November 18, 2019

6101 E. CABALLO LANE

DRAINAGE REPORT

Town of Paradise Valley, AZ

Prepared for:

DK Real Estate Holdings, LLC

130 N. 35th Avenue

Phoenix, Arizona 85009

Prepared by:

Coe & Van Loo Consultants, Inc.

4550 N 12th Street

Phoenix, AZ 85014

602.264.6831

Job # 1-01-0326801

CVL CONSULTANTS

CELEBRATING 60 YEARS

DRAINAGE REPORT FOR

6101 E. CABALLO LANE

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Approved By: _____ _____

Town Engineer *Date*

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Sheet 1 Existing Condition Plan View
Sheet 2 Proposed Condition Plan View
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1.0 INTRODUCTION

1.1 SCOPE

Coe & Van Loo Consultants, Inc. (CVL) has been contracted by DK Real Estate Holding, LLC to provide engineering services to evaluate offsite drainage conditions at 6101 E. Caballo Lane, herein referred to as the site. Please see Figure 1 for the Vicinity Map. The purpose of this report is to provide drainage analysis to evaluate peak flows affecting the site.

This report is focused on providing evaluation and analyses for the 100-year frequency flood. The scope of this assessment does not include, neither did CVL's client request that, evaluation of storm-water runoff resulting from events exceeding the 100-year storm. Hence, it should be noted that a storm event exceeding the 100-year frequency may cause or create the risk of greater flood impact than is addressed and presented in this assessment.

The procedures used herein are derived from, and performed with, currently accepted engineering methodologies and practices. Additionally, the criteria for this evaluation are designed to conform to currently applicable ordinances, regulations and policies as set forth by the Town of Paradise Valley and Maricopa County.

1.2 SITE DESCRIPTION

The site is a residential lot containing two houses and a tennis court and is approximately 2.49 acres in size. The site is bisected by Cherokee Wash. Offsite flows pass through the site and then into Indian Bend Wash. The site is bounded by Caballo Lane on the north, Morning Glory Road on the west, Caballo Drive on the south and two residential lots to the east (see Figure 1 for a Vicinity and Location Map). The site is located in Section 33, Township 3 North, Range 4 East of the Gila and Salt River Base and Meridian, Maricopa County, Arizona.

1.3 REGULATORY JURISDICTION

Site improvements will be designed to meet requirements in the Town of Paradise Valley Engineering Storm Drain Design Manual [1], and in accordance with analysis procedures contained the Drainage Design Manuals for Maricopa County, Arizona, Volume I, Hydrology [2], Volume II, Hydraulics [3], and Drainage Policies and Standards Manual for Maricopa County, Arizona [4].

2.0 HYDROLOGIC SETTING

The Cherokee Wash watershed extends from near Tatum Boulevard to Indian Bend Wash. Hydrologic analysis used for this report was prepared previously for the Doubletree Ranch Road Drainage Improvement Project (Study) (see Appendix A). The site slopes generally northeast at 0.1% slope. Cherokee Wash enters the site from the west, passes through the middle of the site, and then exits to the northeast.

3.0 FEMA FLOODPLAIN CLASSIFICATION

The Maricopa County, Arizona and Unincorporated Areas Flood Insurance Rate Map (FIRM), panel number 04013C1755L, Map Revised October 16, 2013 [5], indicates the site falls within Zone "X."

Zone "X" is defined by FEMA as:

> "Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood."

Refer to Figure 2 for a copy of the Flood Insurance Rate Map (FIRM).

4.0 OFF-SITE DRAINAGE

4.1 OFF-SITE HYDROLOGY

Flow into Cherokee Wash was taken from the Doubletree Ranch Road Drainage Improvement Project Final Design Study Report (see Appendix A). The 100-year peak flow within Cherokee Wash at 56th Street is 1813 cfs. Based on descriptions and results from the Study, not all of the 100-year storm flows can reach the site. Additionally, the report determines that the design of the box culvert at 56th Street was for the 10-year event.

4.2 OFF-SITE RUNOFF BETWEEN 56TH STREET AND THE SITE

In order to determine peak flows arriving at the site, flow patterning from the LIBW ADMS 2D modeling results was reviewed. This review helped to identify potential flow-split locations. Flow split locations were verified based on site visits and existing drainage infrastructure at 56th Street and east to the site. These are shown on the Drainage Map (see Plate 1). Flow-split calculations were prepared using

CulvertMaster v.3.3 and FlowMaster V8i. The culvert size at Cherokee Wash and 56th Street was obtained from the Doubletree Report. Culvert calculation with roadway overtopping (location A1) is located in Appendix B. Results indicate 871 cfs remains in the wash downstream of 56th Street (see Plate 1). Appendix C contains calculations for flow-splits (A2 through A6) east of 56th street which are strategically located to determine flows that do not recombine with Cherokee Wash. Accounting for flow diversions from Cherokee Wash, a peak flow of 378 cfs enters the site (see Plate 1).

