0+00.0, 0.74)	(0+00.0, 0.24)	0.013
(0+00.0, 0.24)	(0+10.5, 0.03)	0.016
(0+10.5, 0.03)	(0+13.5, 0.03)	0.013
(0+13.5, 0.03)	(0+24.0, 0.24)	0.016
(0+24.0, 0.24)	(0+24.0, 0.74)	0.013

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Worksheet for Section 8 - DOWNSTREAM ESMNT - 100 - YR

Results

Flow Area	4.24	ft ²
Wetted Perimeter	24.12	ft
Hydraulic Radius	0.18	ft
Top Width	24.00	ft
Normal Depth	0.30	ft
Critical Depth	0.40	ft
Critical Slope	0.00556	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	0.64	ft
Froude Number	1.98	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.30	ft
Critical Depth	0.40	ft
Channel Slope	2.50	%
Critical Slope	0.00556	ft/ft

Cross Section for Section 8 - DOWNSTREAM ESMNT - 100 - YR

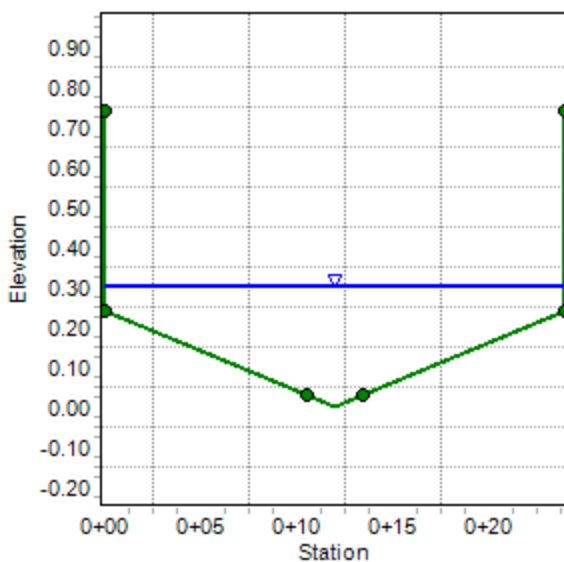
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	2.50	%
Normal Depth	0.30	ft
Discharge	20.00	ft ³ /s

Cross Section Image



Rip Rap Calculations Open Channel

Project Name: All-Storage
Proj. Number: NV-1029-1801
Cross Streets: Cheyenne and Fort Apache
Designed By: DBC
Date: 4/3/2018

Channel Description or Reference Section

Swale along the north Wall - Section 5 - Min Slope

Input Data

Velocity (ft/s) = 2.76
Slope (ft/ft) = 0.016
Spec. Gravity = 2.5
(2.5 min)

Rip Rap Size

d_{50} (in) = 1.10

Use d_{50} (in) = 2
Thickness (in) = 4

Mannings Coefficient

$n = 0.029$

$$V = 3 (d_{50})^{0.5} (S_s - 1) / S^{0.17}$$

$$n = 0.0395 (d_{50})^{1/5}$$

Reference:

Rip Rap Calculations Open Channel

Project Name: All-Storage
Proj. Number: NV-1029-1801
Cross Streets: Cheyenne and Fort Apache
Designed By: DBC
Date: 4/3/2018

Channel Description or Reference Section

Swale along the north Wall - Section 5 - Max Slope

Input Data

Velocity (ft/s) = 4.15
Slope (ft/ft) = 0.073
Spec. Gravity = 2.5
(2.5 min)

Rip Rap Size

d_{50} (in) = 4.18

Use d_{50} (in) = 5
Thickness (in) = 10

Mannings Coefficient

$n = 0.034$

$$V = 3 (d_{50})^{0.5} (S_s - 1) / S^{0.17}$$

$$n = 0.0395 (d_{50})^{1/5}$$

Reference:

Rip Rap Calculations Open Channel

Project Name: All-Storage
Proj. Number: NV-1029-1801
Cross Streets: Cheyenne and Fort Apache
Designed By: DBC
Date: 4/5/2018

Channel Description or Reference Section

BMP Swale along North Wall - Section 7 - Min Slope

Input Data

Velocity (ft/s) = 1.85
Slope (ft/ft) = 0.011
Spec. Gravity = 2.5
(2.5 min)

Rip Rap Size

d_{50} (in) = 0.44

Use d_{50} (in) = 1
Thickness (in) = 2

Mannings Coefficient

$n = 0.026$

$$V = 3 (d_{50})^{0.5} (S_s - 1) / S^{0.17}$$

$$n = 0.0395 (d_{50})^{1/5}$$

Reference:

Rip Rap Calculations Open Channel

Project Name: All-Storage
Proj. Number: NV-1029-1801
Cross Streets: Cheyenne and Fort Apache
Designed By: DBC
Date: 4/5/2018

Channel Description or Reference Section

BMP Swale along North Wall - Section 7 - Max Slope

Input Data

Velocity (ft/s) = 3.11
Slope (ft/ft) = 0.044
Spec. Gravity = 2.5
(2.5 min)

Rip Rap Size

d_{50} (in) = 1.98

Use d_{50} (in) = 2
Thickness (in) = 4

Mannings Coefficient

n = 0.029

$$V = 3 (d_{50})^{0.5} (S_s - 1) / S^{0.17}$$

$$n = 0.0395 (d_{50})^{1/5}$$

Reference:

Rip Rap Calculations Open Channel

Project Name: All-Storage
Proj. Number: NV-1029-1801
Cross Streets: Cheyenne and Fort Apache
Designed By: DBC
Date: 4/5/2018

Channel Description or Reference Section

BMP Swale along Dapple Gray - Section 6 - Min Slope

Input Data

Velocity (ft/s) = 1.88
Slope (ft/ft) = 0.005
Spec. Gravity = 2.5
(2.5 min)

Rip Rap Size

d_{50} (in) = 0.35

Use d_{50} (in) = 1
Thickness (in) = 2

Mannings Coefficient

n = 0.026

$$V = 3 (d_{50})^{0.5} (S_s - 1) / S^{0.17}$$

$$n = 0.0395 (d_{50})^{1/5}$$

Reference:

Rip Rap Calculations Open Channel

Project Name: All-Storage
Proj. Number: NV-1029-1801
Cross Streets: Cheyenne and Fort Apache
Designed By: DBC
Date: 4/4/2018

Channel Description or Reference Section

BMP Swale along Dapple Gray - Section 6 - Max Slope

Input Data

Velocity (ft/s) = 3.79
Slope (ft/ft) = 0.034
Spec. Gravity = 2.5
(2.5 min)

Rip Rap Size

d_{50} (in) = 2.70

Use d_{50} (in) = 3
Thickness (in) = 6

Mannings Coefficient

$n = 0.031$

$$V = 3 (d_{50})^{0.5} (S_b - 1) / S^{0.17}$$

$$n = 0.0395 (d_{50})^{1/5}$$

Reference:

Worksheet for Section 6 - BMP SWALE - 2 - YR

Project Description

Friction Method Manning Formula
Solve For Normal Depth

Input Data

Channel Slope 1.00 %
Discharge 0.63 ft³/s
Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.75
0+03.0	0.00
0+06.0	0.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.75)	(0+06.0, 0.75)	0.030

Options

Current Roughness Weighted Method Pavlovskii's Method
Open Channel Weighting Method Pavlovskii's Method
Closed Channel Weighting Method Pavlovskii's Method

Results

Normal Depth 0.33 ft
Elevation Range 0.00 to 0.75 ft
Flow Area 0.43 ft²
Wetted Perimeter 2.71 ft
Hydraulic Radius 0.16 ft
Top Width 2.63 ft
Normal Depth 0.33 ft
Critical Depth 0.27 ft
Critical Slope 0.02649 ft/ft
Velocity 1.46 ft/s

Worksheet for Section 6 - BMP SWALE - 2 - YR

Results

Velocity Head	0.03	ft
Specific Energy	0.36	ft
Froude Number	0.63	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.33	ft
Critical Depth	0.27	ft
Channel Slope	1.00	%
Critical Slope	0.02649	ft/ft

Cross Section for Section 6 - BMP SWALE - 2 - YR

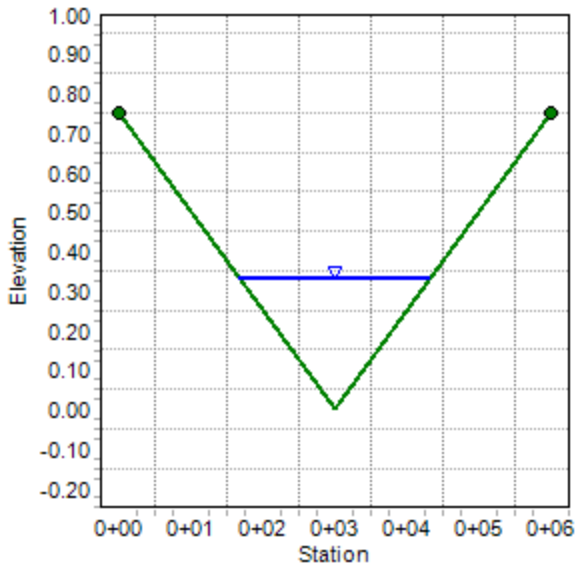
Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00	%
Normal Depth	0.33	ft
Discharge	0.63	ft ³ /s

Cross Section Image



Worksheet for Section 7 - BMP SWALE - 2 - YR

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00	%
Discharge	0.22	ft ³ /s
Section Definitions		

Station (ft)	Elevation (ft)
0+00.0	0.75
0+03.0	0.00
0+06.0	0.75

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.75)	(0+06.0, 0.75)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method
Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Normal Depth	0.22	ft
Elevation Range	0.00 to 0.75 ft	
Flow Area	0.20	ft ²
Wetted Perimeter	1.83	ft
Hydraulic Radius	0.11	ft
Top Width	1.77	ft
Normal Depth	0.22	ft
Critical Depth	0.18	ft
Critical Slope	0.03047	ft/ft
Velocity	1.12	ft/s

Worksheet for Section 7 - BMP SWALE - 2 - YR

Results

Velocity Head	0.02	ft
Specific Energy	0.24	ft
Froude Number	0.59	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.22	ft
Critical Depth	0.18	ft
Channel Slope	1.00	%
Critical Slope	0.03047	ft/ft

