

McCAY ENGINEERING

11700 W. CHARLESTON BLVD., SUITE 170-298
LAS VEGAS, NV 89135
702-860-3897

TECHNICAL DRAINAGE STUDY FOR WOW CARWASH @ DURANGO & ECHELON PT.

LAS VEGAS
January 2021



McCAY ENGINEERING

PREPARED FOR:

MDM Properties, LLC.
P.O. Box 8077
Fremont, California 94537

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: WOW Carwash @ Durango & Echelon Pt. Date: 1/4/2021

Location of Development: a) Descriptive (Cross Streets) North/South: N Durango Drive
East/West: Echelon Point Drive

b) Section: 20 Township: T19S Range: R60E

c) APN: 125-20-301-019

Name of Owner: MDM Properties, LLC

Telephone No.: 602-653-5004 Fax No.: NA E-Mail Address: NA

Address: PO Box 8077 Fremont, CA 94537

Contact Person-Name: Jeremy S. McCay, P.E. Telephone No.: 702-860-3897

* E-Mail Address: jmccay@centurylink.net Fax No.: NA

Firm: McCay Engineering

Address: 11700 W. Charleston Blvd., Suite 170-298, Las Vegas, NV 89135

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: +/- 3.34 Acres Being Developed/Disturbed: +/- 3.34 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: N/A

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: _____
The site is discharged to Durango Drive.

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: WOW Carwash @ Durango & Echelon Point	Map ID:
Firm Name: McCay Engineering	Engineer: Jeremy S. McCay, P.E.
Address: 11700 W. Charleston Blvd., Suite 170-298	
City: Las Vegas	State: NV Zip: 89135
Phone Number: 702-860-3897	Fax Number: NA
Property Owner: MDM Properties, LLC	
Address: PO Box 8077	
City: Fremont	State: CA Zip: 94537
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 (CCRFCDD) 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 property evaluate the intended land use.

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

I. GENERAL REQUIREMENTS

YES NO

- ☒ ☐ Design Manual **Standard Form 1** with the engineer's seal and signature.
- ☒ ☐ Design Manual **Standard Form 4**.
- ☒ ☐ 2 copies of the 24" x 36" Drainage Plan.
- N/A** ☐ A notarized letter from the adjacent property owner (s) allowing off-site grading or discharge.

II. MAPS AND EXHIBITS

YES NO

- ☒ ☐ A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated
- ☒ ☐ A copy of the current CCRFCDD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

YES NO

- | | | |
|-------------------------------------|--------------------------|--|
| ☒ | ☐ | Off-site drainage basin maps for existing, interim and future conditions showing the existing topography, basin boundaries, concentration points, and flows in cfs. |
| ☒ | ☐ | On-site drainage basin maps for existing interim and future conditions showing the existing topography, basin boundaries, concentration points, and on-site and off-site flows in cfs. |
| ☒ | ☐ | Vicinity Map with local and major cross streets identified and a north arrow. |

III. DRAINAGE PLAN

YES NO

- | | | |
|-------------------------------------|--------------------------|--|
| ☒ | ☐ | Sheet size 24"x36" sealed by a registered engineer in the State of Nevada. |
| ☒ | ☐ | Minimum scale: 1"=60'. |
| ☒ | ☐ | Project name. |
| ☒ | ☐ | Vicinity Map with local and major cross streets |
| ☒ | ☐ | Revision box. |
| ☒ | ☐ | North arrow and bar scale. |
| ☒ | ☐ | Engineer's /consultant's address and phone number. |
| ☒ | ☐ | Elevation datum and benchmark. |
| ☒ | ☐ | Legend for symbols and abbreviations. |
| N/A | ☐ | Cut/fill scarps, where applicable. |
| ☒ | ☐ | Street names, grades, widths. |
| ☒ | ☐ | Proposed future and existing spot grades for top of curbs and street crown at lot lines, grade breaks, and along curb returns on both sides of the street. |
| ☒ | ☐ | Existing contours encompassing the site and 100 feet beyond with spot elevations for important locations, where appropriate. |
| ☒ | ☐ | Minimum finish floor elevations with top-of-curb elevations at upstream end of lot. |
| ☒ | ☐ | Proposed typical street sections. |

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

YES NO

- N/A** ☐ Streets with off-set crowns.
- ☒ ☐ Proposed contours or spot elevations in sufficient detail to exhibit intended drainage patterns and slopes.
- ☒ ☐ Property lines.
- ☒ ☐ Right-of-way lines and widths, existing and proposed.
- ☒ ☐ Existing improvements and their elevations.
- ☒ ☐ Delineation of proposed on-site drainage basins indicating area and 10-year and 100-year storm Peak flows at basin concentration points.
- ☒ ☐ Concentration points and drainage flow direction with Q_{100} and V_{100} and D_{100} in streets.
- ☒ ☐ Cumulative flows, velocity, and direction of flow at upstream and downstream ends of site for the 10-year and 100-year flows.
- ☒ ☐ Location and cross-section of street capacity calculations.
- N/A** ☐ Cross-sectional detail for channels, including cutoff wall locations.
- ☒ ☐ Existing and proposed drainage facilities, appurtenances, and connections (i.e., sidewalks, ditches, swales, storm drain systems, unimproved and improved channels, and culverts, etc.) stating size, materials, shape, and slope with plan and profile and HGL calculations.
- N/A** ☐ Existing and proposed drainage easements and widths shown with sufficient detail. A cross sectional detail must be provided that shows appropriate lining and reinforcement.
- N/A** ☐ Location and detail of existing, proposed, and future block wall openings. Minimum size is 16"X48". Wrought iron gate is required for flows > 10 cfs.
- N/A** ☐ Location and detail of floodwalls illustrating depth of flow, proposed grouting height, etc.
- N/A** ☐ 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.
- ☒ ☐ Building and/or lot numbers.
- ☒ ☐ Alignment of all existing, proposed, or future Regional Facilities. Adjacent to the site.
- N/A** ☐ 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 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.
- ☒ ☐ 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 "dxv" 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.

N/A ☐ 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 requirements 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, which ever is greater.

A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones.

N/A ☐

- 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.

N/A ☐ Provide a 50 percent clogging factor in the capacity calculation for drop inlets.

N/A ☐ Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public right-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



CITY OF LAS VEGAS

MINIMUM DRAINAGE STUDY CRITERIA STANDARD FORM 2 CHECKLIST SUPPLEMENT

(Revised 5/18/11)

The following checklist is intended as a supplemental guide for the engineer preparing a Technical Drainage Study submittal to the City of Las Vegas. This supplement focuses on requirements specific to the City of Las Vegas. The requirements presented are in addition to the Clark County Regional Flood Control District (CCRFCDD) Manual Standard Form 2. The listed items are the minimum information required prior to the City performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the CCRFCDD Hydrologic Criteria and Drainage Design Manual (Design Manual).

An appointment must be made to preview this checklist in conjunction with CCRFCDD Standard Form 2 prior to the City accepting a new drainage study for review. The engineer must contact the Flood Control Section at (702) 229-6541 to schedule a submittal appointment.

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

I. GENERAL REQUIREMENT		
Yes	No	
	X	A notarized letter from the adjacent property owner(s) allowing off-site grading. (A copy of the letter must be received prior to final acceptance of the drainage study.)
X		Copies of all conditions of approval for development related to this property. (e.g. zoning, use permit, tentative map, etc.) Verify compliance with conditions.
X		An electronic copy of the complete submittal is required to be submitted with one original hard copy of the study. Electronic documents should be on a universal computer-readable digital output device replicating your submittal. An Indexed Portable Document Format (PDF) or Print Ready CAD file formats with a minimum of 300dpi are the desired formats. If figures are in color, they must be scanned in color and saved as a separate file. _____ by initial here, the engineer on record acknowledges that the electronic copy is an identical replicate of the original hard copy submitted to the City of Las Vegas.

II. GRADING PLAN INFORMATION		
Yes	No	
X		(1) 24" X 36" copy of the Grading Plan, (including all Detail Sheets) sealed by the engineer.
X		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. Note: Proposed top of curb elevations must be provided for both sides of roadways even if only half street construction is required.
X		Label existing topography at a minimum 5 foot elevation interval including adjacent developments, finished floor elevations of existing buildings and top of existing curbs extending 100 feet around the perimeter of the site. (*Measured from the centerline of the adjacent roadway.)

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

II. GRADING PLAN INFORMATION		
Yes	No	
	X	Proposed on-site and off-site storm drains and other flood control facilities with plan and profile sheets for public storm drains showing the class of pipe, (Class III, IV, V, etc.), design hydraulic grade line, (HGL) and 100 year storm flow. A public drainage easement must be provided over on-site storm drains conveying off-site flows. An overflow path must be provided over all storm drains.
X		All existing and "to be constructed" walls with cross-sections showing wall type, (e.g. block wall, retaining wall, flood wall, etc.), with limits clearly defined, adjacent ground elevations. Wall heights must meet current ordinances and in no case exceed 14 feet above the adjacent property.
X		Street slopes for both interior and perimeter streets. Note: The minimum slope for a roadway is 0.4 percent, a minimum 18-inch storm drain must be provided where minimum slopes cannot be met.
NA		Back of lot elevations and lot drainage pattern for all lots including common lots.
	X	Sites with a grade difference two feet above or below existing ground are required to have approval from City of Las Vegas Current Planning. Current Planning approval is required prior to final approval of the drainage study.
X		On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners. (The project must pass flows through the site every 600 feet where the project is blocking flow paths.)
NA		This project uses a solid grouted stem wall (or approved alternate) at the back of sidewalk to provide erosion protection for landscaped areas where the depth of flow in the roadway exceeds the back of walk elevation. A corresponding cross-section detail is included.
X		Commercial and Common Lot Landscape areas are not allowed to drain over the sidewalk. The grading plans show flow lines with grades and sidewalk under drains for all landscape areas draining to the public ROW.

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
X		Concrete valley gutters are required in parking lots with slopes less than 1 percent. Slopes through cul-de-sac must be at a 1 percent minimum where flow is drained through the cul-de-sac.
NA		Ten-foot wide public drainage easements to be privately maintained are allowed for flow less than 20 cfs. The depth of flow entering the easement must be checked using the submerged weir calculation.
NA		The limits of the flood zones and the base flood elevations (BFE) must be shown on all grading plans for all developments within a Special Flood Hazard Zone A, AO, AE, etc.
X		Minimum finish floor elevation is 6 inches above highest adjacent top of curb. Finish floor calculations must include allowances for super elevations on curves and velocity head for tee intersections.
NA		Finished floor elevations for buildings adjacent to public drainage easements must be a minimum of 18 inches above the Q100 weir of submerged weir elevation, whichever is greater.

CITY OF LAS VEGAS MINIMUM DRAINAGE STUDY CRITERIA CHECKLIST

III. Local Entity Criteria - City of Las Vegas – Manual Section 1600		
Yes	No	
NA		Lots with “B and C Type Drainage” that drain from one lot to another through a drainage easement shall be required to install an underground nuisance drainage system or a 2-foot valley gutter. 16” x 24” minimum block wall openings are required for both options.
NA		Bubblers are required across 80 foot and greater ROW streets. When flows exceed 10 cfs, bubblers larger than 18 inches will be required up to a maximum of 36”. Inlets must be sized to match the pipe size provided.

- Contact the Flood Control Section regarding the drainage study review fee. These fees are payable at the time of submittal.
- The Drainage Study must be conditionally approved prior to submitting improvement plans to the Civil and Planning Development of the Department of Building and Safety for review.

This document is intended as an **aid** in preparing Technical Drainage Studies for the City of Las Vegas. 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.



McCay ENGINEERING

11700 W. CHARLESTON BLVD.
SUITE #170-298
LAS VEGAS, NV 89135
JMcCay@CENTURYLINK.NET
(702) 860-3897

January 4, 2021

Albert Sung, P.E.
City of Las Vegas Flood Control
333 N. Rancho Drive
Las Vegas, Nevada 89106

**RE: TECHNICAL DRAINAGE STUDY FOR WOW CARWASH @ DURANGO & ECHELON PT.
Job No. 20349**

Mr. Sung:

McCay Engineering is pleased to submit two copies of the Technical Drainage Study and Grading Plan for your review and approval for the above-mentioned project. The proposed 3.34-acre commercial development is located on the west side of Durango Drive approximately 195 feet south of Deer Springs Way, in a portion of Las Vegas, Nevada.

If you have any questions or comments regarding this project, please do not hesitate to contact this office at (702) 860-3897.

Sincerely,
McCay Engineering

Jeremy S. McCay, P.E.
Principal

TABLE OF CONTENTS

I. INTRODUCTION	1
A. Study Overview and Purpose	1
B. Location	1
C. Existing Site Description	1
D. FEMA Flood Plain Information	1
E. CCRFCD Master Plan Information	1
F. Previous Drainage Studies	2
II. METHODOLOGY	2
A. Compliance with Regulations	2
B. Hydrologic Criteria	2
1. Rainfall Criteria	2
2. Runoff Computations	2
III. DRAINAGE BASIN DESCRIPTIONS	3
A. Existing Offsite Drainage Description	3
B. Existing Onsite Drainage Description	3
C. Future Offsite Drainage Description	4
D. Future Onsite Drainage Description	4
E. Facility Design Calculations	5
IV. CONCLUSIONS	5
V. REFERENCES	5

TABLES

Table 1	Drainage Basin Parameters	3
Table 2	Existing Runoff Amounts	4
Table 3	Future Runoff Amounts	4
Table 4	Offsite Street Flow Calculations	5

FIGURES

Figure 1	Vicinity Map
Figure 1A	Assessor's Parcel Map
Figure 2	Site Description Map
Figure 3	FIRM Map
Figure 4	2018 Master Plan Update Flood Control Facilities Map
Figure 5	2018 Master Plan Update Flood Control Facilities Inventory
Figure 6	2018 Master Plan Update Hydrologic Subareas, Land Use, and Soils
Figure 7	Existing Offsite Basin Map
Figure 8	Existing Onsite Basin Map
Figure 9	Future Offsite Basin Map
Figure 10	Future Onsite Basin Map

APPENDICES

Figures
Hydrologic Parameters
Existing HEC-1 Model
Future HEC-1 Model
Hydraulic Calculations
Excerpts from Technical Drainage Study for Goodwill at Durango & Deer Springs
Excerpts from Technical Drainage Study for Deer Springs-Durango Apartments
Project Plans

I. INTRODUCTION

A. Study Overview and Purpose

This study is intended to serve as the technical hydrology study for the proposed development. The site comprises of approximately 3.34 acres of proposed commercial development. This study is a stand-alone document that presents the findings of a hydrologic analysis of the site and contributing watershed area.

This report will identify any natural washes as well as any existing/proposed drainage facilities that contribute stormwater runoff to the site during a 100- and 10-year, 6-hour storm event. This study has been conducted in accordance with the criteria set forth by the Clark County Regional Flood Control District's (CCRFC) *Hydrologic Criteria and Drainage Design Manual* (Reference #1).

B. Location

The project area is within the Southwest Quarter (SW 1/4) of Section 20, Township 19 South, Range 60 East, Las Vegas, Nevada. The site is located on the west side of Durango Drive approximately 195 feet south of Deer Springs Way (APN 125-20-301-019). See Figures 1 and 1A, *Vicinity Map* and *APN Map*.

C. Existing Site Description

The project site is currently undeveloped desert shrub. The site consists of approximately 3.34 acres in poor hydrologic condition. The general area slopes to the east at approximately 1 percent. The properties adjacent to the site are generally a patchwork of residential developments and commercial properties. See Figure 2, *Site Description Map*.

D. FEMA Flood Plain Information

A review of the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) Community-Panel Number 32003C1745E, effective date September 27, 2002 (Reference #2), indicates the site is not located within a FEMA Zone 'X'. A Zone 'X' is described by FEMA as areas outside of the 0.2% annual chance floodplain. A map depicting the FEMA flood zones in the vicinity of the site is included in the appendix of this study (Figure 3- FIRM Map).

E. CCRFCD Master Plan Information

As shown on Figure F-11 from the *Flood Control Master Plan Update of the Las Vegas Valley* (see Figures 4 and 5 in the appendix), prepared by Atkins, et al. (Reference #3), the subject site is adjacent to existing Master Plan Flood Control Facility RCHB0175. This facility is a 14 foot wide, 7 foot deep concrete channel with 0:1 side slopes. Figure W-2A has also been provided (see Figure 6 in the appendix).

F. Previous Drainage Studies

For this project, basins from the TDS for Deer Springs Durango Apartments (PW#20-11678) and Goodwill at Durango & Deer Springs (DS#4704) were referenced. These referenced basins have not changed since their drainage study submittal. Reference material has been deemed acceptable and excerpts have been included in the appendix.

II. METHODOLOGY**A. Compliance with Regulations**

This study complies with the standards set forth within Reference #1 and City of Las Vegas drainage requirements.

B. Hydrologic Criteria**1. Rainfall Criteria**

The project site is located outside of the McCarran Airport Rainfall Area. The depth-duration-frequency values for the 6-hour, 10-year and 100-year storm events were obtained from Figures 503 and 506 of Reference #1. Since the site encompasses less than 8-square miles a Storm Distribution Number three (SDN #3) was used in the HEC-1 model. The precipitation values are outlined in Table 1.

2. Runoff Computations

The U. S. Army Corps of Engineers HEC-1 flood hydrograph package was used to determine the peak runoff generated during the 100- and 10-year, 6-hour storm event. The HEC-1 computer model simulates the surface runoff response of a given watershed to rainfall. The HEC-1 program represents the watershed as an interconnected system of hydraulic components. Each component represents an aspect of the rainfall runoff process within a portion of the watershed. The smaller portion is referred to as a sub-basin. The computed hydrographs from each sub-basin are then combined at appropriate locations to obtain the final discharge hydrograph. The HEC-1 parameter calculations are located in the appendix of this study.

The SCS curve number method was used to determine the infiltration rates for the drainage basins. The soil groups for the project site were determined using the SCS Soil Survey of the Las Vegas Valley. For a more conservative estimate, curve numbers for the onsite condition were determined using the Curve Number Matrix D5 from the master plan update. Curve numbers for the offsite condition were determined using Tables 602 (1 of 4) and 602 (4 of 4) for pavement and desert shrub, respectively. Soil information has been included in the appendix.

Basin areas for the offsite and onsite drainage basins were determined using a scaled plan.

Lag Time T_L is defined as the time measured from the centroid of effective rainfall to the peak of the outflow hydrograph. It is a measure of the watershed's response time, and is a coherent property to basin length, slope, roughness characteristics, and land use. The lag-times for this study were estimated by calculating the drainage basins' time of concentration, T_C . The time of concentration consists of two components; the initial overland flow time, t_i , and the gutter or

channel flow time, t_t . The equation for the time of concentration is $T_C = t_i + t_t$. The equation for lag time is $T_L = 0.6T_C$.

Precipitation in the Las Vegas Valley is characterized typically by long-duration, low-intensity winter storms and by short-duration, high-intensity summer storms. The winter storms, in general, do not produce major flooding events. The summer storms however can and do produce major flash flooding hazards in the Las Vegas Valley Area.

**TABLE 1
DRAINAGE BASIN PARAMETERS**

BASIN	AREA (acres)	CN	POINT PRECIP. (10 yr/100 yr)	DARF (10 yr/100 yr)	LAG (hr)
EXOF1	0.54	80.5	1.61/2.86	0.56/1.00	0.050
EXOF2	0.64	98.0	1.61/2.86	0.56/1.00	0.050
FUTOF1	0.54	98.0	1.61/2.86	0.56/1.00	0.050
FUTOF2	0.64	98.0	1.61/2.86	0.56/1.00	0.050
EXON1	3.12	63.0	1.61/2.86	0.56/1.00	0.054
FUTON1	3.12	92.0	1.61/2.86	0.56/1.00	0.100

III. DRAINAGE BASIN DESCRIPTIONS

A. Existing Offsite Drainage Description

The existing offsite basins impacting the site were referenced from PW#20-11678 and DS#4704 and were determined from existing contours. Basin EXOF1 conveys flows east and discharges into Durango Drive. Basin EXOF2 conveys flows south into existing drop inlets along Durango Drive. Offsite flows impacting the site are shown on the basin map included in the appendix (Figure 7).

B. Existing Onsite Drainage Description

The existing onsite basins were derived from existing contours. Basin EXON1 conveys flows east and discharges onto Durango Drive (EXOF2). Onsite flows are shown in Figure 8 in the appendix. Table 2 shows a summary of the runoff amounts determined in the existing condition:

TABLE 2
10-YEAR / 100-YEAR, 6-HOUR STORM EVENT
EXISTING RUNOFF AMOUNTS

BASIN NAME/ CONCENTRATION POINT	AREA (acres)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	0.80	<1	1
DON2	0.22	<1	<1
DON3	0.76	<1	1
DDD	0.66	8**	19**
CP3	--	9	20
EXON1	3.12	<1	2
EXOF1	0.54	14*	38*
EXOF2	0.64	1	2
C01	--	24	62

NOTE: Total flow

*NOTE: Base Flow Referenced from PW#20-11678.

**NOTE: Base Flow Referenced from DS#4704

C. Future Offsite Drainage Description

The future offsite basins impacting the site are the same as in the existing condition. Reference flows remain the same in both future and existing conditions. Offsite flows impacting the site are shown on the map included in the appendix (Figure 9).

D. Future Onsite Drainage Description

The future onsite basins were determined from the proposed grading plan. Onsite basin FUTON1 is conveyed to Durango Drive. The delineation of the future onsite basin is shown on Figure 10 included in the appendix. Table 3 shows a summary of the runoff amounts determined in the future condition:

TABLE 3
10-YEAR / 100-YEAR, 6-HOUR STORM EVENT
FUTURE RUNOFF AMOUNTS

BASIN NAME/ CONCENTRATION POINT	AREA (acres)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	0.80	<1	1
DON2	0.22	<1	<1
DON3	0.76	<1	1
DDD	0.66	8**	19**
CP3	--	9	20
FUTON1	3.12	4	9
FUTOF1	0.54	15*	39*
FUTOF2	0.64	1	2
C01	--	29	70

NOTE: Total flow.

*NOTE: Referenced from PW#20-11678.

**NOTE: Referenced from DS#4704

E. Facility Design Calculations

Offsite street flow calculations for the 10-year and 100-year, 6-hour storm events are summarized in the following tables:

**TABLE 4
OFFSITE STREET FLOW CALCULATIONS**

STREET	Q_{10}/Q_{100} (cfs)	D_{10}/D_{100} (ft)	V_{10}/V_{100} (ft/s)	V x D
Echelon Point Drive (Section 1) FUTOF1	15/39	0.38/0.49	4.85/6.05	1.84/2.96
Durango Drive (Section 2) C01	29/70	0.76/0.99	2.94/3.73	2.23/3.70

The street calculations show that the *CCRFCD Hydrologic Criteria & Drainage Design Manual* velocity/depth products criteria are met in the future. The velocity/depth products are below 6 and 8 for the 10- and 100-year storms, respectively.

IV. CONCLUSIONS

The following recommendations are provided to facilitate safety, both public and private, for the proposed commercial development.

1. Elevate the onsite entrances to prevent offsite runoff from entering the site and to maintain conveyance of offsite flow.
2. Nuisance water shall be captured onsite so adjacent properties are not affected during construction.

V. REFERENCES

1. *CCRFCD Hydrologic Criteria and Drainage Design Manual*, WRC Engineering, 1999.
2. *Flood Insurance Rate Map, Community Panel Number 32003C1745E, Clark County, Nevada*, Federal Emergency Management Agency, effective September 27, 2002.
3. *2018 CCRFCD Flood Control Master Plan*, Atkins, et al., 2018.
4. *Technical Drainage Study for Deer Springs-Durango Apartments*, Impulse Engineering, 2020.
5. *Technical Drainage Study for Goodwill at Durango & Deer Springs*, Rietz Consulting, 2014.
6. *HEC-1 Flood Hydrograph Package Version 4.0*, U.S. Army Corps of Engineers Hydrologic Engineering Center, 1990.
7. *Soil Survey of Las Vegas Valley Area, Nevada, Part of Clark County*, Soil Conservation Service, 1985.
8. *FlowMaster User's Manual Version 8.0*, Haestad Methods, Inc., 2005.



Appendix A

Figures

NOTES

This map is for assessment use only and does NOT represent a survey.

No liability is assumed for the accuracy of the data delineated herein. Information on roads and other non-assessed parcels may be obtained from the Road Document Listing in the Assessor's Office.