4.3 HEC-RAS Analysis at the Site

The existing condition of the wash was analyzed using HEC-RAS v5.0.7 to determine water surface elevations through the site. Geometric data for the model was obtained from site survey. Layout of cross-sections starts upstream and downstream of the western and eastern boundaries of the site. Results show the maximum water surface elevation is 1328.34 feet. However, the finished floor elevation for both structures on the site is 1329.40 feet, which allows for a minimum of 1.06 feet of freeboard. Manning's 'n' values were based on site inspection of the channel and Table 7.6, (B.a.1. and B.b.2) of the Drainage Design Manual for Maricopa County Volume 2-Hydraulics [3]. This corresponds to "Clean, after weathering" for the main channel (0.022) and "Stony bottom" for banks (0.035).

A proposed condition wash was also analyzed using HEC-RASv5.0.7. The proposed condition model was developed in order to establish a better-defined drainage easement for the wash in the event of a lot split. The proposed conditions model uses maximum side slopes of 4:1 and maintains the same Manning's n value as the existing condition channel. The proposed condition model shows that the flow is able to be contained within a narrower channel without increasing water surface elevations.

See Appendix D for HEC-RAS output of the existing and proposed models and see Plate2 for HEC-RAS map. Additionally, the Drainage Easement Exhibit shows a comparison of the existing and proposed conditions floodplain.

5.0 SUMMARY AND CONCLUSIONS

1. Off-site peak flows from Cherokee Wash are conveyed through the site.
2. No modifications or improvements are needed as the existing channel has over one foot of freeboard to the finished floor of the house.
3. A proposed condition HEC-RAS model demonstrates the channel can be narrowed while maintaining a foot of freeboard relative to the finished floor elevation.
4. According to the FIRM panel number 04013C1755L, Map Revised: October 16, 2013, the site is located within a Zone "X".
5. Analysis of Cherokee Wash through the site is based on generally accepted engineering practices and is in accordance with local jurisdictional requirements.

6.0 REFERENCES

[1] Town of Paradise Valley, "Storm Drain Design Manual," June, 2018.

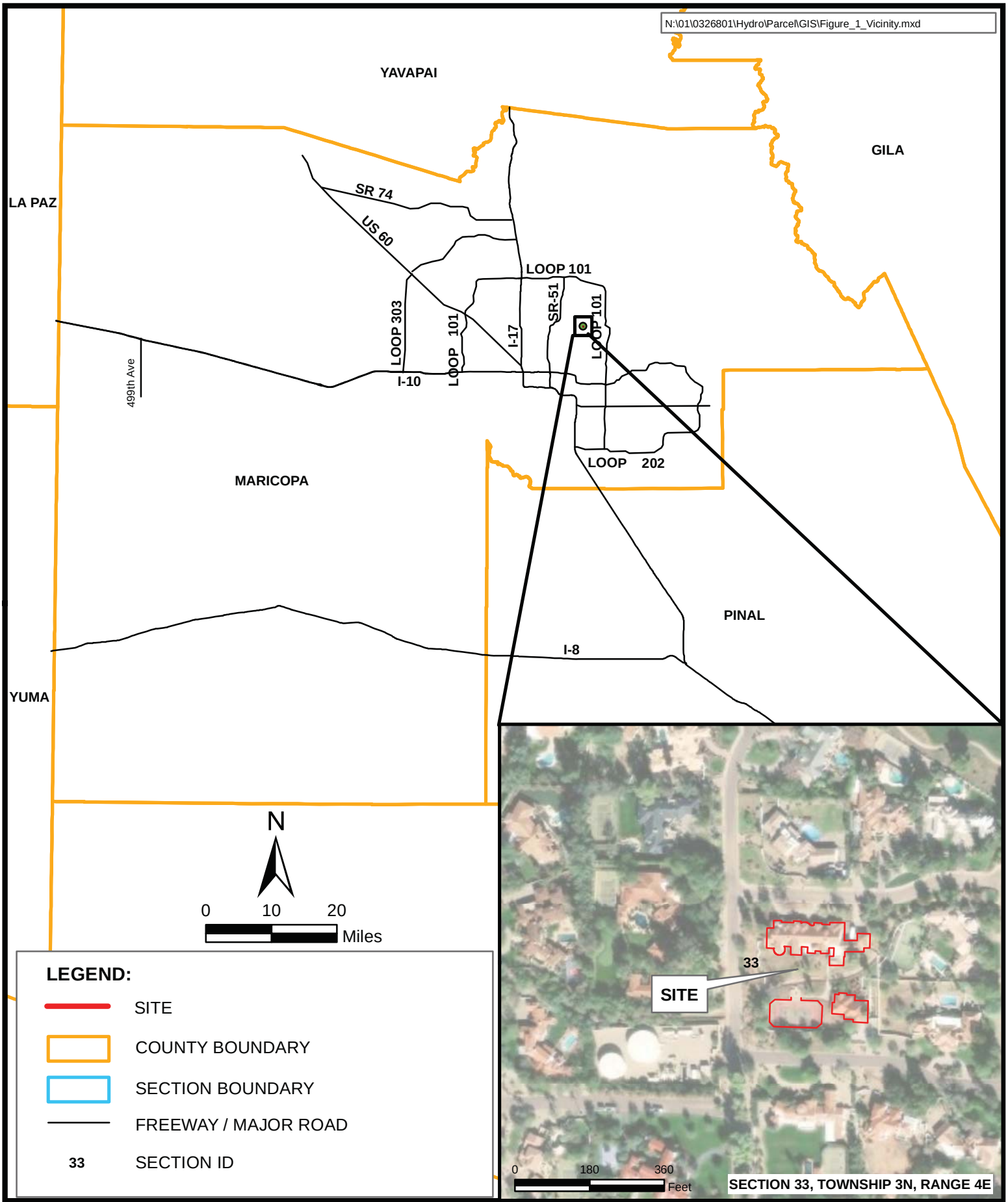
[2] Flood Control District of Maricopa County, "Drainage Design Manual for Maricopa County, Arizona, Volume I, Hydrology," December 14, 2018.