Cross Section for Section 7 - BMP SWALE - 2 - YR

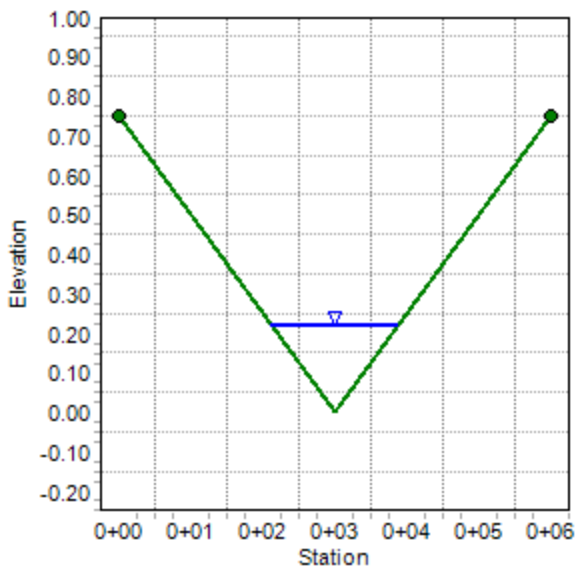
Project Description

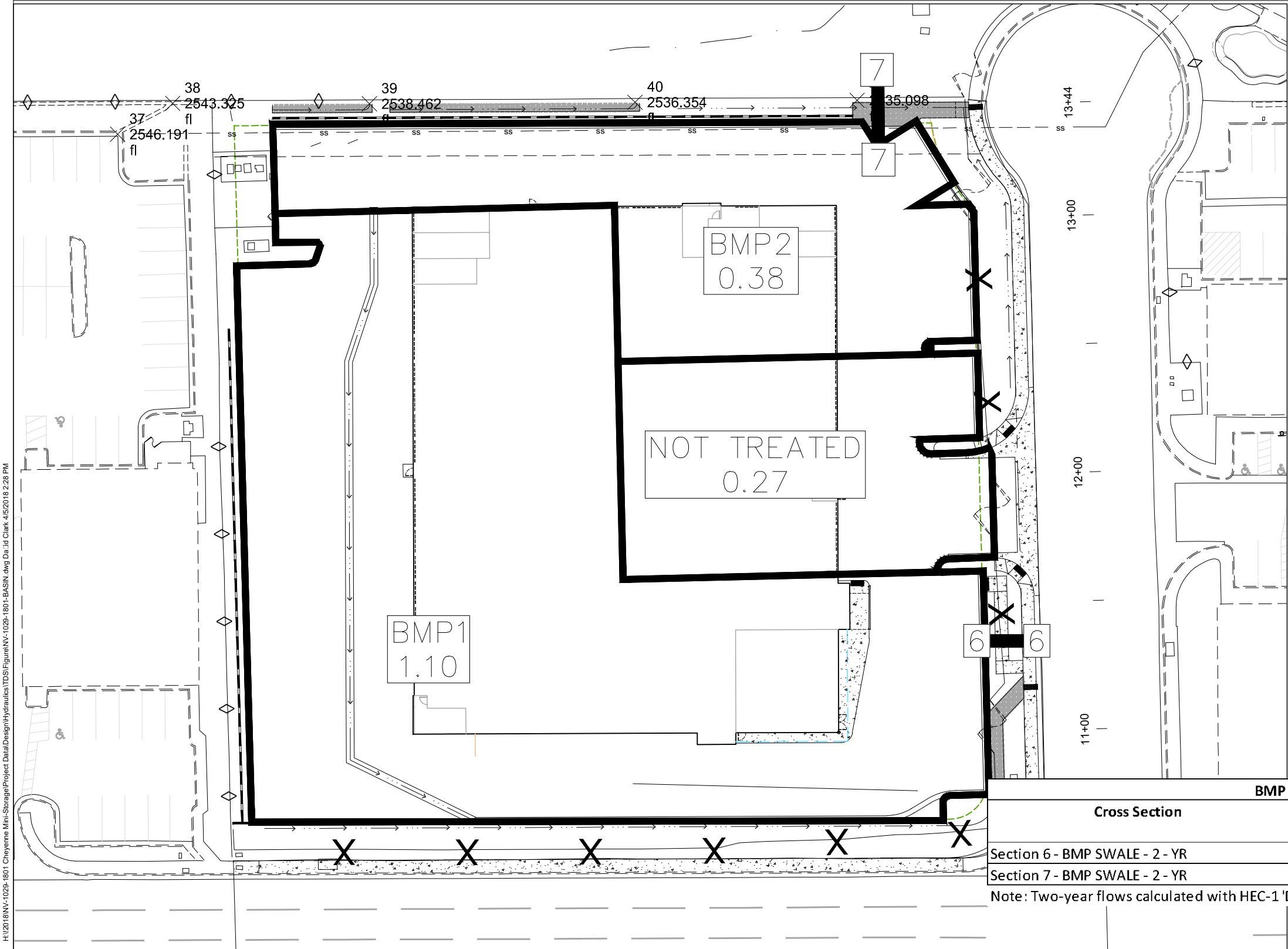
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Channel Slope	1.00	%
Normal Depth	0.22	ft
Discharge	0.22	ft ³ /s

Cross Section Image





BMP BASIN			
Basin	Area (acres)	Q ₂ (cfs)	CFS/AC
SITE	1.74	1	0.57
BMP1	1.1	0.63	0.57
BMP2	0.38	0.22	0.57
NOT TREATED	0.27	0.16	0.57
Parking	1.75	1.01	N/A
Treated: 1.48/1.74 = 85%			

BMP Swale Summary						
Cross Section	Description	Q (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	DxV
Section 6 - BMP SWALE - 2 - YR	OND2	0.63	0.5	0.37	1.12	0.41
Section 7 - BMP SWALE - 2 - YR	OND1	0.22	1.1	0.22	1.16	0.26

Note: Two-year flows calculated with HEC-1 'DEV' model

APPENDIX C. Reference Material

Conceptual Drainage Study for Cheyenne/Campbell, DS 3582

- Approval Letter
- Rational Method

Technical Drainage Study for Cheyenne/Campbell, DS 4106

- Approval Letter
- Peak Flow Rates Table
- Hydrologic Calculations
- Figure 8 – Onsite Basin Map from 4106C
- Figure 8 – Onsite Basin Map from 4106B
- Grading Plans

Technical Hydrology Study for Cheyenne Campbell, DS 3971

- Approval Letter
- Figure 5 – Off-site Drainage Basins
- Figure 6 – Existing Onsite Drainage Basins

Technical Drainage Study for 7-11 at Northeast Corner Cheyenne/Fort Apache 7-11, HTE 98-8063

- Approval Letter
- Basin Flow Rate Table
- Figure 6
- Basin Parameters – Standard Form 4
- Plans

UPDATE #2 TO THE TECHNICAL DRAINAGE STUDY FOR CHEYENNE/CAMPBELL

**CITY OF LAS VEGAS, NEVADA
Project Number: 2076001
November 2016**

Prepared For: KB Home
5795 Badura Avenue
Suite 180
Las Vegas, NV 89118
(702) 266-8512

Prepared By: L.R. Nelson Consulting Engineers
6765 W. Russell Rd., Suite 200
Las Vegas, Nevada 89118
(702) 798-7978

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		December 29, 2016
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	Technical Drainage Study for:	
	Cheyenne / Campbell – Update #2	
Cross Streets:	Cheyenne Avenue and Campbell Road	
File Number:	F:\Depot\DSMEMOS\DS4106E.doc	
Parcel Number:	138-08-401-008 & -009	
Zoning Action:	N/A	
FEMA Flood Zone	YES	NO
Proposed Storm Drain	YES	NO
	X	X
COPIES TO:		
		L.R. Nelson Consulting Engineers
		9030 W. Cheyenne LLC
		Bart Anderson, P.E., DevCo

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Trn. No.
1 st Submittal	12/21/2006	1/4/2007	Not Approved	\$400.00	59722: \$400
2 nd Submittal	2/16/2007 & 3/2/2007	3/5/2007	Conditional Approval	\$400.00	63266: \$400
CCRFCD	4/10/2007	4/11/2007	Concurrence	N/C	N/C
3 rd Submittal	9/11/2007	9/25/2007	Approved	\$100.00	Paid: \$100
4 th Submittal	12/14/2016	12/29/2016	See Comments Below	\$100.00	468824: \$100
			TOTAL FEES (LDDRS):	\$1,000.00	----

REMARKS:

4th Submittal: Update #2 for drainage revision in landscaping between Building D and Building E

3rd Submittal: Update #1 to revise sidewalk from steps to ramp at the northeast corner of "Future Pad" between Building "D" and Building "F"

The Drainage Study for the subject project has been reviewed and:

X	is approved subject to conformance to all City standards and the following conditions:
	must be resubmitted or supplemented including the following:
	is conditionally approved subject to Clark County Regional Flood Control District concurrence.

- The engineer/owner is advised to consult with *City of Las Vegas Planning Department* for the process of updating the **Landscaping Plan** of the commercial subdivision.

NOTE: Please be advised that all land surface area disturbances over 1 acre or any area adjacent to a water way must submit to the Nevada Division of Environmental Protection a "Notice of Intent" to discharge that certifies a stormwater pollution prevention plan has been developed and is maintained on site; for inclusion in the Stormwater General Permit No. NVR100000. A phased construction unit in a contiguous subdivision is considered under construction until all stripped or disturbed surface areas have been covered by paving, building construction or planting. For more information, including forms and applications see <http://ndep.nv.gov/bwpc/storm01.htm> or call (775) 687-9429.

NOTE: Any future changes to the proposed design (or design assumptions) as outlined in the approved drainage study and attached preliminary grading plan which affect drainage must be addressed in a Drainage Study Update and accepted by the *City of Las Vegas Flood Control Section*. Additionally, conditional acceptance of a drainage study is valid for a period of one (1) year. If the proposed construction has not been completed in that time period, the *City of Las Vegas* reserves the right to require additional conditions and/or submission and acceptance of a complete drainage study update prior to further construction of a project.

END OF REMARKS

B&H/ays

T/R/S: T20S/R60E/08

AREA L-08

easterly along Cheyenne Avenue. Flows generated from basin DON1 runs through a proposed wall opening at the existing flood wall southerly boundary of the subject site. The revised Table 4 shown below summarizes the peak flows and flow patterns.

TABLE 4 – PROPOSED CONDITION PEAK FLOW RATES

Basin/ Node	Q₁₀ (cfs)	Q₁₀₀ (cfs)	Area (ac)	Remarks
OFF1	1	4	2.3	Offsite flow routed to CE
DON2	4	9	3.17	Onsite flow routed to CE
CE	5	13		Concentration point CE
CN	2	3	0.8	Offsite flow routed to CC
CHEY	4	7	1.9	Offsite flow routed to CC
DON1	1	3	0.83	Onsite flow routed to CC
*REF	10	18		Existing flow drains to CC
CC	17	31		Concentration point CC2
S	1	2	0.5	Onsite flow routed to CC2
CC2	18	33		Concentration point CC2

Basin SUB1 has been analyzed to determine the minimum prorated flow that runs through the proposed U-gutter that drains the area between existing building D and E. Flow calculations are shown on Table 5 below.

Compare to calculated basin
CHEY from project study.

TABLE 5 – PRORATED FLOWS FROM CONTRIBUTING SUBBASINS

PRORATED BASIN ID	PRORATED AREA (AC)	BASIN ID	BASIN AREA (AC)	BASIN Q10 (cfs)	BASIN Q100 (cfs)	PRORATED Q10 (cfs)	PRORATED Q100 (cfs)
SUB1	0.03	DON1	3.17	4	9	0.04	0.09

HYDRAULIC ANALYSES

Refer to hydraulic analyses in Appendix C and drainage facilities locations in the onsite grading plan in Appendix E for the following discussion. A hydraulic cross section HS1 has been provided to show that the top of existing and proposed flood walls at the southerly boundary of the site are adequately elevated to protect the existing buildings in the subject site from 10-year and 100-year storm event despite the additional flows from onsite basin DON1. Hydraulic cross section HS2 shows that the proposed 1-ft U-gutter can contain the prorated 10-year and 100-year storm flow of from basin SUB1 and that the existing finished floor elevations of adjacent existing buildings D and E exceeds the twice the flow depth requirement per the *Clark County Regional Flood Control District* criteria. Table 6 shown below summarizes the analysis of hydraulic sections HS1 and HS2.

TABLE 6 – HYDRAULIC SECTIONS FLOW CALCULATIONS

Hydraulic Cross Section	Street Slope (%)	Q10 (cfs)	Q100 (cfs)	Depth 10-Yr (ft)	Depth 100-Yr (ft)	V10 (ft/s)	V100 (ft/s)	D*V (10-Yr)	D*V (100-Yr)	Dry Travel Lane (ft)
HS1	0.50	17	31	0.42	0.5	4.06	4.69	1.71	2.35	19.5
HS2	0.50	0.04	0.09	0.04	0.07	0.94	1.27	0.04	0.09	N/A

The wall opening hydraulic analysis shows that the proposed 16” X 4’ wall opening located on the southerly boundary has the capacity to discharge the 100-year storm flows from basin DON1 with the 50% clogging factor.

CONCLUSIONS AND RECOMMENDATIONS

1. The top of existing flood walls are adequately elevated to provide freeboard for the 100-year, 6-Hour design storm flows in the adjacent roadway Cheyenne Avenue and meet the *City of Las Vegas and Clark County Regional Flood Control District* criteria for flood protection elevation for areas located outside the Special Flood Hazard Area.
2. Construction of the proposed onsite improvements per the improvement plans provided by L.R. Nelson Consulting Engineers to be found in Appendix D.

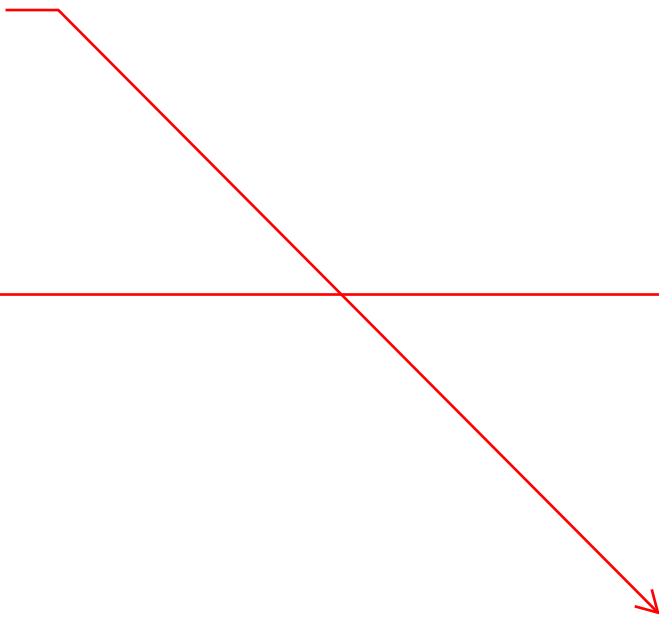
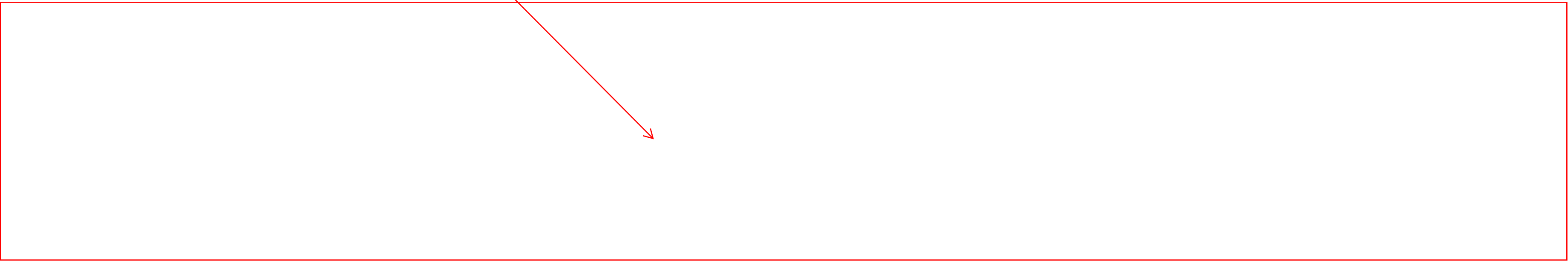
If you have any questions or comments, please do not hesitate to contact me by e-mail: Denmark.Ignacio@lneng.com or by phone: (702) 798-7978.