This map is compiled from official records, including surveys and deeds, but only contains the information required for assessment. See the recorded documents for more detailed legal information.

USE THIS SCALE(FEET) WHEN MAP REDUCED FROM 11X17 ORIGINAL

0 100 200 400 600 800

ASSESSOR'S PARCELS - CLARK COUNTY, NV.

Briana Johnson - Assessor

MAP LEGEND

—	PARCEL BOUNDARY	□	CONDOMINIUM UNIT	001	ROAD PARCEL NUMBER
—	SUB BOUNDARY	□	AIR SPACE PCL	001	PARCEL NUMBER
—	PM/D BOUNDARY	□	RIGHT OF WAY PCL	1.00	ACREAGE
—	ROAD EASEMENT	□	SUB-SURFACE PCL	202	PARCEL SUB/SEQ NUMBER
—	MATCH / LEADER LINE			PB 24-45	PLAT RECORDING NUMBER
—	HISTORIC LOT LINE			5	BLOCK NUMBER
—	HISTORIC SUB BOUNDARY				LOT NUMBER
—	HISTORIC PM/D BOUNDARY			GLS	GOV. LOT NUMBER
—	SECTION LINE				

BOOK T19S R60E

98099	100	101
27126	125	124
96137	138	139

Scale: 1" = 200'

SEC. 20

6	5	4	3	2	1
7	8	9	10	11	12
13	14	15	16	17	18
19	20	21	22	23	24
25	26	27	28	29	30
31	32	33	34	35	36

Rev: 1/8/2019

MAP N 2 SW 4

8	4	8	4
5	1	5	1
6	2	6	2
7	3	7	3
8	4	8	4
5	1	5	1

125-20-3



FIGURE 1A



FIGURE 2
SITE DESCRIPTION MAP

JOB NUMBER: 20349

DRAWN BY: JSM

DATED: JAN-2021



MCCAY ENGINEERING

11700 W. CHARLESTON BLVD.

SUITE #170-298

LAS VEGAS, NEVADA 89135

P 702-860-3897

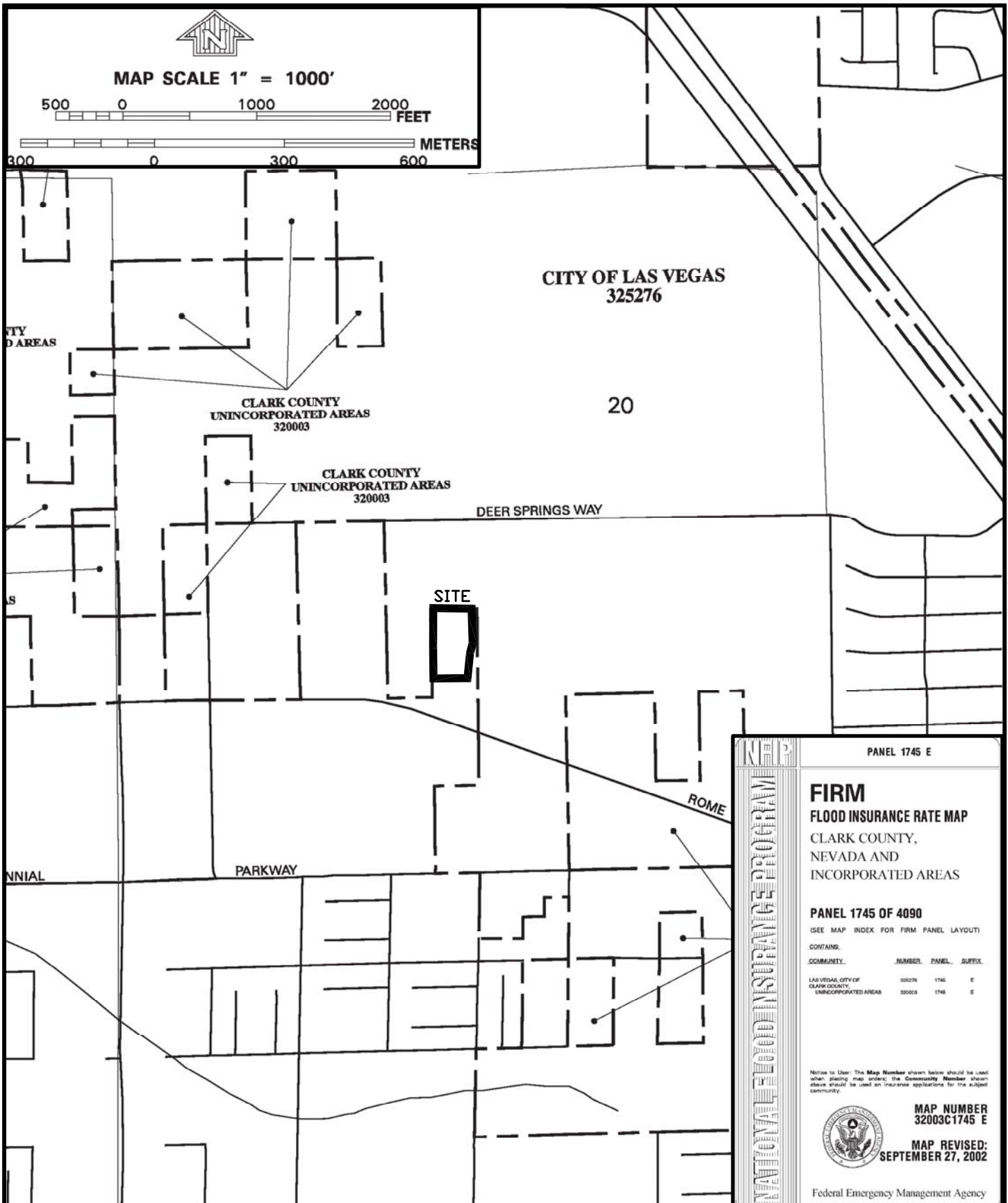


FIGURE 3

FIRM



McCay Engineering

11700 W. CHARLESTON BLVD.
SUITE #170-298
LAS VEGAS, NEVADA 89135
P 702-860-3897

JOB NUMBER: 20349

DRAWN BY: JSM

DATED: JAN-2021



FIGURE 4

ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
BCHU		BELTWAY CHANNEL - HUALAPAI						
0000	E	12' X 5' RCAP	853	206	DBA3-C	WEST3	0.84	1.11
0017	E	8' X 5' RCAP	1216	218	CBA3-C	WEST3	0.84	1.33
0040	E	66" RCP	60	57	DNW26-C	WEST3	0.51	1.04
0042	E	60" RCP	615	57	DNW26-C	WEST3	0.51	1.42
0054	E	54" RCP	615	57	DNW26-C	WEST3	0.51	1.23
BRDB		BRENT DRAINAGE SYSTEM						
0000	E	36" RCP WITH 18" ORIFICE PLATE	2170	36	BRDB	WEST3	2.37	0.40
0031	E	45,080 CFS PMF SPILLWAY		45080	CBRDB	WEST3	2.37	
0032	E	450 AC-FT SOUTH ENVIRONMENTAL ENHANCEMENT AREA		1685	CBRDB	WEST3	2.37	
0033	E	ENERGY DISSIPATOR	100	1052	CNW147W	WEST3	1.75	
0043	E	20' X 7' RCBC	135	1052	CNW147W	WEST3	1.75	0.50
0045	E	CONC CHNL 12W 7'D 2:1 SS	983	1052	CNW147W	WEST3	1.75	2.00
0058	E	12' X 6' RCB	1688	951	CNW113-C	WEST3	1.47	1.81
0107	P	8' X 6' RCB	2560	951	CNW113-C	WEST3	1.47	2.40
0157	P	12' X 7' RCB	2580	621	CNW96-C	WEST3	0.84	0.25
CN95		CENTENNIAL PKWY CHANNEL WEST / U.S 95 BRANCH						
0000	E	20' X 7' RCB	3335	2778	CNWBB3-C	WEST3	3.35	2.00
0068	E	20' X 7' RCB	2300	2725	CNW103-C	WEST3	3.04	2.10
0102	E	CONC CHNL 20W 9'D 0:1 SS	375	2548	2CNW89-C	WEST3	2.65	1.77
0104	E	2: 12' X 10' RCB	300	2548	2CNW89-C	WEST3	2.65	1.10
0167	E	16' X 8' RCB	3521	2548	2CNW89-C	WEST3	2.65	1.58
0199	E	15' X 9' RCB	407	1467	2CNW72-C	WEST3	1.13	0.41
0218	E	15' X 9' RCB	1227	1467	2CNW72-C	WEST3	1.13	0.82
0257	E	TRANSITION STRUCTURE	59	1467	2CNW72-C	WEST3	1.13	0.77
0259	E	15' X 9' RCB	284	599	CNW74-C	WEST3	0.40	0.77
0313	E	10' X 6' RCB	2680	599	CNW74-C	WEST3	0.40	2.50
0318	E	TRANSITION STRUCTURE	60	599	CNW74-C	WEST3	0.40	1.50
0333	E	5' X 5' RCB	670	259	NW62-S	WEST3	0.16	1.50
CNFR		CENTENNIAL PKWY CHANNEL WEST / FARM ROAD						
0000	P	8' X 6' RCB	8350	776	CNW89-C	WEST3	1.05	2.00
CNGT		CENTENNIAL PKWY CHANNEL WEST / GRAND TETON BRANCH						
0000	E	10' X 5' RCB	2376	543	CNW71-E	WEST3	0.47	2.58
0020	E	10' X 5' RCB	1570	543	CNW71-E	WEST3	0.47	3.50
0043	E	8' X 6' RCB	2470	543	CNW71-E	WEST3	0.47	3.60
0118	E	6' X 5' RCAP	5472	349	KYLEDET	KYLEDB	58.61	3.72
CNKC		CENTENNIAL PKWY CHANNEL WEST / KYLE CANYON BRANCH						
0000	E	12' X 4' RCB	377	954	CNW72-C	WEST3	0.74	4.58
0007	E	10' X 5' RCB	874	954	CNW72-C	WEST3	0.74	3.28
0024	E	8' X 5' RCB	1385	954	CNW72-C	WEST3	0.74	2.40
0050	E	72" RCP	2757	437	NW45-S	WEST3	0.31	3.60
CNWE		CENTENNIAL PKWY CHANNEL WEST						
0195	E	CONC CHNL 36W 9'D 0:1 SS	1130	3771	CNW3B3-C	WEST3	5.64	0.60
0200	E	CONC CHNL 36W 9'D 0:1 SS	1340	3523	CNW2D4-C	WEST3	5.14	1.00
0226	E	2: 18' X 8.5' RCBC @ RIO VISTA	100	3523	CNW2D4-C	WEST3	5.14	0.51
0241	E	CONC CHNL 36W 9.5'D 0:1 SS	405	3523	CNW2D4-C	WEST3	5.14	0.51
0251	E	CONC CHNL 36W 9'D 0:1 SS	575	3234	CNW2D3-C	WEST3	4.64	0.51
0271	E	CONC CHNL 32W 10'D 0:1 SS	229	3234	CNW2D3-C	WEST3	4.64	0.51
0274	E	32' X 10' RCBC @ TENAYA	142	3234	CNW2D3-C	WEST3	4.64	0.51
0277	E	CONC CHNL 32W 9'D 0:1 SS	579	3234	CNW2D3-C	WEST3	4.64	0.64
0287	E	CONC CHNL 32W 8'D 0:1 SS	865	2992	CNW2B2-C	WEST3	3.83	1.59
0301	E	2: 15' X 7' RCB	1738	2992	CNW2B2-C	WEST3	3.83	1.30
0304	E	22' X 7' RCB	3410	2992	CNW2B2-C	WEST3	3.83	1.85
0314	E	22' X 7' RCB	703	2822	CNWBD2-N	WEST3	3.45	1.94
EKBU		ELKHORN SPRINGS AND BUFFALO						
0000	E	60" RCP	1046	255	NW134-C	WEST3	0.46	0.89
EKDB		ELKHORN SPRINGS DETENTION BASIN						
0000	E	GRASS CHNL 15W 5.8'D 3.5:1 SS	2575	221	CNW150-C	WEST3	1.41	0.39
0025	E	4' X 3' RCB	160	106	ELKBASIN	WEST3	0.84	0.50
0026	E	48" RCP	1270	106	ELKBASIN	WEST3	0.84	1.23
0049	E	60" RCP	1095	106	ELKBASIN	WEST3	0.84	0.13
0070	E	48 AC-FT ELKHORN SPRINGS DETENTION BASIN		456	CNW133-C	WEST3	0.84	
EKHU		ELKHORN AND HUALAPAI						
0003	E	6' X 4' RCAP	980	393	CNW26-C	WEST3	0.51	3.61
0020	E	6' X 5' RCAP	150	393	CNW26-C	WEST3	0.51	3.61
0023	E	8' X 5' RCAP	1200	393	CNW26-C	WEST3	0.51	0.90
GOEC		GOWAN NORTH - EL CAPITAN BRANCH						
0176	P	78" RCP	1320	190	CCPFR-C	GOW3A	0.46	1.15
GONO		GOWAN NORTH SYSTEM						
0511	P	6' X 5' RCB	1320	326	CCPHW-C	GOW3A	0.60	1.14
LVMD		LAS VEGAS WASH - MIDDLE						
2507	E	2: 13' X 9' RCB	2831	1808	CNW168-C	CWEST3	4.43	0.36
2525	E	24' X 8' RCB	1140	1598	CNW159-C	CWEST3	3.92	0.40
2550	E	24' X 8' RCB	1445	1312	CD161-C	CWEST3	3.42	0.40
2574	E	24' X 8' RCB	1430	1312	CD161-C	CWEST3	3.42	0.41
2599	E	CONC CHNL 24W 7'D 2:1 SS	1577	1268	CNW162-C	CWEST3	3.10	0.51
2632	E	18' X 5' RCB	1443	695	CNW138-C	WEST3	1.16	0.47
2661	E	18' X 5' RCB	3003	695	CNW138-C	WEST3	1.16	0.78
2711	E	10' X 5' RCB	2440	560	CNW139-C	WEST3	0.93	2.00
2737	E	8' X 5' RCB	265	560	CNW139-C	WEST3	0.93	2.25
2763	E	6' X 5' RCB	1565	560	CNW139-C	WEST3	0.93	2.41
2789	E	6' X 5' RCB	910	560	CNW139-C	WEST3	0.93	2.00
MOHU		MOCCASIN-HUALAPAI BRANCH						
0000	P0	13' X 6' RCB	1476	924	2CNW33-C	LOWER3	2.08	1.80
0026	P0	11' X 6' RCB	1654	560	CNW45-N	LOWER3	1.25	0.50
0061	P0	9' X 6' RCB	779	560	CNW45-N	LOWER3	1.25	0.50
0076	P0	60" RCP	1000	263	CNW45-C	LOWER3	1.03	3.00
0095	P0	NATURAL WASH	865	263	CNW45-C	LOWER3	1.03	3.00
0111	P0	6' X 5' RCBC @ EGAN CREB DR	164	263	CNW45-C	LOWER3	1.03	6.10
0116	P0	NATURAL WASH	1900	263	CNW45-C	LOWER3	1.03	3.00
0151	P0	54" RCP @ SHAUMBER	438	72	MODB1	LOWER3	0.86	2.00
MOIR		MOCCASIN - IRON MOUNTAIN BRANCH						
0000	P0	60" RCP	1060	410	CNW33-C	LOWER3	0.83	4.50
0020	P0	54" RCP	1161	71	MODB2	LOWER3	0.56	3.20
0041	P0	42" RCP	1236	71	MODB2	LOWER3	0.56	5.00
0065	P0	60" RCP	1099	71	MODB2	LOWER3	0.56	0.40
MOKC		MOCCASIN AND KYLE CANYON						
0000	P0	9' X 6' RCB	6140	1072	CNW35-C	LOWER3	2.69	3.40
MOLC		MOCCASIN - LOG CABIN BRANCH						
0000	P0	20' X 10' RCB	2206	2265	2CNW64	LOWER3	6.06	0.65
0072	P0	12' X 8' RCB	4493	2265	2CNW64	LOWER3	6.06	2.66
0149	E	13' X 8' RCB	520	1817	CNW62-N	LOWER3	4.88	2.00
0157	P	13' X 8' RCB	288	1817	CNW62-N	LOWER3	4.88	1.40
0162	P0	13' X 6' RCB	435	1817	CNW62-N	LOWER3	4.88	1.80
MSNV		MOUNTAIN SPA/VISTA RANCH						
0000	E	6: 12' X 5' RCBC @ GRAND TETON	273	639	CNW163-C	CWEST3	1.69	0.40
0005	E	GRASS CHNL 100W 4.5'D 10:1 SS	6325	259	CNW155-C	WEST3	4.46	0.40
0125	E	GRASS CHNL 100W 4.5'D 10:1 SS	1300	66	CNW147E	WEST3	1.55	0.40
RACO		RACEL STREET COLLECTOR						
0000	E	14' X 7' RCB BAFFLED ENERGY DISSIPATOR	87	424	CNW111S	WEST3	0.55	0.29
0001	E	78" RCP	3245	424	CNW111S	WEST3	0.55	2.46
0064	E	78" RCP	2650	347	DNW111S	WEST3	0.44	2.09
RCBC		RANCHO ROAD SYSTEM - BELTWAY CHANNEL						
0000	E	6' X 5' RCB	1062	173	FADB	WEST3	1.54	1.04
0002	E	54" RCP OUTLET WITH 41" ORIFICE	503	173	FADB	WEST3	1.54	2.38
0003	E	2,341 CFS PMF SPILLWAY		2341	FADBIN	WEST3	1.54	
0004	E	76 AC-FT FORT APACHE DETENTION BASIN		658	FADBIN	WEST3	1.54	
0007	E	ENERGY DISSIPATOR	100	658	FADBIN	WEST3	1.54	
0009	E	12' X 6' RCBC @ FORT APACHE DETENTION BASIN	133	658	FADBIN	WEST3	1.54	1.79
0012	E	CONC CHNL 12W 6:7'D 0:1 SS	1937	658	FADBIN	WEST3	1.54	3.15
0048	E	12' X 6' RCBC @ GRAND CANYON	140	559	CMNA1	WEST3	1.27	3.15
0051	E	CONC CHNL 12W 6:8'D 0:1 SS	2660	559	CMNA1	WEST3	1.27	3.44
0096	E	1: 10' X 6' AND 1: 6' X 6' RCBC @ HUALAPAI WAY	190	559	CMNA1	WEST3	1.27	1.93
0100	E	CONC CHNL 12W 5.5'D 0:1 SS	2085	475	CDMNA1	WEST3	0.43	2.88
ID / Mile	Status	Facility Description	Length (ft.)	Flow (cfs)	HEC-1 Node	HEC-1 Model	Tributary Area (sq.mi.)	Channel Slope (%) **
RCBC		RANCHO ROAD SYSTEM - BELTWAY CHANNEL						
0140	E	CONC CHNL 10W 5'D 0:1 SS	2155	475	CDMNA1	WEST3	0.43	1.65
RCHB		RANCHO ROAD SYSTEM - BELTWAY						
0053	E	2: 12' X 8' RCBC @ SOUTH RAMP CONNECTOR	85	1465	CDW1C1-C	WEST3	3.55	1.40
0054	E	CONC CHNL 21W 8'D 0:1 SS	432	1465	CDW1C1-C	WEST3	3.55	1.51
0062	E	TRANSITION STRUCTURE	130	1465	CDW1C1-C	WEST3	3.55	1.51
0065	E	24' X 7' RCB	480	1465	CDW1C1-C	WEST3	3.55	0.30
0074	E	24' X 6' RCB	50	1414	CNWB6-C	WEST3	3.41	0.30
0075	E	20' X 6' RCBC @ BELTWAY	428	1414	CNWB6-C	WEST3	3.41	2.81
0083	P	20' X 4' RCB	950	1414	CNWB6-C	WEST3	3.41	2.49
0101	P	CONC CHNL 20W 5'D 0:1 SS	980	1414	CNWB6-C	WEST3	3.41	2.38
0120	E	20' X 6' RCBC @ GRAND MONTECITO	120	1414	CNWB6-C	WEST3	3.41	1.00
0122	P	CONC CHNL 16'-20W 6'D 0:1 SS	350	1414	CNWB6-C	WEST3	3.41	1.84
0130	P	CONC CHNL 16W 5.5'D 0:1 SS	1012	1414	CNWB6-C	WEST3	3.41	2.67
0149	P	CONC CHNL 16W 5-5.5'D 0:1 SS	87	1115	CNWB3-C	WEST3	2.99	2.27
0151	P	CONC CHNL 16W 5'D 0:1 SS	1255	1115	CNWB3-C	WEST3	2.99	2.65
0171	E	16' X 6' RCBC @ EL CAPITAN WAY	234	1115	CNWB3-C	WEST3	2.99	1.75
0175	E	CONC CHNL 14W 7'D 0:1 SS	1220	1115	CNWB3-C	WEST3	2.99	2.93
0198	E	CONC CHNL 14W 7'D 0:1 SS	225	788	CNWB6-C	WEST3	1.88	2.93
0227	E	12' X 6' RCB	995	788	CNWB6-C	WEST3	1.88	1.73
0250	E	12' X 6' RCB	4020	788	CNWB6-C	WEST3	1.88	1.12
0275	E	7' X 6' RCB	2650	535	CNW6-C	WEST3	1.04	3.30
0295	P	7' X 6' RCB	2980	431	CNW53-C	WEST3	0.80	3.60
TSDB		TULE SPRINGS DRAINAGE SYSTEM						
0000	E	2: 10' X 4' RCBC @ ECHO GRANDE	100	25	TULEDB	WEST3	1.37	1.04
0002	E	36" RCP WITH 22" ORIFICE PLATE	320	25	TULEDB	WEST3	1.37	0.33
0010	E	14,013 CFS PMF SPILLWAY		14013	CTULEDB	WEST3	1.37	
0011	E	117 AC-FT NORTH ENVIRONMENTAL ENHANCEMENT AREA		551	CTULEDB	WEST3	1.37	
0012	E	ENERGY DISSIPATOR	260	333	CNW148-C	WEST3</		

