

**TECHNICAL DRAINAGE STUDY
FOR
DURANGO AND 95 – PARCEL 3**

J-1046

October 12, 2022

RICK
RICK ENGINEERING COMPANY
ENGINEERING COMPANY
RICK ENGINEERING CO



**TECHNICAL DRAINAGE STUDY
FOR
DURANGO AND 95 – PARCEL 3
SUBMITTAL NO. 1**

**Section 17, Township 19 South, Range 60 East
City of Las Vegas, Clark County, Nevada**

Design and Analysis Based Upon Vertical Datum NAVD88

Prepared for:

**Rick Barron
Plaster Development Company Inc.
801 S. Rancho Drive, Suite E-4
Las Vegas, NV 89106**

Prepared by:

**RICK ENGINEERING COMPANY, INC.
4255 Dean Martin Drive, Suite F
Las Vegas, Nevada 89103
(702) 827-0650**

J-1046

October 12, 2022

HYDROLOGIC CRITERIA AND DRAINAGE MANUAL
DRAINAGE STUDY INFORMATION FORM

Name of Development: Durango and 95-Parcel 3 Date: 10/12/2022

Location of Development: a) Descriptive (Cross Streets) North/South: Rancho Drive/U.S. 95

East/West: Durango Drive

b) Section: 17 Township: 19S Range: 60E

c) APN : 125-17-702-001

Name of Owner: Durango MB Partners LLC

Telephone No.: (702) 220-6565 Fax No.: _____ E-Mail Address: _____

Address: 11411 Southern Highlands Parkway, Suite 300

Contact Person-Name: Andre Leonard Telephone No.: (702) 827-0650

* E-Mail Address: aleonard@rickengineering.com Fax No.: _____

Firm: Rick Engineering Company

Address: 4255 Dean Martin Drive, Suite F, Las Vegas, NV 89103

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: 10.58 acres Being Developed/Disturbed: 2.33

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.): Medium Density Residential-Town Center (M-TC)

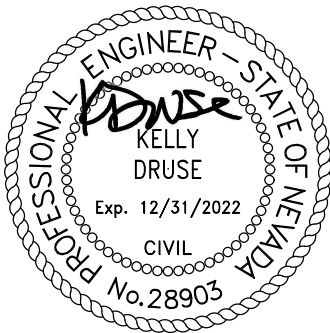
5. Approximate upstream land area which drains to the subject site: 12.1 acres

6. Has the site drainage been evaluated in the past? ☒ YES ☐ NO If yes, please identify documentation: Drainage Study Update to the Technical Drainage Study for The Village of Centennial Springs, Stantec Consulting, Inc. (DS3656)

7. If known, please briefly identify the proposed discharge point(s) of runoff from the site: 1. N/E corner 20' drainage easement into Pitney Avenue

2. 10' drainage easement at south end of street into existing 5' wide rectangular concrete channel along east property line.

8. Briefly describe your proposed schedule for the subject project: A.S.A.P.



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.**

	Revision	Date

Local Entity File No.

REFERENCE:

STANDARD FORM 1

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL																										
DRAINAGE SUBMITTAL CHECKLIST																										
Project Name: Durango and 95 - Phase 3	Map ID:																									
Firm Name: Rick Engineering Company	Engineer: Kelly Druse, P.E.																									
Address: 4255 Dean Martin Drive, Suite F																										
City: Las Vegas	State: NV	Zip: 89103																								
Phone Number: (702) 827-0650		Fax Number: N/A																								
Property Owner: Durango MB Partners LLC - Marc Bolduc																										
Address: 11411 Southern Highlands Parkway																										
City: Las Vegas	State: NV	Zip: 89141																								
Reviewed By:	Date Received:	Date Accepted for Review:																								
The following checklist is intended as a guide for the engineer preparing a Technical Drainage Study to submit to the local entity and Clark County Regional Flood Control District (if necessary). The listed items are the minimum information required prior to the entity performing a review. The engineer will remain responsible to ensure the Technical Drainage Study is prepared within the guidelines as set forth in the Clark County Regional Flood Control District (CCRFCD) Hydrologic Criteria and Drainage Design Manual (MANUAL). This document is intended as an aid in preparing Technical Drainage Studies. Each study submitted is reviewed for compliance with local and regional criteria. This form is not intended to be all inclusive and does not limit the extent of the information, calculations or exhibits which may be necessary to properly evaluate the intended land use. If items are not applicable for the subject site, provide N/A. I. GENERAL REQUIREMENT <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; text-align: center;">Yes</th> <th style="width: 10%; text-align: center;">No</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><u>X</u></td> <td style="text-align: center;"><u> </u></td> <td>Design Manual Standard Form 1 with the engineer's seal and signature.</td> </tr> <tr> <td style="text-align: center;"><u>X</u></td> <td style="text-align: center;"><u> </u></td> <td>Design Manual Standard Form 4.</td> </tr> <tr> <td style="text-align: center;"><u>X</u></td> <td style="text-align: center;"><u> </u></td> <td>2 copies of the 24" x 36" Drainage Plan.</td> </tr> <tr> <td style="text-align: center;"><u>X</u></td> <td style="text-align: center;"><u> </u></td> <td>A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.</td> </tr> </tbody> </table> II. MAPS AND EXHIBITS <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; text-align: center;">Yes</th> <th style="width: 10%; text-align: center;">No</th> <th></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><u>X</u></td> <td style="text-align: center;"><u> </u></td> <td>A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.</td> </tr> <tr> <td style="text-align: center;"><u>X</u></td> <td style="text-align: center;"><u> </u></td> <td>A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.</td> </tr> </tbody> </table>			Yes	No		<u>X</u>	<u> </u>	Design Manual Standard Form 1 with the engineer's seal and signature.	<u>X</u>	<u> </u>	Design Manual Standard Form 4.	<u>X</u>	<u> </u>	2 copies of the 24" x 36" Drainage Plan.	<u>X</u>	<u> </u>	A notarized letter from the adjacent property owner(s) allowing off-site grading or discharge.	Yes	No		<u>X</u>	<u> </u>	A copy of a current Flood Insurance Rate Map (FIRM) with the site delineated.	<u>X</u>	<u> </u>	A copy of the current CCRFCD Master Plan Update Figure, (F-x), for Flood Control Facilities and Environmental areas with the site delineated.
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REFERENCE:		STANDARD FORM 2																								

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

II. MAPS AND EXHIBITS (Continued)

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

III. DRAINAGE PLAN

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

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

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

REFERENCE:

STANDARD FORM 2

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE SUBMITTAL CHECKLIST

III. DRAINAGE PLAN (Continued)

Yes	No	
<u>N/A</u>	<u> </u>	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.
<u>N/A</u>	<u> </u>	Appropriately elevated "humps" 6 inches above the 100 year water surface elevation at site accesses where the intent is to protect the site from the Q_{100} flows.
<u>X</u>	<u> </u>	Street slopes for perimeter and interior streets. The minimum slope is 0.4 percent.
<u>N/A</u>	<u> </u>	Location and detail of best management practice (BMP) for parking lots and low impact development (LID) (if required).

IV. HYDROLOGIC ANALYSIS

Yes	No	
<u>X</u>	<u> </u>	Appropriate soil information and Soils Map for existing and future conditions with subbasins and property delineated.
<u>X</u>	<u> </u>	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.
<u>X</u>	<u> </u>	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.
<u>X</u>	<u> </u>	Use of correct precipitation values in and around the McCarran Airport rainfall area.
<u>X</u>	<u> </u>	A discussion in the text of the hydrologic analysis justifying subbasin boundaries and cutoffs, supporting assumptions, and calculations.
<u>X</u>	<u> </u>	A summary table of stormwater flows showing basin area, Q_{10} and Q_{100} for both individual basins and combined basin flows, where applicable.
<u>X</u>	<u> </u>	Copies of supporting technical information referenced from a previously approved study and a statement accepting these results.
<u>X</u>	<u> </u>	On-site facilities must perpetuate flows through or around the site without significantly impacting adjacent property owners in accordance with current Nevada Drainage Law.
<u>N/A</u>	<u> </u>	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	
<u>N/A</u>	_____	Flow split calculations and supporting documentation or reference for the method of flow split calculations used.
<u>X</u>	_____	Normal depth street flow calculations and cross section diagrams for all interior and perimeter streets. Provide "d x v" products for the Q100 and Q10 flows representing the worst case for interior and all perimeter streets. Q100 d x v < 8. Q10 d x v < 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.
<u>X</u>	_____	A summary table of interior and exterior street capacity calculations showing the street name, Q100 flow, slope, depth of flow, velocity and depth times velocity product and streets needing to meet 12 foot dry lane criteria.
<u>X</u>	_____	Appropriate hydraulic calculations for block wall openings assuming a 50 percent vertical clogging factor. (Assume the lower half of the opening is plugged.)
<u>X</u>	_____	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.
<u>X</u>	_____	Provide necessary freeboard requirements to set the finished floor elevations of all proposed buildings, 2 x depth of flow or depth of flow plus 18 inches of freeboard, whichever is less. The minimum requirement is 6 inches above adjacent upstream top of curb. Buildings adjacent to drainage easements must always be provided with 18 inches of freeboard above the Q100 weir height or flow depth, whichever is greater.
<u>N/A</u>	_____	A complete water surface profile analysis (HEC-2, HEC-RAS, etc.) for channel flows and FEMA Zone A flood zones. • Field survey data. • Input and output information. • Plotted cross-sections based on survey with proper encroachments. • A map showing the location of the cross-sections. • Analysis of both sub and super-critical flow segments. • A summary table and a discussion of the results in the text of the report.
<u>N/A</u>	_____	Provide a 50 percent clogging factor in the capacity calculation for drop inlets.
<u>N/A</u>	_____	Hydraulic calculations for culverts and storm drains. D-Load calculations must be provided for storm drain pipes in public rights-of-way, including headwater pool inundation.
<u>X</u>	_____	The mitigation of nuisance water, both during construction and in the fully developed condition, must be addressed.
<u>N/A</u>	_____	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. <u>KD</u> 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.
X		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.)
	N/A	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.
X		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.
	N/A	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.
X		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	
X		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.
	N/A	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.

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1.0 INTRODUCTION

1.1. Overview

Plaster Development Company Inc. is proposing to construct *Durango and 95 – Parcel 3*, a 2.33- acre (10.58-acre gross), 31-unit Medium Density Residential – Town Center (M-TC) development. This study presents the findings of a hydrologic/hydraulic analysis of the site and contributing watershed area.

1.2. Location and Description

The project site is in the City of Las Vegas at the southeast corner of North Durango Drive and the Rancho Drive – U.S. 95 Off-ramp. The site is further described as being a portion of the Southeast 1/4 of Section 17, Township 19 South, Range 60 East of the M.D.M., Clark County, Nevada (Figure 1). It has been designated an Assessor's Parcel Number (APN) of 125-17-702-001 (Figure 2).

Parcel 3 is bound on the north by an undeveloped portion of Assessor's Parcel Number (APN) 125-17-613-00, to the south and west by the Durango Drive Off-ramp and on the east by The Village of Centennial Springs. Parcel 3 is currently undeveloped (Figure 3).

1.3. FEMA Floodplain Information

The project site lies within FEMA Zone "X" on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM). Figure 3 is reproduced from a portion of Community Panel Number 32003C1745E, effective date September 27, 2002. FEMA defines Zone "X" as areas outside the 0.2-percent-annual-chance (500-year) floodplain.

1.4. Flood Control Master Plan Information

The Regional Flood Control District 2018 Las Vegas Valley Master Plan Update illustrates the existing and proposed Clark County Regional Flood Control District (CCRFCDD) facilities in the area as shown on Figure 5 (F-11) and Figure 6 (F-11). The project site is not located adjacent any existing or proposed Regional Flood Control Facilities.

1.5. Previous Drainage Studies

The following study was reviewed and referenced in the analysis of this project:

- *Drainage Study Update to the Technical Drainage Study for The Village of Centennial Springs*, by Stantec Consulting, Inc., June 2006.

2.0 HYDROLIGIC CRITERIA

2.1. Point Rainfall

The adjusted precipitation values used to model the drainage sub-basins are 1.61 inches and 2.86 inches for the 10-year and 100-year storm events, respectively.

2.2. Design Storm

The *Clark County Regional Flood Control District Hydrologic Criteria and Drainage Design Manual (Design Manual)* specifies the design storm within its jurisdiction as a 6-hour duration storm. Three design storm distributions are used within the Clark County area, SDN 3, SDN 4 and SDN 5. Because the study area is less than 8 square miles in size, the SDN 3 design storm distribution was used in the Army Corps of Engineers Flood Hydrograph Package, HEC-1 model (SCS unit hydrograph method).

2.3. Storm Runoff Methodology

Standard Form 4, from the *Design Manual* was completed to determine the time of concentration (t_c) for each drainage sub-basin. The following equations were used:

$$t_c = t_i + t_t$$

where:

t_c = time of concentration (min.)

t_i = initial overland flow time (min.)

t_t = travel time (min.)

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

where:

$K = 0.0132 (CN) - 0.39$

CN = runoff curve number

L_o = length of overland flow (feet, 500 feet max.)

S = average basin slope (percent)

$$t_t = L / 60 V$$

where:

L = length (ft.)

V = velocity (ft/s) (from Figure 602, *Design Manual*)

The calculated t_c for each urbanized drainage basin is checked against the Lag Time (t_{lag}), calculated from the following equation:

$$t_{lag} = (0.6)t_c$$

2.4. Soils Curve Number (CN)

Table 602 of the *Design Manual* and data obtained from the *Soil Survey Staff of the Natural Resources Conservation Service within the United States Department of Agriculture* as posted online at <http://websoilsurvey.nrcs.usda.gov/>, were used to determine the curve numbers for each existing and future condition drainage sub-basin based on the soil type and land use. The soil type used in the hydrologic calculations and storm runoff modeling of onsite and offsite sub-basins is “A”. Zoning classifications were obtained from the *Regional Flood Control District 2018 Las Vegas Valley Master Plan Update* watershed map. A portion of the watershed map depicting the information is shown on Figure 7 (portion of Figure W2-A).

3.0 HYDROLOGY

3.1. Existing Offsite Conditions

The historic drainage pattern in the area is from west to east as shown by Figures 6 and 7. The upstream area contributing to the proposed site is approximately 12.1-acres. A total of seven (7) sub-basins impacts the project site. A curve number of 77 was used to model all offsite sub-basins except sub-basins EF4, EF5, and EF6 which used a curve number of 98.

Sub-basins EF1 through EF3 consist of steep-clean-earth embankments bound on the west (upstream end) by concrete barrier rail and flattening out towards the west side of the project site. Runoff generally sheet flows from west to east. Sub-basin EF5 is similar in nature to sub-basins EF1 through EF3, with channelizing occurring towards the downstream end. An existing corrugated metal pipe (CMP) culvert fed by runoff from sub-basin EF4 discharges into the upper end of the sub-basin EF5. Sub-basin EF4 is composed of a fully developed roadway.

Sub-basins EF6 and EF7 consist of fully developed roadways with runoff being collected by existing Nevada Department of Transportation (NDOT) slotted CMP drains. The flow discharges to the west where it combines with other offsite flow to combine upstream of an existing 30-inch reinforced concrete pipe (RCP) culvert. Per the *Drainage Study Update to the Technical Drainage Study for The Village of Centennial Springs*, by Stantec Consulting, Inc., this flow was determined to be 27-cfs and 37-cfs for the Q10 and Q100, respectively by VTN in their *Technical Drainage Study for Durango Drive/US 95 Interchange*. This flow discharges into the upstream end of sub-basin EF5 where it combines with flow from EF4 at an existing 20-foot public drainage easement.

This study differs from Stantec’s study, which showed the flow from sub-basins EF6 and EF7 (a portion of their Basin OF1-U) discharging directly to the east. This is not the case as there are no outlets on the east side of the U.S. 95/Durango offramp (FIG. 11, Appendix D). Discharge from basins EF6 and EF7 were assumed to be included with the total flow exiting the existing 30-inch RCP into sub-basin EF5.

3.2. Existing Onsite Conditions

Onsite basins consist of previously graded clean earth. The slopes are generally mild and increase toward the east and south portions of the project site. Sub-basins EN1 and EN2 generally slope to the east where runoff is intercepted by an existing 5-foot-wide rectangular concrete channel. Flow is then directed to the north where it concentrates in Pitney Avenue. Sub-basin EN3 slopes to the east/southeast where the same existing concrete channel directs flows to the south where flows concentrate at an existing 20-foot concrete lined drainage easement. This runoff continues east into Orly Avenue.

Refer to the table below for the existing conditions offsite and onsite peak flow rates and Figure 8 in Appendix A. Hydrologic data sheets are included Appendix B.

EXISTING CONDITIONS PEAK FLOWS					
HEC-1 ID*	Q10 (cfs)	Q100 (cfs)	Basin Area		Remarks
			acres	mi ²	
EN1	<1	1	0.53	0.0008	Onsite Basin
CPEN1	<1	1	-	-	EF1+EN1
EN2	<1	2	1.31	0.0020	Onsite Basin
CPEN2	1	4	-	-	CPEN1+EF2+EN2
EN3	<1	1	0.46	0.0007	Onsite Basin
CPEN3	<1	1	-	-	EF3+EN3
EF1	<1	<1	0.28	0.0004	Offsite Basin
EF2	<1	1	0.63	0.0010	Offsite Basin
EF3	<1	<1	0.23	0.0004	Offsite Basin
EF4	1	2	0.49	0.0008	Offsite Basin
EF5	1	2	0.62	0.0010	Offsite Basin
EF6	<1	<1	0.14	0.0002	Offsite Basin
RF1*	26	35	-	-	RF1-(EF5+EF6)
CPRF1*	27*	37*	-	-	EF5+EF6+RF1
EF7	<1	1	0.57	0.0009	Offsite Basin
CPEF7	29	41	-	-	CPEN3+EF4+RF1+EF7

*Reference approved Stantec DSU to the TDS for The Village of Centennial Springs dated 06/26/06.

3.3. Future Offsite Conditions

Offsite sub-basins were modeled as fully developed using a curve number of 89 (commercial and business) to reflect the impervious area associated with the land use designation (commercial, retail casino, high rise condominiums). Sub-basins EF4, EF5, and EF6 were modeled as impervious, using a curve number of 98.

3.4. Future Onsite Conditions

Onsite sub-basins were modeled using a curve number of 89 to reflect the designated land use of Medium Density Residential – Town Center (M-TC).

Offsite flow from sub-basin FF1 will be intercepted by a proposed 2-foot concrete valley gutter adjacent a screen wall grouted one course above the edge of gutter running along the western parcel boundary. The runoff will then flow into a grouted riprap basin at the low point and pass through a proposed 16-inch by 48-inch block wall opening. The bottom of the riprap basin is proposed to be 12-inches lower than the block wall opening invert to allow sediment capture before passing through.

This flow will then exit onto a splash pad and continue east in the street to the proposed 30-foot drainage easement. This flow will combine with runoff from sub-basin FN1 and flow to Pitney Avenue. Flow from sub-basins FN5 through FN8 drain to 4-inch area drains that discharge into the existing 5-foot-wide concrete channel before combining with other flow in Pitney Avenue. The Stantec study designed for 34-cfs and 45-cfs in the Q10 and Q100, respectively entering Pitney Avenue. Only 3-cfs and 7-cfs will be discharged into Pitney Avenue because of the proposed development. An additional Q10 and Q100 of 31-cfs and 36-cfs, respectively coming from an existing 36-inch CMP from the northwest as indicated in the Stantec study is no longer present.

Minimal runoff from sub-basin FN2, created by the entrance high point, discharges to an existing commercial parking lot to the north.

Runoff from sub-basin FN3 conveys in the street and through a proposed 10-foot-wide concrete-lined drainage easement through a block wall opening. The runoff then enters an existing 5-foot-wide rectangular channel and flows to the south where it combines with runoff from sub-basins FF2 through FF7, sub-basin FN4, and RF1 (flow exiting the existing 30-inch RCP) at an existing 20-foot concrete lined drainage easement. This flow passes through to Orly Avenue. Runoff from sub-basins FF2, FF3, and a portion of FF7 will be intercepted by a proposed 2-foot concrete valley gutter adjacent a screen wall grouted one course above the edge of gutter running along the western parcel boundary prior to combining with runoff from the other sub-basins at the drainage easement. Erosion protection has been provided at the end of the channel. A 12-inch wide by 8-inch-thick riprap with a $D_{50}=4"$ will be installed along the western edge of the concrete valley gutter to prevent undercutting from offsite sheet flow from the west.