Sincerely,

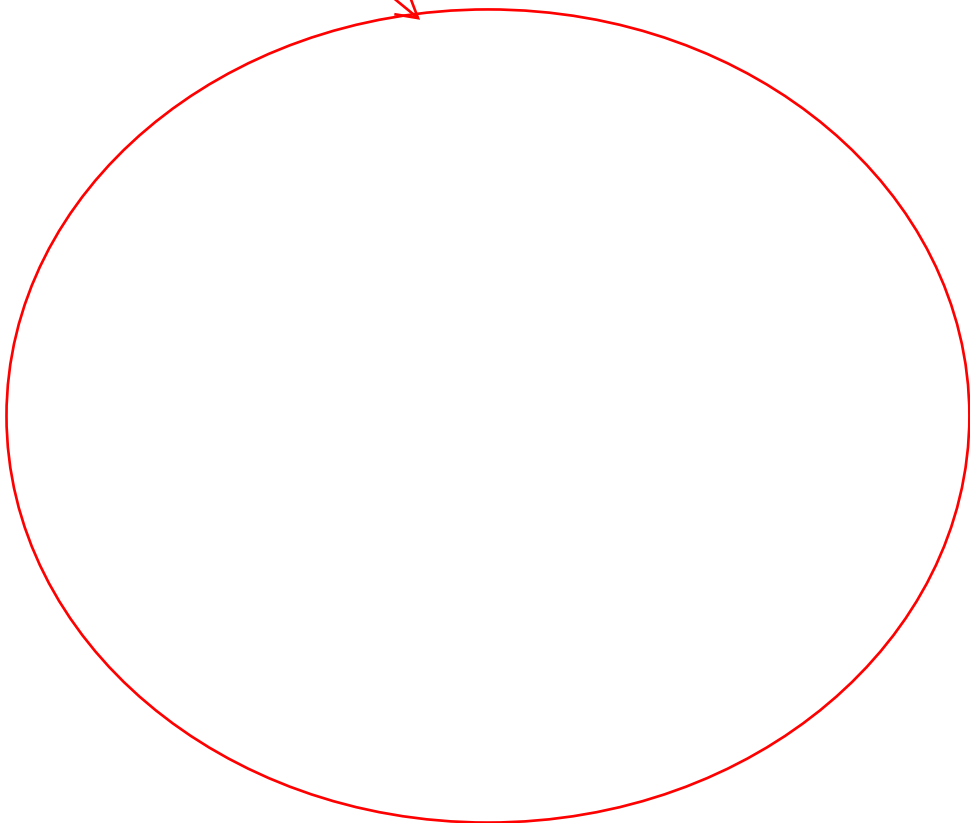
Denmark Ignacio, E.I.

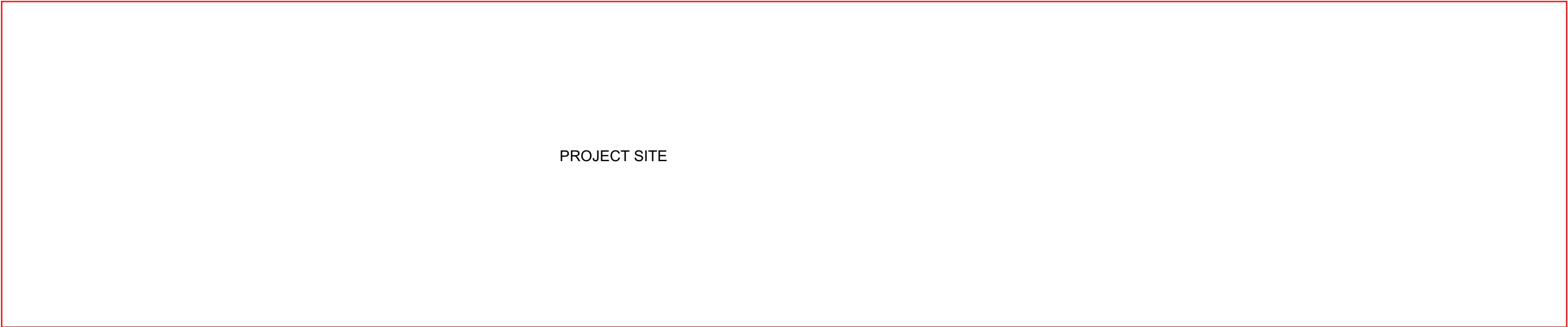


20' public drainage
easement with 3'
Valley Gutter

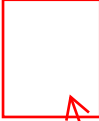


Basin N referenced
for this Study.



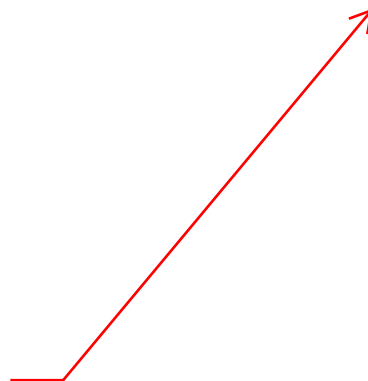


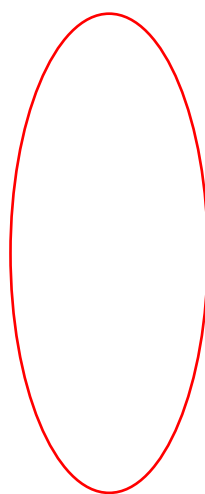
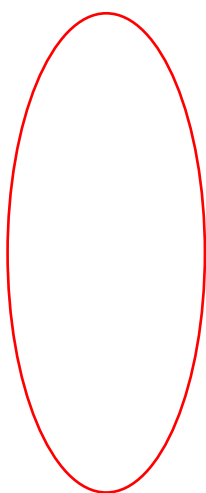
PROJECT SITE



NOTE: BASIN CHEY WAS ORIGINALLY
CALCULATED USING THE RATIONAL
METHOD. FOR THIS STUDY (CHEYENNE
MINI STORAGE) STANDARD FORM 4 WAS
USED TO CALCULATE THE HEC-1
INPUTS, USING A CURVE NUMBER OF 98
FOR ROADWAY. LENGTH = 5700'. AREA
= 7 ACRES. SLOPE: 300 / 5700 = 5.3%

The curve numbers and flows for ON-1 and ON-2 have been updated with a current soils map and HEC-1 Model. The revised flows are 1/3 for both basins.





HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

DEVELOPMENT: 7-11 @ Fort Apache
CALCULATED BY: Michael Graham DATE: March 1, 1998 Rev. 6-8-79

SUB-BASIN DATA				INITIAL OVERLAND TIME (t _o)			TRAVEL TIME (t _t)				A. CHECK (UNORGANIZED BASINS)		FINAL t _c	REMARKS
DESIG.	N	AREA AC	LENGTH N	WIDTH N	PERCENT	t _o MIN	LENGTH N	WIDTH N	PERCENT	t _t MIN	t _t MAX	t _c = t _o + t _t MIN	MAX	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	
OFF-A	0.056	9.1	70	2.0	2.3	3900	3.4	5.0	15.0	-	-	15.3	CN=98	
ON-E	8.508	2.5	100	1.0	4.5	400	2.0	3.0	2.2	-	-	6.7	CN=94	
ON-1	8.508	1.0	100	2.0	5.3	300	2.0	3.0	1.7	-	-	7.0	CN=85	
ON-2	8.508	1.0	100	1.0	4.5	250	2.0	3.0	1.4	-	-	6.0*	CN=94	
							300	3.0	3.5	1.4	-	-	6.0*	CN=94
														</

REFERENCE: $t_c = 1.48 (L + K) / V^{0.58}$ $t_c = t_o + t_t$
 $K = 0.0112 CN + 0.39$ pp. 605

*6.0 MINUTES MIN.

TR-55 GRAPHICAL DISCHARGE METHOD
Project: 7-11 @ Fort Apache / Cheyenne User: MTS Date: 06-08-98
County: Clark State: NV Checked: Date:
Subsite: OFF-A

Data: Drainage Area : 9.1 Acres
Runoff Curve Number : 98
Time of Concentration : 0.26 Hours
Rainfall Type : II
Pond and Swamp Area : NONE

Storm Number	1	2
Frequency (yrs)	10	100
24-hr Rainfall (in)	1.8	2.96
Ia/P Ratio	0.02	0.01
Used	0.10	0.10
Runoff (in)	1.58	2.73
Unit Peak Discharge (cfs/acre/in)	11.133	11.133
Pond and Swamp Factor	1.00	1.00
0.05 Ponds Used		
Peak Discharge (cfs)	16	28

THE CN CALCULATIONS ARE UPDATED WITH CURRENT SOILS INFORMATION.

II. HYDROLOGIC ANALYSIS

Figure 5 shows the upstream off-site drainage basin for this site. Note that since the surrounding land drains typically directly east or to the northeast away from Cheyenne, there is no upstream basin except for the street flow of Cheyenne Avenue itself. The flows at the intersection of Cheyenne and Grand Canyon on the north side are going to drain around the curb return and into Grand Canyon because there is a steep drop. There are other humped street entries to existing residential and other sites east of Grand Canyon which we have assumed will effectively keep the flows impacting Cheyenne within the Cheyenne right-of-way all the way to the Fort Apache/Cheyenne intersection. There have been a number of major improvements in detention basins west of this site and west of Summerlin which have effectively cut off all flows from impacting this site from the major drainage basin in the foothills to the west. This is based on experience with previous drainage reports prepared for the City of Las Vegas. The basin for the on-site flows in the existing conditions is taken to be the entire site as one basin. Note that the entire on-site storm flow is conveyed to the easterly property. Figure 6 shows the on-site proposed drainage basins. Note that some of the drainage is taken into Cheyenne and some of the drainage is taken into the adjacent property to the east to meet existing conditions. Table 1 below indicates these flows as calculated in Appendix A.

TABLE 1

BASIN	Q ₁₀	Q ₁₀₀
Off-Site Basin A	1216	2225
Off-Site Basin B	5	9
On-Site Basin ON-E (Existing)	2	6
On-Site Basin ON-1 (Proposed)	2	4
On-Site Basin ON-2 (Proposed)	2	4

III. HYDRAULIC ANALYSIS

Note that there is a flow split at the Fort Apache/Cheyenne Avenue intersection. We have assumed that the entire flow amount on the north side of the road, or half the flow, is going to divert into Fort Apache. The reason is because even though Cheyenne is falling at a steep rate of grade, there is no cross gutter on the north side of the road, and almost the entire flow is within the first outside land of traffic. This is a conservative condition since the flow will probably actually split partially onto the west side of Fort Apache and partially onto our side of Fort Apache. Since the entire flow then remaining in Cheyenne adjacent to our site is on the south side of the road, again to be conservative we have assumed this entire flow is on the north side of the road to establish flood protection requirements. Table 2 below indicates these values for flows adjacent to the site for and calculates the depth, velocities, and DV factors for each street as calculated in Appendix B.