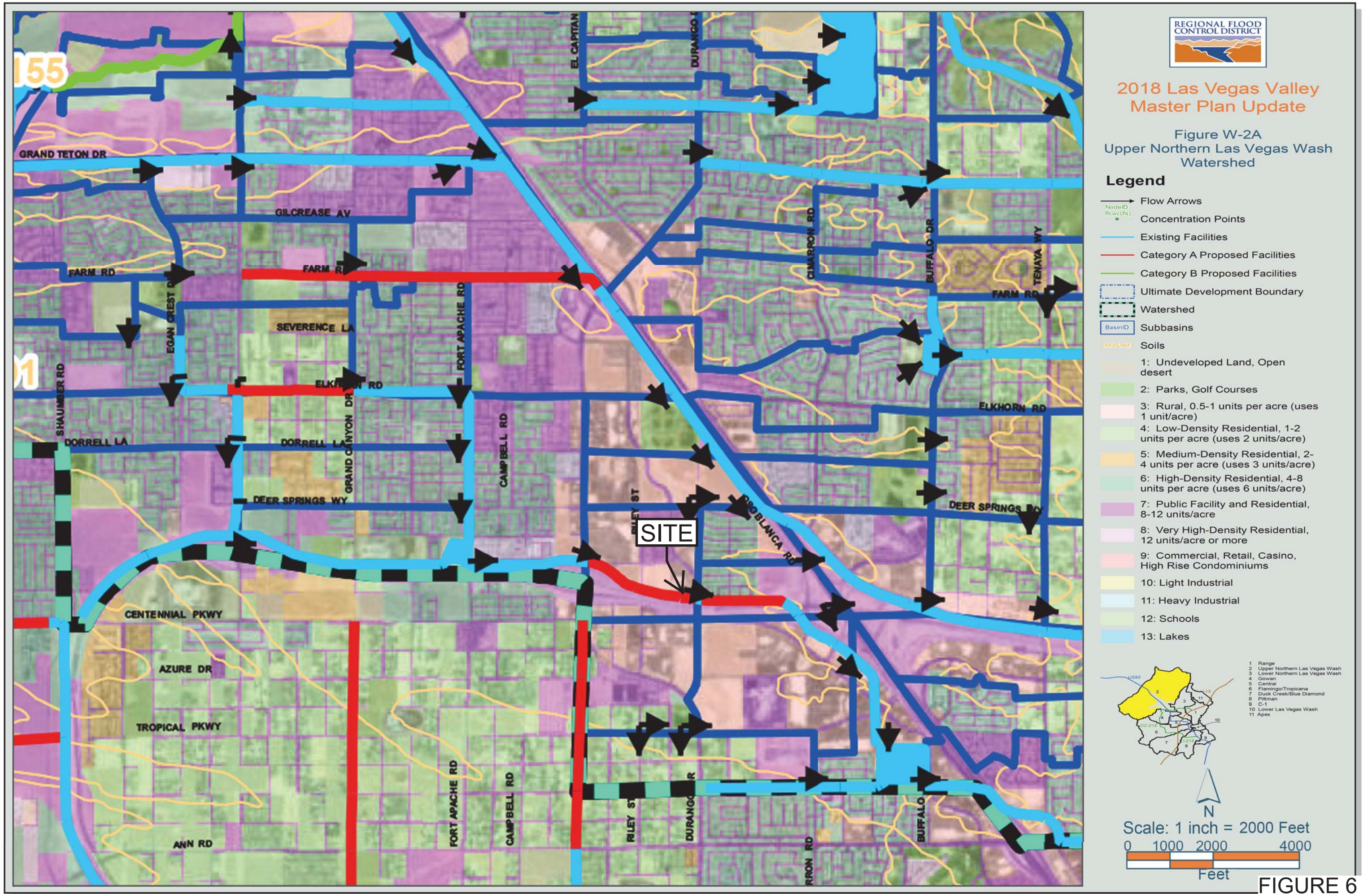
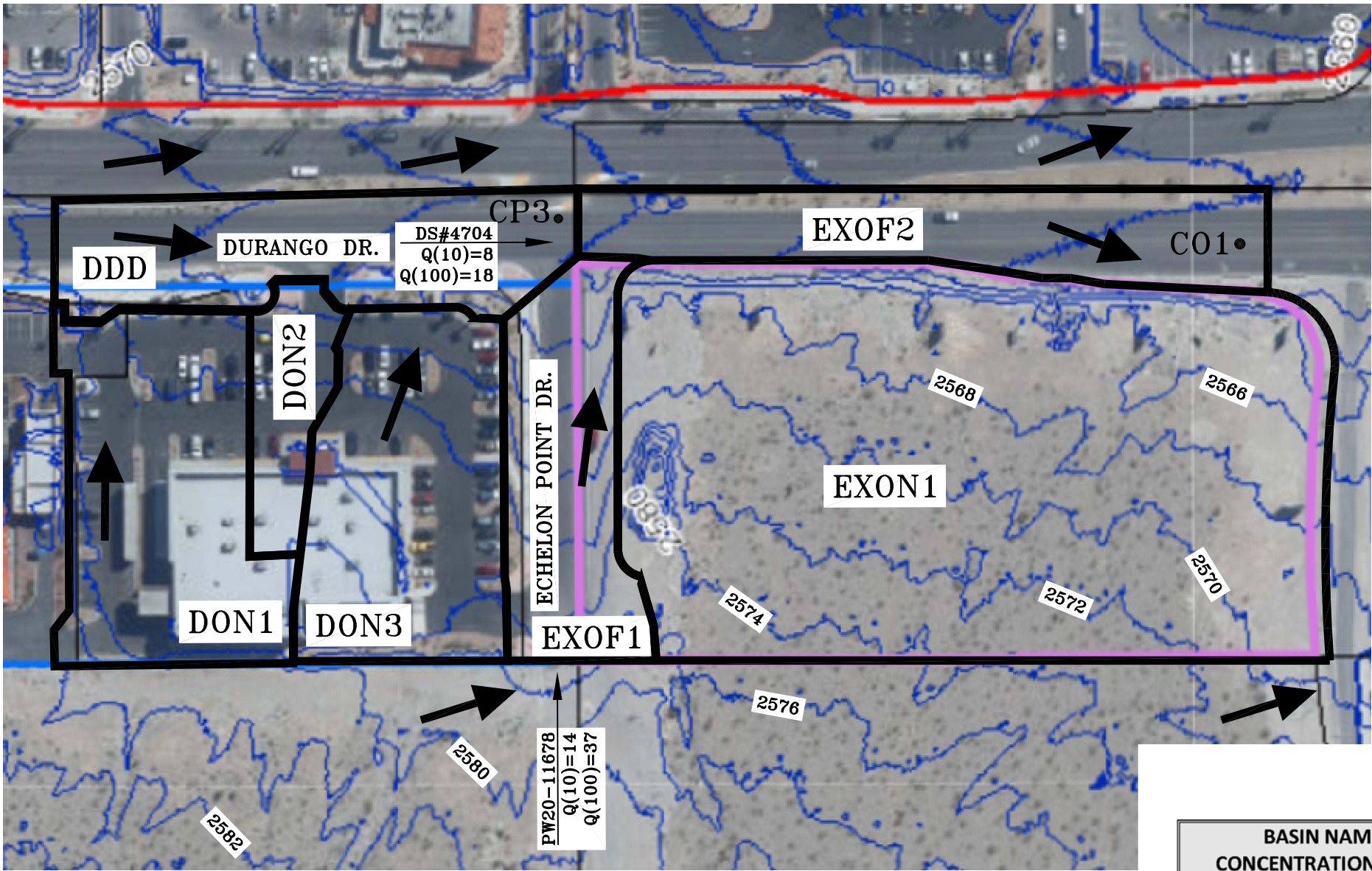
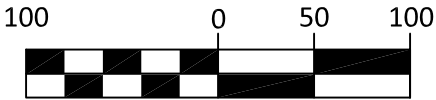


FIGURE 6



GRAPHIC SCALE



(IN FEET)
1 INCH = 100 FT.

LEGEND

- DEV1 BASIN NAME
● CONCENTRATION POINT
➔ FLOW DIRECTION
▬ BASIN BOUNDARY



10-YEAR / 100-YEAR, 6-HOUR STORM EVENT
EXISTING RUNOFF AMOUNTS

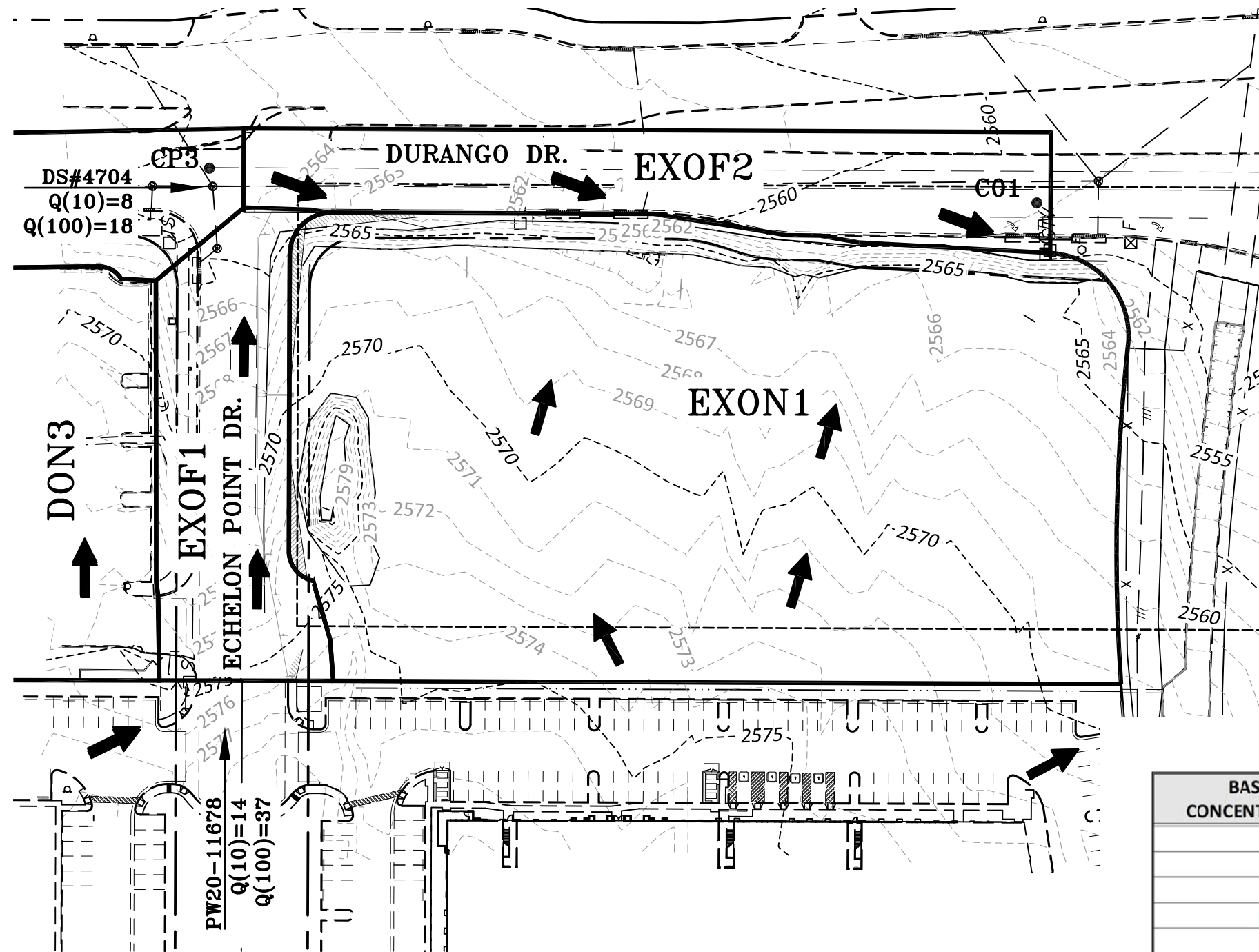
BASIN NAME/ CONCENTRATION POINT	AREA (acres)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	0.80	<1	1
DON2	0.22	<1	<1
DON3	0.76	<1	1
DDD	0.66	8**	19**
CP3	--	9	20
EXON1	3.12	<1	2
EXOF1	0.54	14*	38*
EXOF2	0.64	1	2
C01	--	24	62

NOTE: Total flow
*NOTE: Base Flow Referenced from PW#20-11678.
**NOTE: Base Flow Referenced from DS#4704

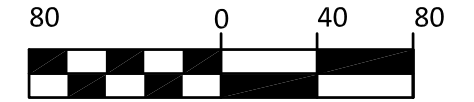
WOW CAR WASH @ DURANGO & ECHELON PT
FIGURE 7 EXISTING OFFSITE BASIN MAP



McCay Engineering
11700 W. Charleston Blvd.
Suite #170-298
Las Vegas, Nevada 89135
p 702-860-3897



GRAPHIC SCALE



(IN FEET)

1 INCH = 80 FT.

LEGEND

DEV1

BASIN NAME

CONCENTRATION POINT

FLOW DIRECTION

BASIN BOUNDARY



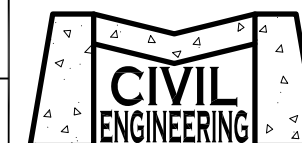
NOTE: Total flow

*NOTE: Base Flow Referenced from PW#20-11678.

**NOTE: Base Flow Referenced from DS#4704

WOW CAR WASH @ DURANGO & ECHELON PT

FIGURE 8 EXISTING ONSITE BASIN MAP



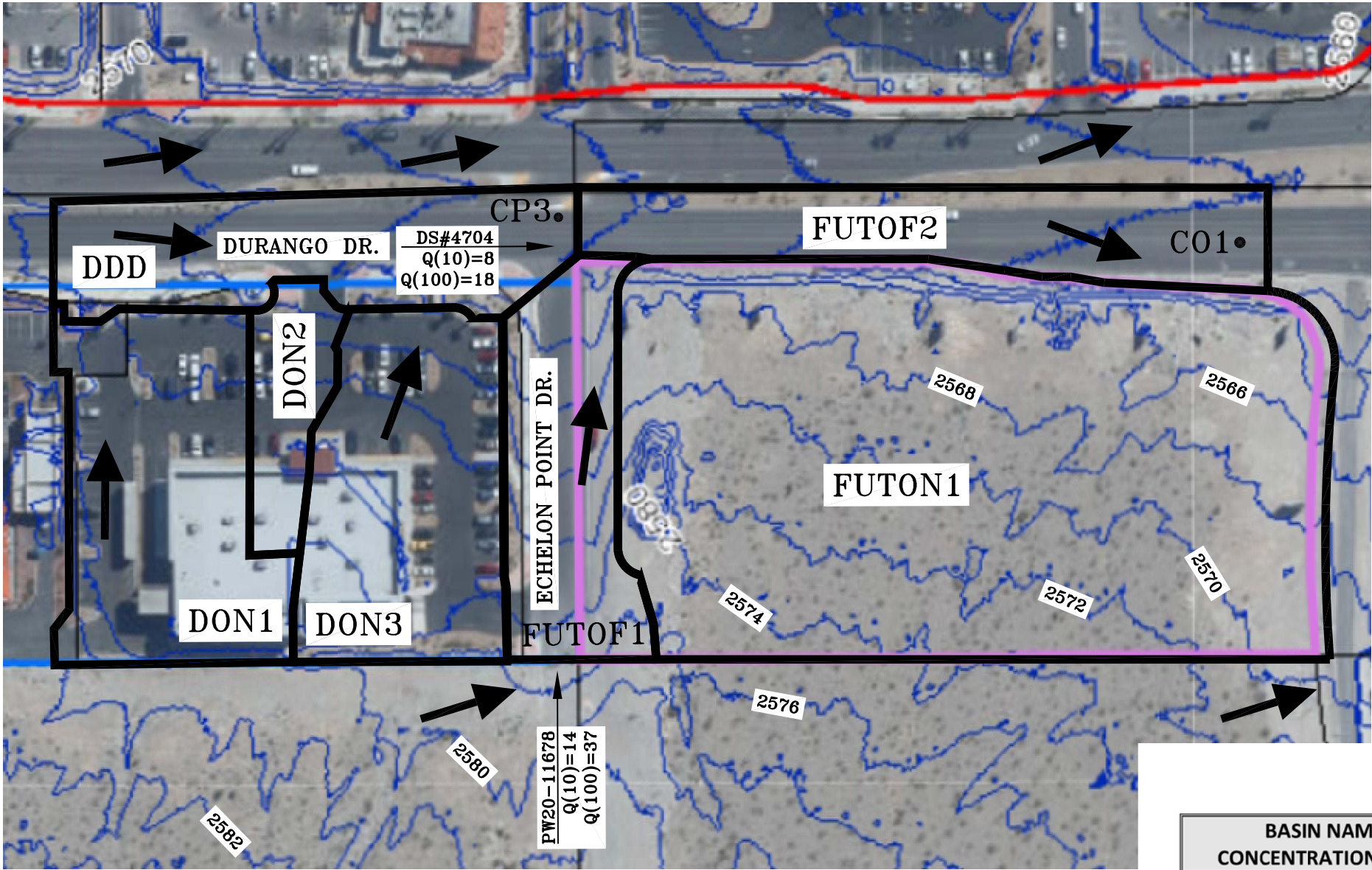
McCay Engineering

11700 W. Charleston Blvd.

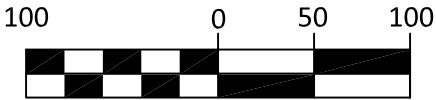
Suite #170-298

Las Vegas, Nevada 89135

p 702-860-3897



GRAPHIC SCALE



(IN FEET)
1 INCH = 100 FT.

LEGEND

- DEV1 BASIN NAME
● CONCENTRATION POINT
➔ FLOW DIRECTION
▬ BASIN BOUNDARY



10-YEAR / 100-YEAR, 6-HOUR STORM EVENT
FUTURE RUNOFF AMOUNTS

BASIN NAME/ CONCENTRATION POINT	AREA (acres)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	0.80	<1	1
DON2	0.22	<1	<1
DON3	0.76	<1	1
DDD	0.66	8**	19**
CP3	--	9	20
FUTON1	3.12	4	9
FUTOF1	0.54	15*	39*
FUTOF2	0.64	1	2
C01	--	29	70

NOTE: Total flow.
*NOTE: Referenced from PW#20-11678.
**NOTE: Referenced from DS#4704

OFFSITE STREET FLOW CALCULATIONS

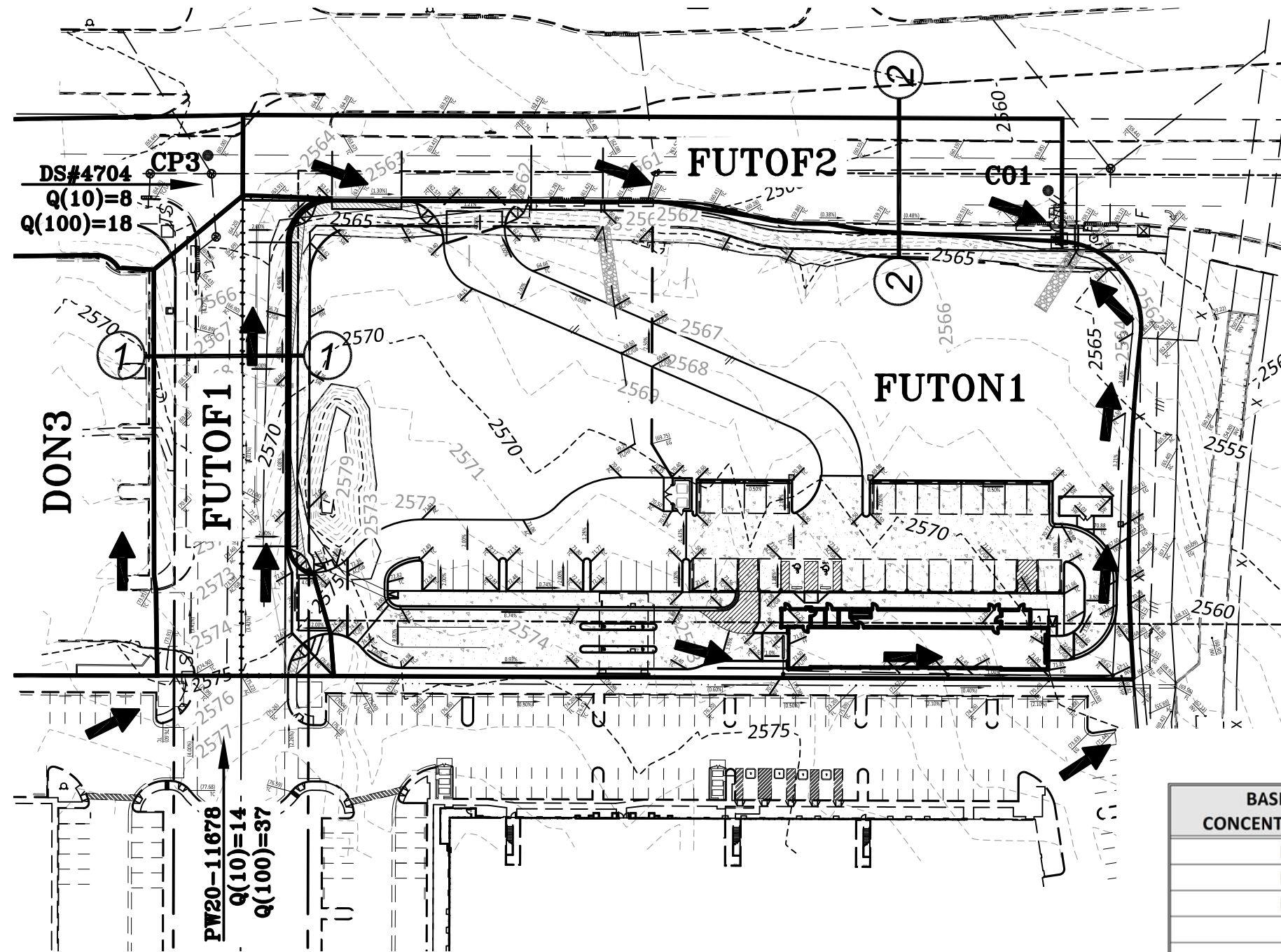
STREET	Q ₁₀ /Q ₁₀₀ (cfs)	D ₁₀ /D ₁₀₀ (ft)	V ₁₀ /V ₁₀₀ (ft/s)	V x D
Echelon Point Drive (Section 1) FUTOF1	15/39	0.38/0.49	4.85/6.05	1.84/2.96
Durango Drive (Section 2) C01	29/70	0.76/0.99	2.94/3.73	2.23/3.70

WOW CAR WASH @ DURANGO & ECHELON PT
FIGURE 9 FUTURE OFFSITE BASIN MAP

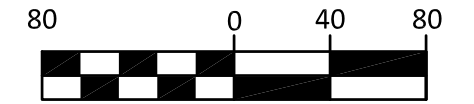


McCay Engineering

11700 W. Charleston Blvd.
Suite #170-298
Las Vegas, Nevada 89135
p 702-860-3897



GRAPHIC SCALE



(IN FEET)

1 INCH = 80 FT.

LEGEND

- DEV1 BASIN NAME
- CONCENTRATION POINT
- ➔ FLOW DIRECTION
- BASIN BOUNDARY
- ⑦ HYDRAULIC SECTION



10-YEAR / 100-YEAR, 6-HOUR STORM EVENT FUTURE RUNOFF AMOUNTS

BASIN NAME/ CONCENTRATION POINT	AREA (acres)	10-YEAR FLOW (cfs)	100-YEAR FLOW (cfs)
DON1	0.80	<1	1
DON2	0.22	<1	<1
DON3	0.76	<1	1
DDD	0.66	8**	19**
CP3	--	9	20
FUTON1	3.12	4	9
FUTOF1	0.54	15*	39*
FUTOF2	0.64	1	2
C01	--	29	70

NOTE: Total flow.

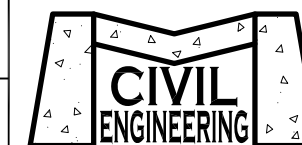
*NOTE: Referenced from PW#20-11678.