[3] Flood Control District of Maricopa County, Arizona, "Draft Drainage Design Manual for Maricopa County, Volume II, Hydraulics," December 14, 2018.

[4] Flood Control District of Maricopa County, "Drainage Policies and Standards," August 22, 2018.

[5] Federal Emergency Management Agency (FEMA), "National Flood Insurance Program, Flood Insurance Rate Map, Maricopa County, Arizona and Incorporated Areas, Panel Numbers 04013C1755L," Revised October 16, 2013.

FIGURES



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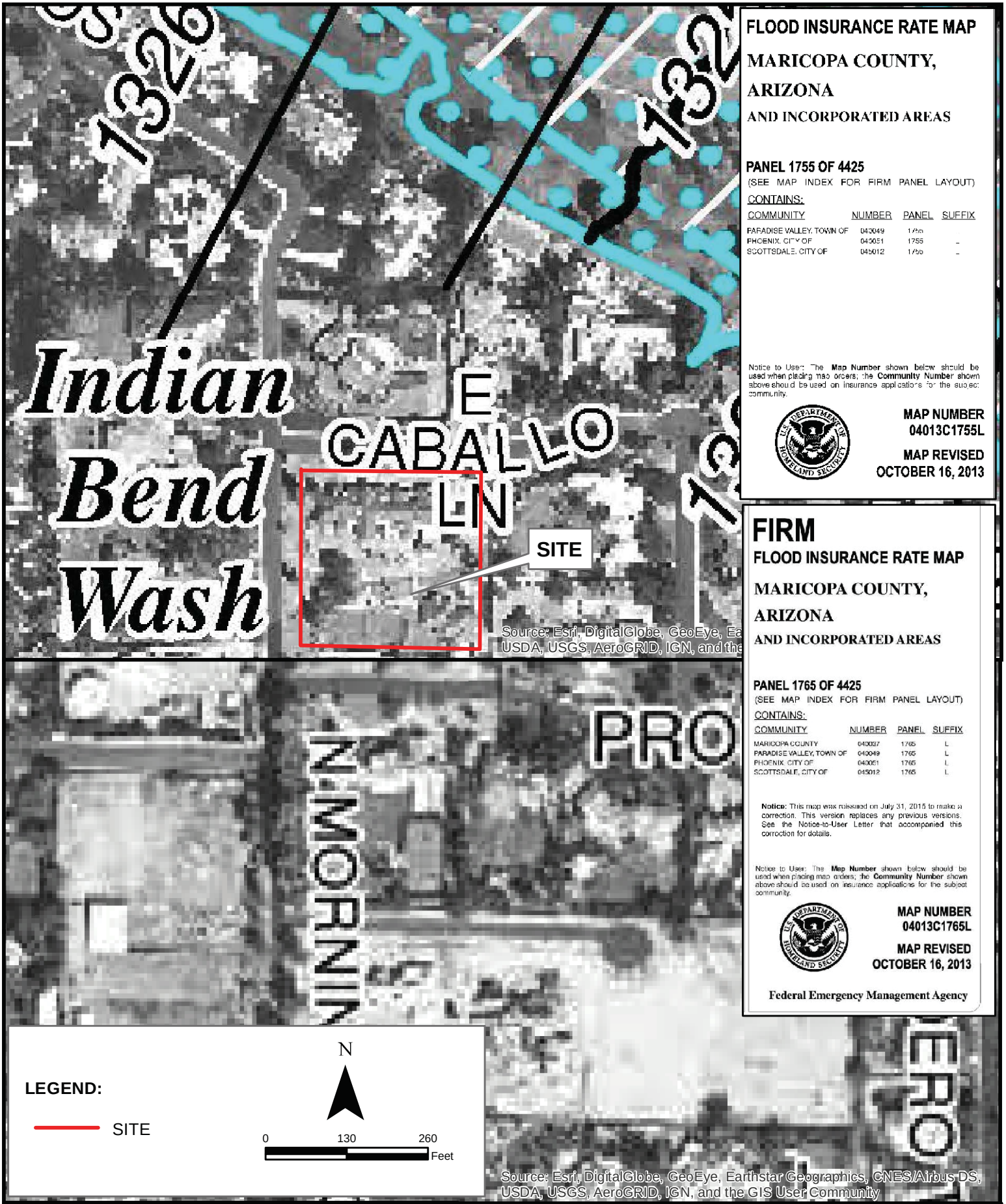
6101 E. CABALLO LANE