TABLE 2

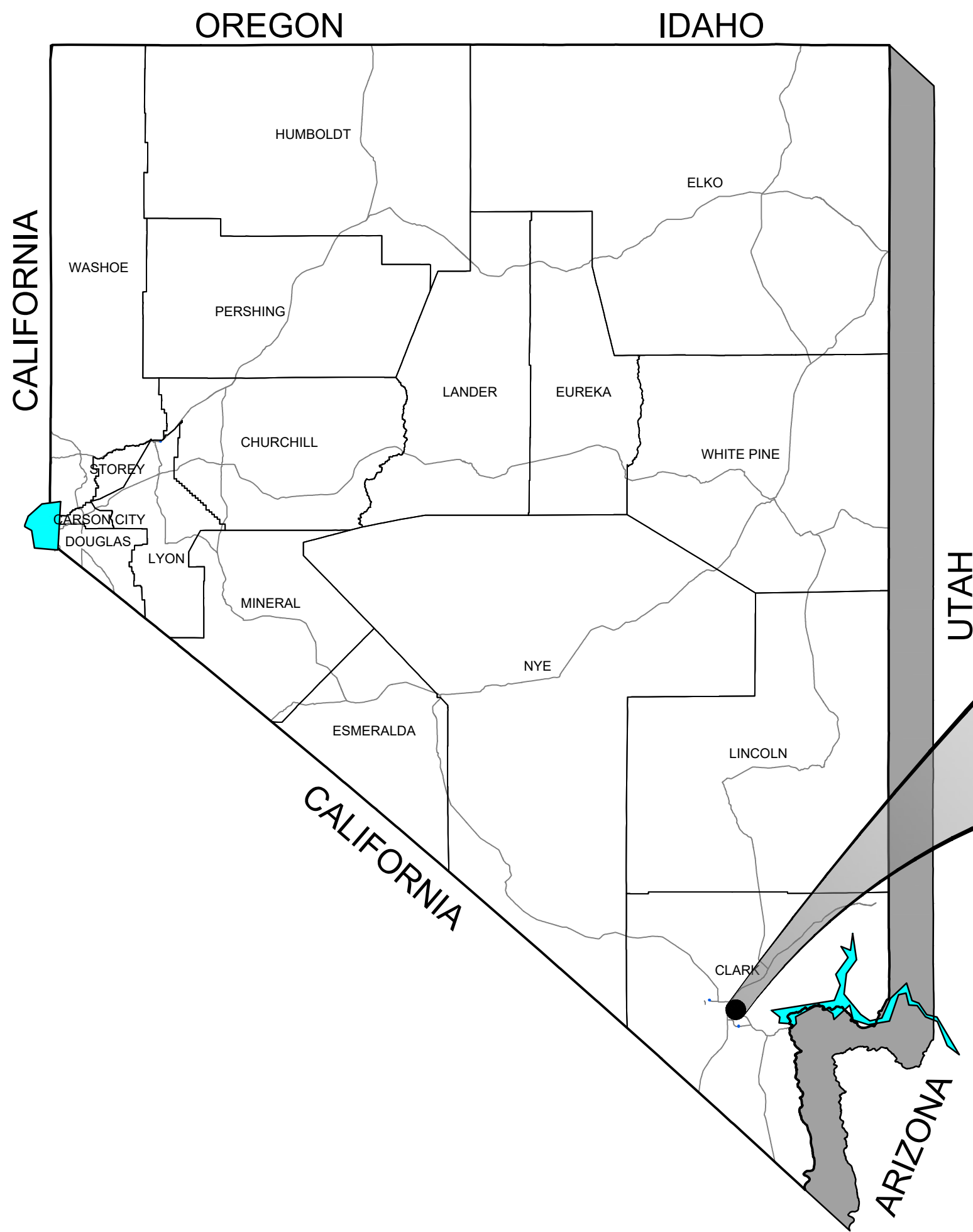
LOCATION	Q ₁₀	D ₁₀	V ₁₀	DV ₁₀	Q ₁₀₀	D ₁₀₀	V ₁₀₀	DV ₁₀₀
Fort Apache *	1113	0.39	3.8	1.4	2025	0.58	5.8	3.8
Cheyenne **	810	0.39	3.8	1.4	1418	0.38	3.8	3.8

* 1/2 Basin OFF A + Basin OFF B
** 1/2 Basin OFF A + Basin ON-1

000396

APPENDIX D. Grading Plan / Plan-Profiles / Sections-Details

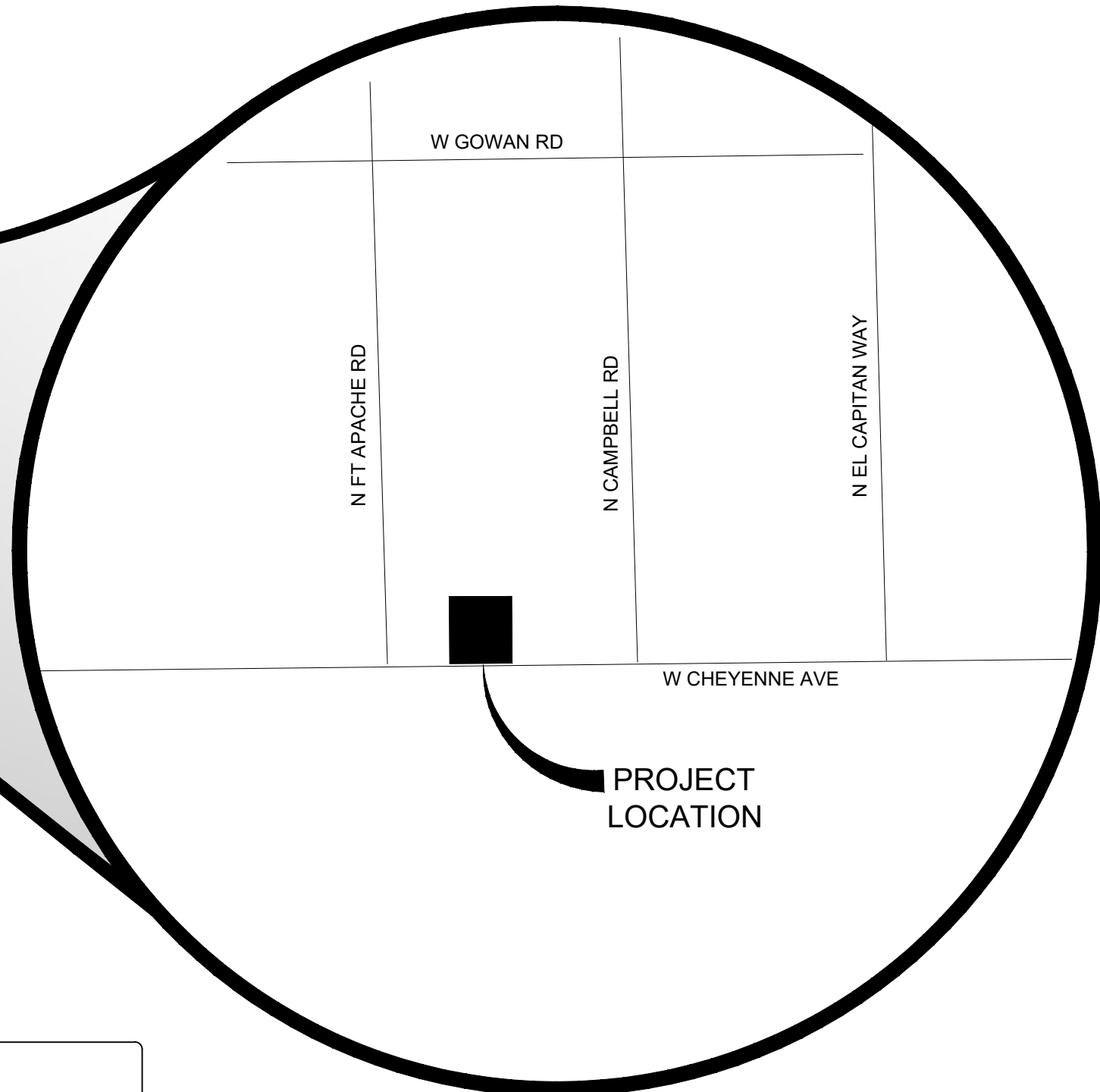
IMPROVEMENT DRAWINGS
FOR
ALL STORAGE
@ CHEYENNE & DAPPLE GRAY
LAS VEGAS, NEVADA
APN# 138-08-401-013



STATE MAP



VICINITY MAP



PROJECT LOCATION

PROJECT SITE

SHEET INDEX		
PAGE #	SHEET #	SHEET TITLE
01	C.0.0	COVER SHEET AND SHEET INDEX
02	C.0.1	NOTES SHEET
03	C.0.2	LEGEND AND ABBREVIATION
04	C.2.0	GRADING PLAN
05	C.5.0	DAPPLE GRAY PLAN AND PROFILE
06	C.6.0	DETAIL SHEET 1
07	C.6.1	DETAIL SHEET 2

ALLEN PAVELKA, PE #9029 CLV CITY ENGINEER	DATE
APPROVAL OF THESE PLANS IS LIMITED TO THOSE IMPROVEMENTS CONSTRUCTED IN THE DEDICATED RIGHT -OF-WAY AND/OR DEDICATED EASEMENTS. THIS APPROVAL DOES NOT AUTHORIZE THE CONSTRUCTION OF ANY IMPROVEMENTS THAT DEVIATE FROM ADOPTED STANDARDS AND/OR SPECIFICATIONS, EXCEPT THOSE SPECIFICALLY LISTED UNDER DEVIATION FROM STANDARD. THE ENGINEER SHALL RESOLVE ANY DEVIATION OTHER THAN THOSE LISTED IN DEVIATIONS FROM STANDARDS IN FAVOR OF THE UNIFORM STANDARD DRAWINGS AND SPECIFICATIONS CLARK COUNTY AREA NEVADA.	
CITY OF LAS VEGAS DEPARTMENT OF PLANNING	DATE
THIS PLAN MEETS THE APPLICABLE STANDARDS OF THE PLANNING DEPARTMENT	
LAS VEGAS FIRE & RESCUE	DATE
SOUTHWEST GAS	DATE
CENTRAL TELEPHONE COMPANY D/B/A CENTURY LINK	DATE
THE AFFIXED CENTRAL TELEPHONE COMPANY 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 RULES AND REGULATIONS.	

NV ENERGY	DATE
NEVADA ENERGY ACKNOWLEDGES THAT WE HAVE RECEIVED YOUR PLANS AND WILL PROVIDE SERVICE TO ALL ELECTRICAL NEEDS ASSOCIATED WITH THIS PROJECT. NEVADA POWER COMPANY 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.	
COX COMMUNICATIONS LAS VEGAS, INC	DATE
APPROVED FOR CONSTRUCTION	
LAS VEGAS VALLEY WATER DISTRICT ENGINEERING SERVICES	
PROJECT NO. _____	FIRST APPROVAL DATE: _____
LVVWD APPROVED FIRE FLOW _____	GPM AT 20 PSI RESIDUAL

ENGINEER:
HORROCKS ENGINEERS
1401 N Green Valley Pkwy., Suite 160
Henderson, NV 89074
(702) 966-4063
CONTACT: LARRY BITTON, PE

UTILITIES:
POWER- NEVADA ENERGY
GAS- SOUTHWEST GAS
SEWER- CITY OF LAS VEGAS
WATER- LVVWD

APPLICANT:
SHURLEY DESIGN STUDIO, LLC.
1980 FESTIVAL PLAZA DR., SUITE 450
LAS VEGAS, NV 89135
(702) 624-0022
CONTACT: GERALD SHURLEY

OWNER:
CHEYENNE INVESTORS, LLC.
530 LOMAS SANTA FE, SUITE C
SOLANO BEACH, CA 92075
(702)348-5100
CONTACT: BLAKE ROSSER

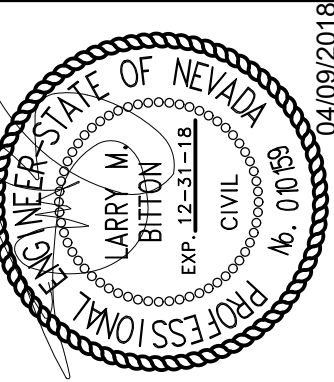
HORROCKS
ENGINEERS

1401 N. Green Valley Pkwy., Suite 160
Henderson, NV 89074
(702) 966-4063
www.horrock.com

WARNING

IF THIS BAR DOES NOT
MEASURE 2" THEN
DRAWING IS NOT TO SCALE

REVISIONS	REV #	DATE



ALL-STORAGE
@ CHEYENNE AND DAPPLE GRAY
LAS VEGAS, NEVADA

COVER SHEET AND SHEET INDEX

138-08-401-013



C.O.O

ABBREVIATIONS

BUILDING / PAD

CONCRETE SIDEWALK / FLATWORK

DECORATIVE BRICK / SIDEWALK / FLATWORK / LANDSCAPE AREAS

POOL DECK

XERISCAPE

LANDSCAPE AREAS / GRASS

HEAVY DUTY PAVEMENT SECTION

LIGHT DUTY PAVEMENT SECTION

ADA ACCESS RAMP TRUNCATED DOMES

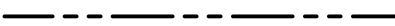
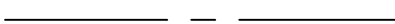
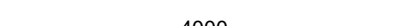
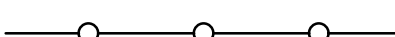
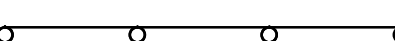
RIPRAP

GRAVEL

EXISTING		PROPOSED
	SEWER MANHOLE	
	STORM DRAIN MANHOLE	
	WATER MANHOLE	
	ELECTRICAL MANHOLE	
	TELEPHONE MANHOLE	
	FIBER OPTIC MANHOLE	
	IRRIGATION MANHOLE	
	GAS MANHOLE	
	CABLE TV MANHOLE	
	STORM DRAIN CATCH BASIN	
	IRRIGATION BOX	
	ELECTRICAL JUNCTION BOX	
	ELECTRICAL BOX	
	TELEPHONE BOX	
	CABLE TV BOX	
	FIBER OPTIC BOX	
	WATER METER	
	GAS METER	
	GATE VALVE	
	BUTTERFLY VALVE	
	PRESSURE REDUCING VALVE	
	FIRE HYDRANT	
	ELECTRICAL POWER POLE	
	TRAFFIC SIGNAL POLE	
	LIGHT POLE	
	SIGN (SINGLE POLE)	
	SIGN (2 POLE)	
	SIGN (3 POLE)	