**NOTE: Referenced from DS#4704

OFFSITE STREET FLOW CALCULATIONS

STREET	Q ₁₀ /Q ₁₀₀ (cfs)	D ₁₀ /D ₁₀₀ (ft)	V ₁₀ /V ₁₀₀ (ft/s)	V x D
Echelon Point Drive (Section 1) FUTOF1	15/39	0.38/0.49	4.85/6.05	1.84/2.96
Durango Drive (Section 2) C01	29/70	0.76/0.99	2.94/3.73	2.23/3.70

WOW CAR WASH @ DURANGO & ECHELON PT FIGURE 10 FUTURE ONSITE BASIN MAP



McCay Engineering

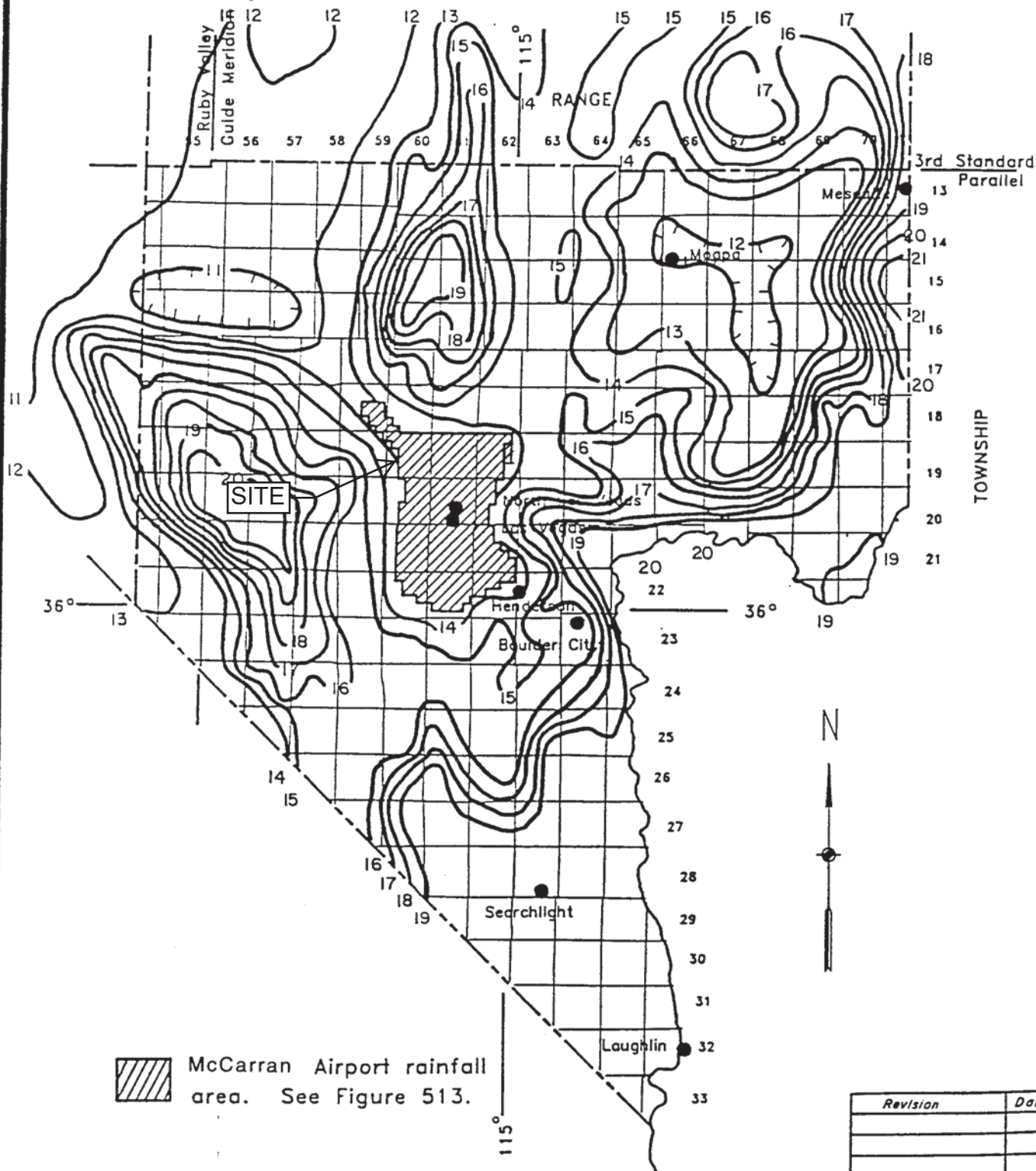
11700 W. Charleston Blvd.
Suite #170-298
Las Vegas, Nevada 89135
p 702-860-3897



Appendix B

Hydrologic Parameters

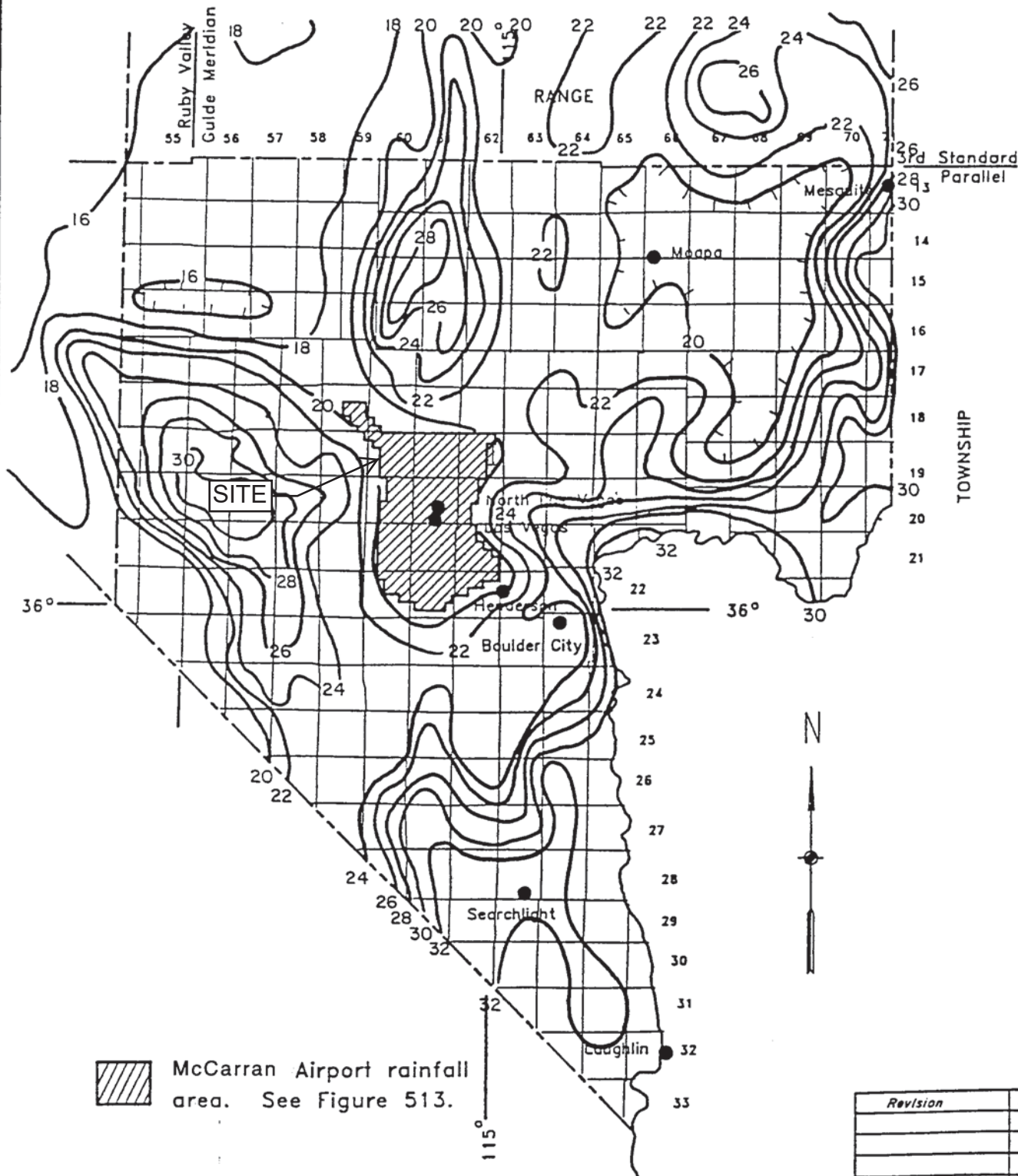
RAINFALL DEPTH-DURATION-FREQUENCY 10-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



 McCarran Airport rainfall area. See Figure 513.

Revision	Date

RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

SIX-HOUR STORM DISTRIBUTIONS

Percent of Total Storm Depth				Percent of Total Storm Depth			
Storm Time (In Minutes)	SDN3	SDN4	SDN5	Storm Time (In Minutes)	SDN3	SDN4	SDN5
0	0.0	0.0	0.0	185	32.2	37.6	43.0
5	2.0	2.0	2.0	190	35.2	41.5	47.7
10	5.7	5.8	5.9	195	40.9	46.2	51.4
15	7.0	7.5	8.0	200	49.9	53.0	56.1
20	8.7	9.9	11.0	205	59.0	61.0	63.0
25	10.8	12.6	14.4	210	71.0	71.0	71.0
30	12.4	13.7	15.0	215	74.4	73.2	72.0
35	13.0	14.5	16.0	220	78.1	75.6	73.1
40	13.0	14.9	16.8	225	81.2	78.2	75.2
45	13.0	15.1	17.1	230	81.9	79.9	77.9
50	13.0	15.5	18.0	235	83.5	81.3	79.0
55	13.0	15.6	18.2	240	85.1	82.3	79.5
60	13.0	15.9	18.7	245	85.6	83.0	80.4
65	13.3	16.2	19.0	250	86.0	83.5	81.0
70	14.0	16.9	19.7	255	86.8	84.4	82.0
75	14.2	17.2	20.2	260	87.6	85.1	82.6
80	14.8	17.9	21.0	265	88.8	86.4	84.0
85	15.8	18.9	22.0	270	91.0	88.5	85.9
90	17.2	20.1	23.0	275	92.6	90.8	88.9
95	18.1	21.1	24.1	280	93.7	92.4	91.0
100	19.0	22.0	25.0	285	95.0	94.4	93.8
105	19.7	22.8	25.9	290	97.0	96.8	96.6
110	19.9	23.2	26.5	295	97.6	97.3	97.0
115	20.0	24.0	28.0	300	98.2	97.8	97.4
120	20.1	24.6	29.0	305	98.5	98.2	97.9
125	20.4	25.2	30.0	310	98.7	98.4	98.1
130	21.4	26.0	30.5	315	98.9	98.6	98.3
135	22.9	26.9	30.9	320	99.0	98.8	98.5
140	24.1	27.6	31.0	325	99.3	99.1	98.9
145	24.9	28.3	31.7	330	99.3	99.2	99.0
150	25.1	28.6	32.1	335	99.4	99.3	99.2
155	25.6	29.2	32.7	340	99.5	99.4	99.3
160	27.0	30.2	33.3	345	99.8	99.7	99.6
165	27.8	31.2	34.6	350	99.8	99.8	99.7
170	28.1	32.1	36.1	355	99.9	99.9	99.9
175	28.3	33.2	38.1	360	100.0	100.0	100.0
180	29.5	35.2	40.8				

- Notes: 1. For drainage areas less than 8 square miles in size, use SDN 3.
 2. For drainage areas greater than or equal to 8 square miles and less than 12 square miles in size, use SDN 4.
 3. For drainage areas greater than or equal to 12 square miles, use SDN 5.
 4. A graphical representation of these values is presented on **Figure 515**.

Revision	Date

REFERENCE:

TABLE 503

RUNOFF CURVE NUMBERS (URBAN AREAS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type and hydrologic condition	Average percent impervious area ²	A	B	C	D
<i>Fully developed urban areas (vegetation established)</i>					
Open space (lawns, parks, golf courses, cemeteries, etc.) ³ :					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved: curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved: open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) ⁴ ...		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					

See Table 602A

Developing urban areas

Newly graded areas (pervious areas only, no vegetation) ⁵	77	86	91	94
--	----	----	----	----

1 Average runoff condition, and $I_p = 0.2S$.

2 The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system. Impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using Figure 603.

3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

4 Composite CN's for natural desert landscaping should be computed using Figure 603 based on the impervious area percentage (CN #98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figure 603 based on the degree of development impervious area percentage) and the CN's for the newly graded pervious areas.

Revision	Date

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

RUNOFF CURVE NUMBERS (SEMIARID RANGELANDS¹)

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition ²	A ³	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

¹Average runoff condition, and $I_a = 0.2S$.

²Poor: <30% ground cover (litter, grass, and brush overstory).

Fair: 30 to 70% ground cover.

Good: >70% ground cover.

³Curve numbers for group A have been developed only for desert shrub.

Revision	Date

Soil Map—Las Vegas Valley Area, Nevada, Part of Clark County



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features



Blowout



Borrow Pit



Clay Spot



Closed Depression



Gravel Pit



Gravelly Spot



Landfill



Lava Flow



Marsh or swamp



Mine or Quarry



Miscellaneous Water



Perennial Water



Rock Outcrop



Saline Spot



Sandy Spot



Severely Eroded Spot



Sinkhole



Slide or Slip



Sodic Spot



Spoil Area



Stony Spot



Very Stony Spot



Wet Spot



Other



Special Line Features

Water Features



Streams and Canals

Transportation



Rails



Interstate Highways



US Routes



Major Roads



Local Roads

Background



Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County

Survey Area Data: Version 16, Aug 26, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 3, 2019—May 14, 2019

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
190	Dalian very gravelly fine sandy loam, 2 to 4 percent slopes	19.4	0.8%
191	Dalian very cobbly fine sandy loam, 2 to 8 percent slopes	2,273.2	96.5%
192	Dalian-McCullough complex, 0 to 4 percent slopes	5.0	0.2%
610	Pits, gravel	58.0	2.5%
Totals for Area of Interest		2,355.7	100.0%

Report—Engineering Properties

Absence of an entry indicates that the data were not estimated. The asterisk "*" denotes the representative texture; other possible textures follow the dash. The criteria for determining the hydrologic soil group for individual soil components is found in the National Engineering Handbook, Chapter 7 issued May 2007(<http://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=17757.wba>). Three values are provided to identify the expected Low (L), Representative Value (R), and High (H).

Engineering Properties—Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
190—Dalian very gravelly fine sandy loam, 2 to 4 percent slopes														
Dalian	100	A	0-4	Very gravelly fine sandy loam	GM	A-1	0- 0- 0	0- 0- 0	30-43-55	25-38-50	20-30-40	10-18-25	0-7 -14	NP
			4-61	Very gravelly sandy loam, extremely gravelly fine sandy loam, very gravelly fine sandy loam	GM, GP-GM	A-1	0- 0- 0	5- 8- 10	30-30-55	25-25-50	20-20-40	10-12-25	0-7 -14	NP
191—Dalian very cobbly fine sandy loam, 2 to 8 percent slopes														
Dalian	100	A	0-5	Very cobbly fine sandy loam	GM	A-1, A-2	0- 0- 0	35-43-50	55-60-65	50-55-60	40-48-55	20-25-30	0-7 -14	NP
			5-60	Very gravelly sandy loam, very gravelly fine sandy loam	GM	A-1	0- 0- 0	5- 8- 10	35-45-55	30-40-50	20-30-40	10-18-25	0-7 -14	NP

Engineering Properties--Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
192—Dalian-McCullough complex, 0 to 4 percent slopes														
Dalian	55	A	0-5	Very gravelly fine sandy loam	GM	A-1	0- 0- 0	0- 0- 0	30-43-55	25-38-50	20-30-40	10-18-25	0-7 -14	NP
			5-60	Very gravelly sandy loam, very gravelly fine sandy loam	GM	A-1	0- 0- 0	5- 8- 10	35-45-55	30-40-50	20-30-40	10-18-25	0-7 -14	NP
Mccullough	35	B	0-5	Very gravelly very fine sandy loam	GM	A-1	0- 0- 0	5- 8- 10	35-40-45	30-35-40	25-33-40	15-20-25	20-23 -25	NP-3 -5
			5-30	Stratified sandy loam to loam	SM	A-2, A-4	0- 0- 0	0- 0- 0	95-98-100	90-95-100	55-60-65	30-35-40	15-20 -25	NP-3 -5
			30-40	Stratified coarse sand to loamy fine sand	SM	A-1, A-2	0- 0- 0	0- 0- 0	80-90-100	75-85-95	40-50-60	10-20-30	0-7 -14	NP
			40-60	Extremely gravelly loamy sand	GP-GM	A-1	0- 0- 0	5- 8- 10	20-25-30	15-20-25	10-13-15	5- 8- 10	0-7 -14	NP
Las vegas	5	D	0-1	Gravelly fine sandy loam	SM	A-1, A-2	0- 0- 0	0- 0- 0	60-70-80	50-63-75	40-53-65	20-25-30	15-20 -25	NP-3 -5
			1-7	Fine sandy loam	SM	A-4	0- 0- 0	0- 0- 0	80-90-100	75-85-95	65-73-80	40-45-50	0-7 -14	NP
			7-11	Gravelly sandy clay loam, gravelly loam	GC, SC	A-2, A-6	0- 0- 0	0- 0- 0	60-70-80	50-63-75	30-40-50	25-35-45	25-30 -35	10-13-15

Engineering Properties--Las Vegas Valley Area, Nevada, Part of Clark County														
Map unit symbol and soil name	Pct. of map unit	Hydrologic group	Depth	USDA texture	Classification		Pct Fragments		Percentage passing sieve number—				Liquid limit	Plasticity index
					Unified	AASHTO	>10 inches	3-10 inches	4	10	40	200		
			<i>In</i>				<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>	<i>L-R-H</i>
			11-15	Indurated	—	—	—	—	—	—	—	—	—	—
Tencee	5	D	0-9	Very gravelly fine sandy loam	GC-GM, GC	A-2	0- 0- 0	0- 8- 15	35-45-55	30-40-50	20-33-45	10-15-20	20-25-30	5-8 -10
			9-15	Extremely gravelly sandy loam, very gravelly loam, very gravelly sandy loam	GC-GM, GC	A-2	0- 0- 0	0-13- 25	35-43-50	25-35-45	15-28-40	5-20- 35	20-25-30	5-8 -10
			15-19	Indurated	—	—	—	—	—	—	—	—	—	—

Data Source Information

Soil Survey Area: Las Vegas Valley Area, Nevada, Part of Clark County

Survey Area Data: Version 16, Aug 26, 2020

Curve Number Matrix

SOIL MAP UNIT	HYDROLOGIC SOIL GROUP					LAND USE CATEGORY INDEX NUMBER												
	A	B	C	D	ROCK OUTCROP	1	2	3	4	5	6	7	8	9	10	11	12	13
	CN ---->					63	47	57	60	62	74	84	89	92	86	92	71	30
		CN ---->				77	66	73	74	76	83	89	93	94	91	94	81	30
			CN ---->			85	77	82	83	84	88	92	95	95	93	95	87	30
				CN ---->		88	83	86	87	88	91	94	96	96	95	96	90	30
					CN ---->	90	90	92	92	92	94	96	96	97	96	97	94	30
	%	%	%	%	%	SOIL TYPE COMPOSITE CN FOR LAND USE CATEGORY												
1100	6	0	0	59	35	87.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1105	55	40	0	5	0	70.0	56.0	65.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1107	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1112	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1113	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1117	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1120	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1127	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1129	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1130	65	0	25	10	0	71.0	58.0	66.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1132	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1133	70	0	10	0	20	71.0	58.0	67.0	68.0	70.0	79.0	87.0	91.0	93.0	89.0	93.0	77.0	30.0
1134	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1135	84	0	0	16	0	67.0	52.0	62.0	64.0	66.0	76.0	85.0	90.0	92.0	87.0	92.0	74.0	30.0
1140	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1141	8	0	2	70	20	86.0	81.0	85.0	86.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1150	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1151	41	0	0	59	0	78.0	68.0	74.0	76.0	77.0	84.0	90.0	93.0	94.0	91.0	94.0	82.0	30.0
1152	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1155	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1156	1	10	0	89	0	87.0	81.0	84.0	85.0	86.0	90.0	93.0	95.0	96.0	94.0	96.0	89.0	30.0
1160	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1160dn	46	1	0	53	0	76.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1165	32	40	15	13	0	75.0	64.0	71.0	73.0	74.0	82.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1181	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1182	95	0	5	0	0	64.0	48.0	58.0	61.0	63.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1183	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1184	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1187	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1190	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1191	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1192	55	55	0	10	0	70.0	57.0	65.0	68.0	70.0	79.0	87.0	91.0	93.0	88.0	93.0	76.0	30.0
1200	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1206	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1207	3	85	5	7	0	78.0	67.0	74.0	75.0	77.0	83.0	89.0	93.0	94.0	91.0	94.0	82.0	30.0
1222	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1225	9	20	50	21	0	82.0	73.0	79.0	80.0	81.0	86.0	91.0	94.0	95.0	92.0	95.0	85.0	30.0
1230	54	0	0	46	0	75.0	63.0	70.0	72.0	74.0	81.0	88.0	92.0	94.0	90.0	94.0	80.0	30.0
1235	66	25	0	9	0	69.0	55.0	64.0	66.0	68.0	77.0	86.0	91.0	93.0	88.0	93.0	75.0	30.0
1236	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1237	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1240	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0
1252	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1255	0	100	0	0	0	77.0	66.0	73.0	74.0	76.0	83.0	89.0	93.0	94.0	91.0	94.0	81.0	30.0
1260	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1262	75	0	0	25	0	69.0	56.0	64.0	67.0	69.0	78.0	86.0	91.0	93.0	88.0	93.0	76.0	30.0
1263	95	0	0	5	0	64.0	48.0	59.0	61.0	64.0	74.0	84.0	90.0	92.0	86.0	92.0	72.0	30.0
1264	100	0	0	0	0	63.0	47.0	57.0	60.0	62.0	74.0	84.0	89.0	92.0	86.0	92.0	71.0	30.0
1270	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1278	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1282	0	0	100	0	0	85.0	77.0	82.0	83.0	84.0	88.0	92.0	95.0	95.0	93.0	95.0	87.0	30.0
1300	0	0	0	100	0	88.0	83.0	86.0	87.0	88.0	91.0	94.0	96.0	96.0	95.0	96.0	90.0	30.0

RAINFALL CALCULATIONS

Taken from the NOAA Atlas 2, Volume VII Nevada, 1973 located in the CCRFCD Hydrologic Criteria and Drainage Design Manual.

Rainfall 10-year, 6 hour storm = 1.3 inches

Rainfall 100-year, 6 hour storm = 2.0 inches

Precipitation Adjustment Values 10-year, 6 hour storm = 1.24

Precipitation Adjustment Values 100-year, 6 hour storm = 1.43

Adjusted Rainfall 10-year, 6 hour storm = $(1.3) \times (1.24) = 1.61$

Adjusted Rainfall 100-year, 6 hour storm = $(2.0) \times (1.43) = 2.86$

Ratio for 100-year rainfall = 1.00

Ratio of (10-year rainfall) / (100-year rainfall) = $(1.61 / 2.86) = 0.56$

SOIL TYPE CALCULATED CURVE NUMBER

Soil Type #191 – (Commercial)

Soil	Percent(%)	Soil Type	CN
Dalain	100	A	92

CN = 92

Soil Type #191 – (Desert Shrub)

Soil	Percent(%)	Soil Type	CN
Dalain	100	A	63

CN = 63

Soil Type #191 – (Pavement)

Soil	Percent(%)	Soil Type	CN
Dalain	100	A	98

CN = 98

BASIN COMPOSITE CN VALUES

EXON1

CN(Composite) = 1*63

CN = 63.0

EXISTING			
Soil Type	Land Use	Percent of Basin	CN Value
1191	Desert Shrub	100	63

EXOF1

CN(Composite) = (0.5*63)+(0.5*98)

CN = 80.5

EXISTING			
Soil Type	Land Use	Percent of Basin	CN Value
1191	Desert Shrub	100	63
1191	Pavement	50	98

EXOF2

CN(Composite) = 1*98

CN = 98.0

EXISTING			
Soil Type	Land Use	Percent of Basin	CN Value
1191	Pavement	100	98

FUTON1

CN(Composite) = 1*92

CN = 92.0

EXISTING			
Soil Type	Land Use	Percent of Basin	CN Value
1191	Commercial	100	92

FUTOF1

CN(Composite) = 1*98

CN = 98.0

EXISTING			
Soil Type	Land Use	Percent of Basin	CN Value
1191	Pavement	100	98

FUTOF2

CN(Composite) = 1*98

CN = 98.0

EXISTING			
Soil Type	Land Use	Percent of Basin	CN Value
1191	Pavement	100	98

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Project No. : 20349

DEVELOPMENT : WOW Carwash @ Durango & Echelon Pt.
Existing Condition

CALCULATED BY : PDW

DATE: January 2021



SUB-BASIN DATA					INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc CHECK URBANIZED BASINS		FINAL Tc	Min Tc	Tlag	REMARKS
DESIG:	CN	K	AREA (acres)	AREA (mi ²)	LENGTH (ft)	SLOPE (%)	Ti (min)	LENGTH (ft)	SLOPE (%)	LAND COVER k	VELOCITY* (fps)	Tt (min)	Tc = Ti + Tt (min)	TOTAL LENGTH (ft)	Tc = (L/180)*10 (min)	(min)	(min)	Tlag= 0.6Tc/60 (hrs)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Existing Onsite Basins																			
EXON 1	63.0	0.4416	3.12	0.0049	38	4.40	4.47	280	2.85	DEV	5.17	0.9	5.4	318.4	11.769	5.37	5.00	0.054	
Existing Offsite Basins																			
EXOF1	80.5	0.6726	0.54	0.0008	53	5.48	3.17	248	4.00	DEV	6.12	0.7	3.9	301.3	11.674	3.85	5.00	0.050	minimum Tc used
EXOF2	98.0	0.9036	0.64	0.0010	58	1.00	2.69	130	1.53	DEV	3.79	0.6	3.3	188.0	11.044	3.26	5.00	0.050	minimum Tc used

$$T_i = 1.8 (1.1 - K) L^{1/2} / S^{1/3}$$

$$T_c = T_i + T_t$$

$$K = 0.0132 (CN) - 0.39 \quad T_{lag} = 0.6T_c$$

* The velocity in column 9 was computed using the equation $V = CS^{0.5}$

C is a coefficient and S is the travel slope, as outlined in section 602.1 of the CCRFCD Manual.

*As recommended in the CCRFCD Manual, C = 30.6 under developed conditions
and C = 29.4 under undeveloped conditions.