VICINITY & LOCATION MAP

JOB NO. 01-0326801

FIGURE 1



FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1755 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
PARADISE VALLEY, TOWN OF	040049	1755	L
PHOENIX, CITY OF	040051	1755	L
SCOTTSDALE, CITY OF	045012	1755	L

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
04013C1755L

MAP REVISED
OCTOBER 16, 2013

FIRM

FLOOD INSURANCE RATE MAP

MARICOPA COUNTY, ARIZONA

AND INCORPORATED AREAS

PANEL 1765 OF 4425

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
MARICOPA COUNTY	040037	1765	L
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PHOENIX, CITY OF	040051	1765	L
SCOTTSDALE, CITY OF	045012	1765	L

Notice: This map was reissued on July 31, 2015 to make a correction. This version replaces any previous versions. See the Notice-to-User Letter that accompanied this correction for details.

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
04013C1765L

MAP REVISED
OCTOBER 16, 2013

Federal Emergency Management Agency

LEGEND:

SITE

N

0 130 260 Feet

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TELEPHONE (602) 264-6831

6101 E. CABALLO LANE

JOB NO.
01-0326801

FIRM MAP

FIGURE 2

APPENDICES

APPENDIX A

Doubletree Ranch Road Drainage Improvement Project Final Design Study Report

CVL CONSULTANTS

DOUBLETREE RANCH ROAD
DRAINAGE IMPROVEMENT PROJECT
- FINAL DESIGN STUDY REPORT -
(FCD 97-32)

Prepared for:

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY
2801 West Durango
Phoenix, Arizona 85009

Prepared by:

DIBBLE & ASSOCIATES, CONSULTING ENGINEERS
2633 East Indian School Road, #401
Phoenix, Arizona 85016
(602) 957-1155

DIBBLE & ASSOCIATES
CONSULTING ENGINEERS
Since 1952

June, 2000

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subdivision drainageways to the IBW. Historically, runoff emanating from the mountains traveled overland through numerous small washes to the IBW. Developments have altered many of these flow paths due to parcel subdivision, landscaping and block wall construction. As a result, Doubletree Ranch Road becomes a major water carrier and is impassable to traffic. Many homes experience flooding during frequent rainfall events and standing water in streets isolates the community. In particular, Cherokee Elementary School at 56th Street, south of Doubletree Ranch Road is isolated during all but the smallest rainfall events.

Computed peak discharges at key concentration points are summarized in **Table 1** for the 10- and 100-year storms for existing conditions and with the recommended 10-year storm drain system in place. The 100-year flows with storm drain are residual overland flow values. The HEC-1 summary output for the 10-, and 100-year models is contained in the **Appendix**.

Table 1

Location	Existing Conditions		10-yr Storm Drain	
	10-yr Overland	100-yr Overland	10-yr with Storm Drain	100-yr Residual overland flow
Tatum Blvd @ Doubletree Ranch Rd.	284	686	284	402
52nd St. @ Butler Drive	92	220	92	128
52nd St. @ Doubletree Ranch Rd./South	N/A	515	209	215
Berneil Wash @ 52nd St.	135	326	135	191
52nd St. @ Doubletree Ranch Rd./North	2	5	135	5
Doubletree Ranch Rd. @ 52nd St.	295	N/A	627	409
Cherokee Wash @ 56th St.	789	1813	789	1813
56th St. @ Cherokee Wash	108	318	184	79
56th St. @ Doubletree Ranch Rd.	145	395	219	120
Doubletree Ranch Rd. @ 56th St.	726	2025	909	933
Doubletree Ranch Rd. @ IBW	925	2145	954	1432

Note: Decreasing flows going downstream include diversions into the storm drain.

within Berneil Wash and divert it south along 52nd Street to the Doubletree Ranch Road Trunkline.