AC ASPHALTIC CEMENT BASE COURSE
ACB AGGREGATE CEMENT OR CONCRETE
CURB BACK OF CURB
BOT BOTTOM OF BASIN
B.S.L. BUILDING SETBACK LINE
BLDG BUILDING
BV BUTTERFLY VALVE
BVC BEGIN VERTICAL CURVE
BVCE BEGIN VERTICAL CURVE ELEVATION
BVCVS BEGIN VERTICAL CURVE STATION
BW BOTTOM OF WALL
C&G CURB & GUTTER
CL CENTERLINE
CB CATCH BASIN
CB CAST IRON
CLR CLEAR
CO CLEANOUT
COM COMPRESSION FITTING
CONC CONCRETE
CONST CONSTRUCT
COW WASHINGTON CITY
CR CURB RETURN
CTS COPPER TUBE STEEL
CY CUBIC YARD
D DEPTH OF FLOW
DIA DIAMETER
DIM DIMENSION
DIP DUCTILE IRON PIPE
DTL DETAIL
DWG DRAWING
E EAST OR EASTING
EA EACH
EG EXISTING GRADE
EL ELEVATION
EOP EDGE OF PAVEMENT
ESEM EASEMENT
EVC END VERTICAL CURVE
EVCE END VERTICAL CURVE ELEVATION
EVCVS END VERTICAL CURVE STATION
EW EACH WAY
EX EXISTING
FC FINISH FLOOR
FE FLANGE END
FG FINISH GRADE
FI FEMALE IRON PIPE FITTING
F FLOW
FLG FLANGE FITTING
FM FORCE MAIN
FP FINISH PAD
FPS FEET PER SECOND
FRP FIBERGLASS REINFORCED PLASTIC
FT FOOT OR FEET
FUT FUTUR
G GUTTER OR GAS LINE
GB GRADE BREAK
GATE VALVE
HGL HYDRAULIC GRADE LINE
HORIZ HORIZONTAL
HPI HIGH POINT FLOWLINE
HTWL HIGH WATER ELEVATION
ID INSIDE DIAMETER
IN INCH(ES)
INV INVERT OR INVERSE
L LINEAR FEET
L/S LANDSCAPE
LS LANDSCAPE EASEMENT
LT LEFT
MAX MAXIMUM
ME MATCH EXISTING
MGFRS MANUFACTURERS
MGD MILLION GALLONS PER DAY
MH MANHOLE
ML MALE IRON PIPE FITTING
MLL MINIMUM LINE
MIN MINIMUM
NO NUMBER
N NORTH OR NORTHING, FRICTION FACTOR
N/A NOT APPLICABLE
NTD NOTED
NTS NOT TO SCALE
NC CENTER
OC-EW ON CENTER EAST AND WEST
OD OUTSIDE DIAMETER
PAV PAVEMENT
PC POINT OF CURVE
PC VC POINT OF CURVATURE VERTICAL CURVE
PCC POINT OF COMPOUND CURVE
PERM PERMANENT
PH PHASE
PI POINT OF INTERSECTION
W WATER
PI EL POINT OF INTERSECTION ELEVATION
PI VC POINT OF INTERSECTION VERTICAL CURVE
PL PROPERTY LINE
PLC POINT OF INTERSECTION CURVE
PT POINT OF TANGENCY
PT VC POINT OF TANGENT VERTICAL CURVE
PUE PUBLIC UTILITY EASEMENT
PCL POLYCHLORIDE
PVI POINT OF VERTICAL INTERSECTION
PWD PUBLIC WORKS DEPARTMENT
PWF RIGHT OF WAY
RWD RIGHT OF WAY
REQD REQUIRED
RES RESERVOIR
REV REVISION
RGCRP RUBBER GASKET REINFORCED CONCRETE
RT RIGHT
S/S SLOPE OR SEWER LINE
SEW SEWERLINE
SIDEWALK
SD STORM DRAIN
SDMH STORM DRAIN MANHOLE
SEC SECTION
SHEET
SPE SPECIFICATIONS
ST or STL STEEL
STA STATION
STD STANDARD
SVE SIGNIFICABILITY EASEMENT
SVT SIGHT VISIBILITY TRIANGLE
T.B. THRUST BLOCK
TBC TOP BACK OF CURB
TBM TEMPORARY BENCH MARK
TOP OF CURB
TEMP TEMPORARY
TFC TOP OF COATING
TGR TOP OF GRATE
TL TRUE LENGTH
TOA TOP OF ASPHALT
TOP OF CONCRETE
TRANS TRANSMISSION OR TRANSITION
TRW TOP OF RETAINING WALL
TS TROUGH
TW TOP OF WALL
TYP TYPICAL
UNTO UNREINFORCED
UG UNLINED BASE COURSE
V VELOCITY
VC VERTICAL CURVE
VERT VERTICAL
VG VALLEY GUTTER
Vprov VOLUME PROVIDED
VREQ VOLUME REQUIRED
V.T. VISIBILITY TRIANGLE
W WEST OR WATER LINE
W/ WITH
WL WATERLINE
WA WATER

CONSTRUCTION KEYNOTE TAGS

	PROPERTY BOUNDARY
	PARCEL LINE
	ROAD CENTERLINE
 ROW	RIGHT-OF-WAY
	CURB & GUTTER
 10'	10' PUBLIC UTILITY & DRAINAGE EASEMENT (P.U.E.)
 4000	EXISTING MAJOR CONTOURS
 4002	EXISTING MINOR CONTOURS
 4000	MAJOR CONTOURS
 4002	MINOR CONTOURS
	ROCK WALL
	SCREEN WALL
	MODULAR BLOCK WALL
	CONCRETE WALL
	CONSTRUCTION FENCE
 X X X	BARB WIRE FENCE
	CHAIN LINK FENCE
	VINYL FENCE
	DECORATIVE FENCE
	EXISTING RAILROAD TRACKS

	OR		DEMO PLAN		POINT OF COMPOUND CURVE
	OR		GRADING PLAN		PERMANENT
	OR		SITE PLAN		PHASE
	OR		WATER		POINT OF INTERSECTION
	OR		SEWER		WATER
	OR		STORM DRAIN		POINT OF INTERSECTION ELEVATION
	OR		IRRIGATION		POINT OF INTERSECTION VERTICAL CURVE
	OR		CABLE TV		PROPERTY LINE
	OR		TELEPHONE		POINT OF REVERSE CURVE
	OR		GAS		POINT OF TANGENCY
	OR		POWER		POINT OF TANGENT VERTICAL CURVE
	OR		SIGNAGE & STRIPING		PUBLIC UTILITY EASEMENT
					POLYVINYL CHLORIDE
					POINT OF VERTICAL INTERSECTION
					PUBLIC WORKS DEPARTMENT
					RATE OF FLOW
					RIGHT OF WAY
					REQUIRED
					RESERVOIR
					REVISION
					RUBBER GASKET REINFORCED CONCRETE
					RIGHT
					SOUTH, SLOPE OR SEWER LINE
					SEWER LINE
					SIDEWALK
					STORM DRAIN
					STORM DRAIN MANHOLE
					SECTION
					SHEET
					SIGNED

CALLOUTS

FF: XXXX.XX

TBC: 93.50

PROPOSED BUILDING FINISHED FLOOR ELEVATION

PROPOSED SPOT ELEVATION (@ TBC, TOC, TOA, FL, ETC.)

DETAIL OR SECTION IDENTIFICATION

DETAIL OR SECTION IS TO BE FOUND ON THE SAME SHEET

⊗ CURVE DATA

Δ = XX°XXXX*

R = XXXX.XXX

L = XXXX.XXX

T = XXXX.XXX

P.I. STA. XX+X.XXX

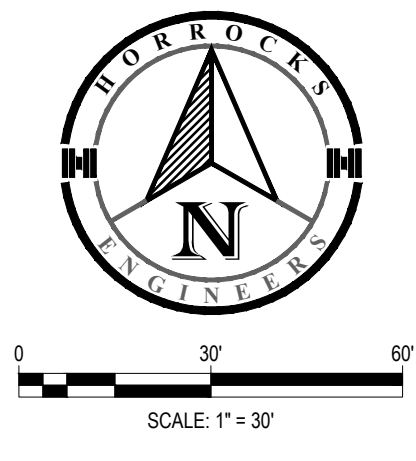
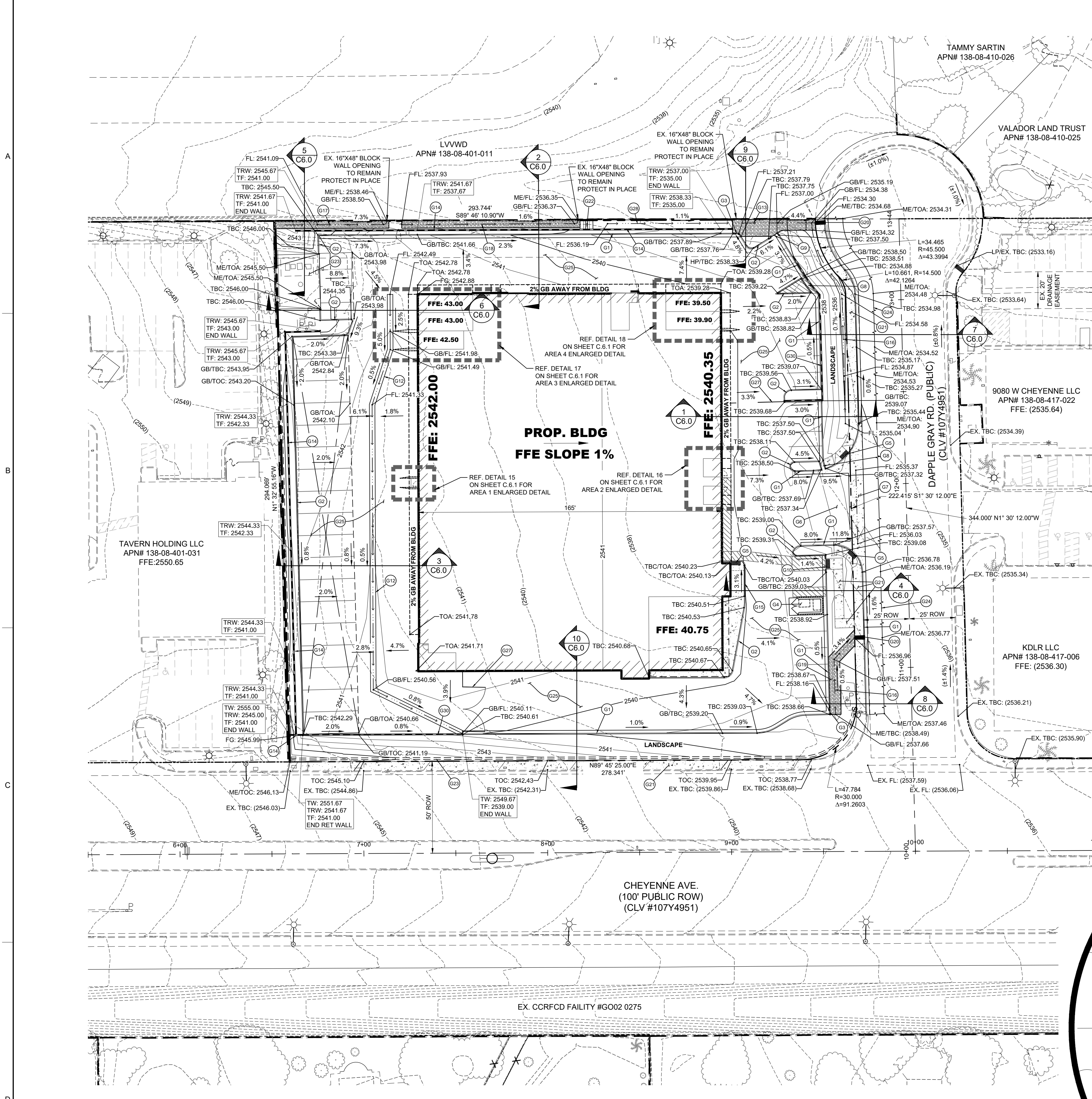
N = XXXXXX.XXXX

E = XXXXXX.XXXX

NOTES:

- XXXXX.
- XXXXXX.
- XXXXXX.