REFERENCE :

STANDARD FORM 4

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

TIME OF CONCENTRATION

Project No. : 20349

DEVELOPMENT : WOW Carwash @ Durango & Echelon Pt.
Future Condition

CALCULATED BY : PDW

DATE: January 2021



SUB-BASIN DATA					INITIAL / OVERLAND TIME (Ti)			TRAVEL TIME (Tt)					Tc	Tc CHECK URBANIZED BASINS		FINAL Tc	Min Tc	Tlag	REMARKS
DESIG:	CN	K	AREA <i>(acres)</i>	AREA <i>(mi^2)</i>	LENGTH <i>(ft)</i>	SLOPE <i>(%)</i>	Ti <i>(min)</i>	LENGTH <i>(ft)</i>	SLOPE <i>(%)</i>	LAND COVER <i>k</i>	VELOCITY* <i>(fps)</i>	Tt <i>(min)</i>	Tc = Ti + Tt <i>(min)</i>	TOTAL LENGTH <i>(ft)</i>	Tc = (L/180)+10 <i>(min)</i>	 <i>(min)</i>	 <i>(min)</i>	Tlag= 0.6Tc/60 <i>(hrs)</i>	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)		(10)	(11)		(12)	(13)	(14)			
Future Onsite Basins																			
FUTON1	92.0	0.8244	3.12	0.0049	25	10.00	1.15	726	2.80	EX	4.92	2.5	3.6	750.6	N/A	3.60	10.00	0.100	minimum Tc used
Future Offsite Basins																			
FUTOF1	98.0	0.9036	0.54	0.0008	36	7.50	1.08	266	3.85	DEV	6.00	0.7	1.8	301.4	11.675	1.82	5.00	0.050	minimum Tc used
FUTOF2	98.0	0.9036	0.64	0.0010	58	1.00	2.69	130	1.50	DEV	3.75	0.6	3.3	188.0	11.044	3.27	5.00	0.050	minimum Tc used

$$T_i = 1.8 (1.1 - K) L^{1/2} / S^{1/3}$$

$$T_c = T_i + T_t$$

$$K = 0.0132 (CN) - 0.39 \quad T_{lag} = 0.6T_c$$

* The velocity in column 9 was computed using the equation $V = CS^{0.5}$

C is a coefficient and S is the travel slope, as outlined in section 602.1 of the CCRFCD Manual.

*As recommended in the CCRFCD Manual, C = 30.6 under developed conditions
and C = 29.4 under undeveloped conditions.

REFERENCE :

STANDARD FORM 4



Appendix C

Existing HEC-1 Model

```

1*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 30DEC20 TIME 15:09:47 *
*****

```

```

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

```

```

X X XXXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID
2 ID
3 ID TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
4 ID LAS VEGAS, NEVADA
5 ID
6 ID PREPARED FOR:
7 ID
8 ID PREPARED BY:
9 ID MCCAY ENGINEERING
10 ID 11700 W. CHARLESTON BLVD, SUITE 170-298
11 ID LAS VEGAS, NV 89135
12 ID
13 ID EXISTING 10 YEAR
14 ID FILENAME:WOW-EX10A.DAT
15 ID JOB#2010667
16 ID
17 ID
18 ID
19 ID *DIAGRAM
20 IT 5 0 0 300
21 IO 5 0 0
22 IN 5 0 0
23 JR PREC 0.56
24 *
25 KK DON1
26 KM REFEBCE BASIN DON1
27 BA 0.0013
28 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
29 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
30 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
31 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
32 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
33 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
34 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
35 PC .998 .999 1.00
36 LS 0 92
37 UD 0.082
38 *
39 KK DON2
40 KM REFEBCE BASIN DON2
41 BA 0.0003
42 LS 0 92
43 UD 0.050
44 *
45 KK DON3
46 KM REFEBCE BASIN DON3
47 BA 0.0012
48 LS 0 92
49 UD 0.066
50 *

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
46 KK DDD
47 KM REFEBCE BASIN DDD
48 BF 8
49 BA 0.0010
50 LS 0 98
51 UD 0.050
52 *
53 KK CP3
54 KM COMBINE BASINS DON1, DON2, DON3, AND DDD
55 HC 4
56 *
57 KK EXOF1
58 KM REFERENCE FLOW, PER FW20-11678
59 BF 14
60 PB 2.86
61 BA 0.0008

```


60	LS	0	80.5
61	UD	0.056	
	*		
62	KK	EXOF2	
63	KM	REFERENCE FLOW, PER DS#4704	
64	BF	0	
65	PB	2.86	
66	BA	0.0010	
67	LS	0	98
68	UD	0.050	
	*		
69	KK	EXON1	
70	KM	EXISTING ONSITE BASIN	
71	BF	0	
72	PB	2.86	
73	BA	0.0049	
74	LS	0	63
75	UD	0.054	
	*		
76	KK	C01	
77	KM	COMBINE BASINS EXOF1, EXOF2, EXON1, AND CP3	
78	HC	4	
	*		
79	ZZ		

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
23	DON1	
	.	
36	DON2	
	.	
41	DON3	
	.	
46	DDD	
	.	
52	CP3	
	.	
55	EXOF1	
	.	
62	EXOF2	
	.	
69	EXON1	
	.	
76	C01	

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 30DEC20 TIME 15:09:47 *

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

TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
LAS VEGAS, NEVADA

PREPARED FOR:

PREPARED BY: MCCAY ENGINEERING
11700 W. CHARLESTON BLVD, SUITE 170-298
LAS VEGAS, NV 89135

EXISTING 10 YEAR
FILENAME:WOW-EX10A.DAT
JOB#2010667

20 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


```

*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 30DEC20 TIME 15:09:57 *
*****

```

```

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

```

```

X X XXXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID
2 ID
3 ID TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
4 ID LAS VEGAS, NEVADA
5 ID
6 ID PREPARED FOR:
7 ID
8 ID PREPARED BY:
9 ID MCCAY ENGINEERING
10 ID 11700 W. CHARLESTON BLVD, SUITE 170-298
11 ID LAS VEGAS, NV 89135
12 ID
13 ID EXISTING 100 YEAR
14 ID FILENAME:WOW-EX100A.DAT
15 ID JOB#2010667
16 ID
17 ID
18 ID
19 IT 5 0 0 300
20 IO 5 0 0
21 IN 5 0 0
22 JR PREC 1.00
*
23 KK DON1
24 KM REFERENCE BASIN DON1
25 BA 0.0013
26 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
27 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
28 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
29 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
30 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
31 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
32 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
33 PC .998 .999 1.00
34 LS 0 92
35 UD 0.082
*
36 KK DON2
37 KM REFERENCE BASIN DON2
38 BA 0.0003
39 LS 0 92
40 UD 0.050
*
41 KK DON3
42 KM REFERENCE BASIN DON3
43 BA 0.0012
44 LS 0 92
45 UD 0.066
*

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
46 KK DDD
47 KM REFERENCE BASIN DDD
48 BF 18
49 BA 0.0010
50 LS 0 98
51 UD 0.050
*
52 KK CP3
53 KM COMBINE BASINS DON1, DON2, DON3, AND DDD
54 HC 4
*
55 KK EXOF1
56 KM REFERENCE FLOW, PER FW20-11678
57 BF 37
58 PB 2.86
59 BA 0.0008

```

60	LS	0	80.5
61	UD	0.056	
	*		
62	KK	EXOF2	
63	KM	REFERENCE FLOW, PER DS#4704	
64	BF	0	
65	PB	2.86	
66	BA	0.0010	
67	LS	0	98
68	UD	0.050	
	*		
69	KK	EXON1	
70	KM	EXISTING ONSITE BASIN	
71	BF	0	
72	PB	2.86	
73	BA	0.0049	
74	LS	0	63
75	UD	0.054	
	*		
76	KK	C01	
77	KM	COMBINE BASINS EXOF1, EXOF2, EXON1, AND CP3	
78	HC	4	
	*		
79	ZZ		

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

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

23 DON1
.
.
36 DON2
.
.
41 DON3
.
.
46 DDD
.
.
52 CP3.....
.
55 EXOF1
.
.
62 EXOF2
.
.
69 EXON1
.
.
76 C01.....

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

*****	*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)	* U.S. ARMY CORPS OF ENGINEERS
* JUN 1998	* HYDROLOGIC ENGINEERING CENTER
* VERSION 4.1	* 609 SECOND STREET
* RUN DATE 30DEC20 TIME 15:09:57	* DAVIS, CALIFORNIA 95616
*	* (916) 756-1104
*****	*****

TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
LAS VEGAS, NEVADA

PREPARED FOR:

PREPARED BY: MCCAY ENGINEERING
11700 W. CHARLESTON BLVD, SUITE 170-298
LAS VEGAS, NV 89135

EXISTING 100 YEAR
FILENAME:WOW-EX100A.DAT
JOB#2010667

20 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
	NDDTIME 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 FLOW	FEET		
		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	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					
RATIOS APPLIED TO PRECIPITATION					
OPERATION	STATION	AREA	PLAN	RATIO 1	1.00
HYDROGRAPH AT +	DON1	.00	1	FLOW TIME	1. 3.50
HYDROGRAPH AT +	DON2	.00	1	FLOW TIME	0. 3.50
HYDROGRAPH AT +	DON3	.00	1	FLOW TIME	1. 3.50
HYDROGRAPH AT +	DDD	.00	1	FLOW TIME	19. 3.50
4 COMBINED AT +	CP3	.00	1	FLOW TIME	20. 3.50
HYDROGRAPH AT +	EXOF1	.00	1	FLOW TIME	38. 3.50
HYDROGRAPH AT +	EXOF2	.00	1	FLOW TIME	2. 3.50
HYDROGRAPH AT +	EXON1	.00	1	FLOW TIME	2. 3.50
4 COMBINED AT +	C01	.01	1	FLOW TIME	62. 3.50
*** NORMAL END OF HEC-1 ***					



Appendix D

Future HEC-1 Model

```

1*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 22DEC20 TIME 09:30:46 *
*****

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

```

```

X X XXXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.

THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,

DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID
2 ID
3 ID TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
4 ID LAS VEGAS, NEVADA
5 ID
6 ID
7 ID
8 ID
9 ID PREPARED BY:
10 ID MCCAY ENGINEERING
11 ID 11700 W. CHARLESTON BLVD, SUITE 170-298
12 ID LAS VEGAS, NV 89135
13 ID
14 ID FUTURE 10 YEAR
15 ID FILENAME:WOW-FUT10A.DAT
16 ID JOB#2010667
17 ID
18 ID
19 ID *DIAGRAM
20 IT 5 0 0 300
21 IO 5 0 0
22 IN 5 0 0
23 JR PREC 0.56
24 *
25
26 KK DON1
27 KM REFEREBCE BASIN DON1
28 BA 0.0013
29 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
30 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
31 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
32 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
33 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
34 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
35 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
36 PC .998 .999 1.00
37 LS 0 92
38 UD 0.082
39 *
40
41 KK DON2
42 KM REFEREBCE BASIN DON2
43 BA 0.0003
44 LS 0 92
45 UD 0.050
46 *
47
48 KK DON3
49 KM REFEREBCE BASIN DON3
50 BA 0.0012
51 LS 0 92
52 UD 0.066
53 *

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
46 KK DDD
47 KM REFEREBCE BASIN DDD
48 BF 8
49 BA 0.0010
50 LS 0 98
51 UD 0.050
52 *
53
54 KK CP3
55 KM COMBINE BASINS DON1, DON2, DON3, AND DDD
56 HC 4
57 *
58
59 KK FUTOF1
60 KM REFERENCE FLOW, PER PW20-11678
61 BF 14
62 PB 2.86
63 BA 0.0008

```

60 LS 0 98
61 UD 0.050
*
62 KK FUTOF2
63 KM REFERENCE FLOW, PER DS#4704
64 BF 0
65 PB 2.86
66 BA 0.0010
67 LS 0 98
68 UD 0.050
*
69 KK FUTON1
70 KM EXISTING ONSITE BASIN
71 BF 0
72 PB 2.86
73 BA 0.0049
74 LS 0 92
75 UD 0.100
*
76 KK C01
77 KM COMBINE BASINS FUTOF1, FUTOF2, FUTON1, AND CP3
78 HC 4
*
79 ZZ

1

SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT
LINE (V) ROUTING (--->) DIVERSION OR PUMP FLOW
NO. (.) CONNECTOR (<---) RETURN OF DIVERTED OR PUMPED FLOW
23 DON1
.
.
36 . DON2
.
.
41 . DON3
.
.
46 . DDD
.
.
52 CP3.....
.
55 . FUTOF1
.
.
62 . FUTOF2
.
.
69 . FUTON1
.
.
76 C01.....

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 22DEC20 TIME 09:30:46 *

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

TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
LAS VEGAS, NEVADA

PREPARED FOR:

PREPARED BY: MCCAY ENGINEERING
11700 W. CHARLESTON BLVD, SUITE 170-298
LAS VEGAS, NV 89135

FUTURE 10 YEAR
FILENAME:WOW-FUT10A.DAT
JOB#2010667

20 IO OUTPUT CONTROL VARIABLES
IPRNT 5 PRINT CONTROL
IFLOT 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			
	PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS		
	FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES		
	TIME TO PEAK IN HOURS		
			RATIOS APPLIED TO PRECIPITATION
OPERATION	STATION	AREA	PLAN
			RATIO 1
			.56
HYDROGRAPH AT			
+	DON1	.00	1
			FLOW
			TIME
			0.
			3.50
HYDROGRAPH AT			
+	DON2	.00	1
			FLOW
			TIME
			0.
			3.50
HYDROGRAPH AT			
+	DON3	.00	1
			FLOW
			TIME
			0.
			3.50
HYDROGRAPH AT			
+	DDD	.00	1
			FLOW
			TIME
			8.
			3.50
4 COMBINED AT			
+	CP3	.00	1
			FLOW
			TIME
			9.
			3.50
HYDROGRAPH AT			
+	FUTOF1	.00	1
			FLOW
			TIME
			15.
			3.50
HYDROGRAPH AT			
+	FUTOF2	.00	1
			FLOW
			TIME
			1.
			3.50
HYDROGRAPH AT			
+	FUTON1	.00	1
			FLOW
			TIME
			4.
			3.50
4 COMBINED AT			
+	C01	.01	1
			FLOW
			TIME
			29.
			3.50
*** NORMAL END OF HEC-1 ***			

```

1*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
* RUN DATE 22DEC20 TIME 09:30:29 *
*****

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

```

```

X X XXXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
 THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
 NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
 DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
 KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
1 ID
2 ID
3 ID TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
4 ID LAS VEGAS, NEVADA
5 ID
6 ID PREPARED FOR:
7 ID
8 ID PREPARED BY:
9 ID MCCAY ENGINEERING
10 ID 11700 W. CHARLESTON BLVD, SUITE 170-298
11 ID LAS VEGAS, NV 89135
12 ID
13 ID FUTURE 100 YEAR
14 ID FILENAME:WOW-FUT100A.DAT
15 ID JOB#2010667
16 ID
17 ID
18 ID
19 ID *DIAGRAM
20 IT 5 0 0 300
21 IO 5 0 0
22 IN 5 0 0
23 JR PREC 1.00
24 *
25 KK DON1
26 KM REFERENCE BASIN DON1
27 BA 0.0013
28 PC .000 .020 .057 .070 .087 .108 .124 .130 .130 .130
29 PC .130 .130 .130 .133 .140 .142 .148 .158 .172 .181
30 PC .190 .197 .199 .200 .201 .204 .214 .229 .241 .249
31 PC .251 .256 .270 .278 .281 .283 .295 .322 .352 .409
32 PC .499 .590 .710 .744 .781 .812 .819 .835 .851 .856
33 PC .860 .868 .876 .888 .910 .926 .937 .950 .970 .976
34 PC .982 .985 .987 .989 .990 .993 .993 .994 .995 .998
35 PC .998 .999 1.00
36 LS 0 92
37 UD 0.082
38 *
39 KK DON2
40 KM REFERENCE BASIN DON2
41 BA 0.0003
42 LS 0 92
43 UD 0.050
44 *
45 KK DON3
46 KM REFERENCE BASIN DON3
47 BA 0.0012
48 LS 0 92
49 UD 0.066
50 *

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
46 KK DDD
47 BF 18
48 KM REFERENCE BASIN DDD
49 BA 0.0010
50 LS 0 98
51 UD 0.050
52 *
53 KK CP3
54 KM COMBINE BASINS DON1, DON2, DON3, AND DDD
55 HC 4
56 *
57 KK FUTOF1
58 KM REFERENCE FLOW, PER PW20-11678
59 BF 37
60 PB 2.86
61 BA 0.0008

```

60 LS 0 98
61 UD 0.050
*

62 KK FUTOF2
63 KM REFERENCE FLOW, PER DS#4704
64 BF 0
65 PB 2.86
66 BA 0.0010
67 LS 0 98
68 UD 0.050
*

69 KK FUTON1
70 KM EXISTING ONSITE BASIN
71 BF 0
72 PB 2.86
73 BA 0.0049
74 LS 0 92
75 UD 0.100
*

76 KK C01
77 KM COMBINE BASINS FUTOF1, FUTOF2, FUTON1, AND CP3
78 HC 4
*
79 ZZ

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
23	DON1	
	.	
36	DON2	
	.	
41	DON3	
	.	
46	DDD	
	.	
52	CP3.....	
	.	
55	FUTOF1	
	.	
62	FUTOF2	
	.	
69	FUTON1	
	.	
76	C01.....	

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

*****	*****
* FLOOD HYDROGRAPH PACKAGE (HEC-1)	* U.S. ARMY CORPS OF ENGINEERS
* JUN 1998	* HYDROLOGIC ENGINEERING CENTER
* VERSION 4.1	* 609 SECOND STREET
* RUN DATE 22DEC20 TIME 09:30:29	* DAVIS, CALIFORNIA 95616
* *****	* (916) 756-1104
	* *****

TECHNICAL DRAINAGE STUDY FOR WOW CAR WASH AT DURANGO
LAS VEGAS, NEVADA

PREPARED FOR:

PREPARED BY: MCCAY ENGINEERING
11700 W. CHARLESTON BLVD, SUITE 170-298
LAS VEGAS, NV 89135

FUTURE 100 YEAR
FILENAME:WOW-FUT100A.DAT
JOB#2010667

20 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IFLOT	0	FLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN	5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	STARTING DATE
ITIME	0000	STARTING TIME
NQ	300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	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	
	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
				1.00

HYDROGRAPH AT				
+	DON1	.00	1 FLOW	1.
			TIME	3.50

HYDROGRAPH AT				
+	DON2	.00	1 FLOW	0.
			TIME	3.50

HYDROGRAPH AT				
+	DON3	.00	1 FLOW	1.
			TIME	3.50

HYDROGRAPH AT				
+	DDD	.00	1 FLOW	19.
			TIME	3.50

4 COMBINED AT				
+	CP3	.00	1 FLOW	20.
			TIME	3.50

HYDROGRAPH AT				
+	FUTOF1	.00	1 FLOW	39.
			TIME	3.50

HYDROGRAPH AT				
+	FUTOF2	.00	1 FLOW	2.
			TIME	3.50

HYDROGRAPH AT				
+	FUTON1	.00	1 FLOW	9.
			TIME	3.50

4 COMBINED AT				
+	C01	.01	1 FLOW	70.
			TIME	3.50

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



**McCay
ENGINEERING**

Appendix E

Hydraulic Calculations

Worksheet for FUT Durango Sect 10 yr

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.0048 ft/ft
Discharge	29.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+50.0	1.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+07.0, 0.13)	0.013
(0+07.0, 0.13)	(0+50.0, 1.13)	0.016

Options

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

Results

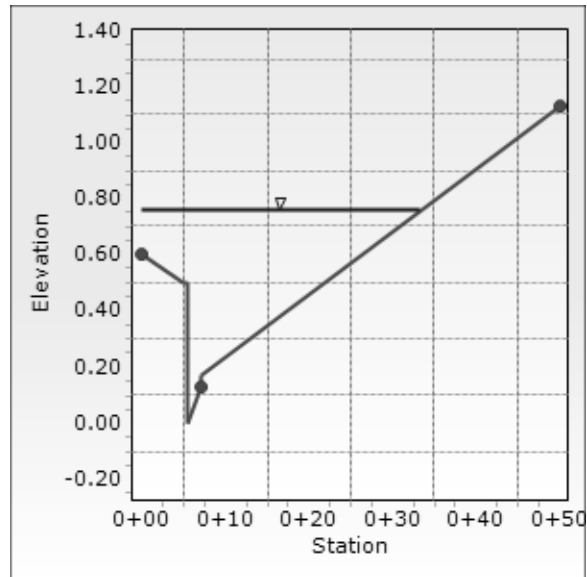
Normal Depth	0.76 ft
Elevation Range	0.00 to 1.13 ft
Flow Area	9.9 ft ²
Wetted Perimeter	33.94 ft
Hydraulic Radius	0.29 ft
Top Width	33.23 ft
Normal Depth	0.76 ft
Critical Depth	0.74 ft
Critical Slope	0.0054 ft/ft
Velocity	2.94 ft/s
Velocity Head	0.13 ft
Specific Energy	0.89 ft
Froude Number	0.950

Worksheet for FUT Durango Sect 10 yr

Results	
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	N/A
Profile Headloss	0.00 ft
Downstream Velocity	0.00 ft/s
Upstream Velocity	0.00 ft/s
Normal Depth	0.76 ft
Critical Depth	0.74 ft
Channel Slope	0.0048 ft/ft
Critical Slope	0.0054 ft/ft
Messages	
Messages	Water Surface Elevation exceeds lowest end station by 0.155530862 127316ft.