(D) 56th Street Lateral

The 60-inch 56th Street Lateral will collect runoff at Cherokee Wash and convey it north along 56th Street to the Doubletree Ranch Road Trunkline. The inlet at Cherokee Wash is designed to intercept the portion of the 10-year discharge in Cherokee Wash that exceeds the channel capacity. The intent is to fully utilize the existing channel capacity and only provide storm drain capacity for the excess flow. This is discussed more fully in the following section.

(E) Cherokee Wash Crossing

One of the issues driving this project is the limitation of access to Cherokee School during small storm events. Cherokee School is located on the east side of 56th Street between Cherokee Wash and Doubletree Ranch Road. The existing Cherokee Wash crossing consists of only a dip section. Therefore, there is water crossing the roadway during any runoff event. Doubletree Ranch Road becomes flooded as well during relatively small storms, thus isolating Cherokee School. Under the proposed plan, access will be possible from Doubletree Ranch Road during a 10-year storm event. Providing a 10-year crossing at Cherokee Wash will allow a second access to the school. A 4 barrel 10' X3' RCBC is proposed for the crossing. The northern-most barrel will discharge into the 56th Street lateral. The remaining three barrels will discharge into Cherokee Wash east of 52nd Street. A short concrete wall at the northern-most barrel will allow low flows to continue in Cherokee Wash during all storms which will help support the existing vegetative habitat downstream from 56th Street. A handrail along each face of the RCBC is preferred by the Town of Paradise Valley over guardrail or any other type of barrier.

The effect of adding a box culvert at this location is investigated. Under existing conditions, the channel upstream of 56th Street has less than a 10-year capacity, as substantiated by an FCDMC two-dimensional hydraulic model. Once channel capacity is exceeded, runoff will flow northeasterly towards Doubletree Ranch Road. About 200 feet upstream of 56th Street, the channel capacity is 300 cfs, which is less than half of the 10-year flow 789 cfs. The hydraulic effect of the culvert before and after improvements is determined for the 300 cfs flow rate, using a HEC-RAS model. As shown in a comparative stream profile plot in the **Appendix**, there would be no increase in water surface elevation after the culvert is constructed.

The culvert is designed for the full 10-year flow rate of 789 cfs. At some point in the future,

channel improvements may be made to Cherokee Wash to contain the 10-year flow. Of the 789 cfs, 184 cfs would be intercepted by the 56th Street storm drain, and 605 cfs would continue downstream. The capacity of Cherokee Wash for a short distance downstream of 56th Street is about 605 cfs. The Cherokee Wash cross section locations and HEC-RAS model output are presented in the **Appendix**. The diskette at the rear of the report contains the HEC-RAS input and output files.

(F) Indian Bend Wash Outlet

The Doubletree Ranch Road storm drain daylights near Indian Bend Wash. At the storm drain outlet, riprap is placed for erosion protection. The storm drain exit velocity will be about 9.5 feet per second, and the 100-foot length of riprap should act to slow this down to the channel velocity of 4.2 feet per second. The riprap apron is set on the same grade as the grass lined swale, which is at a slope of 0.18 percent. The grass-lined swale conveys the flow to the low flow channel of the IBW. The **Appendix** contains the riprap protection design, and the grass-lined channel computations.

APPENDIX B

Cherokee Wash at 56th Street Culvert Calculations

Culvert Designer/Analyzer Report
A1

Analysis Component			
Storm Event	Design	Discharge	1,813.00 cfs

Peak Discharge Method: User-Specified			
Design Discharge	1,813.00 cfs	Check Discharge	1,813.00 cfs

Tailwater Conditions: Constant Tailwater	
Tailwater Elevation	N/A ft

Name	Description	Discharge	HW Elev.	Velocity
Culvert-1	3-10 x 3 ft Box	870.81 cfs	6.51 ft	9.77 ft/s
Culvert-2	1-60 inch Circular	149.81 cfs	6.51 ft	10.18 ft/s
Weir	Roadway	792.69 cfs	6.51 ft	N/A
Total	----------	1,813.32 cfs	6.51 ft	N/A

Culvert Designer/Analyzer Report
A1

Component:Culvert-1

Culvert Summary					
Computed Headwater Elev	6.51	ft	Discharge	870.81	cfs
Inlet Control HW Elev.	6.29	ft	Tailwater Elevation	N/A	ft
Outlet Control HW Elev.	6.51	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.84				

Grades					
Upstream Invert	1.00	ft	Downstream Invert	0.83	ft
Length	85.00	ft	Constructed Slope	0.002000	ft/ft