SCALE: NTS



- TOC: 00.00 TOP OF CONCRETE
TOC DEP: 00.00 TOP OF CONCRETE DEPRESSED
TOA: 00.00 TOP OF ASPHALT
TBC: 00.00 TOP BACK CURB
FG: 00.00 FINISH GRADE
FL: 00.00 FLOW LINE
EX TBC: (00.00) EXISTING TOP BACK CURB
EX TOA: (00.00) EXISTING TOP OF ASPHALT

LEGEND:

- 4000--- EXISTING MAJOR CONTOURS
---4002--- EXISTING MINOR CONTOURS
4000 MAJOR CONTOURS
4002 MINOR CONTOURS
==== CURB & GUTTER
==== EXISTING CURB & GUTTER
--- EXISTING ASPHALT
--- RIGHT OF WAY
--- FLOW LINE
--- RETAINING OR SCREEN WALL
--- EXISTING RETAINING OR SCREEN WALL

FLOOD ZONE:

THIS SITE IS LOCATED IN A ZONE "X". AREAS OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOODPLAIN PER THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL 3203C2135F, CLARK COUNTY, NEVADA DATED NOVEMBER 16, 2011.

BENCHMARK:

RIVET AND PLATE IN TOPO OF CURB AT THE SOUTHEAST CORNER OF CHEYENNE AND FORT APACHE
ELEVATIONS: 778.771 METERS
2555.02 FEET

BASIS OF BEARING:

S89°45'25"W
BEING THE CENTERLINE OF CHEYENNE AVENUE AS SHOWN
ON THE FINAL MAP OF CHEYENNE/CAMBELL PLAT BOOK 139 PAGE 19 O.R.

GRADING KEY NOTES:

- CONSTRUCT "L" CURB AND GUTTER PER CCAUSD #216
- CONSTRUCT "A" CURB PER CCAUSD #219
- CONSTRUCT 2.0' WIDE CURB OPENING PER DETAIL 15 SHEET C.6.0
- CONSTRUCT TRASH ENCLOSURE (SEE ARCHITECTURAL PLANS FOR DETAILS)
- CONSTRUCT SIDEWALK RAMP "CASE 1" PER CCAUSD #235
- CONSTRUCT HEAVY DUTY COMMERCIAL DRIVEWAY PER CCAUSD #226.S3
- CONSTRUCT CROSS GUTTER PER CCAUSD #228
- CONSTRUCT CONCRETE 1.5' WIDE FLUME PER DETAIL 12 SHEET C.6.0
- CONSTRUCT 4.0' WIDE CURB OPENING PER DETAIL 15 SHEET C.6.0
- CONSTRUCT ONSITE SIDEWALK RAMP PER DETAIL 13 SHEET C.6.0
- ALL EX. NVE FACILITIES TO REMAIN. PROTECT IN PLACE.
- CONSTRUCT 3.0' VALLEY GUTTER PER DETAIL 11 SHEET C.6.0
- CONSTRUCT BMP SWALE PER DETAIL 9 SHEET C.6.0.
- CONSTRUCT RETAINING WALL (SEE ARCHITECTURAL & STRUCTURAL PLANS FOR DETAILS)
- CONSTRUCT CURB/SIDEWALK TRANSITION PER DETAIL 14 SHEET C.6.0
- CONSTRUCT LANDSCAPE SWALE PER DETAIL 1 SHEET C.6.0. REF. PLANS FOR DETAILS
- CONSTRUCT LANDSCAPE SWALE PER DETAIL 2 SHEET C.6.0. WITH D50=6", T=12" LANDSCAPE ROCK
- CONSTRUCT LANDSCAPE SWALE PER DETAIL 2 SHEET C.6.0. WITH D50=2", T=4" LANDSCAPE ROCK
- CONSTRUCT BMP SWALE PER DETAIL 8 SHEET C.6.0.
- CONSTRUCT SIDEWALK DRAIN PER CCAUSD #236
- CONSTRUCT 5.0' SIDEWALK PER CCAUSD #234
- CONSTRUCT LANDSCAPE BERM PER DETAIL 16 SHEET C.6.0
- CONSTRUCT LANDSCAPE BERM PER DETAIL 10 SHEET C.6.0
- SAW CUT & MATCH EXISTING PER CCAUSD 500.4. PROVIDE SMOOTH TRANSITION TO PROPOSED IMPROVEMENTS.
- CONSTRUCT 2" ASPHALT PAVEMENT OVER 4" TYPE II AGGREGATE BASE PER GEO HTE #XX-XXXXX
- CONSTRUCT 3" ASPHALT PAVEMENT OVER 4" TYPE II AGGREGATE BASE PER GEO HTE #XX-XXXXX. SEE STREET SECTIONS FOR DETAILS
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- CONSTRUCT PERIMETER SECURITY WALL (SEE ARCHITECTURAL & STRUCTURAL PLANS FOR DETAILS)

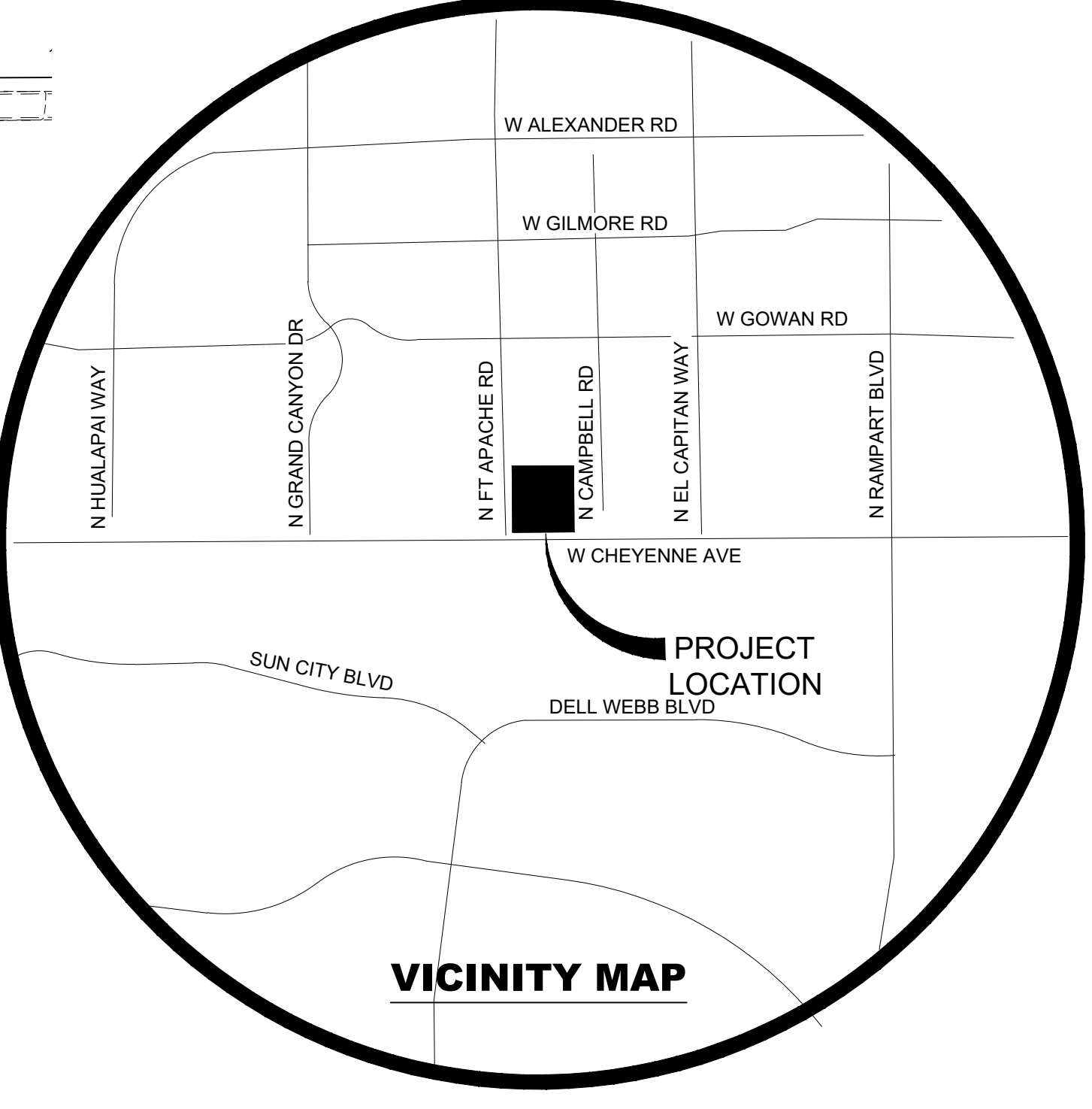
ENGINEER'S NOTES:

- CONTRACTOR IS RESPONSIBLE FOR EROSION AND DUST CONTROL, AND STORMWATER MANAGEMENT DURING CONSTRUCTION.
- SEE HORIZONTAL CONTROL PLAN FOR EXACT PROPERTY LINE DIMENSIONS
- ENGINEER TO BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES BETWEEN THESE PLANS AND FIELD CONDITIONS.
- THESE PLANS SHALL NOT IN PART, OR IN WHOLE, BE USED FOR CONSTRUCTION UNTIL APPROVED AND SIGNED BY GOVERNING AGENCIES.
- ALL GRADING SHALL CONFORM TO SOILS REPORT RECOMMENDATIONS. DURING CONSTRUCTION, SURVEYORS AND CONTRACTORS MUST VERIFY THAT ALL STREETS AND LOTS HAVE POSITIVE DRAINAGE SAME MUST UTILIZE AT LEAST THREE GRADES ON VERTICAL TANGENTS TO VERIFY SLOPES.
- SOILS REPORT NOTE:
GRADING SHALL BE IN ACCORDANCE WITH SOILS REPORT PREPARED BY: SOUTHWEST GEOTECHNICAL
PROJECT NAME: ALL STORAGE - 9172 W CHEYENNE AVE
PROJECT NO.: 175430
DATE: JAN 15, 2018
- CUT/FILL ESTIMATES:
FROM EXISTING TO FINISH GRADE ELEVATIONS
CUT: 1,154 CY
FILL: 4,561 CY
NET: 3,407 CY
- FLOOR SECTION ASSUMES 5" SLAB OVER MIN. 4" TYPE II CONTRACTOR TO VERIFY WITH STRUCTURAL PLANS AND GEOTECHNICAL ENGINEER.

DRAINAGE CERTIFICATION

I CERTIFY THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE WITH THE CITY OF LAS VEGAS FOR THIS PROJECT. (DS)

LARRY M. BITTON 01059 P.E. NO. DATE



VICINITY MAP

HORROCKS ENGINEERS
1401 N. Green Valley Pkwy., Suite 160
Henderson, NV 89074
(702) 966-4063
www.horrocksb.com

WARNING
IF THIS BAR DOES NOT MEASURE 2" THEN DRAWING IS NOT TO SCALE

REV #	DATE	REVISIONS
1	04/09/2018	MDP
2		SS
3		LMB

DRAWING INFO: DATE: 04/09/2018, DESIGNED: MDP, DRAWN: SS, CHECKED: LMB, PROJECT: NV-1029-1801

PROFESSIONAL SEAL: LARRY M. BITTON, CIVIL ENGINEER, STATE OF NEVADA, EXP. 12-31-18, NO. 00183

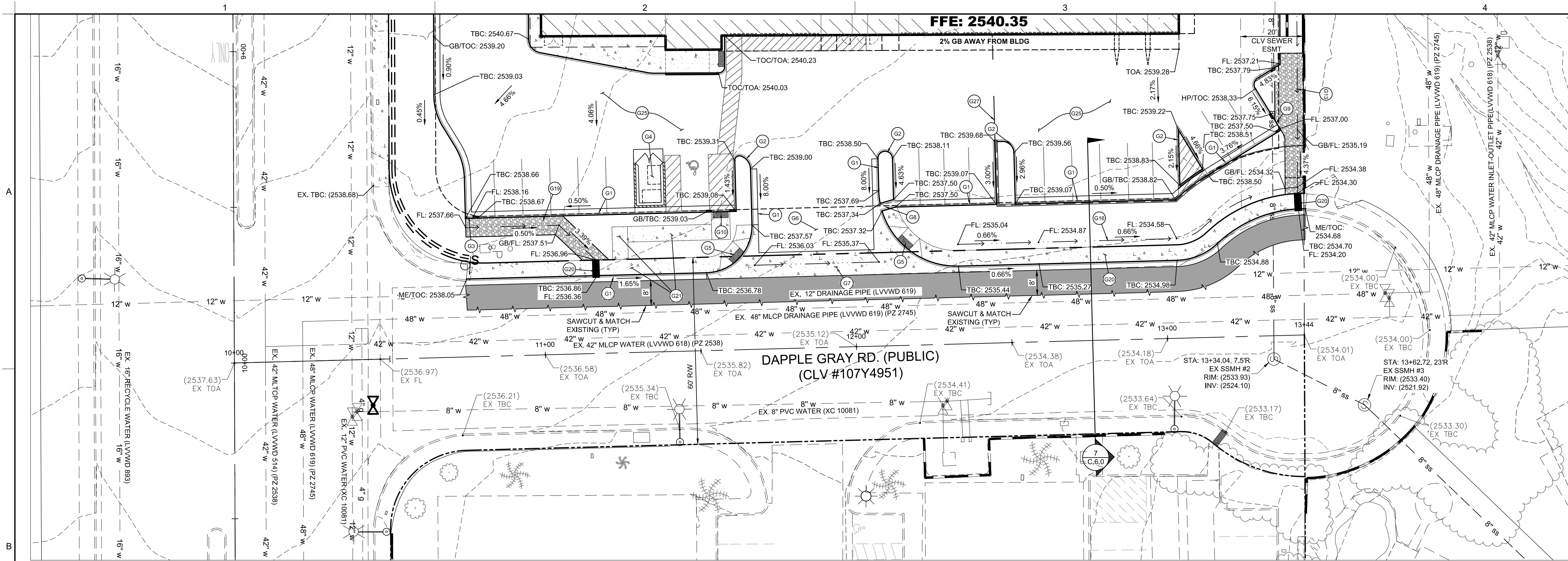
ALL-STORAGE
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LAS VEGAS, NEVADA