Per the Stantec study, a total Q10 and Q100 of 28-cfs and 41-cfs was designed to be discharged through the drainage easement into Orly Avenue. This proposed project slightly increases that to a Q10 and Q100 of 30-cfs and 43-cfs, respectively. However, referring to the Stantec study (FIG. 11) the total flow at CP1 for the Q10 and Q100 is 87-cfs and 145-cfs, respectively. This total includes a Q10 and Q100 of 31-cfs and 36-cfs coming from the non-existent 36-inch CMP from the northwest. Therefore, the total flow is ultimately lower at this point. A hydraulic calculation included in Appendix C comparing the increased runoff normal depth to the Stantec runoff normal depth through the drainage easement shows that the additional 2-cfs increase does not substantially increase the water depth.

Refer to the following table for the proposed conditions offsite and onsite peak flow rates and Figure 9 in Appendix A. Hydrologic data sheets are included Appendix B.

FUTURE CONDITIONS PEAK FLOWS					
HEC-1 ID*	Q10 (cfs)	Q100 (cfs)	Basin Area		Remarks
			acres	mi ²	
FN1	2	4	1.47	0.0023	Onsite Basin
CPFN1	3	7	-	-	FF1+FN1
FN2	<1	<1	0.04	0.0001	Onsite Basin
FN3	<1	1	0.29	0.0005	Onsite Basin
FN4	<1	1	0.21	0.0003	Onsite Basin
FN5	<1	<1	0.08	0.0001	Onsite Basin
FN6	<1	<1	0.08	0.0001	Onsite Basin
FN7	<1	<1	0.08	0.0001	Onsite Basin
FN8	<1	<1	0.08	0.0001	Onsite Basin
CPFN8	3	7	-	-	CPFN1+FN5 thru FN8
FF1	1	2	0.71	0.0011	Offsite Basin
FF2	<1	1	0.20	0.0003	Offsite Basin
FF3	<1	1	0.23	0.0004	Offsite Basin
CPFF3	1	1	-	-	FF2+FF3
FF4	1	2	0.49	0.0008	Offsite Basin
FF5	1	2	0.62	0.0010	Offsite Basin
FF6	<1	<1	0.14	0.0002	Offsite Basin
RF1*	26	35	-	-	-
CPRF1*	27	37	-	-	FF5+FF6+RF1
FF7	1	2	0.54	0.0008	Offsite Basin
CPFF7	30	43	-	-	FN3+FN4+CPFF3+FF4+ CPRF1+FF7

4.0 HYDRAULICS

4.1. Facility Design Calculations

Street capacity calculations for the 10-year and 100-year, 6-hour storm events are summarized in the following table:

STREET CAPACITY CALCULATIONS				
X-SECTION	Q10/Q100 (cfs)	D10/D100 (ft)	V10/V100 (ft/s)	D X V
1	2/4	0.26/0.32	1.99/2.35	0.52/0.75

The street flow calculations show that the criteria in *The Manual* are met in the future conditions. The product of the flow depth in the gutter flow line times the average flow velocity is less than 6 and 8 for the Q10 and Q100, respectively.

Hydraulic calculations for 2-foot concrete valley gutter, drainage easements, block wall

openings and riprap protection are included in Appendix C, with section locations included on Figure 9 in Appendix A. Depths in drainage easements were determined using submerged weir calculations and block wall openings were sized assuming the lower half of the opening is clogged as required by *The Manual*.

5.0 CONCLUSION

1. The gross area of the project site is 10.58 acres (2.33-acres is being improved) and has been designed to conform to the drainage criteria set forth in the *CCRFC D Hydrologic Criteria and Drainage Design Manual*.
2. The project site is located within a FEMA designated Zone “X”. FEMA defines Zone “X” as areas outside the 500-year flood plain.
3. The site is not adjacent existing or proposed CCRFC D Master Plan Facilities and does not require CCRFC D concurrence.
4. The offsite and onsite flows are conveyed east to Pitney Avenue (norther portion) and to an existing 20-foot drainage easement that discharges into Orly Avenue (southern portion) using streets, concrete valley gutters, block wall openings, and concrete lined drainage easements. The block wall opening size used between lots is 16-inch x 24-inch with one 16-inch x 48-inch opening be used to convey offsite flow into the site from the west. A 50% clogging factor (i.e., assuming the lower half of the opening is clogged) was used.
5. Depths of flow entering the drainage easements were checked by using the submerged weir calculation.
6. Finished-floor elevations for the buildings were set a minimum of 6-inches above the highest adjacent top-of-curb or 18-inches above the greater of the Q-100 weir or submerged weir elevation adjacent public drainage easements.
7. The development of the site does not increase the overall downstream flow conditions and no adverse conditions resulting from this development are anticipated.
8. Material referenced in this study was reviewed and accepted as being accurate as noted.
9. Offsite grading is proposed with this project on land granted easement to NDOT. It is understood that concurrence must be obtained from them prior to final approval.
10. This project complies with the applicable Drainage Laws recognized by the State of Nevada.

Disclaimer – *Any deviations from the drainage scheme and hydraulic design presented herein, or any variations in climatic or watershed conditions may affect the functionality and other hydrologic or hydraulic characteristics of this project and nullify the results presented herein.*

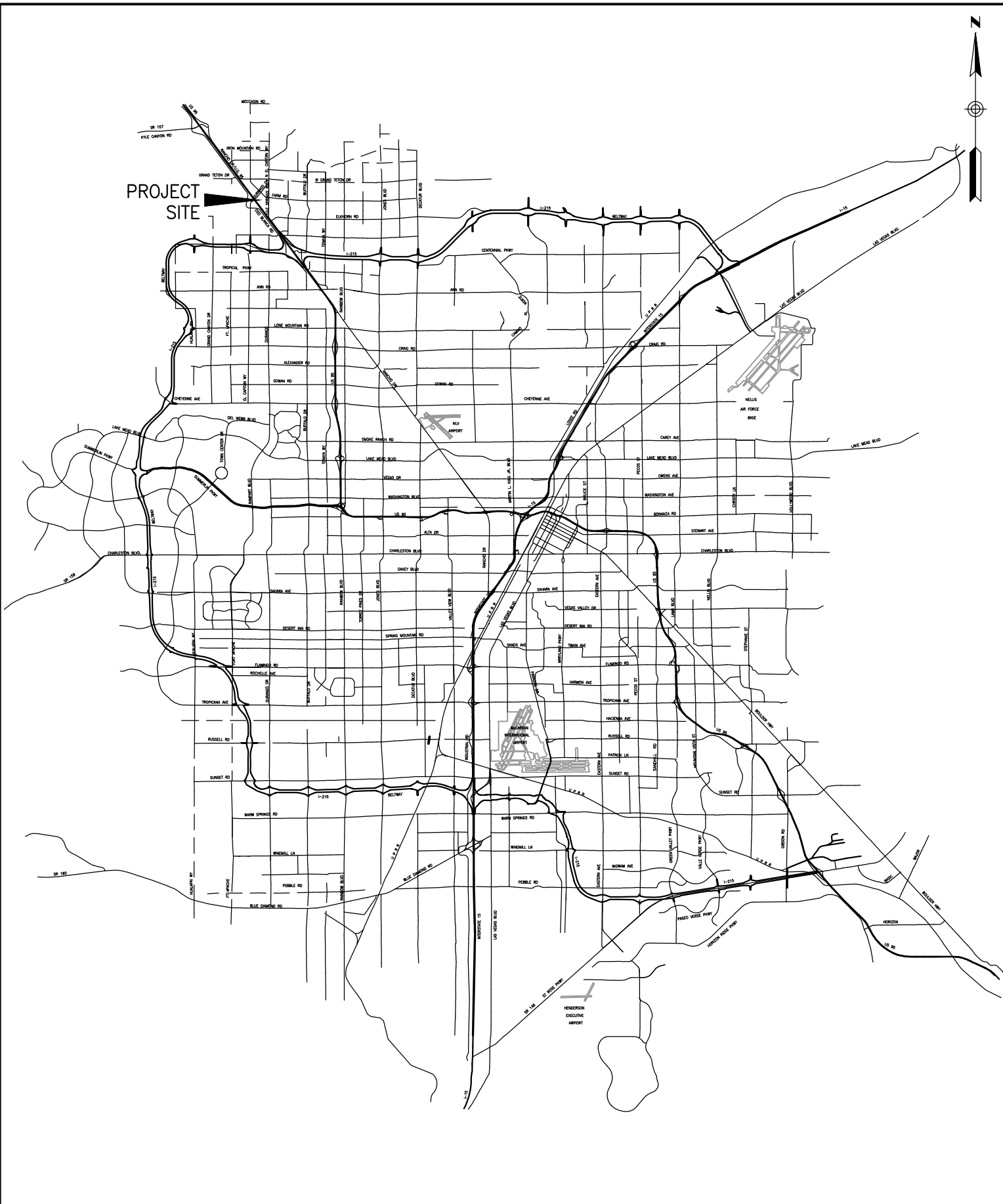
6.0 REFERENCES

1. *Clark County Regional Flood Control District 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 ., December 10, 2018.
4. *Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture*. Web Soil Survey. Available online at the following link: <http://websoilsurvey.sc.egov.usda.gov/>. Accessed [07/12/2022].
5. *Existing Topographic Map*, Aerotech Mapping, Inc., April 2020.
6. *Drainage Study Update to the Technical Drainage Study for The Village of Centennial Springs*, Stantec Consulting, Inc., June 2006, DS-3656.
7. *HEC-1 Flood Hydrograph Package Version 4.1*, U.S. Army Corps of Engineers Hydrologic Engineering Center, 1998.
8. *FlowMaster v. 10.00.00.02*, Bentley. July 31, 2018.

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APPENDIX A - FIGURES AND EXHIBITS

\\\\cp.rickeng.com\\projects\\N01000\\1046_ Durango95ResidentialDev\\WaterRes\\1046_VICINITY MAP.dwg



4255 DEAN MARTIN DRIVE, STE F
LAS VEGAS, NV 89103
702.827.0650
rickengineering.com

**DURANGO AND 95
PARCEL 3
FIGURE 1
VICINITY MAP**

PROJECT NO:	10460
DRAWN BY:	JRK
CHECKED BY:	JRK
SCALE:	NO SCALE
DATE:	7/13/2022

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.

MAP LEGEND

Parcel Boundary

Sub Boundary

PM/LD Boundary

Road Easement

Match / Leader Line

Historic Lot Line

Historic Sub Boundary

Historic PM/LD Boundary

Section Line

Condominium Unit

Air Space PCL

Right of Way PCL

Sub-Surface PCL

001 Road Parcel Number

001 Parcel Number

1.00 Acreage

202 Parcel Sub/Seq Number

PB 24-45 Plat Recording Number

5 Block Number

5 Lot Number

GL5 Gov. Lot Number

ASSESSOR'S PARCELS - CLARK COUNTY, NV.

Briana Johnson - Assessor

BOOK

T19S R60E

SEC.

17

MAP

N 2 SE 4

125-17-7

099 100 101

27126 125 124

36137 138 139

Scale: 1" = 200'

Rev: 6/28/2021

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

0

100

200

400

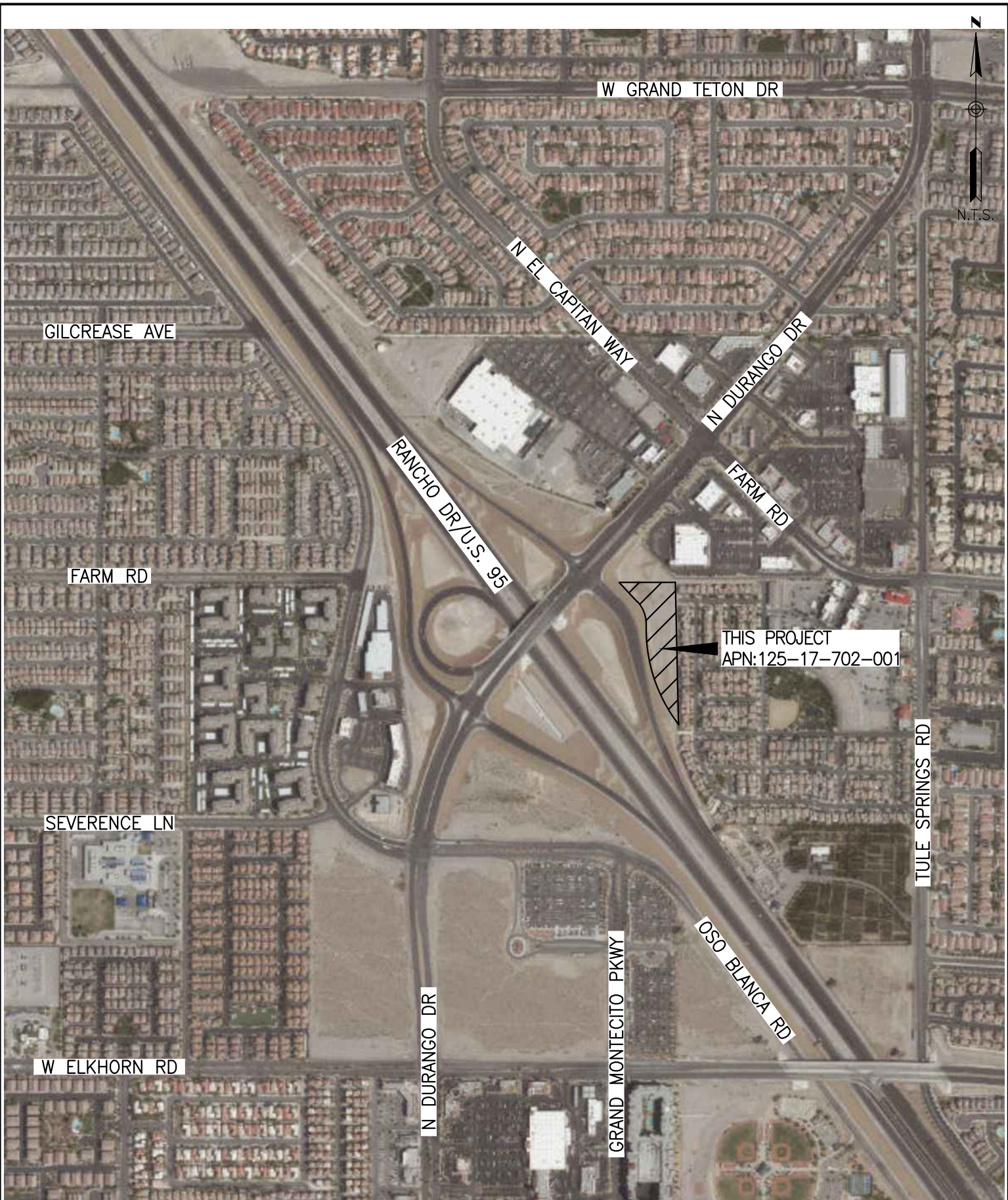
600

800

The map displays a complex arrangement of land parcels in Clark County, Nevada. A large, light gray area on the left is labeled 'RANCHO DR U.S. 95'. To its right, a green shaded area is designated as the 'SITE'. The map is divided into several sections, including 'THE VILLAGE OF CENTENNIAL SPRINGS' and 'MIXED USE FOR THE VILLAGE OF CENTENNIAL SPRINGS'. Various parcel numbers are scattered throughout, such as 001, 002, 003, 004, 005, 006, 007, 008, 009, 010, 011, 012, 013, 014, 015, 016, 017, 018, 019, 020, 021, 022, 023, 024, 025, 026, 027, 028, 029, 030, 031, 032, 033, 034, 035, 036, 037, 038, 039, 040, 041, 042, 043, 044, 045, 046, 047, 048, 049, 050, 051, 052, 053, 054, 055, 056, 057, 058, 059, 060, 061, 062, 063, 064, 065, 066, 067, 068, 069, 070, 071, 072, 073, 074, 075, 076, 077, 078, 079, 080, 081, 082, 083, 084, 085, 086, 087, 088, 089, 090, 091, 092, 093, 094, 095, 096, 097, 098, 099, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202. The map also shows various roads, including Pitney Ave, Kellman Ave, Stuckey Ave, Trudeau Ave, Bellery Ave, and others. A scale bar at the bottom indicates a distance of 800 feet. The map is titled 'ASSESSOR'S PARCELS - CLARK COUNTY, NV. Briana Johnson - Assessor'.

FIGURE 2

\\\\cp.rickeng.com\\projects\\N01000\\1046_ Durango95ResidentialDev\\WaterRes\\1046_SITE DESCRIPTION MAP.dwg



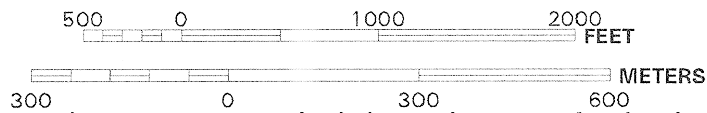
4255 DEAN MARTIN DRIVE, STE F
LAS VEGAS, NV 89103
702.827.0650
rickengineering.com

DURANGO AND 95
PARCEL 3
FIGURE 3
SITE DESCRIPTION MAP

PROJECT NO:	10460
DRAWN BY:	JRK
CHECKED BY:	JRK
SCALE:	N.T.S.
DATE:	7/13/2022



MAP SCALE 1" = 1000'



CLARK COUNTY
INCORPORATED AREAS
320003

CLARK COUNTY
INCORPORATED AREAS
320003

CLARK COUNTY
UNINCORPORATED AREAS
320003

CLARK COUNTY
UNINCORPORATED AREAS
320003

CITY OF LAS VEGAS
325276

20

DEER SPRINGS WAY

DURANGO DRIVE

TULE SPRINGS ROAD

JO MARCY DRIVE

GR1152

PROJECT SITE

PANEL 1745 E

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

PANEL 1745 OF 4090

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:	NUMBER	PANEL	SUFFIX
LAS VEGAS, CITY OF	325276	1745	E
CLARK COUNTY, UNINCORPORATED AREAS	320003	1745	E

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



MAP NUMBER
32003C1745 E

MAP REVISED:
SEPTEMBER 27, 2002

Federal Emergency Management Agency

RICK
ENGINEERING COMPANY

4255 DEAN MARTIN DRIVE, STE F
LAS VEGAS, NV 89103
702.827.0650
rickengineering.com

DURANGO AND 95
PARCEL 3
FIGURE 4
FEMA FIRM

PROJECT NO: 10460
DRAWN BY: JRK
CHECKED BY: JRK
SCALE: 1"=1000'
DATE: 7/13/2022

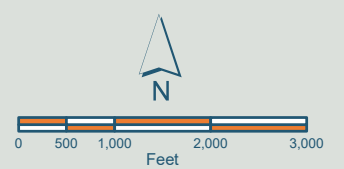


2018
LAS VEGAS VALLEY
FLOOD CONTROL
MASTER PLAN UPDATE

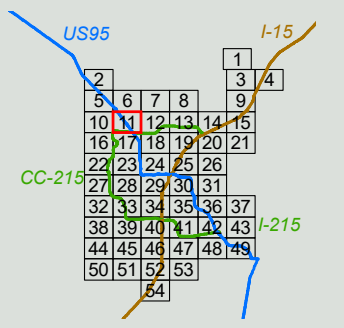
**FIGURE F-11
FLOOD CONTROL FACILITIES**

- LEGEND**
- Ultimate Development Boundary
 - Existing Facilities
 - Category A Proposed Facilities
 - Category B Proposed Facilities
 - Local Existing Facilities
 - Detention Basin
 - Culvert or Bridge Crossing
 - Stormdrain
 - Lined Channel
 - Unlined Channel
 - Levee/Dike
 - Natural Wash/Floodway
 - ID-Mile Separator
- Remove & Replace/Parallel Facilities**
- | Category A | Category B |
|------------|------------|
| Channel | Channel |
| Stormdrain | Stormdrain |
| Crossing | Crossing |