Hydraulic Profile					
Profile	CompositeM2PressureProfile		Depth, Downstream	2.97	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	2.97	ft
Velocity Downstream	9.77	ft/s	Critical Slope	0.003190	ft/ft

Section					
Section Shape	Box		Mannings Coefficient	0.013	
Section Material	Concrete		Span	10.00	ft
Section Size	10 x 3 ft		Rise	3.00	ft
Number Sections	3				

Outlet Control Properties					
Outlet Control HW Elev.	6.51	ft	Upstream Velocity Head	1.45	ft
Ke	0.50		Entrance Loss	0.73	ft

Inlet Control Properties					
Inlet Control HW Elev.	6.29	ft	Flow Control	Submerged	
Inlet Type	45° wingwall flare, d=0.0430		Area Full	90.0	ft²
K	0.51000		HDS 5 Chart	9	
M	0.66700		HDS 5 Scale	1	
C	0.03090		Equation Form	2	
Y	0.80000				

Culvert Designer/Analyzer Report
A1

Component:Culvert-2

Culvert Summary					
Computed Headwater Elev	6.51	ft	Discharge	149.81	cfs
Inlet Control HW Elev.	6.31	ft	Tailwater Elevation	N/A	ft
Outlet Control HW Elev.	6.51	ft	Control Type	Outlet Control	
Headwater Depth/Height	1.10				

Grades					
Upstream Invert	1.00	ft	Downstream Invert	0.85	ft
Length	85.00	ft	Constructed Slope	0.001800	ft/ft

Hydraulic Profile					
Profile	M2		Depth, Downstream	3.51	ft
Slope Type	Mild		Normal Depth	N/A	ft
Flow Regime	Subcritical		Critical Depth	3.51	ft
Velocity Downstream	10.18	ft/s	Critical Slope	0.004689	ft/ft

Section					
Section Shape	Circular		Mannings Coefficient	0.013	
Section Material	Concrete		Span	5.00	ft
Section Size	60 inch		Rise	5.00	ft
Number Sections	1				

Outlet Control Properties					
Outlet Control HW Elev.	6.51	ft	Upstream Velocity Head	1.17	ft
Ke	0.20		Entrance Loss	0.23	ft

Inlet Control Properties					
Inlet Control HW Elev.	6.31	ft	Flow Control	Unsubmerged	
Inlet Type	Beveled ring, 33.7° bevels		Area Full	19.6	ft²
K	0.00180		HDS 5 Chart	3	
M	2.50000		HDS 5 Scale	B	
C	0.02430		Equation Form	1	
Y	0.83000				

Culvert Designer/Analyzer Report
A1

Component:Weir

Hydraulic Component(s): Roadway					
Discharge	792.69	cfs	Allowable HW Elevation	6.51	ft
Roadway Width	38.00	ft	Overtopping Coefficient	3.02	US
Low Point	2.37	ft	Headwater Elevation	6.51	ft
Discharge Coefficient (Cr)	3.02		Submergence Factor (Kt)	1.00	
Tailwater Elevation	-9,999.00	ft			

Sta (ft)	Elev. (ft)
0.00	5.00
10.50	2.37
21.00	5.00
22.00	5.00
22.10	4.50
23.52	4.58
41.10	4.93
56.68	4.58
60.10	4.50
60.20	5.00
66.20	5.00
72.20	4.00
78.00	2.75
80.00	5.00

Typical Minor Arterial Section @Cherokee Wash and 56th Street

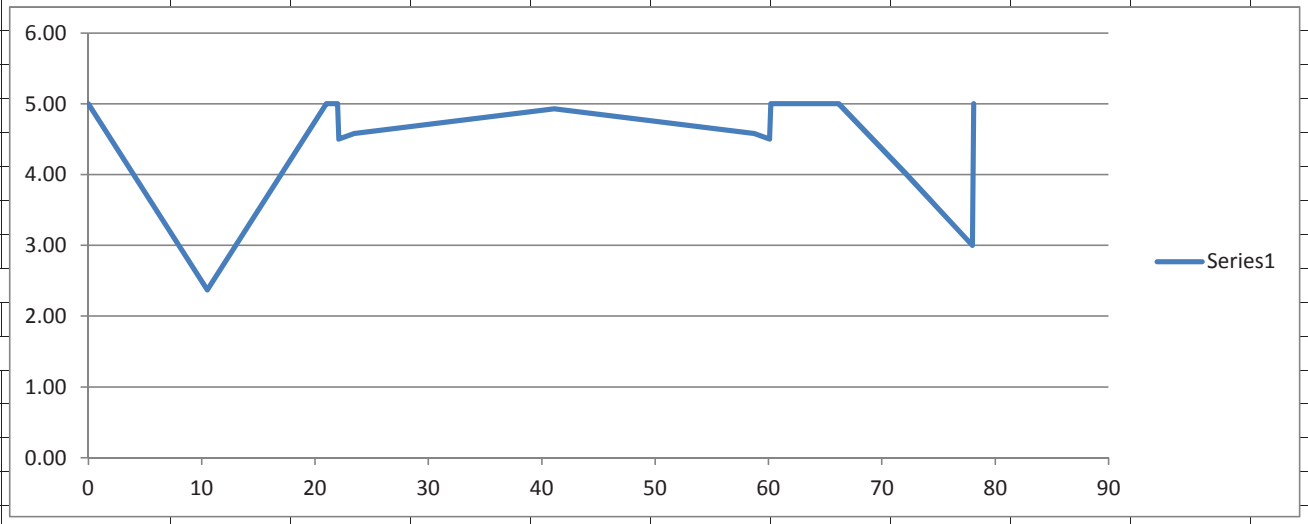
for Roadway Overtopping Analysis (see Culvert A1)