GRADING PLAN
138-08-401-013

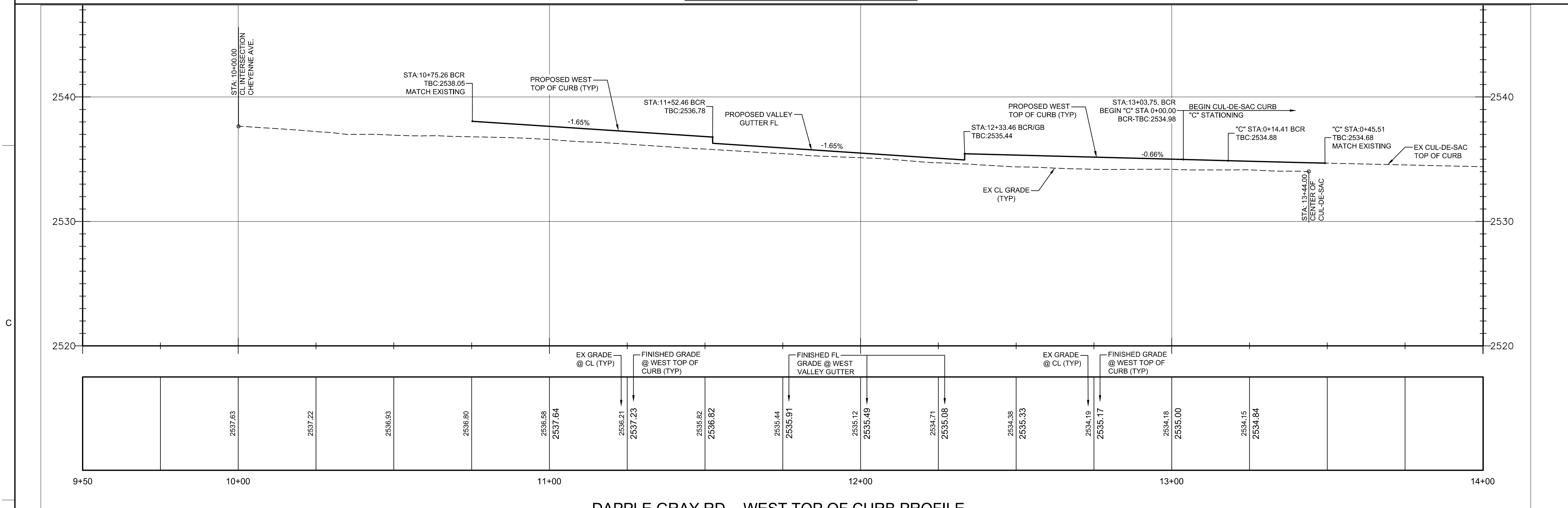
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Call before you dig
1-702-227-2929

FAST
Call before you dig
UnderGround
1-702-432-5300



DAPPLE GRAY RD. PLAN VIEW



DAPPLE GRAY RD. - WEST TOP OF CURB PROFILE

SCALE: 1" = 20' H
SCALE: 1" = 5' V

BENCHMARK:

RIVET AND PLATE IN TOPO OF CURB AT THE SOUTHEAST CORNER OF CHEYENNE AND FORT APACHE
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2555.02 FEET

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S89°45'25"W
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ON THE FINAL MAP OF CHEYENNE/CAMBELL PLAT BOOK 139 PAGE 19 OR.

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THIS SITE IS LOCATED IN A ZONE "X", AREAS OUTSIDE OF THE 0.2% ANNUAL CHANCE FLOODPLAIN. PER THE FLOOD INSURANCE RATE MAP COMMUNITY PANEL 32003C2135F. CLARK COUNTY, NEVADA DATED NOVEMBER 16, 2011.



0 20' 40'
SCALE: 1" = 20'

GRADING KEY NOTES:

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GRADING SHALL BE IN ACCORDANCE WITH SOILS REPORT PREPARED BY: SOUTHWEST GEOTECHNICAL
PROJECT NAME: ALL STORAGE - 9172 W CHEYENNE AVE
PROJECT NO.: 175430
DATE: JAN 15, 2018
- CUT/FILL ESTIMATES:
FROM EXISTING TO FINISH GRADE ELEVATIONS
CUT: 1,154 CY
FILL: 4,581 CY
NET: 3,497 CY
- FLOOR SECTION ASSUMES 5" SLAB OVER MIN. 4" TYPE II. CONTRACTOR TO VERIFY WITH STRUCTURAL PLANS AND GEOTECHNICAL ENGINEER.

DRAINAGE CERTIFICATION

I CERTIFY THIS GRADING PLAN IS IN CONFORMANCE WITH THE APPROVED DRAINAGE STUDY ON FILE WITH THE CITY OF LAS VEGAS FOR THIS PROJECT. (DS 4906B)

LARRY M. BITTON 01059
P.E. NO. DATE

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ENGINEERS

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Henderson, NV 89074

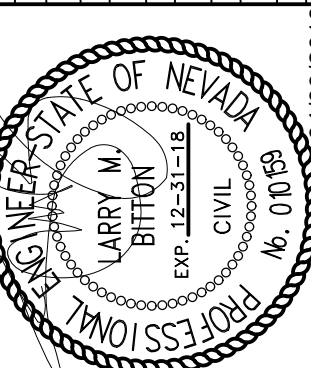
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WARNING

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REVISIONS

DRAWING INFO



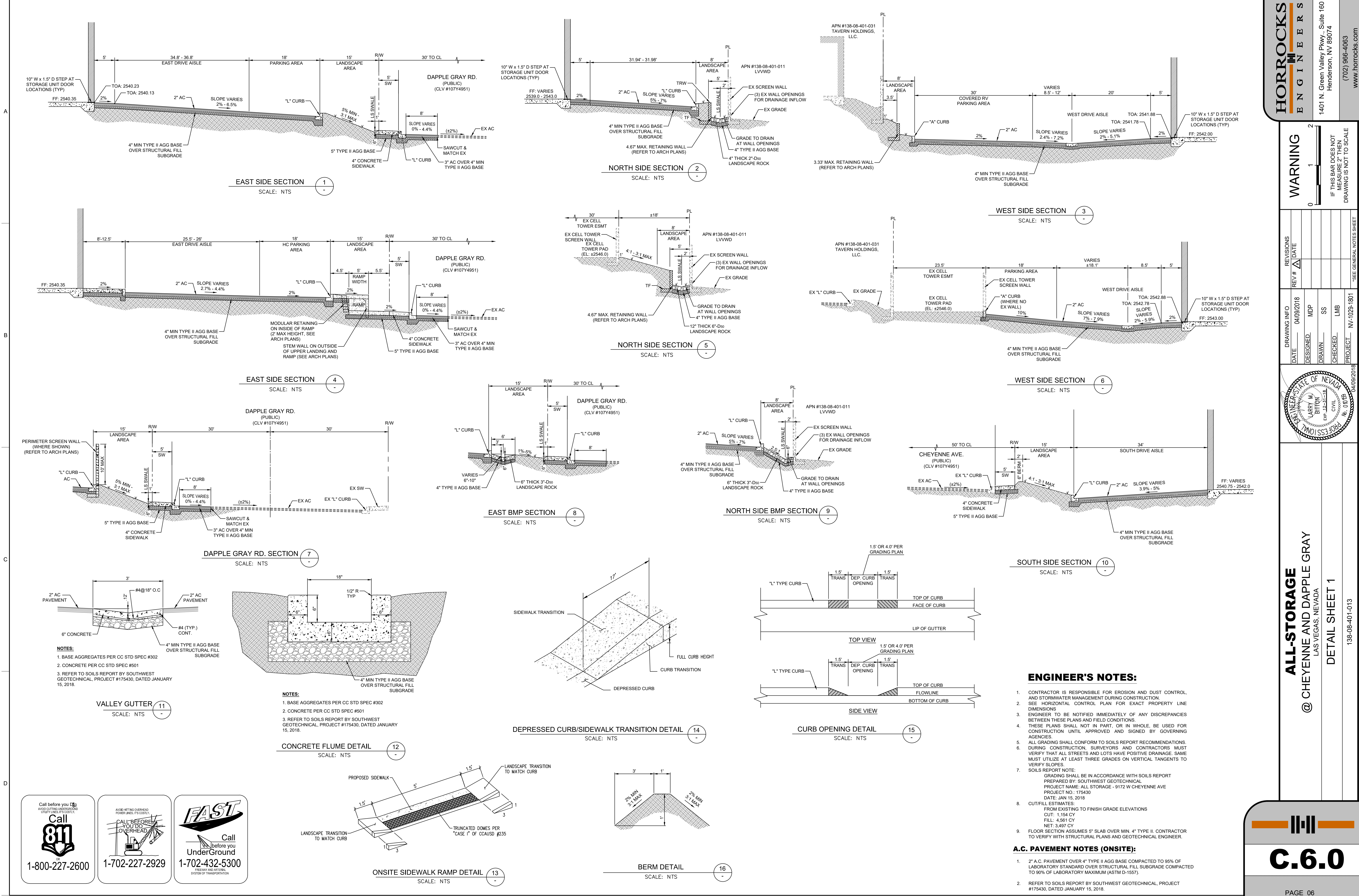
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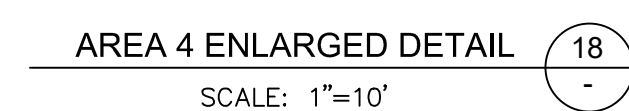
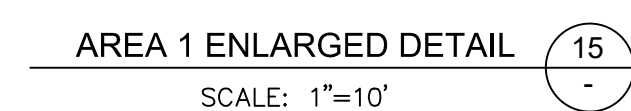
@ CHEYENNE AND DAPPLE GRAY
LAS VEGAS, NEVADA

DAPPLE GRAY PLAN AND PROFILE

138-08-401-013

C.5.0





1. CONTRACTOR IS RESPONSIBLE FOR EROSION AND DUST CONTROL, AND STORMWATER MANAGEMENT DURING CONSTRUCTION.
2. SEE HORIZONTAL CONTROL PLAN FOR EXACT PROPERTY LINE DIMENSIONS.
3. ENGINEER TO BE NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES BETWEEN THESE PLANS AND FIELD CONDITIONS.
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 - PROJECT NAME: ALL STORAGE - 9172 W CHEYENNE AVE
 - PROJECT NO. 175430
 - DATE: JAN 15, 2018
7. CUT/FILL ESTIMATES:
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 - CUT: 1,154 CY
 - FILL: 4,561 CY
 - NET: 3,407 CY
8. FLOOR SECTION ASSUMES 5" SLAB OVER MIN. 4" TYPE II CONTRACTOR TO VERIFY WITH STRUCTURAL PLANS AND GEOTECHNICAL ENGINEER.

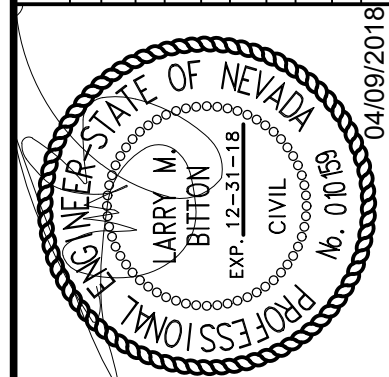
1. 2" A.C. PAVEMENT OVER 4" TYPE II AGG BASE COMPACTED TO 95% OF LABORATORY STANDARD OVER STRUCTURAL FILL SUBGRADE COMPACTED TO 90% OF LABORATORY MAXIMUM (ASTM D-1557).
2. REFER TO SOILS REPORT BY SOUTHWEST GEOTECHNICAL, PROJECT #175430, DATED JANUARY 15, 2018.