FIGURE 5

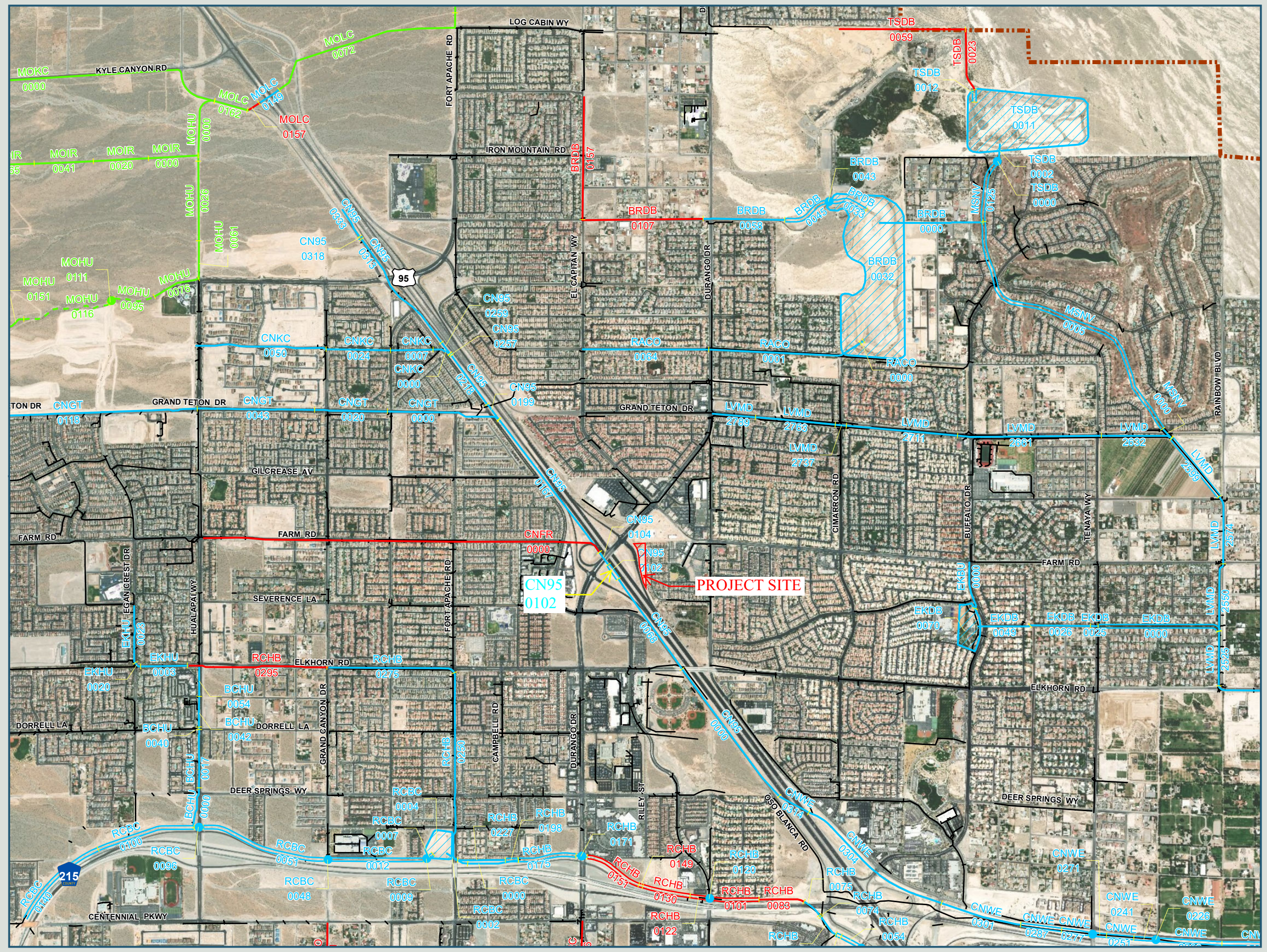


AAerialSource:Esri World Imagery 2017

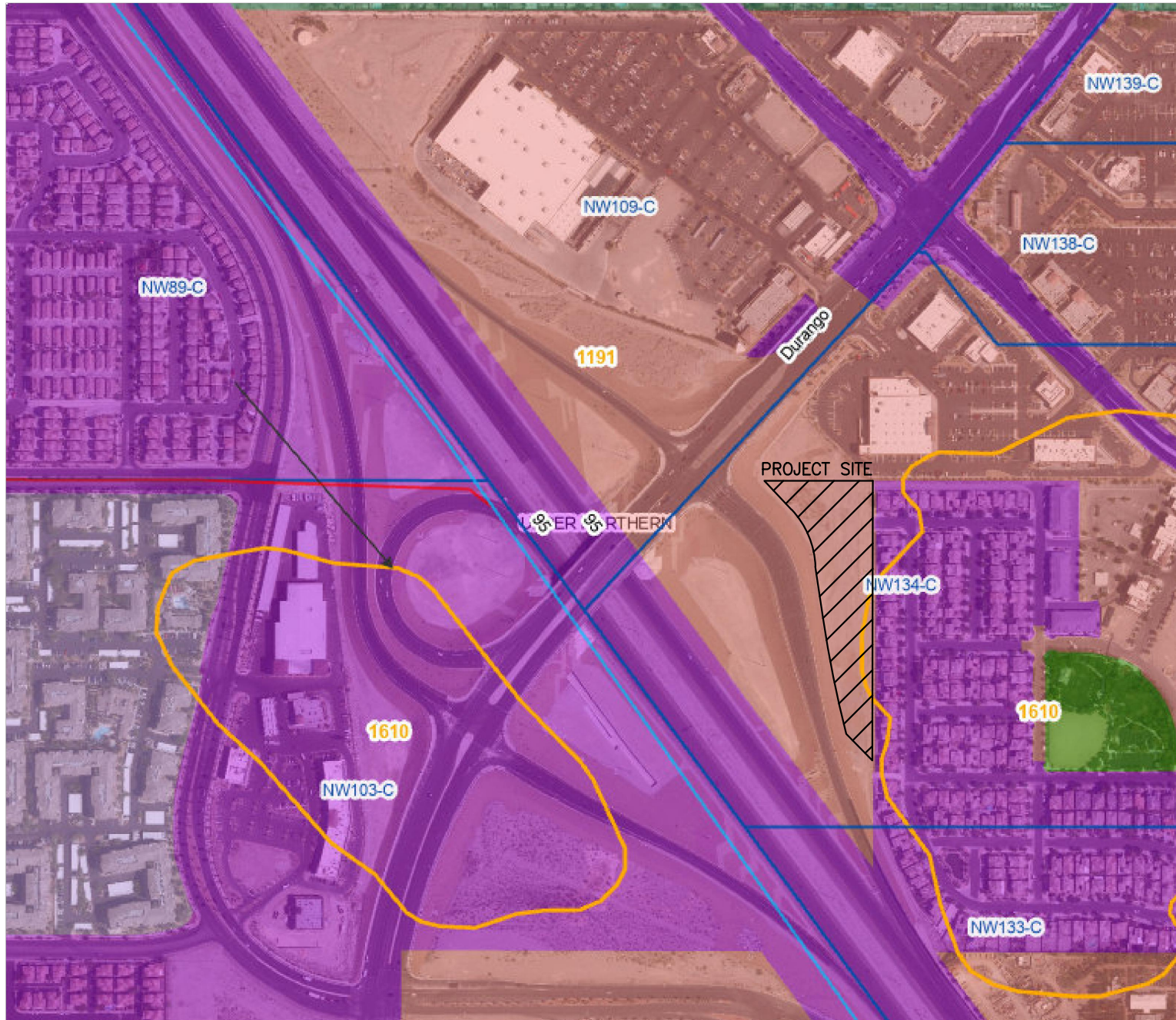


ATKINS
Member of the SNC-Lavalin Group

Louis Berger



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	CNW66-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		



Legend

- Flow Arrows
- Concentration Points
- Existing Facilities
- Category A Proposed Facilities
- Category B Proposed Facilities
- Ultimate Development Boundary
- Watershed
- Subbasins
- Soils
- 1: Undeveloped Land, Open desert
- 2: Parks, Golf Courses
- 3: Rural, 0.5-1 units per acre (uses 1 unit/acre)
- 4: Low-Density Residential, 1-2 units per acre (uses 2 units/acre)
- 5: Medium-Density Residential, 2-4 units per acre (uses 3 units/acre)
- 6: High-Density Residential, 4-8 units per acre (uses 6 units/acre)
- 7: Public Facility and Residential, 8-12 units/acre
- 8: Very High-Density Residential, 12 units/acre or more
- 9: Commercial, Retail, Casino, High Rise Condominiums
- 10: Light Industrial
- 11: Heavy Industrial
- 12: Schools
- 13: Lakes
- SFHA Zone AE
- SFHA Zone A
- SFHA Zone AO
- Zone X (Shaded)

1 inch = 417 feet

N

0 215 430 Feet



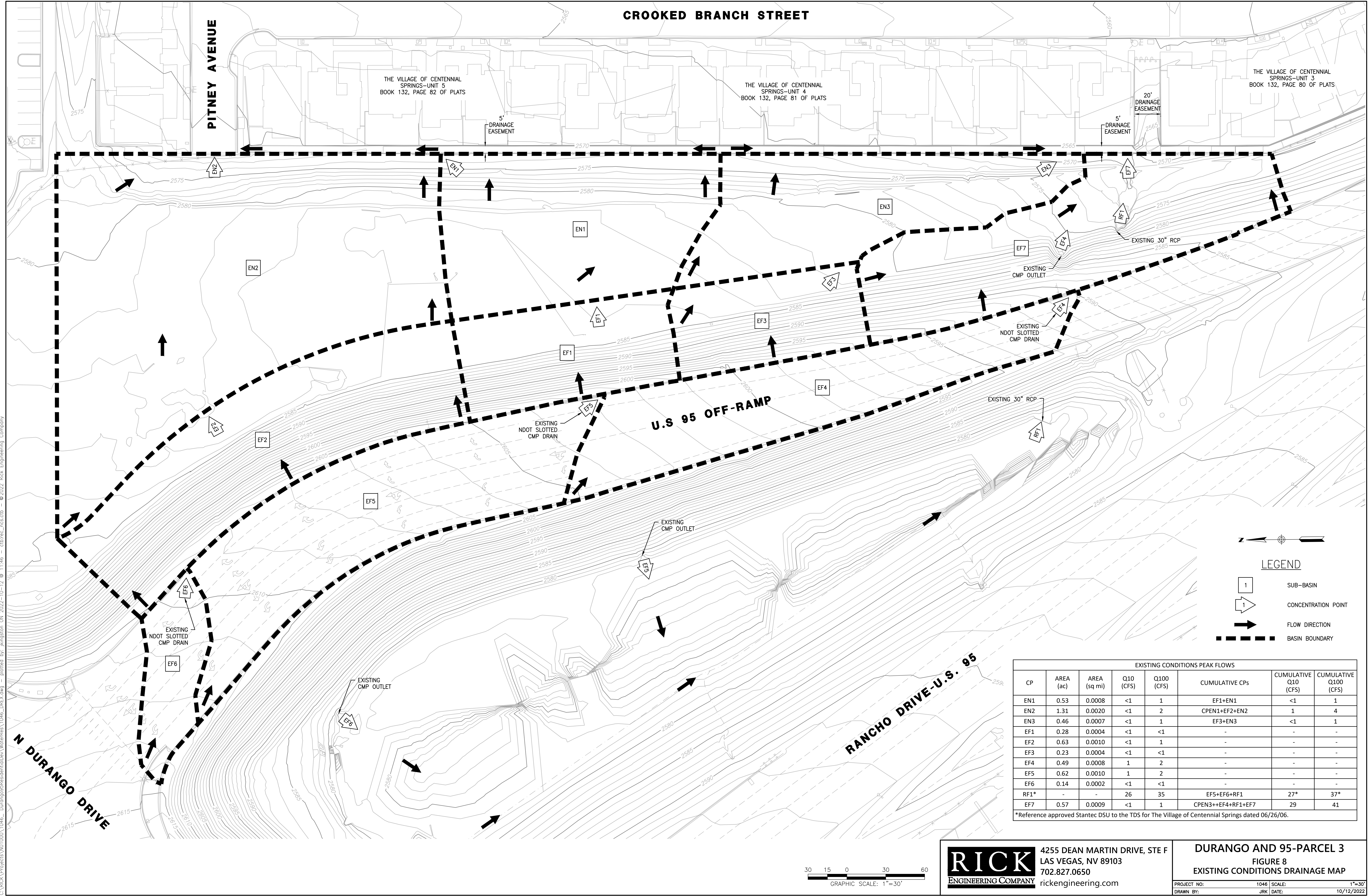
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DURANGO AND 95-PARCEL 3
FIGURE 7
UPPER NORTHERN LAS VEGAS WASH
WATERSHED

PROJECT NO:	10460
DRAWN BY:	JRK
CHECKED BY:	JRK
SCALE:	1"=417'
DATE:	7/14/2022

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LEGEND

1

SUB-BASIN

1

CONCENTRATION POINT

FLOW DIRECTION

BASIN BOUNDARY

EXISTING CONDITIONS PEAK FLOWS							
CP	AREA (ac)	AREA (sq mi)	Q10 (CFS)	Q100 (CFS)	CUMULATIVE CPs	CUMULATIVE Q10 (CFS)	CUMULATIVE Q100 (CFS)
EN1	0.53	0.0008	<1	1	EF1+EN1	<1	1
EN2	1.31	0.0020	<1	2	CPEN1+EF2+EN2	1	4
EN3	0.46	0.0007	<1	1	EF3+EN3	<1	1
EF1	0.28	0.0004	<1	<1	-	-	-
EF2	0.63	0.0010	<1	1	-	-	-
EF3	0.23	0.0004	<1	<1	-	-	-
EF4	0.49	0.0008	1	2	-	-	-
EF5	0.62	0.0010	1	2	-	-	-
EF6	0.14	0.0002	<1	<1	-	-	-
RF1*	-	-	26	35	EF5+EF6+RF1	27*	37*
EF7	0.57	0.0009	<1	1	CPEN3++EF4+RF1+EF7	29	41

*Reference approved Stantec DSU to the TDS for The Village of Centennial Springs dated 06/26/06.



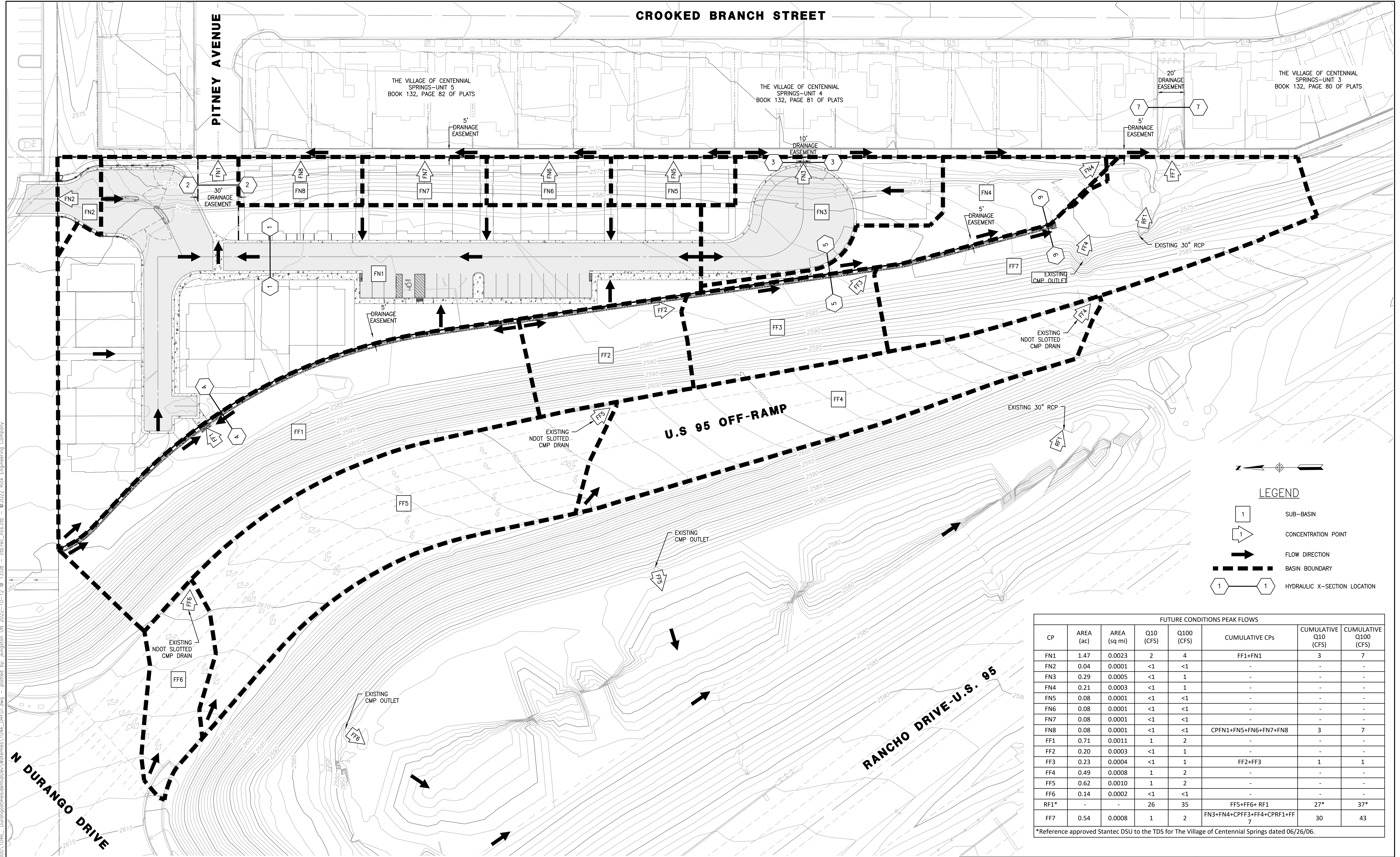
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DURANGO AND 95-PARCEL 3
FIGURE 8
EXISTING CONDITIONS DRAINAGE MAP

PROJECT NO: 1046 | SCALE: 1"=30'
DRAWN BY: JRK | DATE: 10/12/2022

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LEGEND

- SUB-BASIN
- CONCENTRATION POINT
- FLOW DIRECTION
- BASIN BOUNDARY
- HYDRAULIC X-SECTION LOCATION

FUTURE CONDITIONS PEAK FLOWS							
CP	AREA (ac)	AREA (sq mi)	Q10 (CFS)	Q100 (CFS)	CUMULATIVE CPs	CUMULATIVE Q10 (CFS)	CUMULATIVE Q100 (CFS)
FN1	1.47	0.0023	2	4	FF1+FN1	3	7
FN2	0.04	0.0001	<1	<1	-	-	-
FN3	0.29	0.0005	<1	1	-	-	-
FN4	0.21	0.0003	<1	1	-	-	-
FN5	0.08	0.0001	<1	<1	-	-	-
FN6	0.08	0.0001	<1	<1	-	-	-
FN7	0.08	0.0001	<1	<1	-	-	-
FN8	0.08	0.0001	<1	<1	CPFN1+FN5+FN6+FN7+FN8	3	7
FF1	0.71	0.0011	1	2	-	-	-
FF2	0.20	0.0003	<1	1	-	-	-
FF3	0.23	0.0004	<1	1	FF2+FF3	1	1
FF4	0.49	0.0008	1	2	-	-	-
FF5	0.62	0.0010	1	2	-	-	-
FF6	0.14	0.0002	<1	<1	-	-	-
RF1*	-	-	26	35	FF5+FF6+ RF1	27*	37*
FF7	0.54	0.0008	1	2	FN3+FN4+CPFF3+FF4+CPRF1+FF7	30	43

*Reference approved Stantec DSU to the TDS for The Village of Centennial Springs dated 06/26/06.