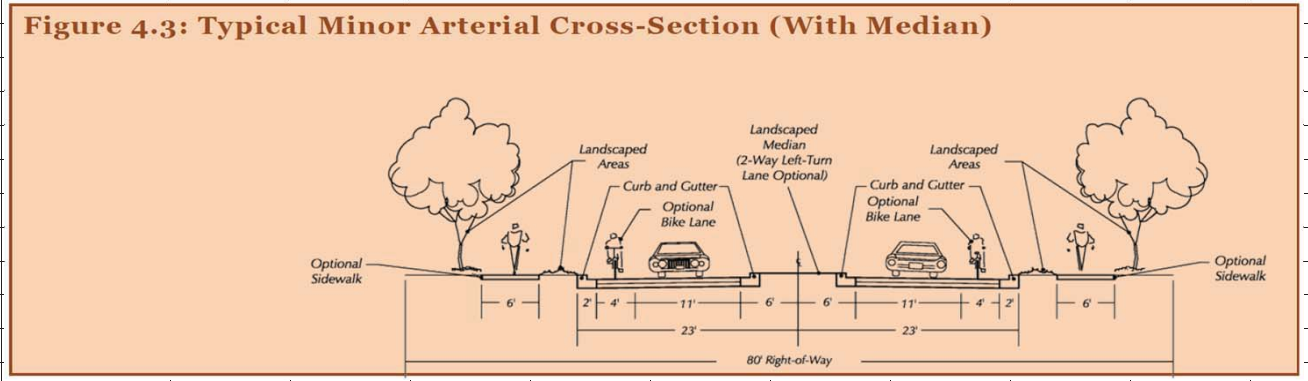
Typical Section

Sta	Elev	Notes
0	5.00	At wall
10.5	2.37	2:1 ditch
21	5.00	
22	5.00	TOC
22.1	4.50	6" C/G
23.52	4.58	Gutter Pan
41.1	4.93	Centerline
58.68	4.58	Gutter Pan
60.1	4.50	6" C/G
60.2	5.00	TOC
66.2	5.00	
72.2	4.00	
78	3.00	
78.1	5.00	

Note:

Typical Section Sta/Elev modified per site visit and aerial mapping.





Typical Minor Arterial per 2012 General Plan

APPENDIX C

Flowsplit Calculations East of 56th Street

E Caballo Drive(A2)

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00260	ft/ft
Normal Depth	1.10	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	5.80
0+08	4.80
0+10	4.30
0+28	4.66
0+46	4.30
0+48	4.80
0+63	5.40

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 5.80)	(0+63, 5.40)	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

Discharge		159.71	ft³/s
Elevation Range	4.30 to 5.80 ft		
Flow Area		42.46	ft²
Wetted Perimeter		59.98	ft
Hydraulic Radius		0.71	ft
Top Width		59.80	ft

E Caballo Drive(A2)

Results

Normal Depth		1.10	ft
Critical Depth		0.98	ft
Critical Slope		0.00436	ft/ft
Velocity		3.76	ft/s
Velocity Head		0.22	ft
Specific Energy		1.32	ft
Froude Number		0.79	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.10	ft
Critical Depth	0.98	ft
Channel Slope	0.00260	ft/ft
Critical Slope	0.00436	ft/ft

A2 (East Caballo Drive)

Sta	Elev	
0	5.8	
8	4.8	Edge of S/W
10	4.3	
28	4.66	Centerline
46	4.3	
48	4.8	Edge of S/W
63	5.4	

Notes:

Section based on measurement in Google Earth and PV typical roadway section.

Section taken at narrowest point between walls.