WARNING

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DRAWING INFO		REV #	REVISIONS
DATE	04/09/2018		DATE
DESIGNED	MDP		
DRAWN	SS		
CHECKED	LMB		
PROJECT	NV-1029-1801		

*SEE GENERAL NOTES SHEET



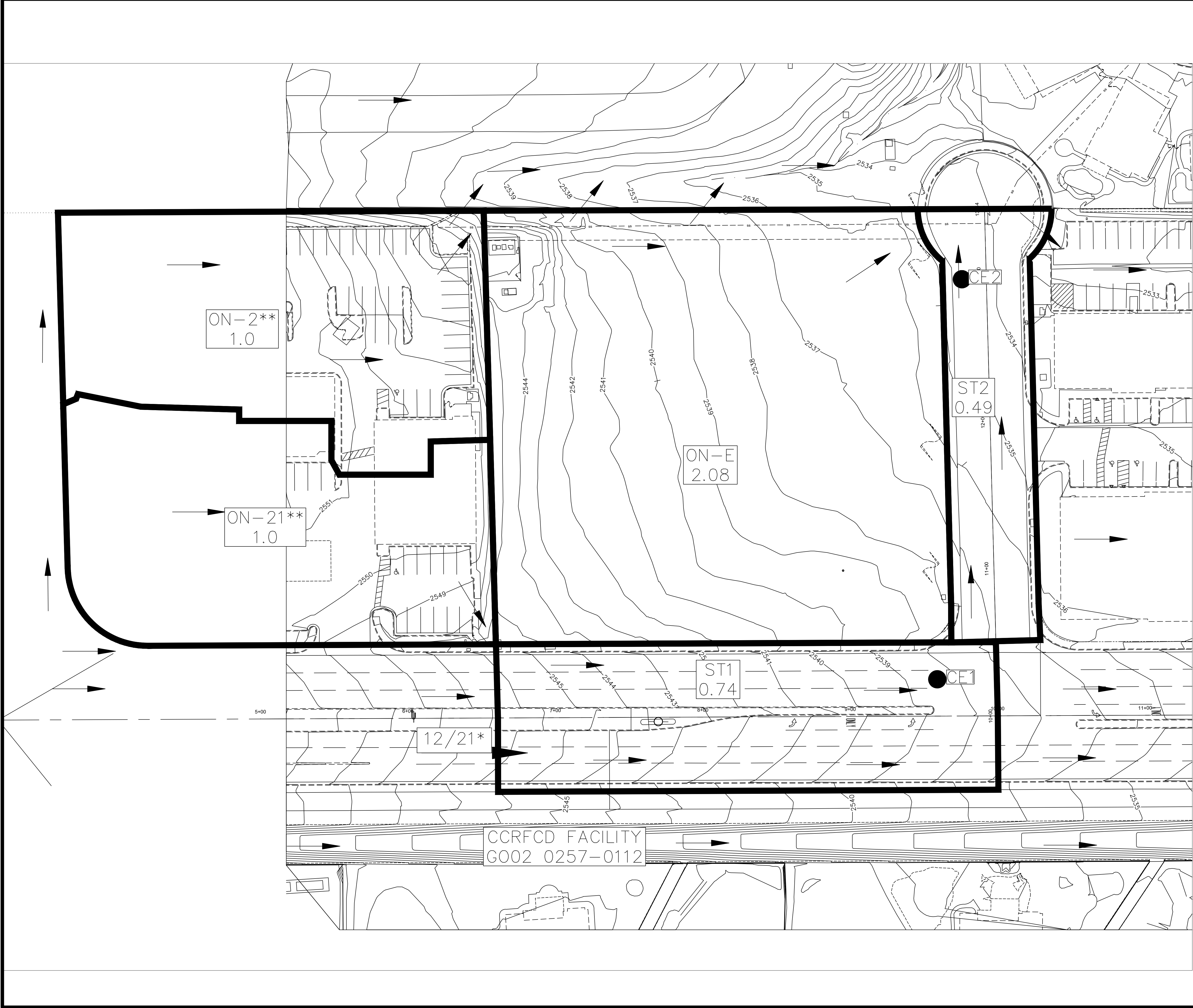
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DETAIL SHEET 2

138-08-401-013



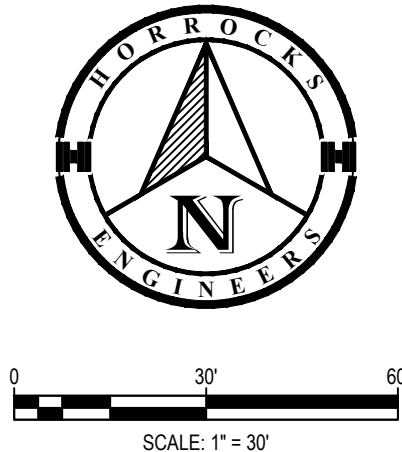
C.6.1



Existing Condition			
Basin	Area (acres)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
CE1	-	14	25
CE2	-	1	3
CHEY*	7.0	12	21
ON-1**	1.0	1	3
ON-2**	1.0	1	3
ON-E	2.1	0	1
ST1	0.7	2	3
ST2	0.5	1	2

*HEC-1 parameters taken from referenced rational method calculations and referenced figures.
**Basins referenced from the 7-11 Study

* BASIN PARAMETERS REFERENCED FROM THE CHEYENNE/CAMPBELL STUDY. DS# 3971
** REFERENCED FROM THE 7-11 CHEYENNE STUDY. HTE: 98-8063



KEY:

- ST1 0.74 BASIN NAME/AREA
- OND2 0.49 PRORATE BASIN NAME/AREA
- CE1 CONCENTRATION POINT
- Flow arrow FLOW DIRECTION
- Cross section symbol CROSS SECTION
- Solid line BASIN BOUNDARY
- Dashed line PRORATE BASIN BOUNDARY

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WARNING

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DRAWING INFO		REVISIONS	
DATE	03/27/2018	REV #	DATE
DESIGNED			
DRAWN			
CHECKED			
PROJECT	NV-1029-1801	*SEE GENERAL NOTES SHEET	

PRELIMINARY

NOT FOR CONSTRUCTION

ALL-STORAGE

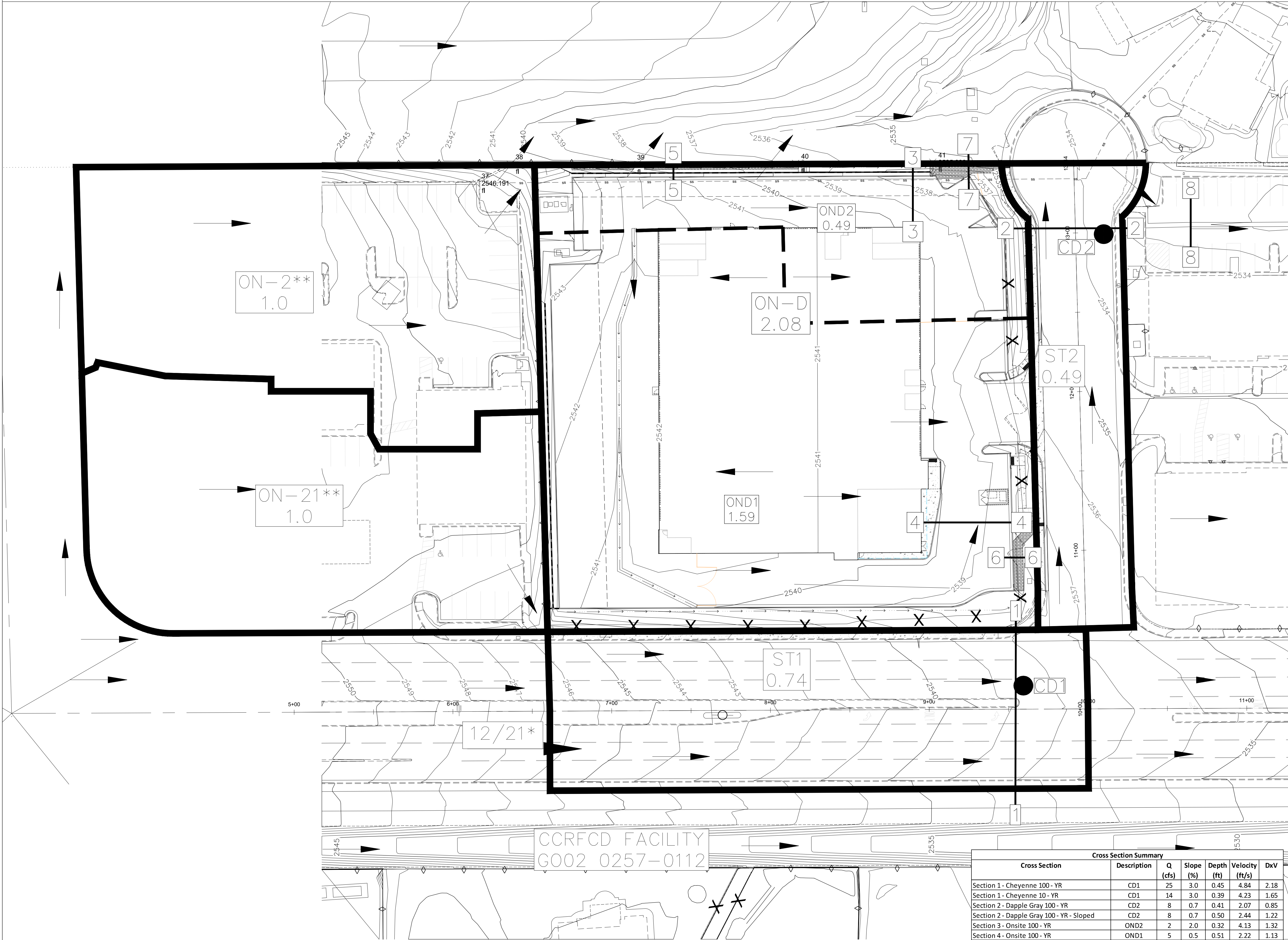
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EXISTING CONDITIONS BASIN MAP

138-08-401-013

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PAGE #



Cross Section Summary						
Cross Section	Description	Q (cfs)	Slope (%)	Depth (ft)	Velocity (ft/s)	DxV
Section 1 - Cheyenne 100 - YR	CD1	25	3.0	0.45	4.84	2.18
Section 1 - Cheyenne 10 - YR	CD1	14	3.0	0.39	4.23	1.65
Section 2 - Dapple Gray 100 - YR	CD2	8	0.7	0.41	2.07	0.85
Section 2 - Dapple Gray 100 - YR - Sloped	CD2	8	0.7	0.50	2.44	1.22
Section 3 - Onsite 100 - YR	OND2	2	2.0	0.32	4.13	1.32
Section 4 - Onsite 100 - YR	OND1	5	0.5	0.51	2.22	1.13
Section 5 - EASEMENT - 100 - YR - Max Slope	ON-2**	3	7.3	0.45	4.15	1.87
Section 5 - EASEMENT - 100 - YR - Min Slope	ON-2**	3	1.6	0.56	2.76	1.55
Section 6 - BMP SWALE - 100 - YR - Max Slope	OND1	4.59	3.4	0.55	3.79	2.08
Section 6 - BMP SWALE - 100 - YR - Min Slope	OND1	4.59	0.5	0.78	1.88	1.47
Section 7 - BMP SWALE - 100 - YR - Max Slope	OND2	1.41	4.4	0.34	3.11	1.06
Section 7 - BMP SWALE - 100 - YR - Min Slope	OND2	1.41	1.1	0.44	1.85	0.81
Section 8 - DOWNSTREAM ESMINT - 100 - YR	CD2 + 6/12***	20	2.5	0.30	4.72	1.42

**Referenced from the 7-11 Study HTE: 98-8063
***6/12 cfs is referenced from basin N from the Cheyenne/Campbell Study. DS4106

Developed Condition			
Basin	Area (acres)	Q ₁₀ (cfs)	Q ₁₀₀ (cfs)
CD1	-	14	25
CD2	-	4	8
CHEY*	7.0	12	21
ON-1**	1.0	1	3
ON-2**	1.0	1	3
ON-D	2.1	2	6
ST1	0.7	2	3
ST2	0.5	1	2

*HEC-1 parameters taken from referenced rational method calculations and referenced figures.
**Basins referenced from the 7-11 Study

Prorate Calculations			
Basin	Area (acres)	Q ₁₀₀ (cfs)	CFS/AC
ON-D	2.08	6	2.88
OND1	1.59	4.59	2.88
OND2	0.49	1.41	2.88
Parking	2.08	6.00	N/A



0 30' 60'
SCALE: 1" = 30'

* BASIN PARAMETERS REFERENCED FROM THE CHEYENNE/CAMPBELL STUDY. DS# 3971
** REFERENCED FROM THE 7-11 CHEYENNE STUDY. HTE: 98-8063

KEY:

ST1
0.74

BASIN NAME/AREA

OND2
0.49

PRORATE BASIN
NAME/AREA

CE1

CONCENTRATION POINT

Flow direction arrow

FLOW DIRECTION

4-4

CROSS SECTION

Thick solid line

BASIN BOUNDARY

Dashed line

PRORATE BASIN
BOUNDARY

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WARNING

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REVISIONS

REV #

DATE

DESIGNED

DRAWN

CHECKED

PROJECT

NV-1029-1801

*SEE GENERAL NOTES SHEET

PRELIMINARY
NOT FOR
CONSTRUCTION

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DEVELOPED CONDITIONS BASIN MAP

138-08-401-013



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PAGE #