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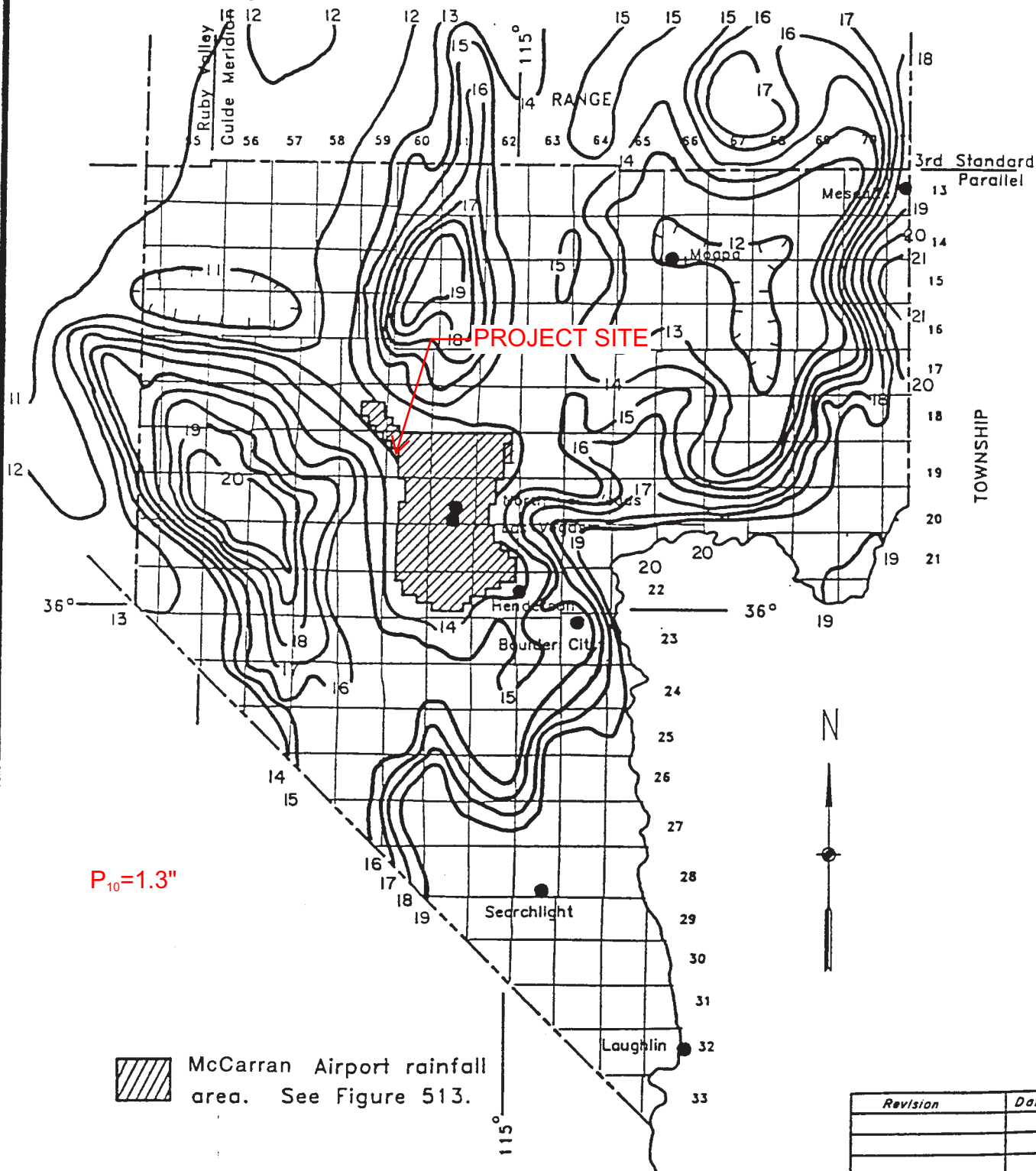
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DURANGO AND 95-PARCEL 3
FIGURE 9
FUTURE CONDITIONS DRAINAGE MAP

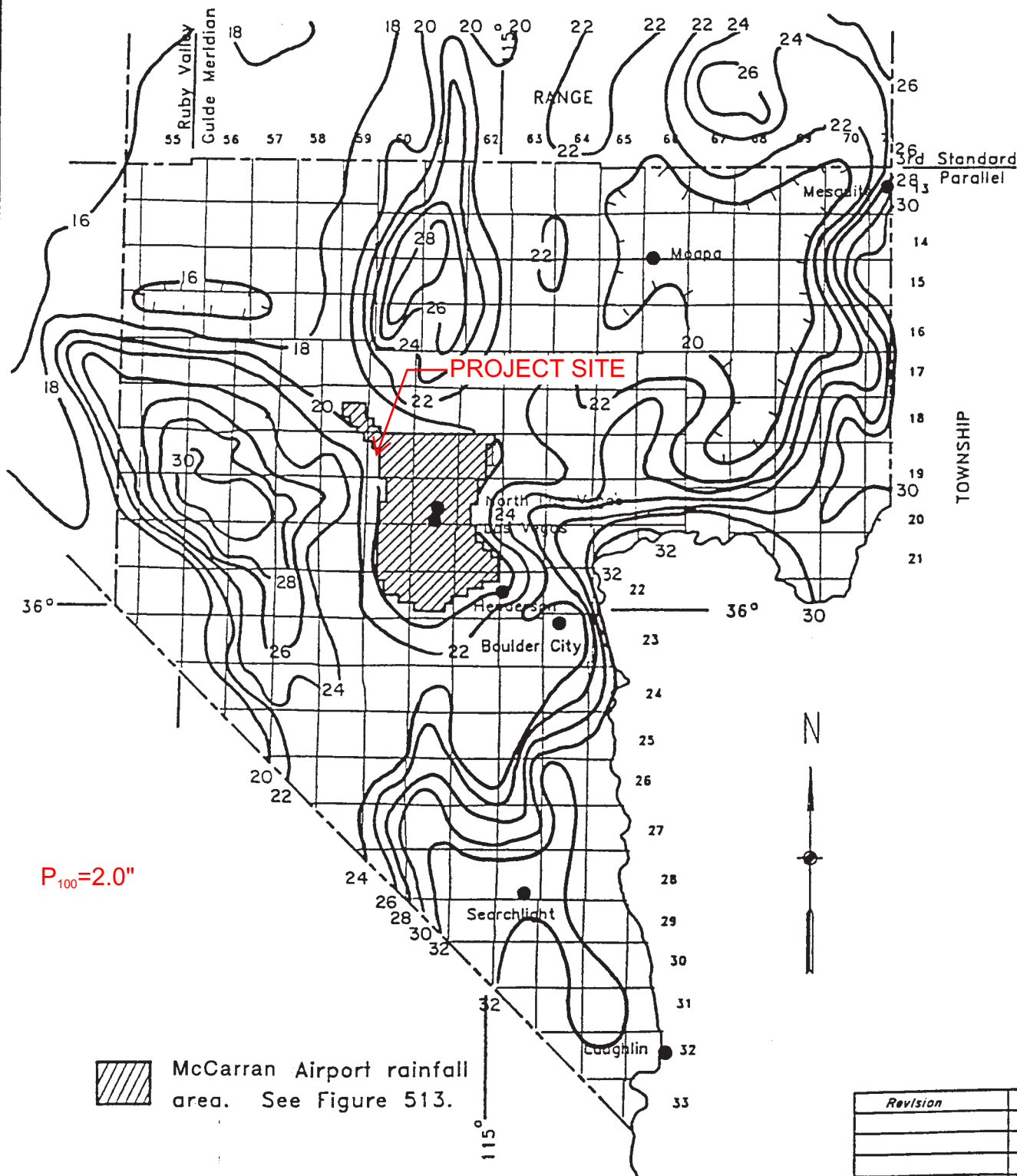
PROJECT NO: 1046 | SCALE: 1"=30'
DRAWN BY: JRK | DATE: 10/12/2022

APPENDIX B - HYDROLOGIC DATA SHEETS

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

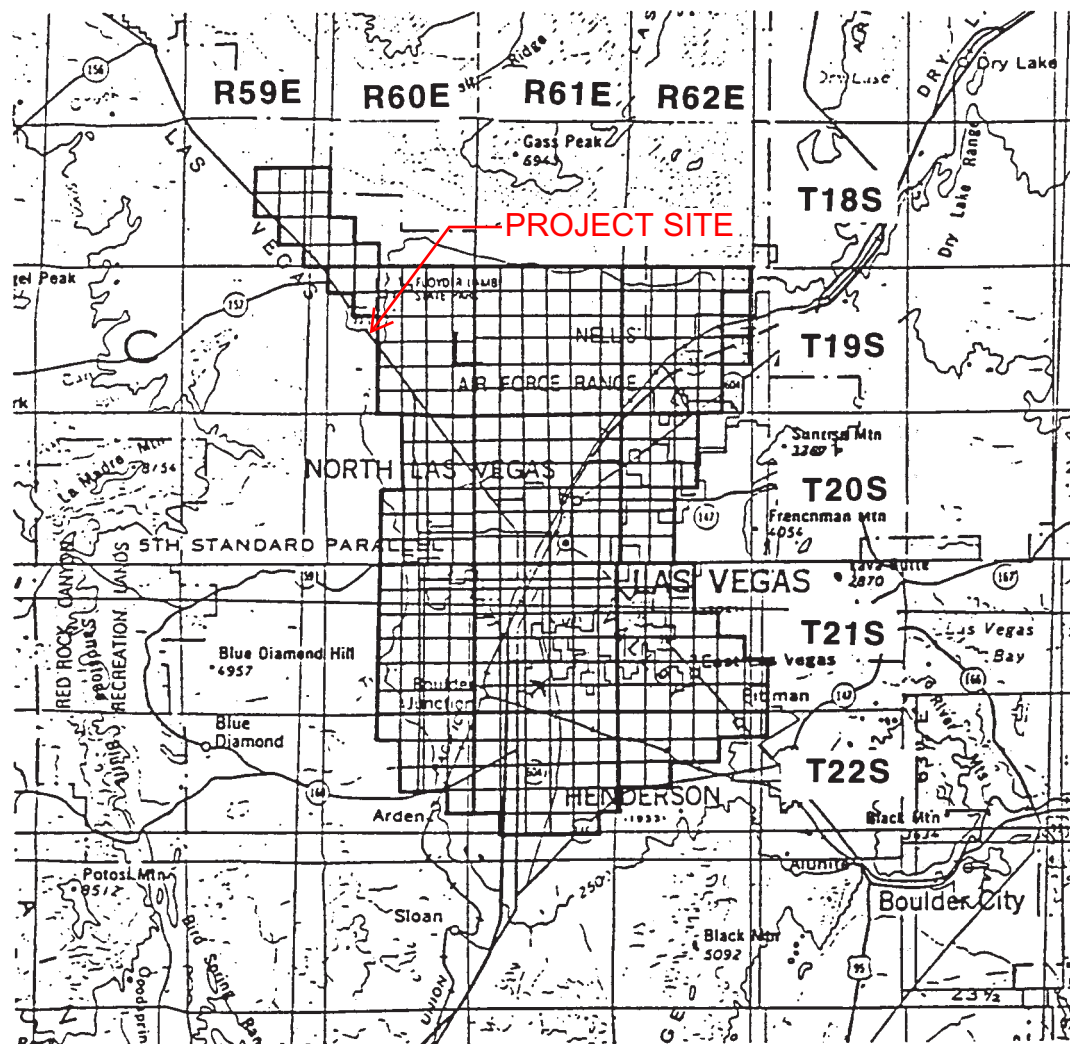


RAINFALL DEPTH-DURATION-FREQUENCY 100-YEAR, 6-HOUR (DEPTHS IN TENTHS OF INCHES)



HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

McCARRAN AIRPORT RAINFALL AREA



TOWNSHIP RANGE SECTIONS

18 South	59 East	13-15, 22-26, 36
18 South	60 East	30-32
19 South	60 East	1-6, 8-16, 21-28, 33-36
19 South	61 East	ALL SECTIONS
19 South	62 East	2-11, 14-23, 27-34
20 South	60 East	1-3, 10-15, 21-28, 33-36
20 South	61 East	ALL SECTIONS

TOWNSHIP RANGE SECTIONS

20 South	62 East	4-9, 16-20, 29-32
21 South	60 East	1-4, 9-16, 21-28, 33-36
21 South	61 East	ALL SECTIONS
21 South	62 East	4-9, 15-23, 25-36
22 South	60 East	1-4, 10-15, 24
22 South	61 East	1-24, 26-29
22 South	62 East	1-10, 17-18

Notes:

1. Refer to Table 505 and Figure 516 Depth-Duration-Frequency values in the McCarran Airport Rainfall Area.
2. Refer to Table 506 and Figure 517 for Time-Intensity-Frequency values on the McCarran Airport Rainfall Area.

Revision	Date

REFERENCE:

PRECIPITATION ADJUSTMENT RATIOS

<u>Recurrence Interval</u>	<u>Ratio to NOAA Atlas 2</u>
2-year	1.00
5-year	1.16
10-year	1.24
25-year	1.33
50-year	1.39
100-year	1.43

$$P_{10\text{ADJUSTED}} = 1.3" * 1.24 = 1.61"$$

$$P_{100\text{ADJUSTED}} = 2.0" * 1.43 = 2.86"$$

$$P_{10\text{ADJUSTED}}/P_{100\text{ADJUSTED}} = 1.61"/2.86" = 0.56$$

- NOTE: 1. Multiply the values obtained from the NOAA Atlas 2 by the above ratios to obtain the adjusted precipitation values.
2. NOAA Atlas 2 values for use with TR-55 shall not be adjusted by the above ratios.
3. Tables 505 and 506 require no adjustments.

<i>Revision</i>	<i>Date</i>

SIX HOUR DEPTH-AREA REDUCTION FACTORS

<u>Drainage Area (Square Miles)</u>	<u>Six-Hour Depth-Area Reduction Factor</u>
0.0	1.00
0.5	0.98
1.0	0.97
2.0	0.93
4.0	0.91
6.0	0.90
8.0	0.88
10.0	0.86
20.0	0.79
30.0	0.74
50.0	0.68
100.0	0.60
150.0	0.55
200.0	0.51
300.0	0.46
400.0	0.42
500.0	0.39

- NOTES: 1. A graphical representation of these factors is presented in Figure 514.
2. Consult with the local entity and/or the CCRFCD for guidance in using the Depth-Area Reduction Factors for drainage areas greater than 200 square miles.

<i>Revision</i>	<i>Date</i>

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 $I_a = 0.2S$.

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.

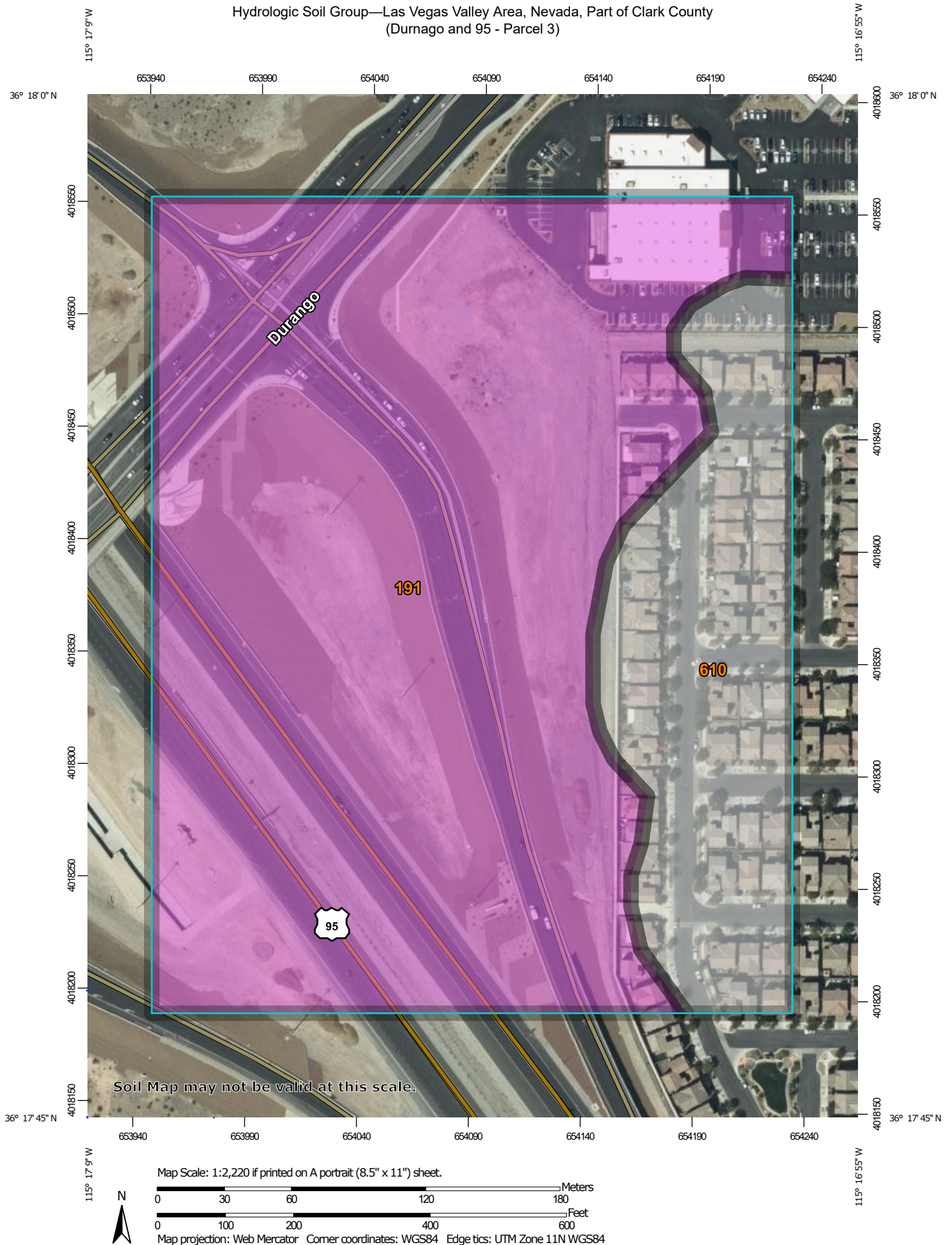
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

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 Soil Group—Las Vegas Valley Area, Nevada, Part of Clark County
(Durnago and 95 - Parcel 3)



MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Lines

 A
 A/D
 B
 B/D
 C
 C/D
 D
 Not rated or not available

Soil Rating Points

 A
 A/D
 B
 B/D

 C
 C/D
 D
 Not rated or not available

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 17, Sep 9, 2021

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.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
191	Dalian very cobbly fine sandy loam, 2 to 8 percent slopes	A	20.4	79.1%
610	Pits, gravel		5.4	20.9%
Totals for Area of Interest			25.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*      JUN 1998
*      VERSION 4.1
*
* RUN DATE 12OCT22 TIME 10:45:43
*
*****

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*****
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* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

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X X XXXXXXX XXXX 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

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

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

1 HEC-1 INPUT PAGE 1

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
1 ID TECHNICAL DRAINAGE STUDY FOR DURANGO AND 95 - PARCEL 3
2 ID EXISTING CONDITIONS
3 ID 10-YR AND 100-YR, 6 HOUR STORM EVENT
4 ID STORM DRAIN DISTRIBUTION #3
5 ID File:D95-EX.dat
6 ID
7 IT 5 0 0 300
8 IO 5
9 JR PREC 0.56 1.00

10 KK EF1
11 KM OFFSITE BASIN
12 BA .0004
13 PB 2.86
14 PC 0.0000 0.0200 0.0570 0.0700 0.0870 0.1080 0.1240 0.1300 0.1300 0.1300
15 PC 0.1300 0.1300 0.1300 0.1330 0.1400 0.1420 0.1480 0.1580 0.1720 0.1810
16 PC 0.1900 0.1970 0.1990 0.2000 0.2010 0.2040 0.2140 0.2290 0.2410 0.2490
17 PC 0.2510 0.2560 0.2700 0.2780 0.2810 0.2830 0.2950 0.3220 0.3520 0.4090
18 PC 0.4990 0.5900 0.7100 0.7440 0.7810 0.8120 0.8190 0.8350 0.8510 0.8560
19 PC 0.8600 0.8680 0.8760 0.8880 0.9100 0.9260 0.9370 0.9500 0.9700 0.9760
20 PC 0.9820 0.9850 0.9870 0.9890 0.9900 0.9930 0.9930 0.9940 0.9950 0.9980
21 PC 0.9980 0.9990 1.0000
22 LS 0 77 0
23 UD .050