Cross Section for FUT Durango Sect 10 yr

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.0048 ft/ft
Normal Depth	0.76 ft
Discharge	29.00 cfs



Worksheet for FUT Echelon Sect 10 yr

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.0408 ft/ft
Discharge	15.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+40.0	0.83
0+73.0	0.17
0+73.0	0.13
0+74.5	0.00
0+74.5	0.50
0+75.0	0.50
0+80.0	0.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+07.0, 0.13)	0.013
(0+07.0, 0.13)	(0+73.0, 0.13)	0.016
(0+73.0, 0.13)	(0+80.0, 0.60)	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	0.38 ft
Elevation Range	0.00 to 0.83 ft
Flow Area	3.1 ft ²
Wetted Perimeter	24.62 ft
Hydraulic Radius	0.13 ft
Top Width	23.77 ft

Worksheet for FUT Echelon Sect 10 yr

Results

Normal Depth	0.38 ft
Critical Depth	0.49 ft
Critical Slope	0.0065 ft/ft
Velocity	4.85 ft/s
Velocity Head	0.36 ft
Specific Energy	0.74 ft
Froude Number	2.368
Flow Type	Supercritical

GVF Input Data

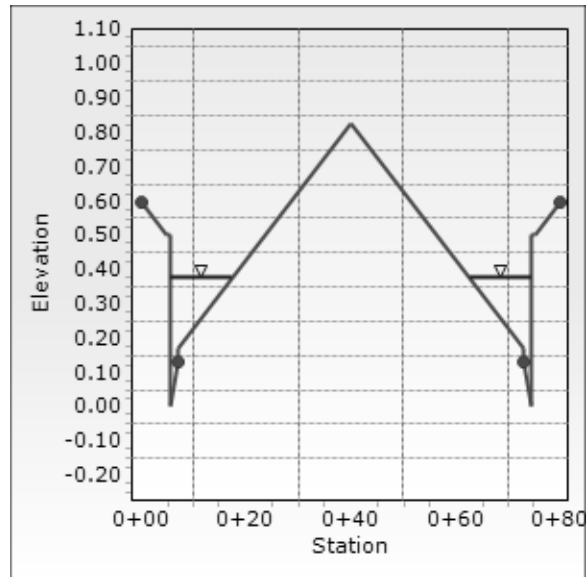
Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.38 ft
Critical Depth	0.49 ft
Channel Slope	0.0408 ft/ft
Critical Slope	0.0065 ft/ft

Cross Section for FUT Echelon Sect 10 yr

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.0408 ft/ft
Normal Depth	0.38 ft
Discharge	15.00 cfs



Worksheet for FUT Durango Sect 100 yr

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.0048 ft/ft
Discharge	70.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+50.0	1.13

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+07.0, 0.13)	0.013
(0+07.0, 0.13)	(0+50.0, 1.13)	0.016

Options

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

Results

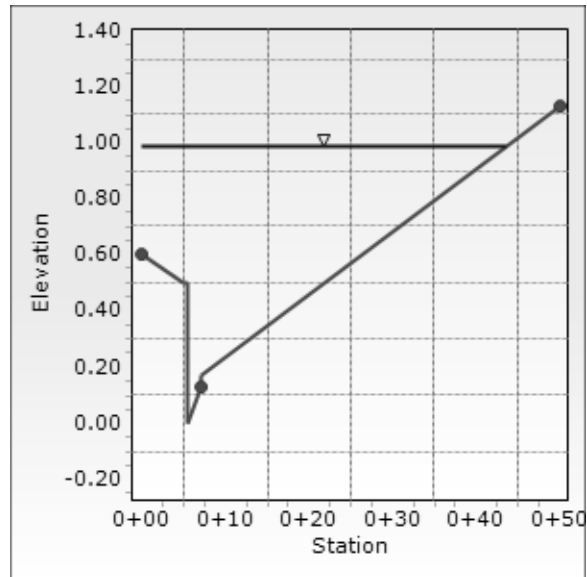
Normal Depth	0.99 ft
Elevation Range	0.00 to 1.13 ft
Flow Area	18.8 ft ²
Wetted Perimeter	44.55 ft
Hydraulic Radius	0.42 ft
Top Width	43.61 ft
Normal Depth	0.99 ft
Critical Depth	0.99 ft
Critical Slope	0.0048 ft/ft
Velocity	3.73 ft/s
Velocity Head	0.22 ft
Specific Energy	1.20 ft
Froude Number	1.002

Worksheet for FUT Durango Sect 100 yr

Results	
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	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.99 ft
Critical Depth	0.99 ft
Channel Slope	0.0048 ft/ft
Critical Slope	0.0048 ft/ft

Cross Section for FUT Durango Sect 100 yr

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.0048 ft/ft
Normal Depth	0.99 ft
Discharge	70.00 cfs



Worksheet for FUT Echelon Sect 100 yr

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.0408 ft/ft
Discharge	39.00 cfs

Section Definitions

Station (ft)	Elevation (ft)
0+00.0	0.60
0+05.0	0.50
0+05.5	0.50
0+05.5	0.00
0+07.0	0.13
0+07.0	0.17
0+40.0	0.83
0+73.0	0.17
0+73.0	0.13
0+74.5	0.00
0+74.5	0.50
0+75.0	0.50
0+80.0	0.60

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00.0, 0.60)	(0+07.0, 0.13)	0.013
(0+07.0, 0.13)	(0+73.0, 0.13)	0.016
(0+73.0, 0.13)	(0+80.0, 0.60)	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	0.49 ft
Elevation Range	0.00 to 0.83 ft
Flow Area	6.4 ft ²
Wetted Perimeter	36.23 ft
Hydraulic Radius	0.18 ft
Top Width	35.15 ft

Worksheet for FUT Echelon Sect 100 yr

Results

Normal Depth	0.49 ft
Critical Depth	0.65 ft
Critical Slope	0.0060 ft/ft
Velocity	6.05 ft/s
Velocity Head	0.57 ft
Specific Energy	1.06 ft
Froude Number	2.490
Flow Type	Supercritical

GVF Input Data

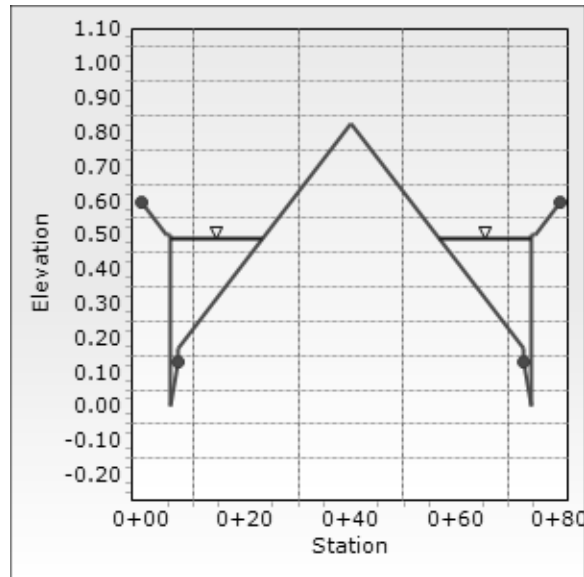
Downstream Depth	0.00 ft
Length	0.00 ft
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00 ft
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	0.49 ft
Critical Depth	0.65 ft
Channel Slope	0.0408 ft/ft
Critical Slope	0.0060 ft/ft

Cross Section for FUT Echelon Sect 100 yr

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.0408 ft/ft
Normal Depth	0.49 ft
Discharge	39.00 cfs





**McCay
ENGINEERING**

Appendix F

Excerpts from Technical Drainage Study for
Goodwill at Durango & Deer Springs

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		January 7, 2015
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: Goodwill at Durango & Deer Springs		COPIES TO: Rietz Consulting, Inc
Cross Streets:	NWC of Durango Road & Echelon Point Dr.	BCP-Deer Springs, LLC
File Number:	F:\Depot\DSMemos\DS4704C.doc	Bart Anderson, P.E., DevCo
Parcel Number:	125-20-301-028	
Zoning Action:	MOD-55735 & SDR-55737	
FEMA Flood Zone	YES NO X	
Proposed Storm Drain	YES X NO	

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Payment Trn #
1 st Submittal	10/21/2014	11/3/2014	Not Approved	\$400.00	374079: \$400
2 nd Submittal	11/24/2014	12/8/2014	Conditional Approval	\$400.00	377747: \$400
Supplement	1/7/2015	1/7/2015	See Comments Below	N/C	N/C
TOTAL FEES (LDDRS):				\$800.00	----

REMARKS:

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.
	is conditionally approved subject to Clark County Public Works Department concurrence.

1. All drainage easements must be public drainage easements to be privately maintained by the property owner to be labeled on the grading plans and to be dedicated as such in the final map or by separate document. The proposed public drainage easements must be recorded prior to the final approval of the improvement plans.

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

ays

T/R/S: T19S/R60E/20

AREA G-20

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

```

X      X  XXXXXXXX  XXXXXX  X
X      X  X      X      X  XX
X      X  X      X      X  X
XXXXXXXX  XXXX  X      XXXXXX  X
X      X  X      X      X      X
X      X  X      X      X      X
X      X  XXXXXXXX  XXXXXX  XXXX

```

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

[illegible]

95	LS	0	86
96	UD	0.100	
	*		
97	KK	CP1	
98	HC	3	
	*		
99	KK	DON1	
100	BA	.0013	
101	LS	0	92
102	UD	0.082	
	*		
103	KK	CP2	
104	HC	2	
	*		
105	KK	DON2	
106	BA	.0003	
107	LS	0	92
108	UD	0.050	
	*		

1

HEC-1 INPUT

PAGE 4

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

109	KK	DON3	
110	BA	.0012	
111	LS	0	92
112	UD	0.066	
	*		
113	KK	DDD	
114	BA	0.0010	
115	LS	0	98
116	UD	0.050	
	*		
117	KK	CP3	
118	HC	4	
	*		
119	KK	EOF2C	
120	BA	0.0024	
121	LS	0	86
122	UD	0.100	
	*		
123	KK	EOF2D	
124	BA	0.0009	
125	LS	0	86
126	UD	0.100	
	*		
127	KK	EEP1	
128	BA	0.0009	
129	LS	0	86
130	UD	0.100	

165	UD	0.050	
	*		
166	KK	DON3	
167	BA	.0012	
168	LS	0	92
169	UD	0.066	
	*		
170	KK	DDD	
171	BA	0.0010	
172	LS	0	98
173	UD	0.050	
	*		

1

HEC-1 INPUT

PAGE 6

LINE	ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
------	---

174	KK	CP3	
175	HC	4	
	*		
176	KK	DOF2C	
177	BA	0.0024	
178	LS	0	92
179	UD	0.057	
	*		
180	KK	DOF2D	
181	BA	0.0009	
182	LS	0	92
183	UD	0.050	
	*		
184	KK	DEF1	
185	BA	0.0009	
186	LS	0	98
187	UD	0.050	
	*		
188	KK	CP5	
189	HC	3	
	*		
190	KK	DEF2	
191	BA	.0009	
192	LS	0	98
193	UD	0.050	
	*		
194	KK	CP6	
195	HC	2	
	*		
196	KK	CP7	
197	HC	2	
	*		
198	ZZ		

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
19	EOF2	
	.	
34	.	EOF2A
	.	
38	CP1.....	
	.	
40	.	EOF2B
	.	
44	.	EON1
	.	
48	CP2.....	
	.	
50	.	EDD
	.	
54	CP3.....	
	.	
56	.	EOF2C
	.	
60	.	EON2
	.	
64	.	CP4.....
	.	
66	.	EOF2D
	.	
70	.	EEP1
	.	
74	.	CP5.....
	.	
76	.	EEP2
	.	
80	.	CP6.....
	.	
82	CP7.....	
	.	
84	.	EOF2
	.	
	.	

89	.	.	EOF2A	.
	.	.	.	.
93	.	.	.	EOF2B
	.	.	.	.
97	.	CP1.....	.	.
	.	.	.	.
99	.	.	DON1	.
	.	.	.	.
103	.	CP2.....	.	.
	.	.	.	.
105	.	.	DON2	.
	.	.	.	.
109	.	.	.	DON3
	.	.	.	.
113	.	.	.	DDD
	.	.	.	.
117	.	CP3.....	.	.
	.	.	.	.
119	.	.	EOF2C	.
	.	.	.	.
123	.	.	.	EOF2D
	.	.	.	.
127	.	.	.	EEP1
	.	.	.	.
131	.	.	CP5.....	.
	.	.	.	.
133	.	.	.	DEP2
	.	.	.	.
137	.	.	CP6.....	.
	.	.	.	.
139	.	CP7.....	.	.
	.	.	.	.
141	.	.	DOF2	.
	.	.	.	.
146	.	.	.	DOF2A
	.	.	.	.
150	.	.	.	DOF2B
	.	.	.	.
154	.	.	CP1.....	.
	.	.	.	.
	.	.	.	.


```

156      .      .      .      DON1
      .      .      .      .
      .      .      .      .
160      .      .      CP2.....
      .      .      .      .
      .      .      .      .
162      .      .      .      DON2
      .      .      .      .
      .      .      .      .
166      .      .      .      .      DON3
      .      .      .      .      .
      .      .      .      .      .
170      .      .      .      .      .      DDD
      .      .      .      .      .      .
      .      .      .      .      .      .
174      .      .      CP3.....
      .      .      .      .
      .      .      .      .
176      .      .      .      DOF2C
      .      .      .      .
      .      .      .      .
180      .      .      .      .      DOF2D
      .      .      .      .      .
      .      .      .      .      .
184      .      .      .      .      .      DEP1
      .      .      .      .      .      .
      .      .      .      .      .      .
188      .      .      .      CP5.....
      .      .      .      .
      .      .      .      .
190      .      .      .      .      DEP2
      .      .      .      .      .
      .      .      .      .      .
194      .      .      .      CP6.....
      .      .      .      .
      .      .      .      .
196      .      .      CP7.....

```

{***} RUNOFF ALSO COMPUTED AT THIS LOCATION

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1) *
* JUN 1998 *
* VERSION 4.1 *
*
* RUN DATE 20SEP14 TIME 15:54:41 *
*
*****

```

```

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

```

EXISTING, INTERIM, AND FUTURE CONDITIONS MODEL
GOODWILL DURANGO AND DEER SPRINGS
MOMENTUM ENGINEERS FOR RIETZ CONSULTING - B BROWN

6-HOUR STORM DISTRIBUTION #3

10- AND 100-YEAR STORM EVENTS

JR CARDS CONTAIN DARFS BASED ON THE FOLLOWING VALUES:

16 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						
+	EOF2	.00	1	FLOW	1.	2.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	EOF2A	.00	1	FLOW	0.	1.
				TIME	3.50	3.50
2 COMBINED AT						

EXISTING

+	CP1	.00	1	FLOW TIME	1. 3.58	3. 3.50
HYDROGRAPH AT						
+	EOF2B	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	EON1	.00	1	FLOW TIME	1. 3.58	3. 3.50
3 COMBINED AT						
+	CP2	.00	1	FLOW TIME	3. 3.58	7. 3.50
HYDROGRAPH AT						
+	EDD	.00	1	FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT						
+	CP3	.01	1	FLOW TIME	4. 3.50	9. 3.50
HYDROGRAPH AT						
+	EOF2C	.00	1	FLOW TIME	1. 3.58	3. 3.50
HYDROGRAPH AT						
+	EON2	.00	1	FLOW TIME	0. 3.50	1. 3.50
2 COMBINED AT						
+	CP4	.00	1	FLOW TIME	2. 3.58	4. 3.50
HYDROGRAPH AT						
+	EOF2D	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	EEP1	.00	1	FLOW TIME	0. 3.50	1. 3.50
2 COMBINED AT						
+	CP5	.00	1	FLOW TIME	1. 3.50	3. 3.50
HYDROGRAPH AT						
+	EEP2	.00	1	FLOW TIME	0. 3.50	1. 3.50
3 COMBINED AT						
+	CP6	.01	1	FLOW TIME	3. 3.58	8. 3.50
2 COMBINED AT						
+	CP7	.01	1	FLOW TIME	7. 3.50	17. 3.50
HYDROGRAPH AT						

EXISTING
CONDITIONS

(FROM
THE N.)

$$CP3 = 4/9 + 8/18 = 12/27$$

(FROM
THE W.)

$$CP5 = 1/3 + 12/28 = 13/31$$

$$CP6 = 3/8 + 12/28 = 15/36$$

$$CP7 = 7/17 + 8/18 + 12/28 = 27/63$$

(N.) (W.)

+	EOF2	.00	1	FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT						
+	EOF2A	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	EOF2B	.00	1	FLOW TIME	0. 3.50	1. 3.50
3 COMBINED AT						
+	CP1	.00	1	FLOW TIME	1. 3.58	4. 3.50
HYDROGRAPH AT						
+	DON1	.00	1	FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT						
+	CP2	.00	1	FLOW TIME	2. 3.50	6. 3.50
HYDROGRAPH AT						
+	DON2	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	DON3	.00	1	FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT						
+	DDD	.00	1	FLOW TIME	1. 3.50	2. 3.50
4 COMBINED AT						
+	CP3	.01	1	FLOW TIME	5. 3.50	12. 3.50
HYDROGRAPH AT						
+	EOF2C	.00	1	FLOW TIME	1. 3.58	3. 3.50
HYDROGRAPH AT						
+	EOF2D	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	EEP1	.00	1	FLOW TIME	0. 3.50	1. 3.50
3 COMBINED AT						
+	CP5	.00	1	FLOW TIME	2. 3.58	6. 3.50
HYDROGRAPH AT						
+	DEP2	.00	1	FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT						

INTERIM
CONDITIONS

(FROM
THE N.)

$$CP3 = 5/12 + 8/18 = 13/30$$

(FROM
THE W.)

$$CP5 = 2/6 + 12/28 = 14/34$$

+	CP6	.01	1	FLOW TIME	3. 3.50	8. 3.50
2 COMBINED AT						
+	CP7	.01	1	FLOW TIME	9. 3.50	20. 3.50
HYDROGRAPH AT						
+	DOF2	.00	1	FLOW TIME	2. 3.50	3. 3.50
HYDROGRAPH AT						
+	DOF2A	.00	1	FLOW TIME	1. 3.50	1. 3.50
HYDROGRAPH AT						
+	DOF2B	.00	1	FLOW TIME	0. 3.50	1. 3.50
3 COMBINED AT						
+	CP1	.00	1	FLOW TIME	3. 3.50	6. 3.50
HYDROGRAPH AT						
+	DON1	.00	1	FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT						
+	CP2	.00	1	FLOW TIME	4. 3.50	8. 3.50
HYDROGRAPH AT						
+	DON2	.00	1	FLOW TIME	0. 3.50	1. 3.50
HYDROGRAPH AT						
+	DON3	.00	1	FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT						
+	DDD	.00	1	FLOW TIME	1. 3.50	2. 3.50
4 COMBINED AT						
+	CP3	.01	1	FLOW TIME	7. 3.50	14. 3.50
HYDROGRAPH AT						
+	DOF2C	.00	1	FLOW TIME	2. 3.50	5. 3.50
HYDROGRAPH AT						
+	DOF2D	.00	1	FLOW TIME	1. 3.50	2. 3.50
HYDROGRAPH AT						
+	DEP1	.00	1	FLOW TIME	1. 3.50	2. 3.50
3 COMBINED AT						

$$CP6 = 3/8 + 12/28 = 15/36 \quad (\text{INTERIM})$$

(FROM THEN.)

$$CP7 = 9/20 + 12/28 + 8/18 = 29/66$$

(FROM THEN.)

↓ BEGIN FUTURE CONDITIONS

$$CP3 = 7/14 + 8/18 = 15/32$$

(FROM THEN.)

+	CP5	.00	1	FLOW TIME	4. 3.50	9. 3.50
HYDROGRAPH AT						
+	DEF2	.00	1	FLOW TIME	1. 3.50	2. 3.50
2 COMBINED AT						
+	CP6	.01	1	FLOW TIME	6. 3.50	11. 3.50
2 COMBINED AT						
+	CP7	.01	1	FLOW TIME	12. 3.50	25. 3.50

FUTURE CONDITIONS =

$$CP5 = 4/9 + 12/28 = 16/37$$

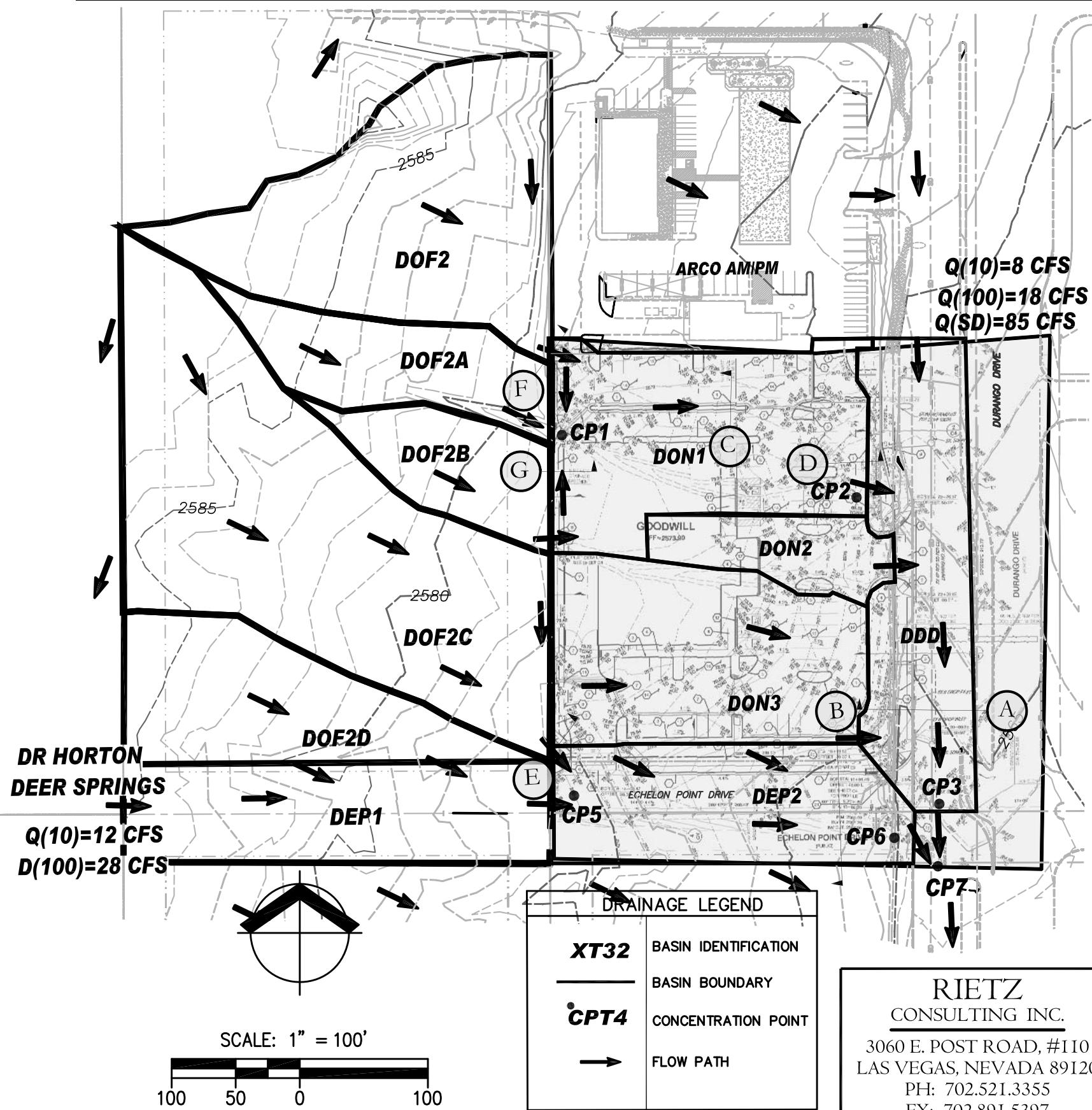
$$CP6 = 6/11 + 12/28 = 18/39$$

$$CP7 = 12/25 + 12/28 + 8/18 = 32/71$$

(W.) (N.)

*** NORMAL END OF REC-1 ***

NORMAL DEPTH FLOW CALCULATIONS					
FUTURE CONDITIONS					
STREET NAME OR LOCATION	SLOPE, %	Q(10) / Q(100) CFS	D(10) / D(100), FEET	V(10) / V(100), FPS	V(10)*D(10) / V(100)*D(100)
Section A - Durango Drive West half street	1.50	15 / 32	0.53 / 0.65	3.7 / 4.3	2.0 / 2.8
Section B - Echelon Point Drive north half street (30' back of curb to CL)	4.40	18 / 39	0.48 / 0.60	6.0 / 6.7	2.9 / 4.0



SUMMARY OF PEAK FLOW RATES-FUTURE CONDITIONS

CONC. POINT/ DRAINAGE AREA	AREA, ACRES	PEAK FLOW, CFS		NOTES
		10-YR	100-YR	
CP1		3	6	
CP2		4	8	
CP3		15	32	A, C
CP5		16	37	B
CP6		15	36	B
CP7		32	71	A, B, C
DDD	0.66	1	2	
DEP1	0.60	1	2	
DEP2	0.58	1	2	
DOF2	1.05	2	3	
DOF2B	0.29	<1	1	
DOF2C	1.54	2	5	
DOF2D	0.55	1	2	
DON1	0.80	1	2	
DON2	0.22	<1	1	
DON3	0.76	1	2	

10/9/2014

A. Peak flow rates referenced from the Technical Drainage Study for Arco AM/PM @ Deer Springs and Durango, by Walker Engineering are added directly to the peak flow rates at this location:
 $Q(10)=8$ cfs, $Q(100)=18$ CFS

B. Peak flow rates referenced from the Technical Drainage Study for D R Horton Deer Springs, by Slater Hanifan, are added directly to the peak flow rates at this location:
 $Q(10)=12$ cfs, $Q(100)=28$ CFS

C. Table reports surface flow only at this location. Approximate 10- and 100-yr flow in the underground storm drain is 85 cfs.

MISCELLANEOUS ONSITE FLOW CALCULATIONS
FUTURE CONDITIONS

LOCATION	SLOPE, PERCENT	Q ₁₀₀ CFS	D ₁₀₀ NORMAL FEET	VEL. HEAD, FEET	WEIR DEPTH, FEET
Section C - L-curb flowline	0.4	8	0.64	0.09	NA
Section D - L-curb flowline	2.3	8	0.49	0.34	NA
Section E - 5' concrete flume	1.0	5	0.10	0.07	NA
Section F - 5' concrete flume	10.0	3	0.09	0.63	0.34
Section G - 5' concrete flume	0.6	1	0.11	0.05	NA

GOODWILL AT
DURANGO & DEER SPRINGS
FUTURE CONDITIONS
DRAINAGE BASINS

FIGURE
5



Appendix G

Excerpts from Technical Drainage Study for Deer
Springs-Durango Apartments



Department of Public Works

500 S Grand Central Pky • Box 554000 • Las Vegas NV 89155-4000
(702) 455-6000 • Fax (702) 455-6040

Denis Cederburg, P.E., Director • E-Mail: dlc@ClarkCountyNV.gov

PW20-11678

LTR

Drainage Study Approval Letter

Date: March 4, 2020
Firm: Impulse Civil Engineering & Planning
Engineer: Peter J. Laas, P.E.
Address: 7485 West Azure Avenue, Suite 226, Las Vegas, NV 89130
Phone: (702) 815-0720
Fax: (702) 478-8535
E-mail: plaas@impulsecivil.net

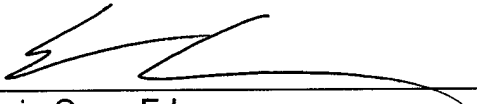
Subject: Technical Drainage Study for Deer Springs-Durango Apartments
Location: SW of Deer Springs Way and Durango Drive
APN: 125-20-301-008,-20
Sec, Township, Range: S20, T19S, R60E
Flood Zone & Panel: Zone X, 1745E, dated September 27, 2002
Application Number: PW20-11678

Submittals	Date Received	Date Returned	Reviewer	Miscellaneous
Technical	02/20/2020	03/04/2020	EC	
Addendum 1	02/20/2020	03/04/2020	EC	

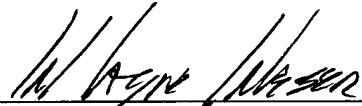
The above-referenced project is located within the **City of Las Vegas** adjacent to Clark County unincorporated areas. The drainage study was submitted to the County for concurrence on February 20, 2020. In addition, the County has received the City of Las Vegas acceptance letter dated February 18, 2020 for the Technical Drainage Study (DS05244B).

The County concurs with the acceptance of this Drainage Study by the City of Las Vegas. Please note that the County's review of this development is limited to drainage issues significant to Clark County unincorporated areas.

The County's review is solely based on the information submitted by the Engineer of Record. The County's review is strictly limited to compliance with minimum County Codes and Standards. The Engineer of Record is responsible for researching and addressing situations that may require designs above and beyond the minimum codes for issues of public safety and impacts to upstream, downstream and adjacent properties. The County assumes no liability for information data, designs or conclusions of the Engineer of Record.



Ernie Corn, E.I.
Associate Civil Engineer
Development Review
ernie.corn@ClarkCountyNV.gov



W. Layne Weber, P.E., CFM
Principal Engineer
Development Review
wlweber@ClarkCountyNV.gov