24 KK EN1
25 KM ONSITE BASIN
26 BA .0008
27 LS 0 77 0
28 UD .064

29 KK CPEN1
30 KM COMBINE FLOW FROM BASINS EF1 AND EN1 IN EXISTING 5' WIDE RECTANGULAR CHANNEL
31 HC 2

32 KK EF2
33 KM OFFSITE BASIN
34 BA .0010
35 LS 0 77 0
36 UD .050

37 KK EN2
38 KM ONSITE BASIN
39 BA .0020
40 LS 0 77 0
41 UD .086

42 KK CPEN2
43 KM COMBINE FLOW FROM BASINS EF1, EN1, EF2 AND EN2 AT PITNEY AVENUE
44 HC 3

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
45 KK EF3
46 KM OFFSITE BASIN
47 BA .0004
48 LS 0 77 0
49 UD .050
50 KK EN3

```

51	KM	ONSITE BASIN			
52	BA	.0007			
53	LS	0	77	0	
54	UD	.061			
55	KK	CPEN3			
56	KM	COMBINE FLOW FROM BASINS EF3 AND EN3 IN EXISTING 5' WIDE RECTANGULAR CHANNEL			
57	HC	2			
58	KK	EF4			
59	KM	OFFSITE BASIN			
60	BA	.0008			
61	LS	0	98	0	
62	UD	.050			
63	KK	EF7			
64	KM	OFFSITE BASIN			
65	BA	.0009			
66	LS	0	77	0	
67	UD	.050			
68	KK	CPEF7			
69	KM	COMBINE FLOW FROM BASINS EF3, EN3, EF4, AND EF7 AT EXISTING DRAINAGE EASEMEN			
70	HC	3			
71	KK	EF5			
72	KM	OFFSITE BASIN (PORTION OF REFERENCED OFFSITE FLOW)			
73	BA	.0010			
74	LS	0	98	0	
75	UD	.050			
76	KK	EF6			
77	KM	OFFSITE BASIN (PORTION OF REFERENCED OFFSITE FLOW)			
78	BA	.0002			
79	LS	0	98	0	
80	UD	.050			
81	ZZ				

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
10	EF1	
24	EN1	
29	CPEN1.....	
32	EF2	
37	EN2	
42	CPEN2.....	
45	EF3	
50	EN3	
55	CPEN3.....	
58	EF4	
63	EF7	
68	CPEF7.....	
71	EF5	
76	EF6	

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
* JUN 1998
* VERSION 4.1
* RUN DATE 12OCT22 TIME 10:45:43
*
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* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

```

EXISTING CONDITIONS
 10-YR AND 100-YR, 6 HOUR STORM EVENT
 STORM DRAIN DISTRIBUTION #3
 File:D95-EX.dat

8 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					
+	EF1	.00	1	FLOW	0.
				TIME	3.50
HYDROGRAPH AT					
+	EN1	.00	1	FLOW	0.
				TIME	3.50
2 COMBINED AT					
+	CPEN1	.00	1	FLOW	0.
				TIME	3.50
HYDROGRAPH AT					
+	EF2	.00	1	FLOW	0.
				TIME	3.50
HYDROGRAPH AT					
+	EN2	.00	1	FLOW	0.
				TIME	3.58
3 COMBINED AT					
+	CPEN2	.00	1	FLOW	1.
				TIME	3.50
HYDROGRAPH AT					
+	EF3	.00	1	FLOW	0.
				TIME	3.50
HYDROGRAPH AT					
+	EN3	.00	1	FLOW	0.
				TIME	3.50
2 COMBINED AT					
+	CPEN3	.00	1	FLOW	0.
				TIME	3.50
HYDROGRAPH AT					
+	EF4	.00	1	FLOW	1.
				TIME	3.50
HYDROGRAPH AT					
+	EF7	.00	1	FLOW	0.
				TIME	3.50
3 COMBINED AT					
+	CPEF7	.00	1	FLOW	2.
				TIME	3.50
HYDROGRAPH AT					
+	EF5	.00	1	FLOW	1.
				TIME	3.50

HYDROGRAPH AT						
+	EF6	.00	1	FLOW	0.	0.
				TIME	3.50	3.50

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


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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*      JUN 1998
*      VERSION 4.1
*
* RUN DATE 12OCT22 TIME 13:04:24
*
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* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
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X X XXXXXXX XXXXX X
X X X X X XX
X X X X X
XXXXXXX XXXX X XXXXX X
X X X X X
X X X X X
X X XXXXXXX XXXXX XXX

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

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

1 HEC-1 INPUT PAGE 1

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LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
*DIAGRAM
1 ID TECHNICAL DRAINAGE STUDY FOR DURANGO AND 95 - PARCEL 3
2 ID FUTURE CONDITIONS
3 ID 10-YR AND 100-YR, 6 HOUR STORM EVENT
4 ID STORM DRAIN DISTRIBUTION #3
5 ID File:D95-FUT.dat
6 ID
7 IT 5 0 0 300
8 IO 5
9 JR PREC 0.56 1.00

10 KK FF1
11 KM OFFSITE BASIN
12 BA .0011
13 PB 2.86
14 PC 0.0000 0.0200 0.0570 0.0700 0.0870 0.1080 0.1240 0.1300 0.1300 0.1300
15 PC 0.1300 0.1300 0.1300 0.1330 0.1400 0.1420 0.1480 0.1580 0.1720 0.1810
16 PC 0.1900 0.1970 0.1990 0.2000 0.2010 0.2040 0.2140 0.2290 0.2410 0.2490
17 PC 0.2510 0.2560 0.2700 0.2780 0.2810 0.2830 0.2950 0.3220 0.3520 0.4090
18 PC 0.4990 0.5900 0.7100 0.7440 0.7810 0.8120 0.8190 0.8350 0.8510 0.8560
19 PC 0.8600 0.8680 0.8760 0.8880 0.9100 0.9260 0.9370 0.9500 0.9700 0.9760
20 PC 0.9820 0.9850 0.9870 0.9890 0.9900 0.9930 0.9930 0.9940 0.9950 0.9980
21 PC 0.9980 0.9990 1.0000
22 LS 0 89 0
23 UD .053

24 KK FN1
25 KM ONSITE BASIN
26 BA .0023
27 LS 0 89 0
28 UD .050

29 KK CFPN1
30 KM COMBINE FLOW FROM BASINS FF1 AND FN1 AT PITNEY AVENUE
31 HC 2

32 KK FN5
33 KM ONSITE BASIN
34 BA .0001
35 LS 0 89 0
36 UD .050

37 KK FN6
38 KM ONSITE BASIN
39 BA .0001
40 LS 0 89 0
41 UD .050

42 KK FN7
43 KM ONSITE BASIN
44 BA .0001
45 LS 0 89 0
46 UD .050

```

1 HEC-1 INPUT PAGE 2

```

LINE ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10
47 KK FN8
48 KM ONSITE BASIN
49 BA .0001
50 LS 0 89 0
51 UD .050

```

52	KK	CPFN8			
53	KM	COMBINE FLOW FROM BASINS FF1, FN1, AND FN5 THRU FN8 AT PITNEY AVENUE			
54	HC	5			
55	KK	FN2			
56	KM	ONSITE BASIN			
57	BA	.0001			
58	LS	0	98	0	
59	UD	.050			
60	KK	FN3			
61	KM	ONSITE BASIN			
62	BA	.0005			
63	LS	0	89	0	
64	UD	.050			
65	KK	FN4			
66	KM	ONSITE BASIN			
67	BA	.0003			
68	LS	0	89	0	
69	UD	.068			
70	KK	FF2			
71	KM	OFFSITE BASIN			
72	BA	.0003			
73	LS	0	89	0	
74	UD	.050			
75	KK	FF3			
76	KM	OFFSITE BASIN			
77	BA	.0004			
78	LS	0	89	0	
79	UD	.050			
80	KK	CPFF3			
81	KM	COMBINE FLOW FROM BASINS FF2 AND FF3			
82	HC	2			
83	KK	FF4			
84	KM	OFFSITE BASIN			
85	BA	.0008			
86	LS	0	98	0	
87	UD	.050			

1

HEC-1 INPUT

PAGE 3

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

88	KK	FF7			
89	KM	OFFSITE BASIN			
90	BA	.0008			
91	LS	0	89	0	
92	UD	.050			
93	KK	CPFF7			
94	KM	COMBINE BASINS FN3, FN4, FF2 THRU FF4, AND FF7 AT EX. 20' DRAINAGE EASEMENT			
95	HC	5			
96	KK	FF5			
97	KM	OFFSITE BASIN			
98	BA	.0010			
99	LS	0	98	0	
100	UD	.050			
101	KK	FF6			
102	KM	OFFSITE BASIN			
103	BA	.0002			
104	LS	0	98	0	
105	UD	.050			
106	ZZ				

1

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE	(V) ROUTING	(--->) DIVERSION OR PUMP FLOW
NO.	(.) CONNECTOR	(<---) RETURN OF DIVERTED OR PUMPED FLOW
10	FF1	
	.	
24	.	FN1
	.	
29	CPFN1.....	
	.	
32	.	FN5
	.	
37	.	.
	.	FN6
	.	.
42	.	.
	.	FN7
	.	.
47	.	.
	.	FN8
	.	.
52	CPFN8.....	
	.	

```

55      .      FN2
      .      .
60      .      .      FN3
      .      .      .
65      .      .      .      FN4
      .      .      .      .
70      .      .      .      .      FF2
      .      .      .      .      .
75      .      .      .      .      .      FF3
      .      .      .      .      .      .
80      .      .      .      .      .      .      CPFF3.....
      .      .      .      .      .      .      .
83      .      .      .      .      .      .      .      FF4
      .      .      .      .      .      .      .      .
88      .      .      .      .      .      .      .      .      FF7
      .      .      .      .      .      .      .      .      .
93      .      .      .      .      .      .      .      .      .      CPFF7.....
      .      .      .      .      .      .      .      .      .      .
96      .      .      .      .      .      .      .      .      .      .      FF5
      .      .      .      .      .      .      .      .      .      .      .
101     .      .      .      .      .      .      .      .      .      .      .      FF6

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(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****
*
* FLOOD HYDROGRAPH PACKAGE (HEC-1)
*      JUN 1998
*      VERSION 4.1
* RUN DATE 12OCT22 TIME 13:04:24
*
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* HYDROLOGIC ENGINEERING CENTER
* 609 SECOND STREET
* DAVIS, CALIFORNIA 95616
* (916) 756-1104
*
*****

```

TECHNICAL DRAINAGE STUDY FOR DURANGO AND 95 - PARCEL 3
 FUTURE CONDITIONS
 10-YR AND 100-YR, 6 HOUR STORM EVENT
 STORM DRAIN DISTRIBUTION #3
 File:D95-FUT.dat

```

8 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					
+	FF1	.00	1	FLOW	1. 2.
				TIME	3.50 3.50

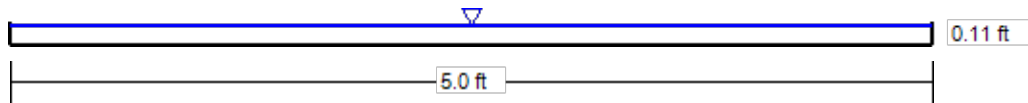
HYDROGRAPH AT						
+	FN1	.00	1	FLOW	2.	4.
				TIME	3.50	3.50
2 COMBINED AT						
+	CPFN1	.00	1	FLOW	3.	7.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN5	.00	1	FLOW	0.	0.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN6	.00	1	FLOW	0.	0.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN7	.00	1	FLOW	0.	0.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN8	.00	1	FLOW	0.	0.
				TIME	3.50	3.50
5 COMBINED AT						
+	CPFN8	.00	1	FLOW	3.	7.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN2	.00	1	FLOW	0.	0.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN3	.00	1	FLOW	0.	1.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FN4	.00	1	FLOW	0.	1.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FF2	.00	1	FLOW	0.	1.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FF3	.00	1	FLOW	0.	1.
				TIME	3.50	3.50
2 COMBINED AT						
+	CPFF3	.00	1	FLOW	1.	1.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FF4	.00	1	FLOW	1.	2.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FF7	.00	1	FLOW	1.	2.
				TIME	3.50	3.50
5 COMBINED AT						
+	CPFF7	.00	1	FLOW	3.	6.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FF5	.00	1	FLOW	1.	2.
				TIME	3.50	3.50
HYDROGRAPH AT						
+	FF6	.00	1	FLOW	0.	0.
				TIME	3.50	3.50

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

APPENDIX C - HYDRAULIC CALCULATIONS

Cross Section for Velocity Check_Basin EN1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005
Normal Depth	0.11
Bottom Width	5.0
Discharge	1.00



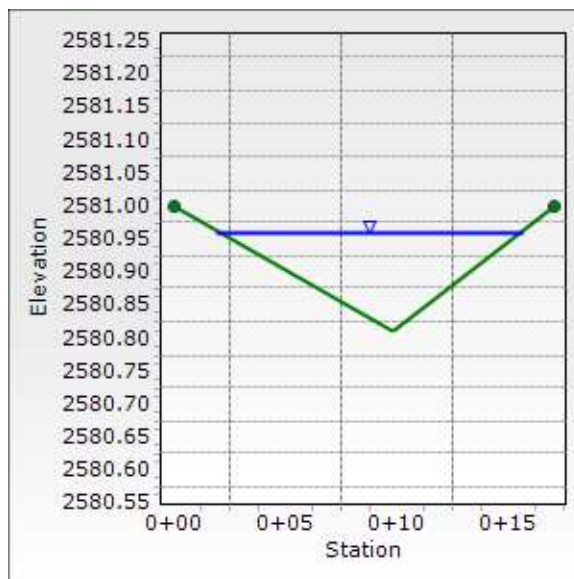
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Worksheet for Velocity Check_Basin EN1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.005
Bottom Width	5.0
Discharge	1.00
Results	
Normal Depth	0.11
Flow Area	0.6
Wetted Perimeter	5.22
Hydraulic Radius	0.11
Top Width	5.0
Critical Depth	0.11
Critical Slope	0.005
Velocity	1.81
Velocity Head	0.05
Specific Energy	0.16
Froude Number	0.96
Flow Type	Subcritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.11
Critical Depth	0.11
Channel Slope	0.005
Critical Slope	0.005

Cross Section for Velocity Check_Basin EN2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.030
Normal Depth	0.15
Discharge	2.00



Worksheet for Velocity Check_Basin EN2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.030
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,581.00
0+09.89	2,580.81
0+17.11	2,581.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,581.00)	(0+17.11, 2,581.00)	0.025

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	0.15
Elevation Range	2,580.810 to 2,581.000 ft
Flow Area	1.1
Wetted Perimeter	13.87
Hydraulic Radius	0.08
Top Width	13.9
Normal Depth	0.15
Critical Depth	0.16
Critical Slope	0.021
Velocity	1.87
Velocity Head	0.05
Specific Energy	0.21
Froude Number	1.19
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

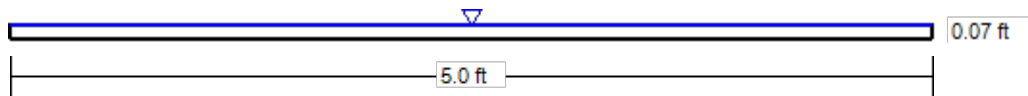
GVF Output Data	
Upstream Depth	0.00

Worksheet for Velocity Check_Basin EN2

GVF Output Data	
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.15
Critical Depth	0.16
Channel Slope	0.030
Critical Slope	0.021

Cross Section for Velocity Check_Basin EN3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.021
Normal Depth	0.07
Bottom Width	5.0
Discharge	1.00



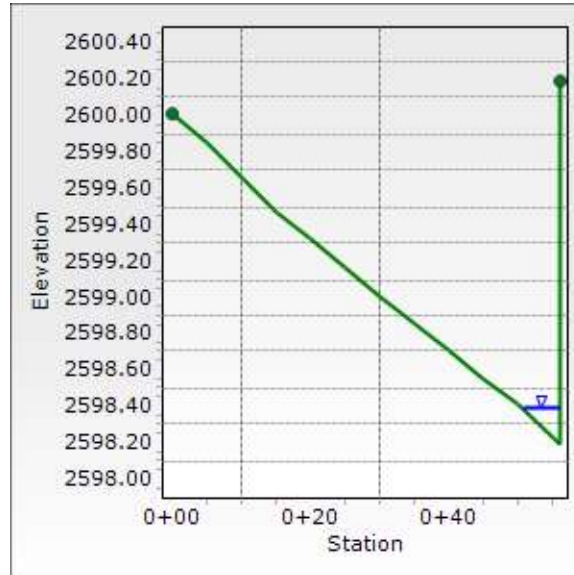
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Worksheet for Velocity Check_Basin EN3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.021
Bottom Width	5.0
Discharge	1.00
Results	
Normal Depth	0.07
Flow Area	0.4
Wetted Perimeter	5.14
Hydraulic Radius	0.07
Top Width	5.0
Critical Depth	0.11
Critical Slope	0.005
Velocity	2.80
Velocity Head	0.12
Specific Energy	0.19
Froude Number	1.84
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.07
Critical Depth	0.11
Channel Slope	0.021
Critical Slope	0.005

Cross Section for Velocity Check_Basin EF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.034
Normal Depth	0.20
Discharge	2.00



Worksheet for Velocity Check_Basin EF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.034
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,600.01
0+05.00	2,599.85
0+10.00	2,599.66
0+15.00	2,599.47
0+20.00	2,599.32
0+25.00	2,599.16
0+30.00	2,599.01
0+35.00	2,598.86
0+40.00	2,598.71
0+45.00	2,598.55
0+50.00	2,598.41
0+55.00	2,598.22
0+55.97	2,598.19
0+55.98	2,600.19

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,600.01)	(0+55.98, 2,600.19)	0.016

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

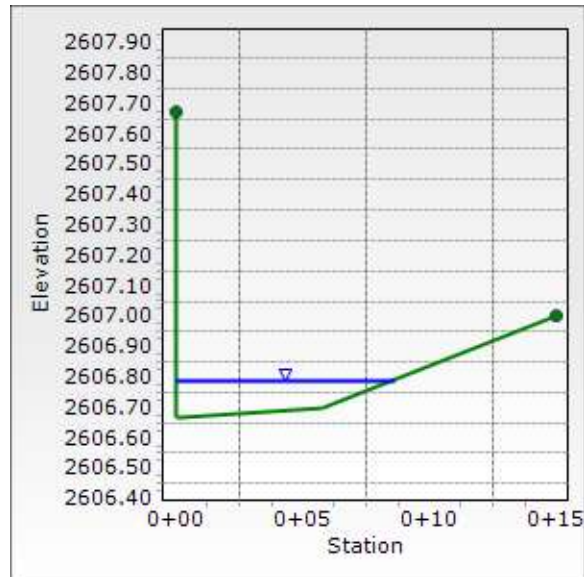
Results	
Normal Depth	0.20
Elevation Range	2,598.19 to 2,600.19 ft
Flow Area	0.5
Wetted Perimeter	5.59
Hydraulic Radius	0.10
Top Width	5.4
Normal Depth	0.20
Critical Depth	0.27
Critical Slope	0.008
Velocity	3.64
Velocity Head	0.21
Specific Energy	0.40

Worksheet for Velocity Check_Basin EF4

Results	
Froude Number	2.01
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.20
Critical Depth	0.27
Channel Slope	0.034
Critical Slope	0.008

Cross Section for Velocity Check_Basin EF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.021
Normal Depth	0.12
Discharge	2.00



Worksheet for Velocity Check_Basin EF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.021
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,607.67
0+00.00	2,606.67
0+05.73	2,606.70
0+15.00	2,607.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,607.67)	(0+15.00, 2,607.00)	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	0.12
Elevation Range	2,606.670 to 2,607.670 ft
Flow Area	0.8
Wetted Perimeter	8.76
Hydraulic Radius	0.09
Top Width	8.6
Normal Depth	0.12
Critical Depth	0.16
Critical Slope	0.008
Velocity	2.63
Velocity Head	0.11
Specific Energy	0.23
Froude Number	1.56
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

GVF Output Data	
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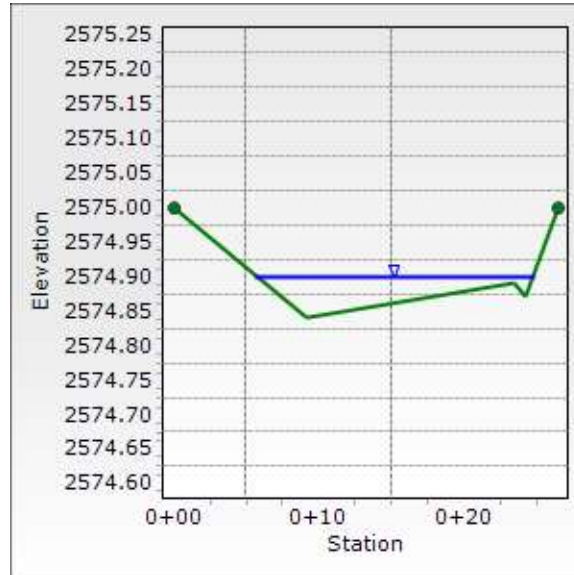
Worksheet for Velocity Check_Basin EF5

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.12
Critical Depth	0.16
Channel Slope	0.021
Critical Slope	0.008

Cross Section for Velocity Check_Basin EF7

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.048
Normal Depth	0.06
Discharge	1.00



Worksheet for Velocity Check_Basin EF7

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.048
Discharge	1.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,575.00
0+09.22	2,574.84
0+23.53	2,574.89
0+24.32	2,574.87
0+26.53	2,575.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,575.00)	(0+26.53, 2,575.00)	0.025

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	0.06
Elevation Range	2,574.840 to 2,575.000 ft
Flow Area	0.7
Wetted Perimeter	19.35
Hydraulic Radius	0.04
Top Width	19.4
Normal Depth	0.06
Critical Depth	0.07
Critical Slope	0.026
Velocity	1.43
Velocity Head	0.03
Specific Energy	0.10
Froude Number	1.32
Flow Type	Supercritical

GVF Input Data

Downstream Depth	0.00
Length	0.00
Number Of Steps	0

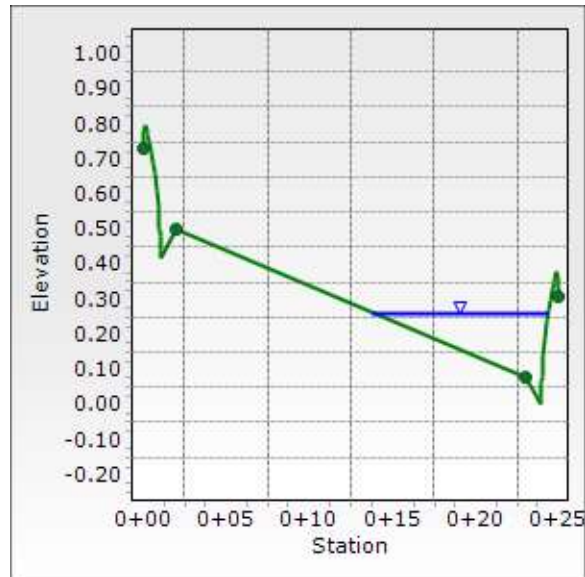
Worksheet for Velocity Check_Basin EF7

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.06
Critical Depth	0.07
Channel Slope	0.048
Critical Slope	0.026

Cross Section for Velocity Check_Basin FN1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.022
Normal Depth	0.26
Discharge	4.00



Worksheet for Velocity Check_Basin FN1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.022
Discharge	4.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.73
0+00.02	0.78
0+00.07	0.80
0+00.17	0.78
0+00.27	0.77
0+00.37	0.75
0+00.47	0.72
0+00.57	0.69
0+00.67	0.66
0+00.77	0.61
0+00.87	0.56
0+00.97	0.50
0+00.98	0.49
0+00.99	0.48
0+01.00	0.44
0+01.00	0.42
0+01.02	0.42
0+02.00	0.50
0+23.00	0.08
0+23.98	0.00
0+24.00	0.00
0+24.00	0.02
0+24.02	0.06
0+24.02	0.07
0+24.03	0.08
0+24.13	0.14
0+24.23	0.19
0+24.33	0.24
0+24.43	0.27
0+24.53	0.30
0+24.63	0.33
0+24.73	0.35
0+24.83	0.36
0+24.93	0.38
0+24.98	0.36
0+25.00	0.31

Roughness Segment Definitions

Worksheet for Velocity Check_Basin FN1

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 0.73)	(0+02.00, 0.50)	0.016
(0+02.00, 0.50)	(0+23.00, 0.08)	0.013
(0+23.00, 0.08)	(0+25.00, 0.31)	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	0.26
Elevation Range	0.000 to 0.800 ft
Flow Area	1.1
Wetted Perimeter	10.76
Hydraulic Radius	0.10
Top Width	10.7
Normal Depth	0.26
Critical Depth	0.33
Critical Slope	0.005
Velocity	3.58
Velocity Head	0.20
Specific Energy	0.46
Froude Number	1.95
Flow Type	Supercritical

GVF Input Data

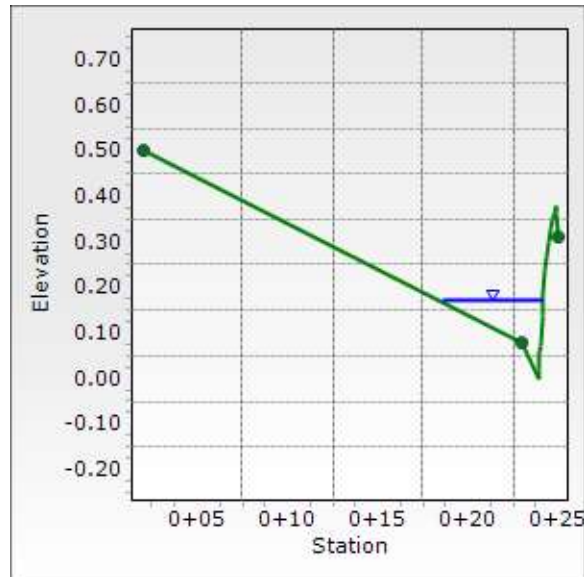
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.26
Critical Depth	0.33
Channel Slope	0.022
Critical Slope	0.005

Cross Section for Velocity Check_Basin FN3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.045
Normal Depth	0.17
Discharge	1.00



Worksheet for Velocity Check_Basin FN3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.045
Discharge	1.00

Section Definitions

Station (ft)	Elevation (ft)
0+02.00	0.50
0+23.00	0.08
0+23.98	0.00
0+24.00	0.00
0+24.00	0.02
0+24.02	0.06
0+24.02	0.07
0+24.03	0.08
0+24.13	0.14
0+24.23	0.19
0+24.33	0.24
0+24.43	0.27
0+24.53	0.30
0+24.63	0.33
0+24.73	0.35
0+24.83	0.36
0+24.93	0.38
0+24.98	0.36
0+25.00	0.31

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+02.00, 0.50)	(0+23.00, 0.08)	0.016
(0+23.00, 0.08)	(0+25.00, 0.31)	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	0.17
Elevation Range	0.000 to 0.500 ft
Flow Area	0.3
Wetted Perimeter	5.63
Hydraulic Radius	0.06
Top Width	5.5

Worksheet for Velocity Check_Basin FN3

Results

Normal Depth	0.17
Critical Depth	0.21
Critical Slope	0.008
Velocity	3.05
Velocity Head	0.14
Specific Energy	0.31
Froude Number	2.21
Flow Type	Supercritical

GVF Input Data

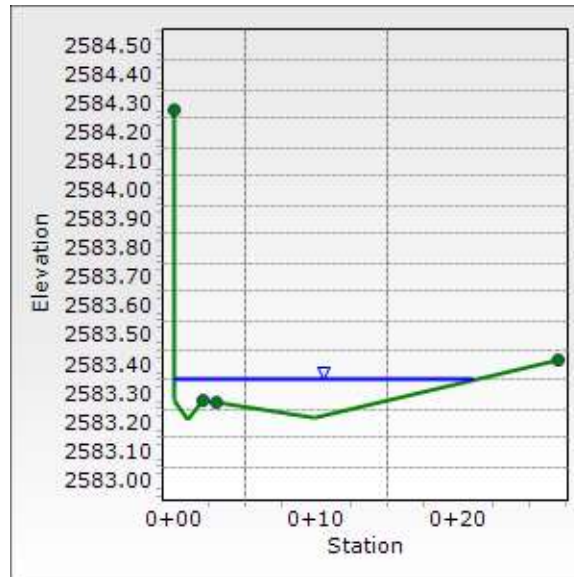
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Length	0.00
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.17
Critical Depth	0.21
Channel Slope	0.045
Critical Slope	0.008

Cross Section for Velocity Check_Basin FF1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Normal Depth	0.14
Discharge	2.00



Worksheet for Velocity Check_Basin FF1

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,584.28
0+00.00	2,583.28
0+01.00	2,583.21
0+02.00	2,583.28
0+03.00	2,583.27
0+09.94	2,583.22
0+27.06	2,583.42

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,584.28)	(0+02.00, 2,583.28)	0.015
(0+02.00, 2,583.28)	(0+03.00, 2,583.27)	0.033
(0+03.00, 2,583.27)	(0+27.06, 2,583.42)	0.025

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	0.14
Elevation Range	2,583.21 to 2,584.28 ft
Flow Area	1.7
Wetted Perimeter	21.18
Hydraulic Radius	0.08
Top Width	21.1
Normal Depth	0.14
Critical Depth	0.12
Critical Slope	0.022
Velocity	1.15
Velocity Head	0.02
Specific Energy	0.16
Froude Number	0.70
Flow Type	Subcritical

GVF Input Data

Worksheet for Velocity Check_Basin FF1

GVF Input Data

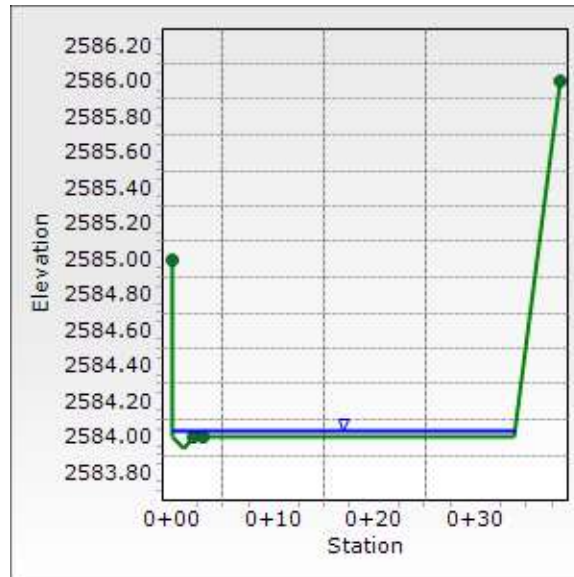
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	0.00
Upstream Velocity	0.00
Normal Depth	0.14
Critical Depth	0.12
Channel Slope	0.010
Critical Slope	0.022

Cross Section for Velocity Check_Basin FF2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Normal Depth	0.10
Discharge	1.00



Worksheet for Velocity Check_Basin FF2

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Discharge	1.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,585.00
0+00.00	2,584.00
0+01.00	2,583.94
0+02.00	2,584.00
0+03.00	2,584.00
0+33.86	2,584.00
0+38.36	2,586.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,585.00)	(0+02.00, 2,584.00)	0.015
(0+02.00, 2,584.00)	(0+03.00, 2,584.00)	0.033
(0+03.00, 2,584.00)	(0+38.36, 2,586.00)	0.025

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	0.10
Elevation Range	2,583.94 to 2,586.00 ft
Flow Area	1.4
Wetted Perimeter	34.00
Hydraulic Radius	0.04
Top Width	33.9
Normal Depth	0.10
Critical Depth	0.09
Critical Slope	0.029
Velocity	0.71
Velocity Head	0.01
Specific Energy	0.11
Froude Number	0.62
Flow Type	Subcritical

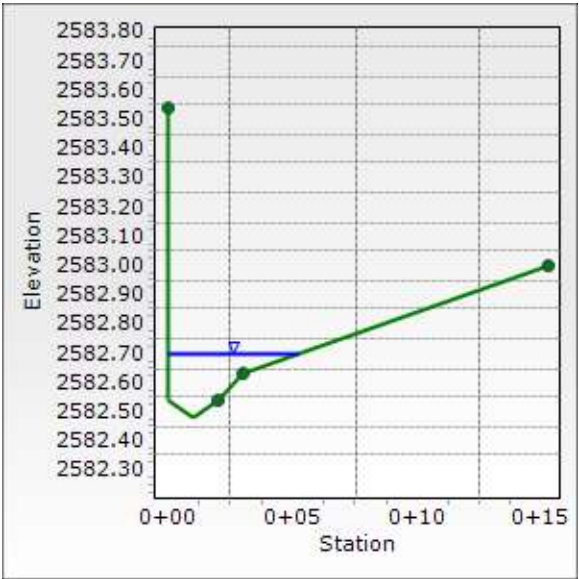
GVF Input Data

Worksheet for Velocity Check_Basin FF2

GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	0.00
Upstream Velocity	0.00
Normal Depth	0.10
Critical Depth	0.09
Channel Slope	0.010
Critical Slope	0.029

Cross Section for Velocity Check_Basin FF3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.019
Normal Depth	0.22
Discharge	1.00



Worksheet for Velocity Check_Basin FF3

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.019
Discharge	1.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,583.54
0+00.00	2,582.54
0+01.00	2,582.48
0+02.00	2,582.54
0+03.00	2,582.63
0+15.27	2,583.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,583.54)	(0+02.00, 2,582.54)	0.015
(0+02.00, 2,582.54)	(0+03.00, 2,582.63)	0.033
(0+03.00, 2,582.63)	(0+15.27, 2,583.00)	0.030

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

Results	
Normal Depth	0.22
Elevation Range	2,582.480 to 2,583.540 ft
Flow Area	0.6
Wetted Perimeter	5.43
Hydraulic Radius	0.10
Top Width	5.3
Normal Depth	0.22
Critical Depth	0.21
Critical Slope	0.021
Velocity	1.76
Velocity Head	0.05
Specific Energy	0.27
Froude Number	0.95
Flow Type	Subcritical

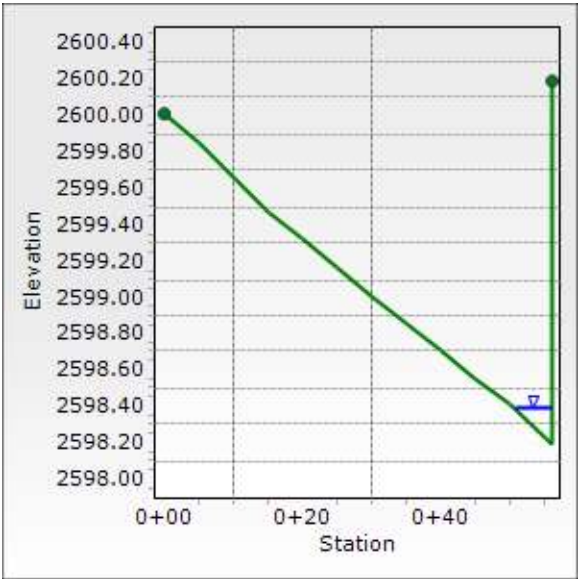
GVF Input Data	
Downstream Depth	0.00

Worksheet for Velocity Check_Basin FF3

GVF Input Data	
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	0.00
Upstream Velocity	0.00
Normal Depth	0.22
Critical Depth	0.21
Channel Slope	0.019
Critical Slope	0.021

Cross Section for Velocity Check_Basin FF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.034
Normal Depth	0.20
Discharge	2.00



Worksheet for Velocity Check_Basin FF4

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.034
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,600.01
0+05.00	2,599.85
0+10.00	2,599.66
0+15.00	2,599.47
0+20.00	2,599.32
0+25.00	2,599.16
0+30.00	2,599.01
0+35.00	2,598.86
0+40.00	2,598.71
0+45.00	2,598.55
0+50.00	2,598.41
0+55.00	2,598.22
0+55.97	2,598.19
0+55.98	2,600.19

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,600.01)	(0+55.98, 2,600.19)	0.016

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

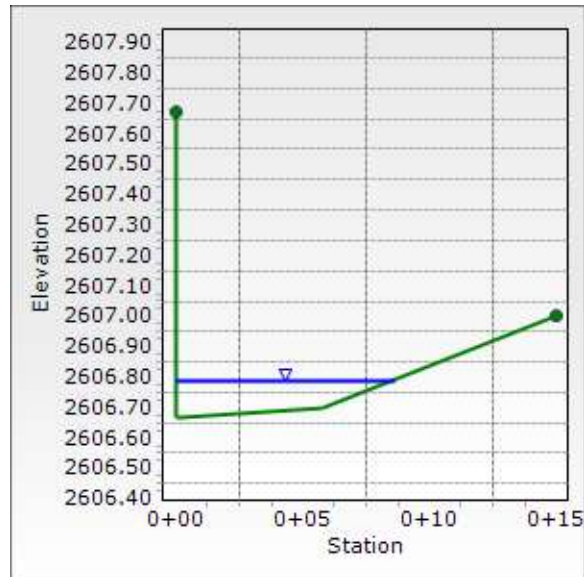
Results	
Normal Depth	0.20
Elevation Range	2,598.19 to 2,600.19 ft
Flow Area	0.5
Wetted Perimeter	5.59
Hydraulic Radius	0.10
Top Width	5.4
Normal Depth	0.20
Critical Depth	0.27
Critical Slope	0.008
Velocity	3.64
Velocity Head	0.21
Specific Energy	0.40

Worksheet for Velocity Check_Basin FF4

Results	
Froude Number	2.01
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.20
Critical Depth	0.27
Channel Slope	0.034
Critical Slope	0.008

Cross Section for Velocity Check_Basin FF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.021
Normal Depth	0.12
Discharge	2.00



Worksheet for Velocity Check_Basin FF5

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.021
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,607.67
0+00.00	2,606.67
0+05.73	2,606.70
0+15.00	2,607.00

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,607.67)	(0+15.00, 2,607.00)	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	0.12
Elevation Range	2,606.670 to 2,607.670 ft
Flow Area	0.8
Wetted Perimeter	8.76
Hydraulic Radius	0.09
Top Width	8.6
Normal Depth	0.12
Critical Depth	0.16
Critical Slope	0.008
Velocity	2.63
Velocity Head	0.11
Specific Energy	0.23
Froude Number	1.56
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

GVF Output Data	
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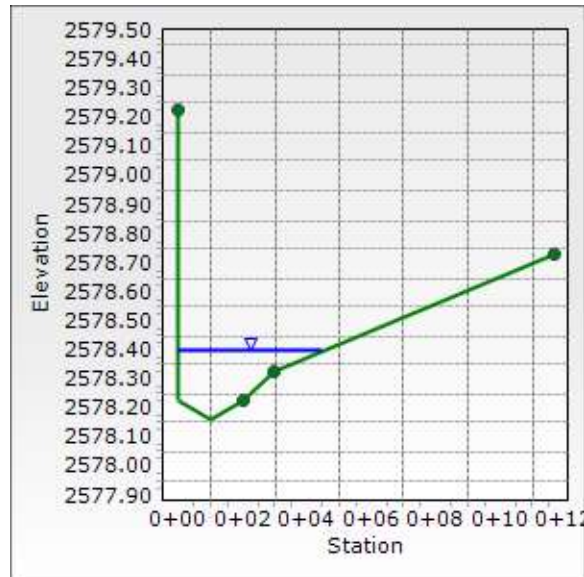
Worksheet for Velocity Check_Basin FF5

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.12
Critical Depth	0.16
Channel Slope	0.021
Critical Slope	0.008

Cross Section for Velocity Check-Basin FF7

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.048
Normal Depth	0.24
Discharge	2.00



Worksheet for Velocity Check-Basin FF7

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.048
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,579.23
0+00.00	2,578.23
0+01.00	2,578.16
0+02.00	2,578.23
0+03.00	2,578.33
0+11.67	2,578.73

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,579.23)	(0+02.00, 2,578.23)	0.015
(0+02.00, 2,578.23)	(0+03.00, 2,578.33)	0.033
(0+03.00, 2,578.33)	(0+11.67, 2,578.73)	0.025