```

1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*   JUN 1998
*   VERSION 4.1
*
* RUN DATE 23MAY13 TIME 09:14:27
*
*****

```

PROP.OUT

```

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

```

```

      X  X XXXXXX XXXX      X
      X  X X      X      XX
      X  X X      X      X
      XXXXXX XXXX X      XXXX X
      X  X X      X      X
      X  X X      X      X
      X  X XXXXXX XXXXX XXX

```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE. THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION

NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE, SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY, DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION

KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1 HEC-1 INPUT PAGE 1

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

1          *DIAGRAM
2          ID      SLATER HANIFAN GROUP
3          ID      DEER SPRINGS
4          ID      D.R. HORTON
5          ID      PROPOSED CONDITION
6          ID      RETURN PERIOD ----- 100-YR & 10-YR
7          ID      DISTRIBUTION ----- 6-HOUR SDN3
8          ID      PROJECT NO. ----- DRH1231.003
9          ID      FILENAME ----- PROP.H1
10         ID      DATE ----- 05/23/2013
11         ID      MODELED BY ----- ARP
12         ID
13         ID      PRECIPITATION STORM EVENT RATIOS
14         ID      STORM EVENT          RATIO
15         ID      10-YR                0.52
16         ID
17         IT      5          0          0          300
18         IO      5          0          0
19         IN      5          0          0
20         JR      PREC      1.00      0.52
21         *
22         KK      OFF1
23         KM      EXISTING PORTION OF ECHELON
24         BA      .0045
25         PB      2.86
26         PC      0          0.020      0.057      0.070      0.087      0.108      0.124      0.130      0.130      0.130
27         PC      0.130      0.130      0.130      0.133      0.140      0.142      0.148      0.158      0.172      0.181
28         PC      0.190      0.197      0.199      0.200      0.201      0.204      0.214      0.229      0.241      0.249
29         PC      0.251      0.256      0.270      0.278      0.281      0.283      0.295      0.322      0.352      0.403
30         PC      0.499      0.590      0.710      0.744      0.781      0.812      0.819      0.835      0.851      0.856
31         PC      0.860      0.868      0.876      0.888      0.910      0.926      0.937      0.950      0.970      0.976
32         PC      0.982      0.985      0.987      0.989      0.990      0.993      0.993      0.994      0.995      0.998
33         PC      0.998      0.999      1
34         LS      0          88.2
35         UD      0.050
36         *
37         KK      ON3D
38         KM      DEVELOPED ONSITE BASIN SOUTH OF ECHELON POINT TO WEST
39         BA      .0115
40         LS      0          92.2
41         UD      0.080
42         *
43         KK      ECH1
44         KM      DEVELOPED ECHELON POINT STREET BASIN (WEST)
45         BA      .0012
46         LS      0          98.0
47         UD      0.050
48         *

```

1 HEC-1 INPUT PAGE 2

```

LINE      ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

45         KK      CAM
46         KM      DEVELOPED CAMPBELL STREET BASIN
47         BA      .0008
48         LS      0          98.0
49         UD      0.052
50         *
51         KK      CP1
52         KM      COMBINATION POINT FLOWS TO REGIONAL CHANNEL (WEST)
53         HC      4
54         *

```

53	KK	ON2D	
54	KM	DEVELOPED ONSITE BASIN SOUTH OF ECHELON POINT TO EAST	
55	BA	.0131	
56	LS	0	92.2
57	UD	0.078	
	*		
58	KK	ON1D	
59	KM	DEVELOPED ONSITE BASIN NORTH OF ECHELON POINT	
60	BA	.0130	
61	LS	0	92.2
62	UD	0.086	
	*		
63	KK	EC2Z	
64	KM	DEVELOPED ECHELON POINT STREET BASIN (EAST)	
65	BA	.0016	
66	LS	0	98.0
67	UD	0.050	
	*		
68	KK	CPE	
69	KM	COMBINATION POINT FLOWS SOUTH IN REGIONAL CHANNEL	
70	HC	2	
	*		
71	KK	DER	
72	KM	DEVELOPED DEER SPRING STREET BASIN	
73	BA	.0010	
74	LS	0	98.0
75	UD	0.050	
	*		
76	ZZ		

```

SCHEMATIC DIAGRAM OF STREAM NETWORK
INPUT LINE      (V) ROUTING      (--->) DIVERSION OR PUMP FLOW
NO.             (.) CONNECTOR    (<---) RETURN OF DIVERTED OR PUMPED FLOW

21             OFF1
.
35             ON3D
.
40             ECH1
.
45             CAM
.
50             CP1.....
.
53             ON2D
.
58             ON1D
.
63             ECH2
.
68             CPE.....
.
71             DER

```

```

1 *****
*
*      FLOOD HYDROGRAPH PACKAGE  (HEC-1)
*      JUN 1998
*      VERSION 4.1
*
*      RUN DATE   23MAY13   TIME  09:14:27
*
* *****

```

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

```
PRECIPITATION STORM EVENT RATIOS
STORM EVENT          RATIO
10-YR                0.52
```

```

OUTPUT CONTROL VARIABLES
      IPRNT      5  PRINT CONTROL
      IPLOT      0  PLOT CONTROL
      QSCAL      0.  HYDROGRAPH PLOT SCALE

```

PROP.OUT

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

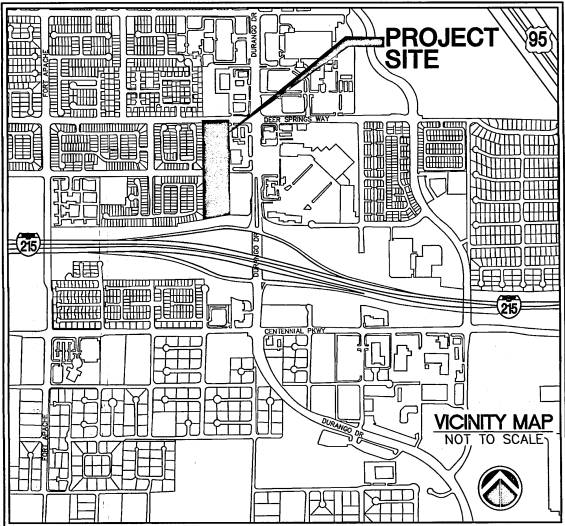
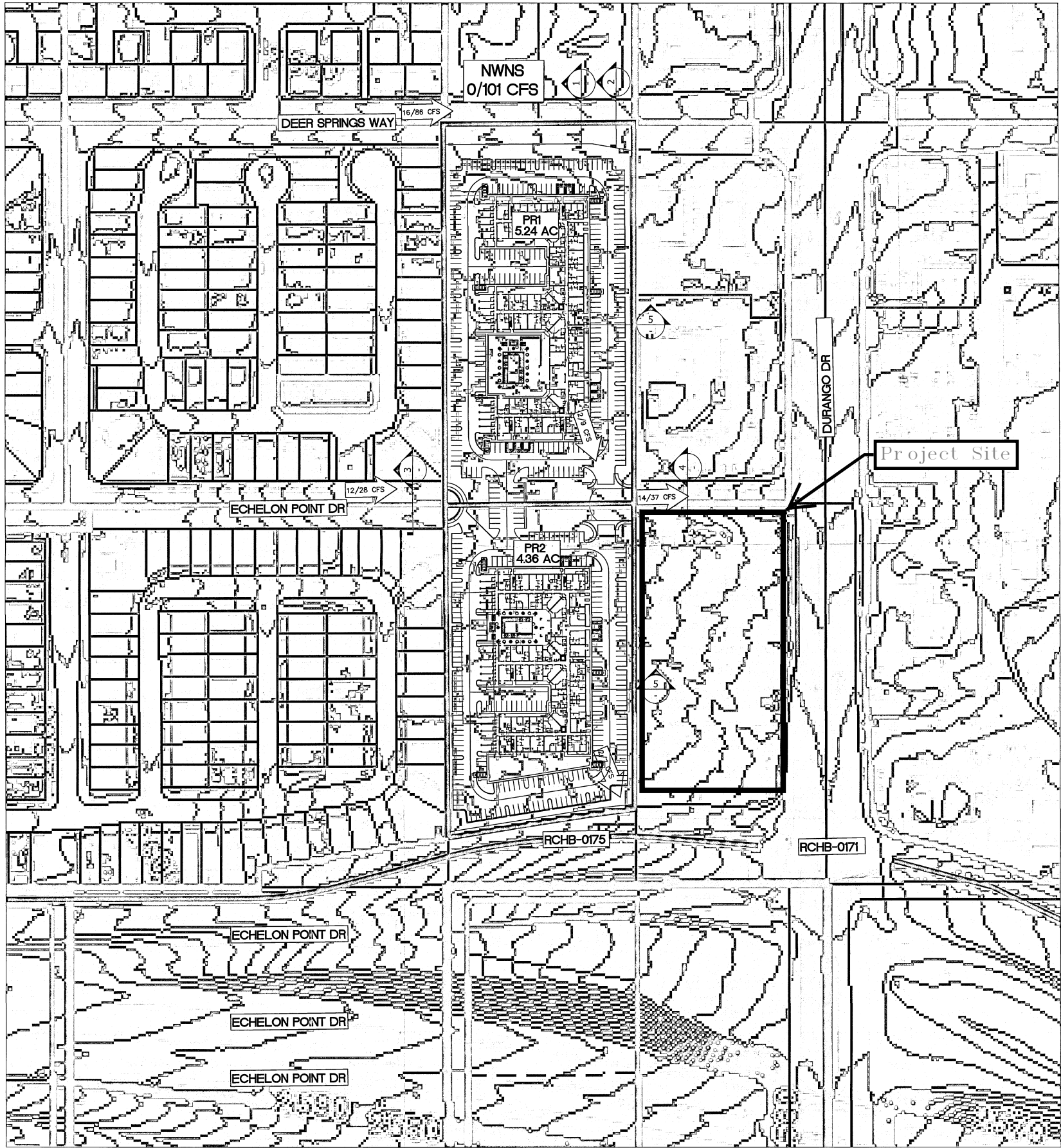
JR MULTI-RATIO OPTION
 RATIOS OF PRECIPITATION
 1.00 .52

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 1.00	RATIO 2 .52
HYDROGRAPH AT +	OFF1	.00	1	FLOW TIME	8. 3.50	3. 3.50
HYDROGRAPH AT +	ON3D	.01	1	FLOW TIME	22. 3.50	9. 3.50
HYDROGRAPH AT +	ECH1	.00	1	FLOW TIME	3. 3.50	1. 3.50
HYDROGRAPH AT +	CAM	.00	1	FLOW TIME	2. 3.50	1. 3.50
4 COMBINED AT +	CP1	.02	1	FLOW TIME	35. 3.50	15. 3.50
HYDROGRAPH AT +	ON2D	.01	1	FLOW TIME	25. 3.50	10. 3.50
HYDROGRAPH AT +	ON1D	.01	1	FLOW TIME	24. 3.50	10. 3.50
HYDROGRAPH AT +	ECH2	.00	1	FLOW TIME	4. 3.50	2. 3.50
2 COMBINED AT +	CPE	.01	1	FLOW TIME	28. 3.50	12. 3.50
HYDROGRAPH AT +	DER	.00	1	FLOW TIME	2. 3.50	1. 3.50

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



Interim/Ultimate Condition Results					
Basin	Acreage	Q ₁₀	Q ₁₀₀	Collection Point	Q ₁₀ Q ₁₀₀
PR1	5.24	2	9		
PR2	4.36	2	7		

Deer Springs - Durango Apartments												
Interim/Ultimate Condition Street Flow Calculations												
Street Name	Sec #	Slope (%)	R.O.W. Width (ft)	Q ₁₀ (cfs)	V ₁₀ (ft/s)	d ₁₀ (ft)	V ₁₀ * d ₁₀	Q ₁₀₀ (cfs)	V ₁₀₀ (ft/s)	d ₁₀₀ (ft)	V ₁₀₀ * d ₁₀₀	Dry Lane (ft)
Deer Springs Way	1	2.44	100	16	4.58	0.51	2.34	86	6.79	0.81	5.50	19.00
Deer Springs Way NWNS	2	2.44	100	0	0.00	0.00	0.00	101	7.10	0.85	6.04	44.50
Echelon Point Drive	3	1.95	80	12	3.39	0.40	1.36	28	4.09	0.50	2.05	14.50
Echelon Point Drive DS	4	4.40	80	14	5.66	0.45	2.55	37	6.57	0.60	3.94	12.00
Onsite Street	5	0.60	63	2	1.56	0.23	0.36	9	2.28	0.40	0.91	N/A
Dry Lane Calculations:												
For 80-foot Right of Way: Dry Lane = ((Crown - d ₁₀) / Cross Slope) * (Center Turn Lane / 2)												
For 100-foot Right of Way: Dry Lane = ((0.83 - d ₁₀) / .02) - 7												
Dry Lane = ((1.03 - d ₁₀) / .02) - 7												

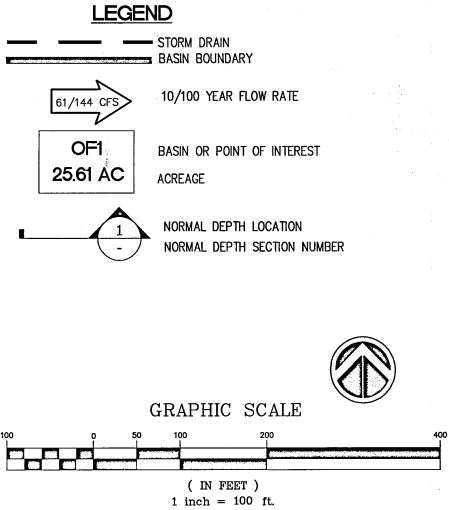


FIGURE 4

INTERIM CONDITION BASIN MAP

DEER SPRINGS - DURANGO

CLARK COUNTY, NEVADA

PROJECT

Impulse

Civil Engineers - PLANNERS

7405 WEST ALPINE DRIVE, SUITE 200

LAS VEGAS, NEVADA 89120

PHONE (702) 854-0700

FACSIMILE (702) 476-8535

NO. # : 01-1946

DATE : 10/19/19

SCALE : 1" = 200'

SHEET 1 OF 1

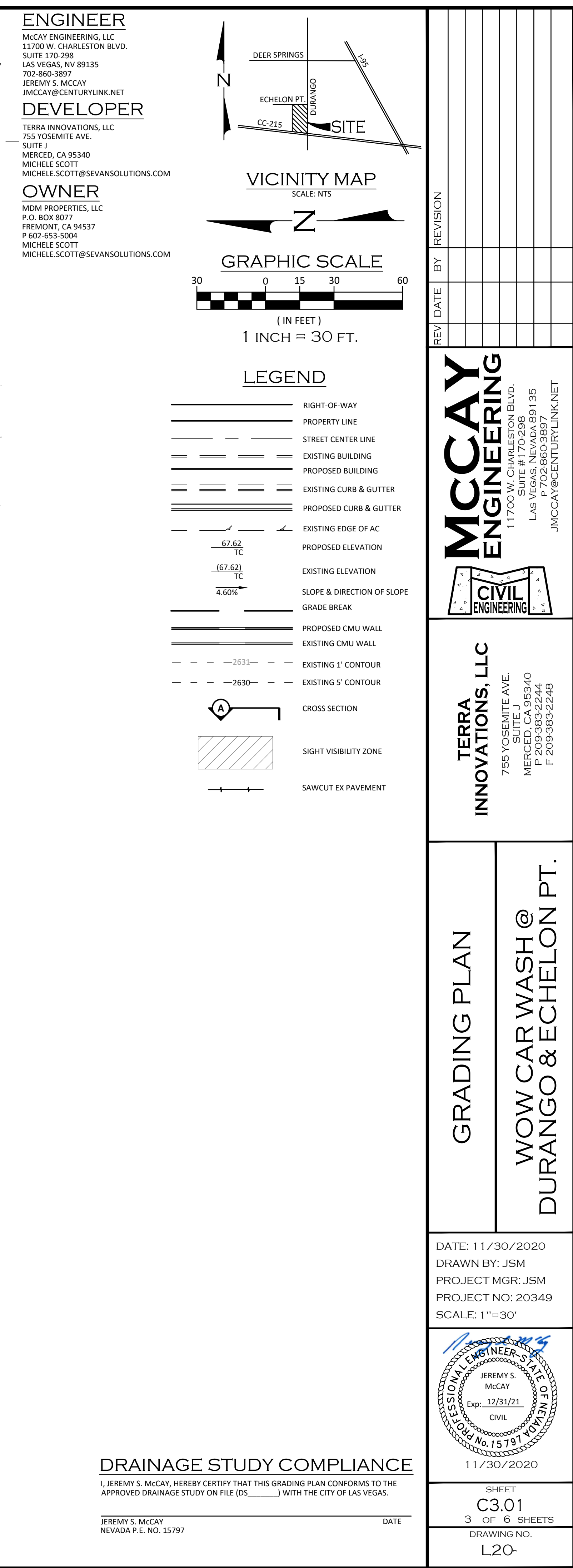
SHEETS

PW20-11676



**McCay
ENGINEERING**

Project Plans



1. THE OWNER, SITE DEVELOPER, CONTRACTOR, AND/OR THEIR AUTHORIZED AGENTS SHALL EACH HAVE TO REMOVE ALL SEDIMENT, MUD, CONSTRUCTION DEBRIS, OR OTHER POTENTIAL POLLUTANTS THAT MAY HAVE BEEN DISCHARGED TO, OR ACCUMULATED IN, THE PUBLIC RIGHTS OF WAY OF CLARK COUNTY AS A RESULT OF CONDUCTING ANY CONSTRUCTION ACTIVITY OR ANY OTHER ACTIVITY IN CONNECTION WITH THE CONSTRUCTION PROJECT. SUCH MATERIAL SHALL BE PREVENTED FROM ENTERING THE STORM SEWER SYSTEM.
2. ADDITIONAL CONSTRUCTION SITE DISCHARGE BEST MANAGEMENT PRACTICES MAY BE REQUIRED OF THE CONTRACTOR IF THIS OR ANY OTHER ACTIVITY OR CONSTRUCTION ACTIVITY IN CONNECTION THEREWITH DOES NOT MEET THE PERFORMANCE STANDARDS SPECIFIED IN CLARK COUNTY AND THE LAS VEGAS VALLEY CONSTRUCTION SITE BMP GUIDANCE MANUAL.
3. TEMPORARY OR PERMANENT STABILIZATION PRACTICES WHICH ARE INSTALLED ON DISTURBED AREAS AS SOON AS PRACTICABLE AND NO LATER THAN 14 DAYS AFTER THE CONSTRUCTION ACTIVITY IN THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. SOME EXCEPTIONS MAY APPLY; REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NV1R100000, SITE STABILIZATION REQUIREMENTS, SCHEDULES, AND DEADLINES.
4. AT ALL TIMES, THE CONTRACTOR OR ITS AGENT SHALL INSPECT ALL DISTURBED AREAS, AREAS USED FOR STORAGE OF MATERIALS AND EQUIPMENT THAT ARE EXPOSED TO PRECIPITATION, VEHICLE ENTRANCE AND EXIT LOCATIONS, AND ALL BMPs WEEKLY, AND WITHIN 24 HOURS AFTER ANY RAIN EVENT OF 0.5 INCHES OR MORE. THE CONTRACTOR OR ITS AGENT SHALL MAINTAIN RECORDS OF ALL SUCH INSPECTIONS AND REPORTING PLAN AS NECESSARY. SOME EXCEPTIONS TO WEEKLY INSPECTIONS MAY APPLY, SUCH AS SUSPENSION OF LAND DISTURBANCE ACTIVITIES. REFER TO THE NEVADA STORMWATER GENERAL PERMIT FOR CONSTRUCTION ACTIVITY NV1R100000, INSPECTIONS SECTION.
5. ACCORDING TO SEDIMENT CONTROL, SEDIMENT SHALL BE REMOVED WITHIN SEVEN DAYS AFTER A STORMWATER RUNOFF EVENT OR PRIOR TO THE NEXT ANTICIPATED STORM EVENT, WHICHEVER IS EARLIER. SEDIMENT SHALL BE REMOVED WHEN BMP DESIGN CAPACITY HAS BEEN REDUCED BY 50 PERCENT OR MORE.
6. AT ALL TIMES, THE CONTRACTOR SHALL PREVENT ANY STORMWATER FROM ENTERING ANY OF THE DRAINAGE ACTIONS IN THE MANNER PRESCRIBED BY CLARK COUNTY, INCLUDING BUT NOT LIMITED TO PROVIDING PHOTOS AND DESCRIPTIONS OF THE CORRECTIONS COMPLETED BY THE CONTRACTOR OR HIS AGENT.

THE EAST HALF (E 1/2) OF THE SOUTHEAST QUARTER (SE 1/4) OF THE
NORTHEAST QUARTER (NE 1/4) OF THE SOUTHWEST QUARTER (SW
1/4) OF SECTION 20, TOWNSHIP 19S, RANGE 60E, M.D.B. & M., CLARK
COUNTY, NEVADA.

CITY OF LAS VEGAS BENCHMARK "5LV9020S6", CITY OF LAS VEGAS
PIN AND PLATE IN TOP OF CURB, SOUTHWEST CORNER OF
DURANGO DR. AND WEST BOUND 215 ENTRANCE NEAR THE PT OF
DURANGO DRIVE.

ELEVATION: 2,558.03 (US SURVEY FEET)
779.689 (METERS)

THE CENTERLINE OF DURANGO DRIVE AND THE EAST LINE OF THE
SOUTHEAST QUARTER (SE 1/4) OF THE NORTHEAST QUARTER (NE
1/4) OF THE SOUTHWEST QUARTER (SW 1/4) OF SECTION 20,
TOWNSHIP 19 SOUTH, RANGE 60 EAST, M.D.M., CITY OF LAS VEGAS,
CLARK COUNTY, NEVADA, HAVING A BEARING OF S 0° 15' 41" W,
ALSO BEING S 0° 15' 39" W AS SHOWN ON MAP THEREOF ON FILE
IN FILE 216 OF SURVEYS, PAGE 94, OFFICIAL RECORDS, CLARK
COUNTY NEVADA.

EXISTING UTILITY LOCATIONS SHOWN HEREIN ARE APPROXIMATE ONLY. THE CONTRACTOR SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO DETERMINE THE EXACT VERTICAL AND HORIZONTAL LOCATION OF ALL EXISTING UNDER-GROUND UTILITIES PRIOR TO COMMENCING CONSTRUCTION. NO REPRESENTATION IS MADE THAT ALL EXISTING UTILITIES ARE SHOWN HEREON. THE ENGINEER ASSUMES NO RESPONSIBILITY FOR UTILITIES NOT SHOWN OR UTILITIES NOT SHOWN IN THEIR PROPER LOCATION. ALL DISCREPANCIES MUST BE IMMEDIATELY REPORTED TO THE ENGINEER.
CALL BEFORE YOU DIG: 1-800-227-2600.