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	0.24
Elevation Range	2,578.16 to 2,579.23 ft
Flow Area	0.6
Wetted Perimeter	4.67
Hydraulic Radius	0.12
Top Width	4.5
Normal Depth	0.24
Critical Depth	0.30
Critical Slope	0.015
Velocity	3.46
Velocity Head	0.19
Specific Energy	0.43
Froude Number	1.70
Flow Type	Supercritical

GVF Input Data

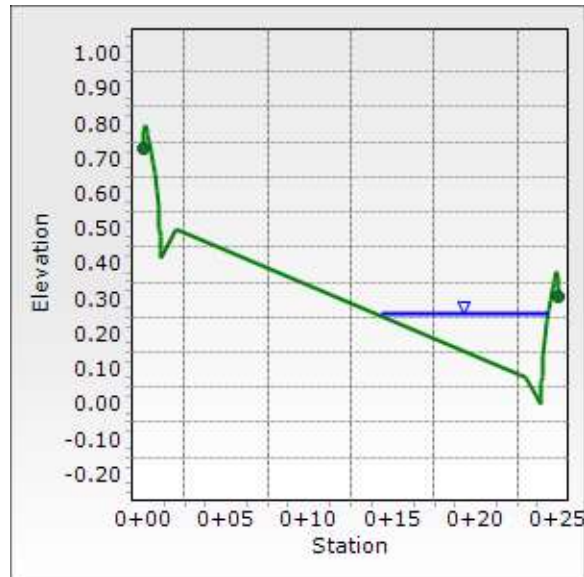
Downstream Depth	0.00
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Worksheet for Velocity Check-Basin FF7

GVF Input Data	
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.24
Critical Depth	0.30
Channel Slope	0.048
Critical Slope	0.015

Cross Section for X-Section 1 (Street)-Q10

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Normal Depth	0.26
Discharge	2.00



Worksheet for X-Section 1 (Street)-Q10

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.73
0+00.02	0.78
0+00.07	0.80
0+00.17	0.78
0+00.27	0.77
0+00.37	0.75
0+00.47	0.72
0+00.57	0.69
0+00.67	0.66
0+00.77	0.61
0+00.87	0.56
0+00.97	0.50
0+00.98	0.49
0+00.99	0.48
0+01.00	0.44
0+01.00	0.42
0+01.02	0.42
0+02.00	0.50
0+23.00	0.08
0+23.98	0.00
0+24.00	0.00
0+24.00	0.02
0+24.02	0.06
0+24.02	0.07
0+24.03	0.08
0+24.13	0.14
0+24.23	0.19
0+24.33	0.24
0+24.43	0.27
0+24.53	0.30
0+24.63	0.33
0+24.73	0.35
0+24.83	0.36
0+24.93	0.38
0+24.98	0.36
0+25.00	0.31

Roughness Segment Definitions

Worksheet for X-Section 1 (Street)-Q10

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 0.73)	(0+25.00, 0.31)	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	0.26
Elevation Range	0.000 to 0.795 ft
Flow Area	1.0
Wetted Perimeter	10.18
Hydraulic Radius	0.10
Top Width	10.1
Normal Depth	0.26
Critical Depth	0.26
Critical Slope	0.008
Velocity	1.99
Velocity Head	0.06
Specific Energy	0.32
Froude Number	1.11
Flow Type	Supercritical

GVF Input Data

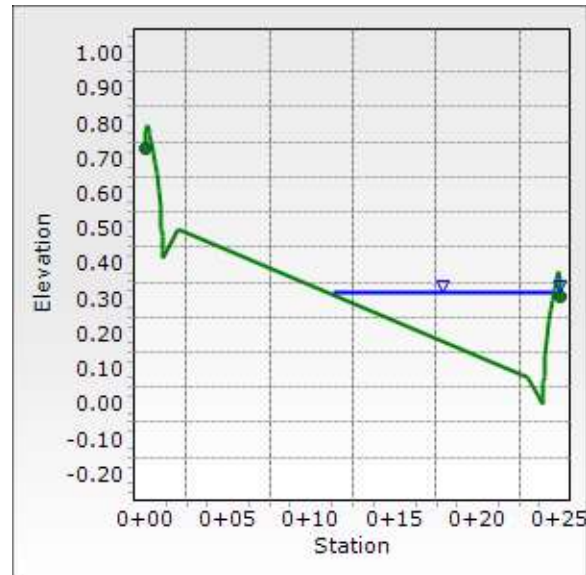
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.26
Critical Depth	0.26
Channel Slope	0.010
Critical Slope	0.008

Cross Section for X-Section 1 (Street)-Q100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Normal Depth	0.32
Discharge	4.00



Worksheet for X-Section 1 (Street)-Q100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Discharge	4.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	0.73
0+00.02	0.78
0+00.07	0.80
0+00.17	0.78
0+00.27	0.77
0+00.37	0.75
0+00.47	0.72
0+00.57	0.69
0+00.67	0.66
0+00.77	0.61
0+00.87	0.56
0+00.97	0.50
0+00.98	0.49
0+00.99	0.48
0+01.00	0.44
0+01.00	0.42
0+01.02	0.42
0+02.00	0.50
0+23.00	0.08
0+23.98	0.00
0+24.00	0.00
0+24.00	0.02
0+24.02	0.06
0+24.02	0.07
0+24.03	0.08
0+24.13	0.14
0+24.23	0.19
0+24.33	0.24
0+24.43	0.27
0+24.53	0.30
0+24.63	0.33
0+24.73	0.35
0+24.83	0.36
0+24.93	0.38
0+24.98	0.36
0+25.00	0.31

Roughness Segment Definitions

Worksheet for X-Section 1 (Street)-Q100

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 0.73)	(0+25.00, 0.31)	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	0.32
Elevation Range	0.000 to 0.795 ft
Flow Area	1.7
Wetted Perimeter	13.37
Hydraulic Radius	0.13
Top Width	13.3
Normal Depth	0.32
Critical Depth	0.33
Critical Slope	0.007
Velocity	2.35
Velocity Head	0.09
Specific Energy	0.40
Froude Number	1.16
Flow Type	Supercritical

GVF Input Data

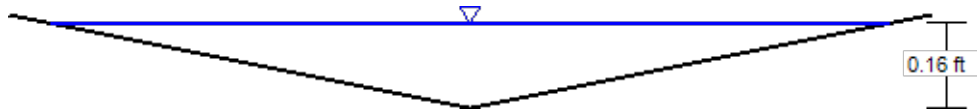
Downstream Depth	0.00
Length	0.00
Number Of Steps	0

GVF Output Data

Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.32
Critical Depth	0.33
Channel Slope	0.010
Critical Slope	0.007

Cross Section for X-Section 2 (30' Drainage Easement)-Q100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.015
Channel Slope	0.092
Normal Depth	0.16
Left Side Slope	50.000
Right Side Slope	50.000
Discharge	7.00



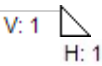
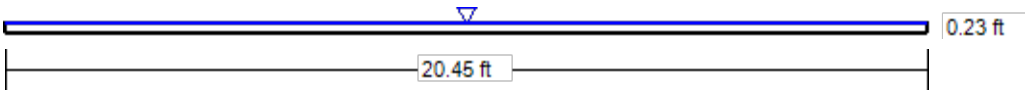
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Worksheet for X-Section 2 (30' Drainage Easement)-Q100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.015
Channel Slope	0.092
Left Side Slope	50.000
Right Side Slope	50.000
Discharge	7.00
Results	
Normal Depth	0.16
Flow Area	1.3
Wetted Perimeter	15.89
Hydraulic Radius	0.08
Top Width	15.9
Critical Depth	0.26
Critical Slope	0.006
Velocity	5.55
Velocity Head	0.48
Specific Energy	0.64
Froude Number	3.47
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.16
Critical Depth	0.26
Channel Slope	0.092
Critical Slope	0.006

Cross Section for 30' Drainage Easement-Submerged Weir Calculation

Project Description	
Solve For	Headwater Elevation
Input Data	
Discharge	7.00
Headwater Elevation	0.23
Crest Elevation	0.00
Tailwater Elevation	0.16
Crest Surface Type	Paved
Crest Breadth	1.0
Crest Length	20.45

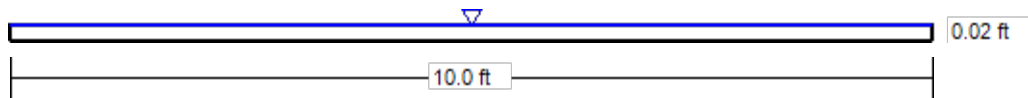


Worksheet for 30' Drainage Easement-Submerged Weir Calculation

Project Description	
Solve For	Headwater Elevation
Input Data	
Discharge	7.00
Crest Elevation	0.00
Tailwater Elevation	0.16
Crest Surface Type	Paved
Crest Breadth	1.0
Crest Length	20.45
Results	
Headwater Elevation	0.23
Headwater Height Above Crest	0.23
Tailwater Height Above Crest	0.16
Weir Coefficient	3.07
Submergence Factor	1.00
Adjusted Weir Coefficient	3.07
Flow Area	4.7
Velocity	1.48
Wetted Perimeter	20.91
Top Width	20.5

Cross Section for X-Section 3 (10' Drainage Easement)-Q100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.668
Normal Depth	0.02
Bottom Width	10.0
Discharge	1.00



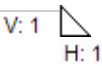
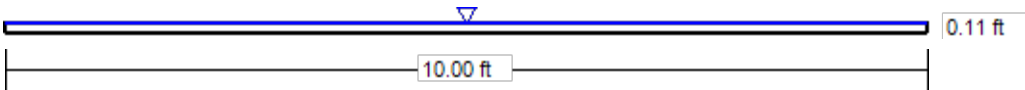
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Worksheet for X-Section 3 (10' Drainage Easement)-Q100

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.668
Bottom Width	10.0
Discharge	1.00
Results	
Normal Depth	0.02
Flow Area	0.2
Wetted Perimeter	10.03
Hydraulic Radius	0.02
Top Width	10.0
Critical Depth	0.07
Critical Slope	0.006
Velocity	6.01
Velocity Head	0.56
Specific Energy	0.58
Froude Number	8.21
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.02
Critical Depth	0.07
Channel Slope	0.668
Critical Slope	0.006

Cross Section for 10' Drainage Easement-Submerged Weir Calculation

Project Description	
Solve For	Headwater Elevation
Input Data	
Discharge	1.00
Headwater Elevation	0.11
Crest Elevation	0.00
Tailwater Elevation	0.02
Crest Surface Type	Paved
Crest Breadth	1.0
Crest Length	10.00

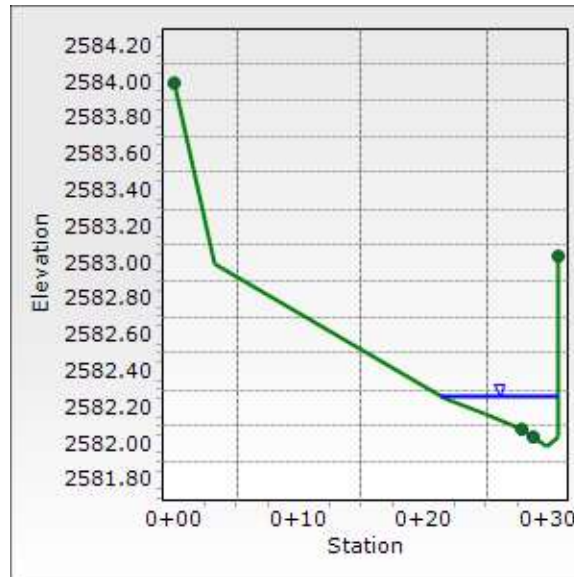


Worksheet for 10' Drainage Easement-Submerged Weir Calculation

Project Description	
Solve For	Headwater Elevation
Input Data	
Discharge	1.00
Crest Elevation	0.00
Tailwater Elevation	0.02
Crest Surface Type	Paved
Crest Breadth	1.0
Crest Length	10.00
Results	
Headwater Elevation	0.11
Headwater Height Above Crest	0.11
Tailwater Height Above Crest	0.02
Weir Coefficient	2.93
Submergence Factor	1.00
Adjusted Weir Coefficient	2.93
Flow Area	1.1
Velocity	0.95
Wetted Perimeter	10.21
Top Width	10.0

Cross Section for X-Section 4_2-ft Valley Gutter

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Normal Depth	0.28
Discharge	2.00



Worksheet for X-Section 4_2-ft Valley Gutter

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.010
Discharge	2.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,584.00
0+03.22	2,583.00
0+21.71	2,582.25
0+25.05	2,582.17
0+27.88	2,582.08
0+28.88	2,582.04
0+29.88	2,581.98
0+30.88	2,582.04
0+30.88	2,583.04

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,584.00)	(0+27.88, 2,582.08)	0.025
(0+27.88, 2,582.08)	(0+28.88, 2,582.04)	0.033
(0+28.88, 2,582.04)	(0+30.88, 2,583.04)	0.015

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

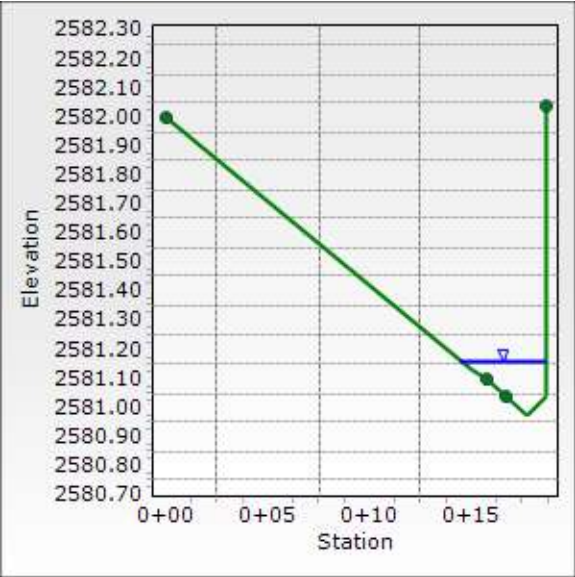
Results	
Normal Depth	0.28
Elevation Range	2,581.98 to 2,584.00 ft
Flow Area	1.3
Wetted Perimeter	9.67
Hydraulic Radius	0.13
Top Width	9.4
Normal Depth	0.28
Critical Depth	0.25
Critical Slope	0.018
Velocity	1.59
Velocity Head	0.04
Specific Energy	0.32
Froude Number	0.77
Flow Type	Subcritical

Worksheet for X-Section 4_2-ft Valley Gutter

GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	0.00
Upstream Velocity	0.00
Normal Depth	0.28
Critical Depth	0.25
Channel Slope	0.010
Critical Slope	0.018

Cross Section for X-Section 5_2-ft Valley Gutter

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.024
Normal Depth	0.19
Discharge	1.00



Worksheet for X-Section 5_2-ft Valley Gutter

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.024
Discharge	1.00

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,582.00
0+15.06	2,581.13
0+15.74	2,581.10
0+16.74	2,581.04
0+17.74	2,580.97
0+18.74	2,581.04
0+18.74	2,582.04

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,582.00)	(0+15.74, 2,581.10)	0.025
(0+15.74, 2,581.10)	(0+16.74, 2,581.04)	0.033
(0+16.74, 2,581.04)	(0+18.74, 2,582.04)	0.015

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	0.19
Elevation Range	2,580.97 to 2,582.04 ft
Flow Area	0.5
Wetted Perimeter	4.39
Hydraulic Radius	0.10
Top Width	4.3
Normal Depth	0.19
Critical Depth	0.21
Critical Slope	0.017
Velocity	2.20
Velocity Head	0.08
Specific Energy	0.27
Froude Number	1.19
Flow Type	Supercritical

GVF Input Data

Worksheet for X-Section 5_2-ft Valley Gutter

GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.19
Critical Depth	0.21
Channel Slope	0.024
Critical Slope	0.017

Cross Section for X-Section 6_2-ft Valley Gutter

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.034
Normal Depth	0.21
Discharge	1.80



Worksheet for X-Section 6_2-ft Valley Gutter

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Channel Slope	0.034
Discharge	1.80

Section Definitions

Station (ft)	Elevation (ft)
0+00.00	2,575.65
0+00.00	2,574.65
0+01.00	2,574.59
0+02.00	2,574.65
0+03.00	2,574.65
0+09.20	2,576.70

Roughness Segment Definitions

Start Station & Elevation	End Station & Elevation	Roughness Coefficient
(0+00.00, 2,575.65)	(0+02.00, 2,574.65)	0.015
(0+02.00, 2,574.65)	(0+03.00, 2,574.65)	0.033
(0+03.00, 2,574.65)	(0+09.20, 2,576.70)	0.025

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	0.21
Elevation Range	2,574.59 to 2,576.70 ft
Flow Area	0.5
Wetted Perimeter	3.62
Hydraulic Radius	0.15
Top Width	3.4
Normal Depth	0.21
Critical Depth	0.26
Critical Slope	0.014
Velocity	3.36
Velocity Head	0.18
Specific Energy	0.38
Froude Number	1.50
Flow Type	Supercritical

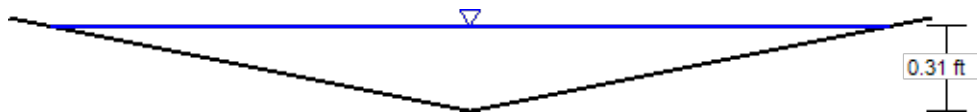
GVF Input Data	
Downstream Depth	0.00

Worksheet for X-Section 6_2-ft Valley Gutter

GVF Input Data	
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.21
Critical Depth	0.26
Channel Slope	0.034
Critical Slope	0.014

Cross Section for X-Section 7_Ex. Easement-Q100-Stantec

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.015
Channel Slope	0.084
Normal Depth	0.31
Left Side Slope	50.000
Right Side Slope	50.000
Discharge	41.00



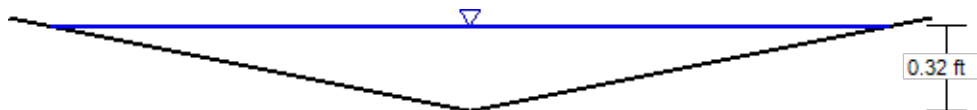
V: 10
H: 1

Worksheet for X-Section 7_ Ex. Easement-Q100-Stantec

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.015
Channel Slope	0.084
Left Side Slope	50.000
Right Side Slope	50.000
Discharge	41.00
Results	
Normal Depth	0.31
Flow Area	4.9
Wetted Perimeter	31.38
Hydraulic Radius	0.16
Top Width	31.4
Critical Depth	0.53
Critical Slope	0.005
Velocity	8.33
Velocity Head	1.08
Specific Energy	1.39
Froude Number	3.71
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.31
Critical Depth	0.53
Channel Slope	0.084
Critical Slope	0.005

Cross Section for X-Section 7_ Ex. Easement-Q100-Rick

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.015
Channel Slope	0.084
Normal Depth	0.32
Left Side Slope	50.000
Right Side Slope	50.000
Discharge	43.00



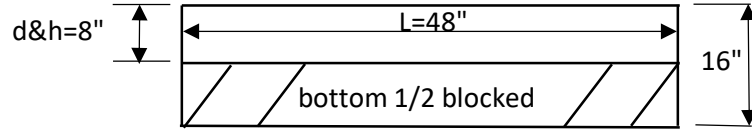
V: 10
H: 1

Worksheet for X-Section 7_ Ex. Easement-Q100-Rick

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.015
Channel Slope	0.084
Left Side Slope	50.000
Right Side Slope	50.000
Discharge	43.00
Results	
Normal Depth	0.32
Flow Area	5.1
Wetted Perimeter	31.95
Hydraulic Radius	0.16
Top Width	31.9
Critical Depth	0.54
Critical Slope	0.005
Velocity	8.43
Velocity Head	1.10
Specific Energy	1.42
Froude Number	3.72
Flow Type	Supercritical
GVF Input Data	
Downstream Depth	0.00
Length	0.00
Number Of Steps	0
GVF Output Data	
Upstream Depth	0.00
Profile Description	N/A
Profile Headloss	0.00
Downstream Velocity	Infinity
Upstream Velocity	Infinity
Normal Depth	0.32
Critical Depth	0.54
Channel Slope	0.084
Critical Slope	0.005

Interception Capacity For: Block Wall Opening

CP: **FF1**
Q100: **2** cfs



Referenced from *Hydraulic Engineering Circular No. 22, Third Edition*
Urban Drainage Design Manual

Find: The amount of flow intercepted (Q_i).

1. Determination of weir control block wall length opening (L):

The flow intercepted under weir control in a sag condition is given by Equation 4-30:

$$Q_i = 3.0Ld^{1.5} \text{ or } L = Q_i / (3d^{1.5})$$

Q = flow intercepted **2** cfs
d = depth at invert of opening **0.67** ft
L = **1.22** ft

2. Determination of orifice control block wall opening Length (L):

The flow intercepted under orifice control in a sag condition is given by Equation 4-31a

$$Q_i = C_o h L (2g(d_i - (h/2)))^{0.5} \text{ or } L = Q_i / 0.67 h (2g(d_i - (h/2)))^{0.5}$$

Q_i = flow intercepted **2** cfs
h = height of opening **0.67** ft
d_i = depth at invert of opening **0.67** ft
L = **0.96** ft

3. Determine if wall opening is operating under weir control or orifice control:

Type of control is determined by using the higher of the two opening lengths.

Control is: **WEIR**

L = **1.2** ft

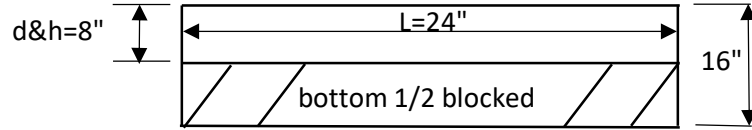
Use L = **4.0** ft

Minimum opening size per
Section 1602 of CCRFCD
HCDDM.

Prepared by: JRK Checked by: Company: Rick Engineering Date: 10/12/22

Interception Capacity For: Block Wall Opening

CP: **FN3**
Q100: **1** cfs



Referenced from *Hydraulic Engineering Circular No. 22, Third Edition*
Urban Drainage Design Manual

Find: The amount of flow intercepted (Q_i).

1. Determination of weir control block wall length opening (L):

The flow intercepted under weir control in a sag condition is given by Equation 4-30:

$$Q_i = 3.0Ld^{1.5} \text{ or } L = Q_i / (3d^{1.5})$$

Q = flow intercepted **1** cfs
d = depth at invert of opening **0.67** ft
L = **0.61** ft

2. Determination of orifice control block wall opening Length (L):

The flow intercepted under orifice control in a sag condition is given by Equation 4-31a

$$Q_i = C_o h L (2g(d_i - (h/2)))^{0.5} \text{ or } L = Q_i / 0.67 h (2g(d_i - (h/2)))^{0.5}$$

Q_i = flow intercepted **1** cfs
h = height of opening **0.67** ft
d_i = depth at invert of opening **0.67** ft
L = **0.48** ft

3. Determine if wall opening is operating under weir control or orifice control:

Type of control is determined by using the higher of the two opening lengths.

Control is: **WEIR**

L = **0.6** ft

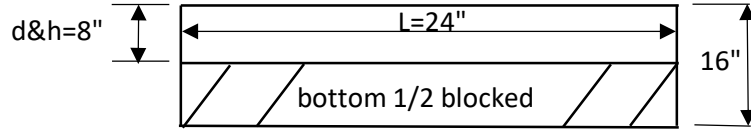
Use L = **2.0** ft

Minimum opening size per
Section 1602 of CCRFCD
HCDDM.

Prepared by: JRK Checked by: _____ Company: Rick Engineering Date: 10/12/22

Interception Capacity For: Block Wall Opening

CP: **FN4**
Q100: **1** cfs



Referenced from *Hydraulic Engineering Circular No. 22, Third Edition*
Urban Drainage Design Manual

Find: The amount of flow intercepted (Q_i).

1. Determination of weir control block wall length opening (L):

The flow intercepted under weir control in a sag condition is given by Equation 4-30:

$$Q_i = 3.0Ld^{1.5} \text{ or } L = Q_i / (3d^{1.5})$$

Q = flow intercepted **1** cfs
d = depth at invert of opening **0.67** ft
L = **0.61** ft

2. Determination of orifice control block wall opening Length (L):

The flow intercepted under orifice control in a sag condition is given by Equation 4-31a

$$Q_i = C_o h L (2g(d_i - (h/2)))^{0.5} \text{ or } L = Q_i / 0.67 h (2g(d_i - (h/2)))^{0.5}$$

Q_i = flow intercepted **1** cfs
h = height of opening **0.67** ft
d_i = depth at invert of opening **0.67** ft
L = **0.48** ft

3. Determine if wall opening is operating under weir control or orifice control:

Type of control is determined by using the higher of the two opening lengths.

Control is: **WEIR**

L = **0.6** ft

Use L = **2.0** ft

Minimum opening size per
Section 1602 of CCRFCD
HCDDM.

Prepared by: JRK Checked by: _____ Company: Rick Engineering Date: 10/12/22

RIPRAP SIZING CALCULATION - X-SECTION 6

(eq. 734) $V = 3(d50)^{0.5}(S_s - 1)S^{0.17}$

Where:

V= 3.69 fps (Pre-Riprap Velocity)
S= 0.034 ft/ft
S_s= 2.65
d50= Rock size in feet for which 50% of the rip rap by weight is smaller.

Solve for d50:

$$d50 = [V(S^{0.17}) / 3(S_s - 1)]^2$$

d50= 0.18 ft.

DEPTH OF BLANKET

Depth= 2*d50= 0.35 ft.

USE D50 = 0.33'

BLANKET DEPTH = 0.67'

Per Eqn. 732 (CCRFCD HC&DDM), $n = 0.0395(d50)^{1/6}$

d50= 0.33

n= 0.033

APPENDIX D - REFERENCE DOCUMENTATION

CITY OF LAS VEGAS		DATE:
INTER-OFFICE MEMORANDUM		July 20, 2006
TO: Land Development Services Department of Public Works		FROM: Albert Sung, P.E. Flood Control Project Engineer Department of Public Works
SUBJECT:	COPIES TO:	
Technical Drainage Study for:	Stantec Consulting Inc.	
Village of Centennial Springs – Update #6		
Cross Streets:	SWC of Tule Springs & El Capitan (Farm)	Carina Homes
File Number:	F:\#Depot\DSMEMOS\DS3656M.doc	Bart Anderson, P.E., DevCo
Parcel Number:	125-17-702-002	NDOT
Zoning Action:	N/A	
FEMA Flood Zone	YES	NO X
Proposed Storm Drain	YES X	NO

HISTORY	DATE RECEIVED	DATE REVIEWED	COMMENTS	REVIEW FEES	FEES PAID Trn. No.
1 st Submittal	9/23/2004	10/06/2004	Not Approved	\$400.00	9950: \$400
2 nd Submittal	11/24/2004	12/8/2004	Not Approved	\$400.00	12699: \$400
3 rd Submittal	12/21/2004	1/4/2005	Conditional Approval	\$400.00	13952: \$400
4 th Submittal	3/29/2005 & 5/2/2005	5/3/2005	Approved	\$400.00	18998: \$400
Revision	5/5/2005	5/6/2005	Approved	N/C	N/C
5 th Submittal	6/1/2005	6/2/2005	Approved	\$400.00	22960: \$400
6 th Submittal	8/15/2005	8/19/2005	Approved	\$100.00	27750: \$100
7 th Submittal	9/16/2005	9/29/2005	Not Approved	\$400.00	29833: \$400
8 th Submittal	10/24/2005	10/24/2005	Approved	N/C	N/C
Revision	11/9/2005	11/9/2005	Approved	N/C	N/C
9 th Submittal	11/10/2005	11/21/2005	Approved	\$100.00	33246: \$100
10 th Submittal	2/10/2006 & 3/1/2006	3/6/2006	Approved	\$400.00	38542: \$400
11 th Submittal	3/9/2006	3/23/2006	Approved	\$400.00	40223: \$400
12 th Submittal	6/28/2006	7/19/2006	See Comments Below	\$400.00	Paid: \$400
TOTAL FEES (LDDRS):				\$3,800.00	---

REMARKS:

12th Submittal: Update to adjust the finish floor elevations for Buildings 10 & 14 to 16

11th Submittal: Update to Raise the F.F. and to Adjust the lot lines of Lots 126-131. Also to relocate SDMH #2, DI #3 and DI #4 approximately 15' to the east

10th Submittal: Update to revise F.F. / street grading in Unit 4, Unit 5 and the Brownstones

9th Submittal: Update to revise offsite channel geometry along the west property line

7th & 8th Submittals: Update #3 and Supplement to change the Finish Floor Elevation of

Buildings 1 & 2 and Additional Building in Park Only

6th Submittal: Update #2 to revise the size of storm drain in Tule Springs Road

5th Submittal: Update #1 to adjust the finish floor elevations from Lot 126 through Lot 131

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 Nevada Department of Transportation (NDOT) concurrence

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 Amendment 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.

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

END OF REMARKS

B&H/PBJ/ays

T/R/S: T19S/R60E/17

AREA G-17

Stantec Consulting Inc.
7251 West Charleston Boulevard
Las Vegas NV 89117
Tel: (702) 258-0115 Fax: (702) 258-4956
stantec.com



Stantec

DRAINAGE STUDY UPDATE
TO THE
TECHNICAL DRAINAGE STUDY
FOR
THE VILLAGE OF
CENTENNIAL SPRINGS

June, 2006

Prepared For

CARINA HOMES

1050 Indigo Drive
Las Vegas, NV 89145
(702) 228-6376
Fax: (702) 228-6002

Prepared By

STANTEC CONSULTING, INC.

7251 W Charleston Blvd
Las Vegas, NV 89117
(702) 258-0115
Fax: (702) 258-4956

PLANNING • ENGINEERING • LAND SURVEYING • DEVELOPER SERVICES
WATER RESOURCES • PUBLIC WORKS

Req.
6/28/06
DS 3656-6
6-29-00
\$400
6-17

APN: 12517 702016

HYDROLOGIC CRITERIA AND DRAINAGE DESIGN MANUAL

DRAINAGE STUDY INFORMATION FORM

Name of Development: The Village of Centennial Springs Date: June 26, 2006

Location of Development: a) Descriptive (Cross Streets) North/South Tule Springs Road East/West Farm Road
b) Sect. 17 Twn. 19 South Rng. 60 East

Name of Owner: Carina Corporation Assessors Parcel No: 125-17-702-005

Telephone No: 702-228-6376 Facsimile No: 702-228-6002

Address: 2881 Business Park Court, #226
Las Vegas, NV. 89128

Contact Person-Name: Ali Shahabi (P.E) Telephone No: (702) 258-0115

Firm: Stantec Consulting Inc

Address: 7251 W charleston Blvd, Las Vegas, NV 89117

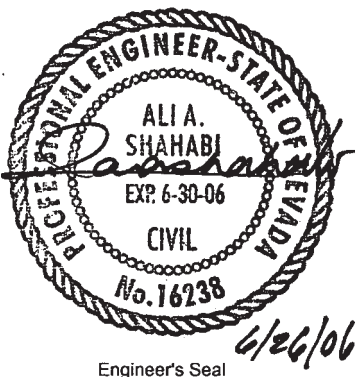
Type of Land Development/Land Disturbance Process:

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

- Total Owned Land Area: At Site: 41 Being Developed/Disturbed: 41.02
- Is a portion or all of the subject property located in a designated FEMA Flood Hazard Area? YES NO
- Is the property bordered or crossed by an existing or proposed Clark County Regional Flood Control District Master Planned Facility? YES NO
- Proposed type of development (Residential, Commercial, Etc.)? Residential And Commercial
- Approximate upstream land area which drains to the subject site? 500 Acres
- Has the site drainage been evaluated in the past? YES NO If yes, please identify documentation:

- If known, please briefly identify the proposed discharge point(s) of runoff from the site:
Tule Springs and Farm Roads

- Briefly describe your proposed schedule for the subject project: As soon as possible



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.

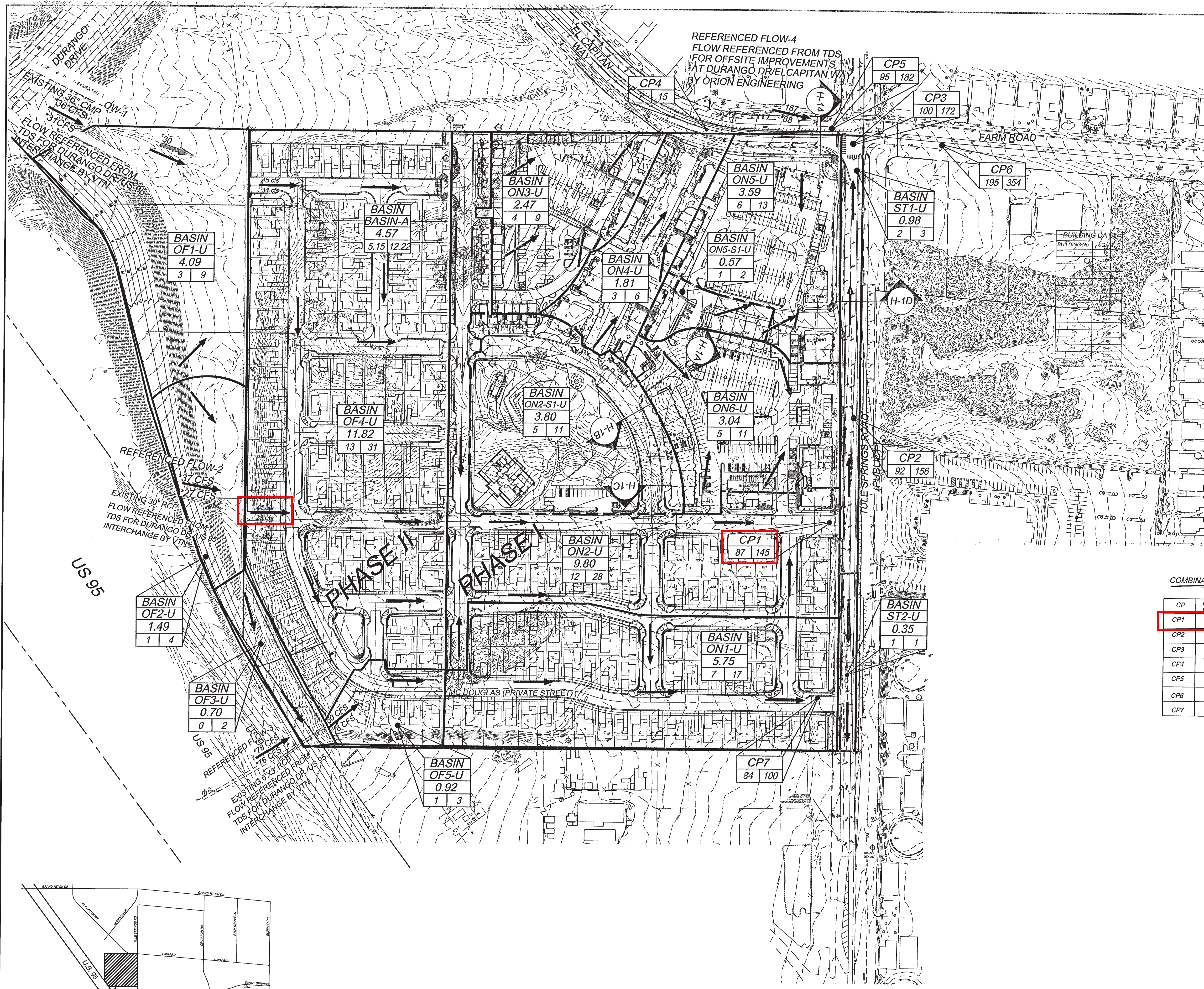
* Review and concurrence of the Clark County Regional Flood Control District is required.

Local Entity File No. _____

Revision	Date

Reference: Durango Drive/US 95 Interchange By VTN
Offsite Improvements for Durango Drive and El Capitan Way by Orion Engg

STANDARD FORM 1



LEGEND

- COMBINATION POINT
- FLOW ARROW
- CONTOUR
- REFERENCED FLOWS
FLOW ABOVE ARROW REPRESENTS Q100
FLOW BELOW ARROW REPRESENTS Q10
- DRAINAGE BASIN
AREA IN ACRES
FLOW IN CFS
- HYDRAULIC SECTION
NOTE: ARROW POINTS TO THE DIRECTION OF FLOW
- TDS TECHNICAL DRAINAGE STUDY

CP
Q10 Q100

DRAINAGE NOTES

1. FLOWS REFERENCED FROM THE TECHNICAL DRAINAGE STUDY FOR THE DURANGO DRIVE/US 95 INTERCHANGE BY VTN
2. FLOWS REFERENCED FROM THE TECHNICAL DRAINAGE STUDY FOR THE OFFSITE IMPROVEMENTS AT DURANGO DRIVE AND EL CAPITAN WAY BY ORION ENGINEERING AND SURVEYING, CLV DS#2638

COMBINATION POINTS

CP	Q10 CFS	Q100 CFS	COMBINING FLOWS
CP1	87	145	REFERENCED FLOW-1&2+OF1-U+OF2-U+OF4-U+ON2-U
CP2	92	156	CP1+ON6-U
CP3	100	172	CP2+ON5-U+ST1-U
CP4	7	15	ON3-U+ON4-U
CP5	95	182	REFERENCED FLOW-4+CP-4
CP6	195	354	CP3+CP5
CP7	84	100	REFERENCED FLOW-3+OF3-U+OF5-U+ON1-U

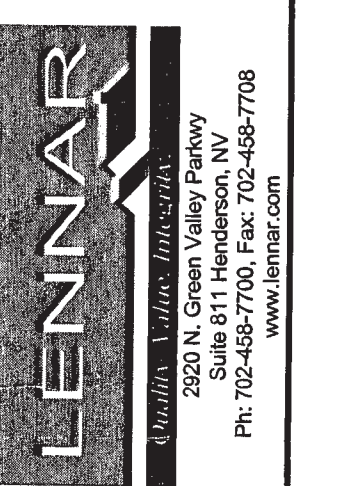
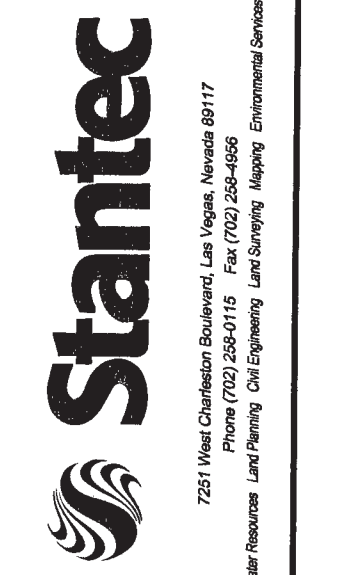
FLOW SUMMARY
ULTIMATE CONDITIONS

BASIN	AREA ACRES	Q10 CFS	Q100 CFS
ON1-U	5.75	7	17
ON2-U	9.80	12	28
ON3-U	2.47	4	9
ON4-U	1.81	3	6
ON5-U	3.59	6	13
ON6-U	3.04	5	11
ST1-U	0.98	2	3
ST2-U	0.35	1	1
OF1-U	4.09	3	9
OF2-U	1.62	1	4
OF3-U	0.70	0	2
OF4-U	11.82	13	31
OF5-U	0.92	1	3

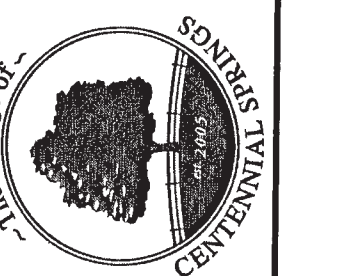
NOTE: BASIN A REPRESENTS THE FLOW IMPACTING THE HYDRAULIC SECTION-1B
NOTE: FLOW GENERATED BY AREA ENCLOSED WITHIN BASIN A IS OBTAINED BY PRORATING THE FLOW FROM OF4-U & ON2-U

DRAWING ISSUE LOG:

REV.	DESCRIPTION	DATE



THE VILLAGE OF
CENTENNIAL SPRINGS
BASIN MAP-ULTIMATE



REVISIONS:

DATE	BY	DESCRIPTION

DATE: May 31, 2006
DRAWING NO.: 052007
FILE NAME:
DRAWING SCALE: AS SHOWN
SHEET NO.: XXXX
CLV #