ALL BMP SWALES TO BE IN ACCORDANCE WITH HCDDM
SECTION 1500:
SLOPE - 1% MAX SLOPE FOR LAST 30 FEET OF SWALE LENGTH
4:1 SIDE SLOPES

ADD 2500 FEET TO ABBREVIATIONS TO GET TRUE ELEVATION

NO WALLS, FENCES, SHRUBS, UTILITY APPURTENANCES OR ANY OTHER OBJECT, OTHER THAN TRAFFIC CONTROL DEVICES, FIRE HYDRANTS, TREES, AND STREETLIGHT POLES, MAY BE CONSTRUCTED OR INSTALLED WITHIN THE SIGHT VISIBILITY ZONE UNLESS SAID OBJECT IS MAINTAINED AT LESS THAN 24 INCHES IN HEIGHT, MEASURED FROM TOP OF CURB, OR WHERE NO CURB EXISTS, A HEIGHT OF 27 INCHES MEASURED FROM THE STREET SURFACE. THIS RESTRICTION EXTENDS ALONG THE SIGHT VISIBILITY LINE THROUGHOUT LANDSCAPED MEDIANS.

AS SHOWN BY FLOOD INSURANCE RATE MAP NO. 32003C1745E, DATED SEPTEMBER 27, 2002, THE SITE IS LOCATED IN ZONE X, AREAS OF 2% ANNUAL CHANCE FLOODPLAIN.

TOTAL SITE AREA	3.34 ACRES
ONSITE AREA OF DISTURBANCE	1.69 ACRES
OFFSITE AREA OF DISTURBANCE	0.43 ACRES

GEOTECHNICAL STUDY

THE SITE SHALL BE GRADED PER RECOMMENDATIONS AS OUTLINE
WITHIN THE GEOTECHNICAL STUDY FOR DURANGO CAR WASH BY
NOVA GEOTECHNICAL. DATED JULY 17, 2020, PROJECT NO.
G-20-085.

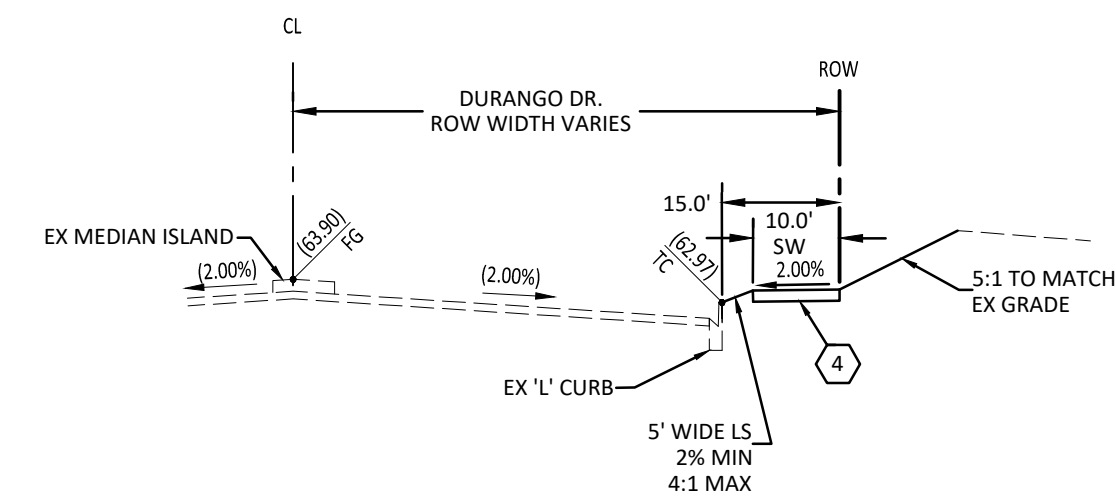
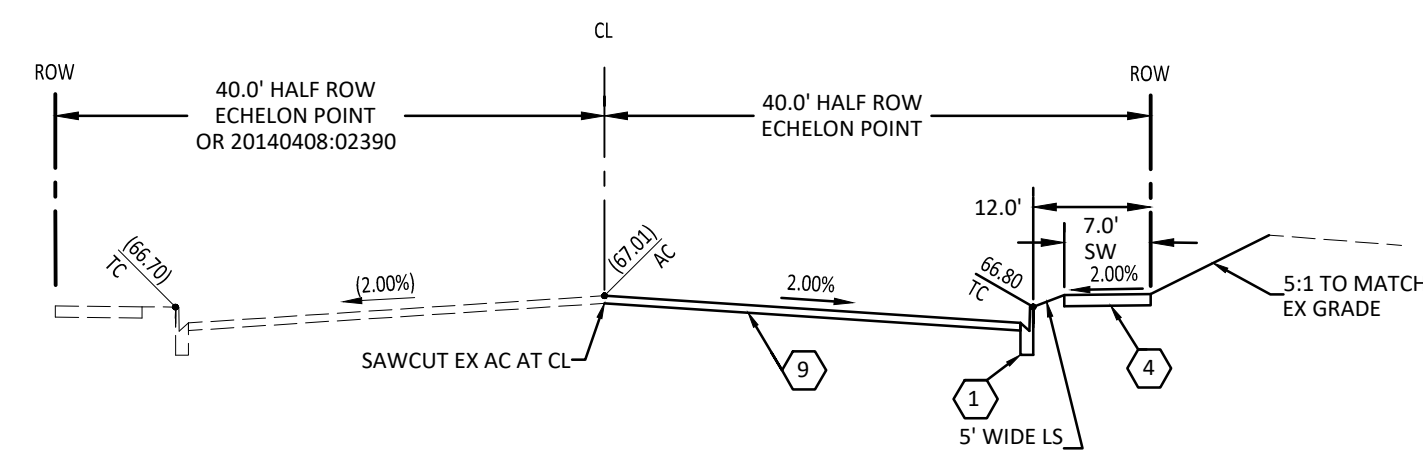
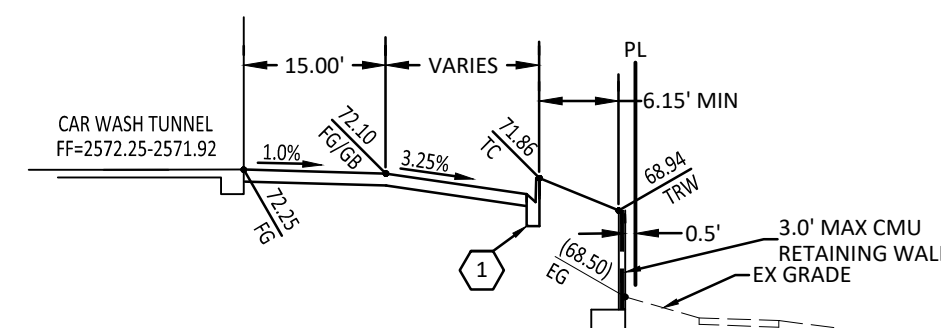
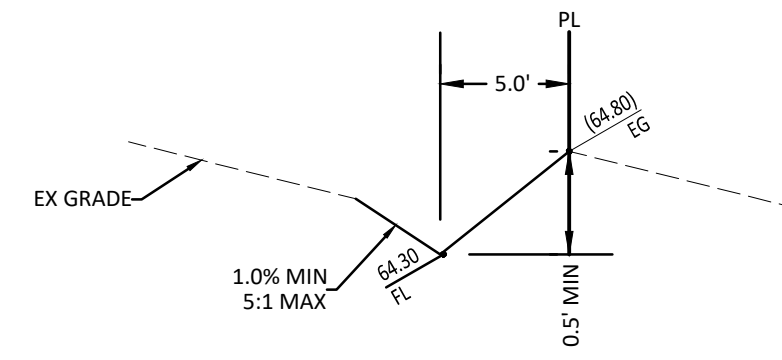
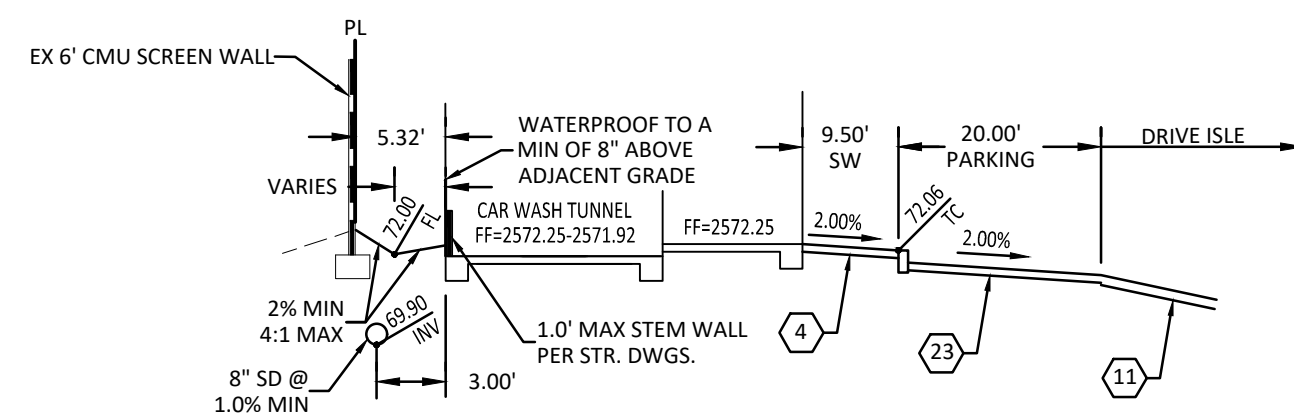
1. INSTALL "1" TYPE CURB AND GUTTER PER CAUSD# #216
2. INSTALL ONSITE "A" TYPE CURB (BLACK CONCRETE WHERE INDICATED ON PLAN)
PER DETAIL ON C3.02
3. INSTALL "A" TYPE CURB PER CAUSD# #219
4. INSTALL CONCRETE SIDEWALK PER CAUSD# #234
5. INSTALL SIDEWALK DRAIN PER CAUSD# #236
6. INSTALL SIDEWALK CURB RAMP PER CAUSD# #238
7. INSTALL ONSITE CUBB RAMP PER DETAIL ON C3.02
8. INSTALL ONSITE CUBB RAMP "A" TYPE AGG. BASE PER CAUSD# #235
9. INSTALL ONSITE CUBB RAMP "I" PER DETAIL ON C3.02
10. INSTALL "3" (SIDEWALK) SIDEWALK AGG. BASE "A" TYPE AGG. BASE
PER DETAIL ON C3.02
11. INSTALL "2" (PARKING) AGG. BASE "I" TYPE AGG. BASE.
12. INSTALL "6" CONCRETE OVER "4" TYPE II AGG. BASE WITH STEEL REINFORCEMENT
OR WEAKENED PLANE CONTROL JOINTS PER GEOTECH STUDY.
13. INSTALL EMPER PIPING LINED SWEAL PER NOTE THIS SHEET AND DETAIL ON SHEET
C3.02
14. INSTALL DEPRESSION CURB ON DETAIL ON SHEET C3.02
15. INSTALL CONCRETE DRIVEWAY PER DETAIL #222: 1 & 228
16. INSTALL TRASH ENCLOSURE PER ARCH DWG#
17. SAWCUT AND REMOVE AGG. BEYOND. PROTECT EDGE FROM DAMAGE
18. INSTALL ARCH DRAIN OVERLAP DETAIL ON SHEET C3.02
19. INSTALL ZURB 288S TRUCK DRAIN SYSTEM WITH 18" TRAFFIC RATED AND
COMPLIANT GAGE, OR APPROVED EQUIV. (INV.UT)=70.55
20. INSTALL "6" PVC STORMDRAIN @ 1.00% MIN WITH MITERED DRAIN FLOWLINE
TERMINATED IN BUILDING
21. INSTALL "1.0" MAX STEAM WALL. SEE STRUCTURAL DWG#
22. INSTALL "3" MAX RETAINING WALL PER SBNBRS B-100-1
23. INSTALL "6" CONCRETE OVER "4" TYPE II AGG. BASE WITH STEEL REINFORCEMENT
OR WEAKENED PLANE CONTROL JOINTS PER GEOTECH STUDY.

I, JEREMY S. McCAY, HEREBY CERTIFY THAT THIS GRADING PLAN CONFORMS TO THE APPROVED DRAINAGE STUDY ON FILE (DS _____) WITH THE CITY OF LAS VEGAS.

JEREMY S. McCAY
NEVADA B.E. NO. 15707

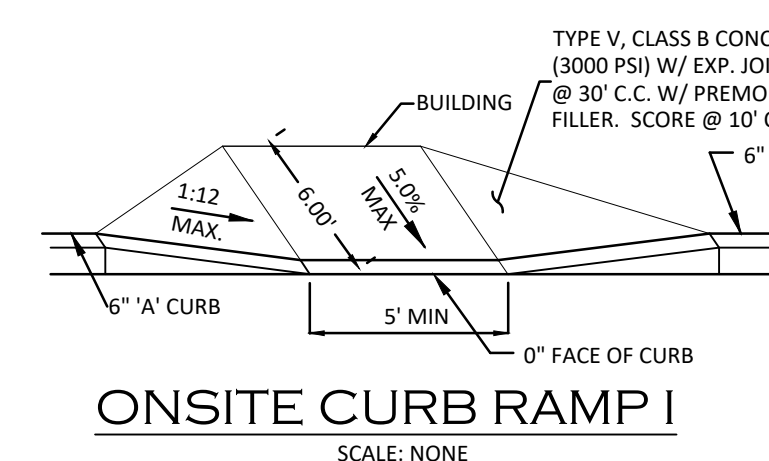
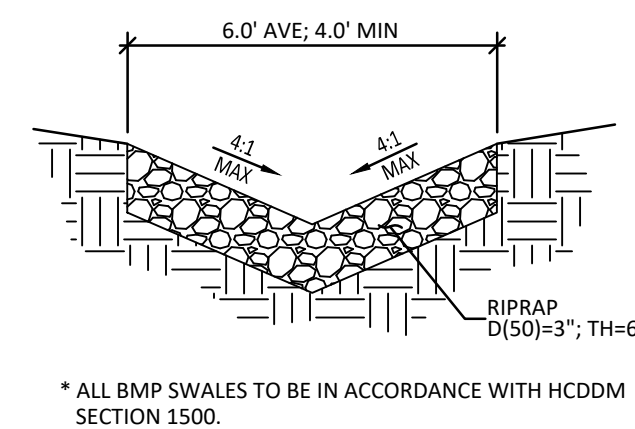
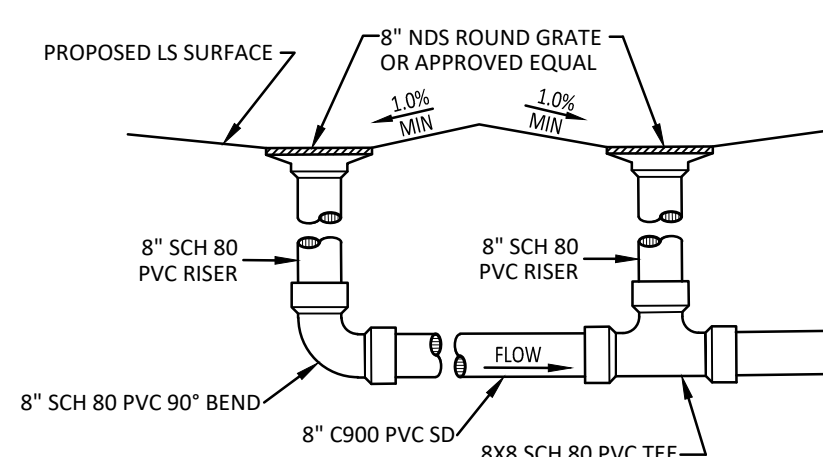
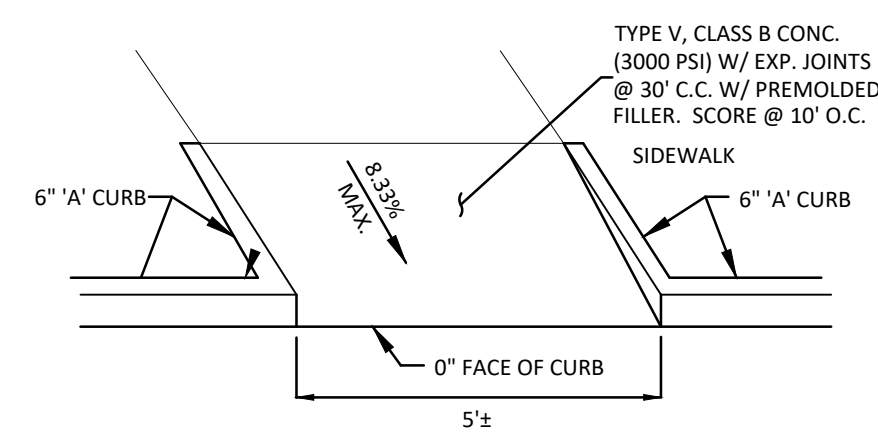
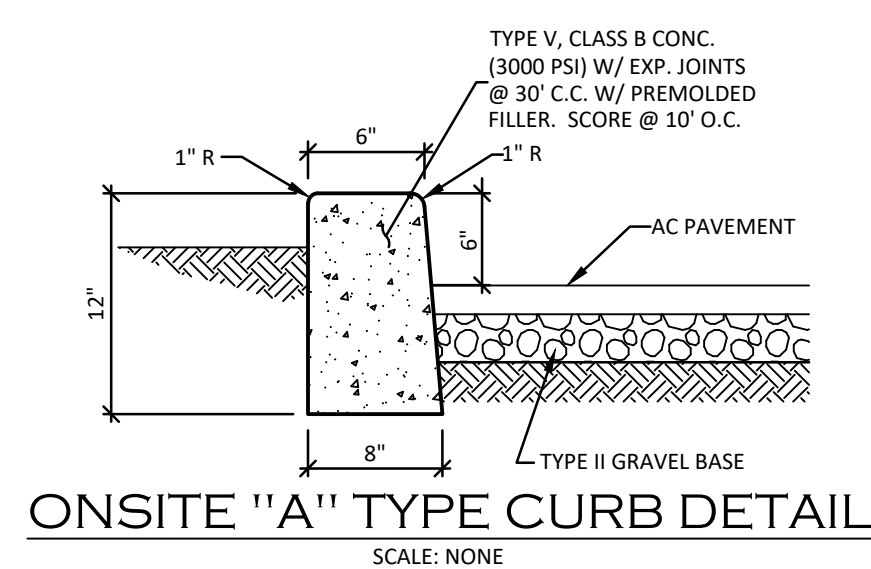
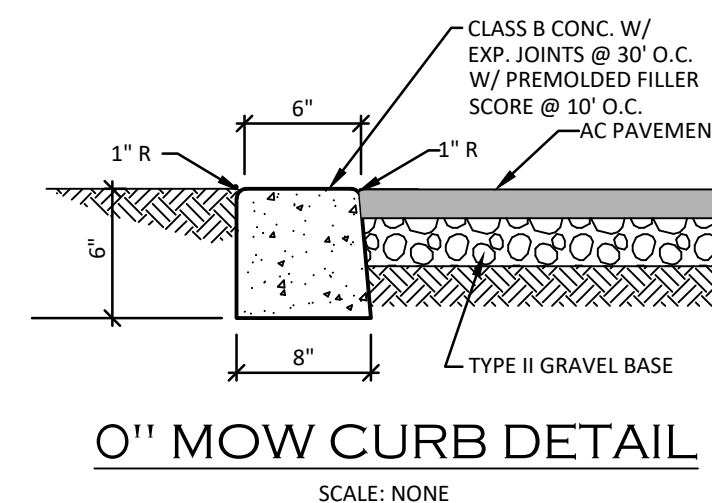
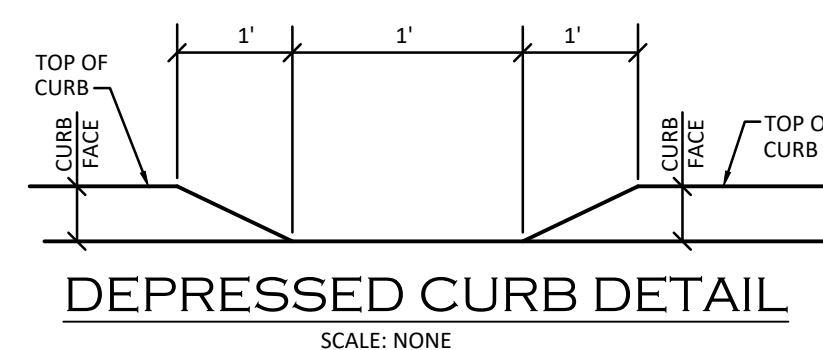
DATE

NEVADA P.E. NO. 15797



CONSTRUCTION NOTES:

1. INSTALL 1" TYPE CURB AND GUTTER PER CAUSD #216
2. INSTALL ONSITE "A" TYPE CURB (BLACK CONCRETE (WHERE INDICATED ON PLAN) PER DETAIL ON C3.02
3. INSTALL 1" TYPE CURB PER CAUSD #219
4. INSTALL CONCRETE SIDEWALK PER CAUSD #234
5. INSTALL SIDEWALK RAMP PER CAUSD #236
6. INSTALL 1" TYPE CURB (BLACK CONCRETE (WHERE INDICATED) DOWMS PER CAUSD #235
7. INSTALL ONSITE CURB RAMP 1" PER DETAIL ON C3.02
8. INSTALL ONSITE CURB RAMP 1" PER DETAIL ON C3.02
9. INSTALL 1" PAVING & DRIVE ISL & C&G BASE PER DETAIL ON C3.02 AGG. BASE
10. INSTALL 2" (PARKING) AC OVER 4" TYPE II AGG. BASE
11. INSTALL 6" CONCRETE OVER 4" TYPE II AGG. BASE WITH STEEL REINFORCEMENT OR WEAKENED PLAN CONJOINT JOINTS PER GEOTECH SHEET
12. INSTALL SMP RIBBED LINER SWALE PER NOTE THIS SHEET DETAIL ON SHEET C3.02
13. INSTALL DERESSED CURB PER DETAIL ON SHEET C3.02
14. INSTALL MINIMUMAL DRIVEWAY CURB DETAIL #222.3 & 228
15. INSTALL TRASH ENCLOSURE PER ARCH DWGS
16. SAWCUT AND REMOVE AC BEYOND . PROTECT EDGE FROM DAMAGE
17. INSTALL 3X3 RIBBAP OUTLET PAD, DISO3=3" MIN, TH6=7" MIN
18. INSTALL 24" DIA TRENCH WITH 18" DIA. WITH TRAFFIC RATED AND ADA COMPLIANT GRATE, OR APPROVED EQL. INVOIUT=70.55
19. INSTALL 6" PVC STORMDRAIN & 1.00K MIN WITH MITERED DRAIN FLOWLINE
20. INTERFERE WITH EXISTING DRIVEWAY & SIDEWALKS. PROVIDE ADJACENT OUTLET
21. INSTALL 1.0" MAX STEEL WALL. SEE STRUCTURAL DWGS
22. INSTALL 3.0" MAX RETAINING WALL PER SNBORS 8-100-1
23. INSTALL 1.0" CONCRETE CURB WITH STEEL REINFORCEMENT OR WEAKENED PLAN CONJOINT JOINTS PER GEOTECH SHEET

[illegible]

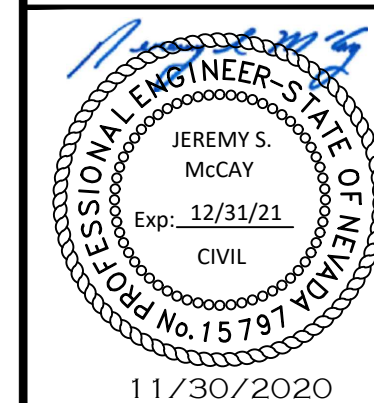
**TERRA
INNOVATIONS, LLC**

755 YOSEMITE AVE.
SUITE J
MERCED, CA 95340
P 209-383-2244
F 209-383-2248

SECTIONS & DETAILS

WOW CAR WASH @
DURANGO & ECHELON PT.

DATE: 11/30/2020
DRAWN BY: JSM
PROJECT MGR: JSM
PROJECT NO: 20349
SCALE: 1"=30'



11/30/2020

SHEET
C4.01
4 OF 6 SHEETS
DRAWING NO.
L20-