A3

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00500	ft/ft
Normal Depth	1.69	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	1341.33
0+06	1341.14
0+11	1340.93
0+14	1339.30
0+15	1338.97
0+16	1338.96
0+29	1338.86
0+35	1338.81
0+44	1339.56
0+63	1340.67

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1341.33)	(0+63, 1340.67)	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

Discharge	205.28	ft^3/s
Elevation Range	1338.81 to 1341.33 ft	
Flow Area	54.30	ft^2

A3

Results

Wetted Perimeter		48.41	ft
Hydraulic Radius		1.12	ft
Top Width		47.93	ft
Normal Depth		1.69	ft
Critical Depth		1.32	ft
Critical Slope		0.01365	ft/ft
Velocity		3.78	ft/s
Velocity Head		0.22	ft
Specific Energy		1.91	ft
Froude Number		0.63	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

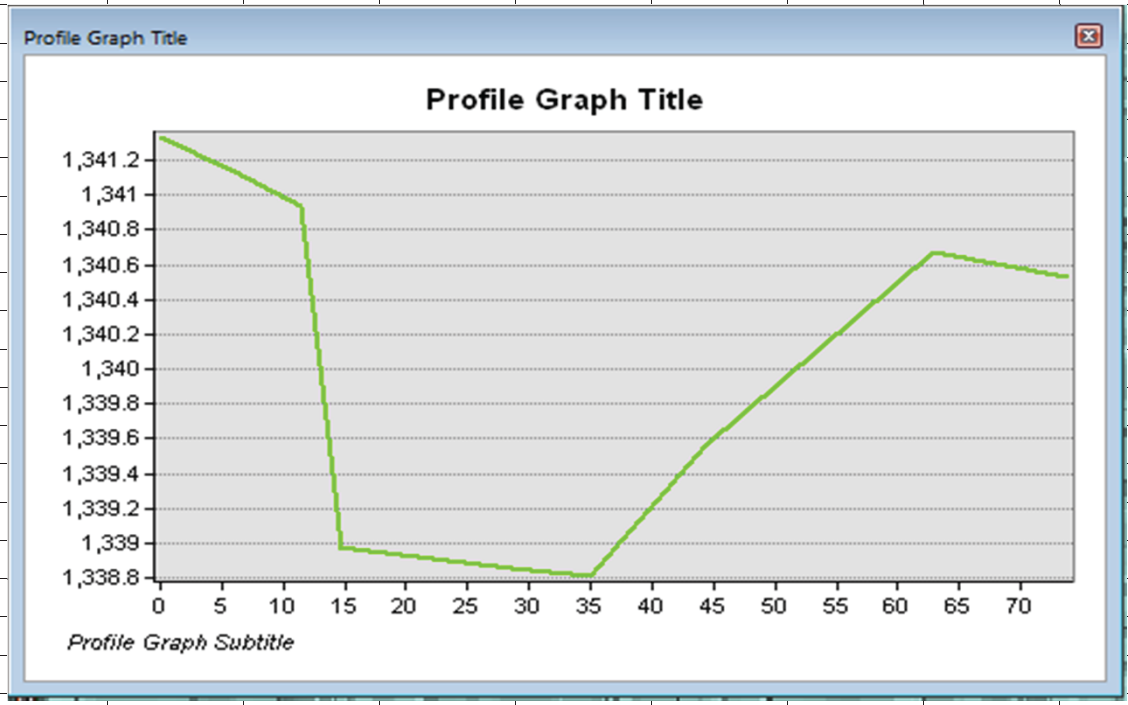
Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.69	ft
Critical Depth	1.32	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.01365	ft/ft

A3

Station (ft)	Elevation (ft)
0+00	1341.33
0+06	1341.14
0+11	1340.93
0+14	1339.3
0+15	1338.97
0+16	1338.96
0+29	1338.86
0+35	1338.81
0+44	1339.56
0+63	1340.67

Note:

Elevation data obtained from FCDMC for Indian Bend Wash Mapping on 11/2/2007



A4

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00240	ft/ft
Normal Depth	0.70	ft

Section Definitions

Station (ft)	Elevation (ft)
0+93	1333.66
0+94	1333.50
0+97	1333.35
1+01	1333.08
1+04	1332.96
1+12	1334.34
1+13	1334.67

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+93, 1333.66)	(1+13, 1334.67)	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

Discharge	6.87	ft^3/s
Elevation Range	1332.96 to 1334.67 ft	
Flow Area	5.51	ft^2
Wetted Perimeter	14.96	ft
Hydraulic Radius	0.37	ft
Top Width	14.88	ft

A4

Results

Normal Depth		0.70	ft
Critical Depth		0.47	ft
Critical Slope		0.02142	ft/ft
Velocity		1.25	ft/s
Velocity Head		0.02	ft
Specific Energy		0.72	ft
Froude Number		0.36	
Flow Type	Subcritical		

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

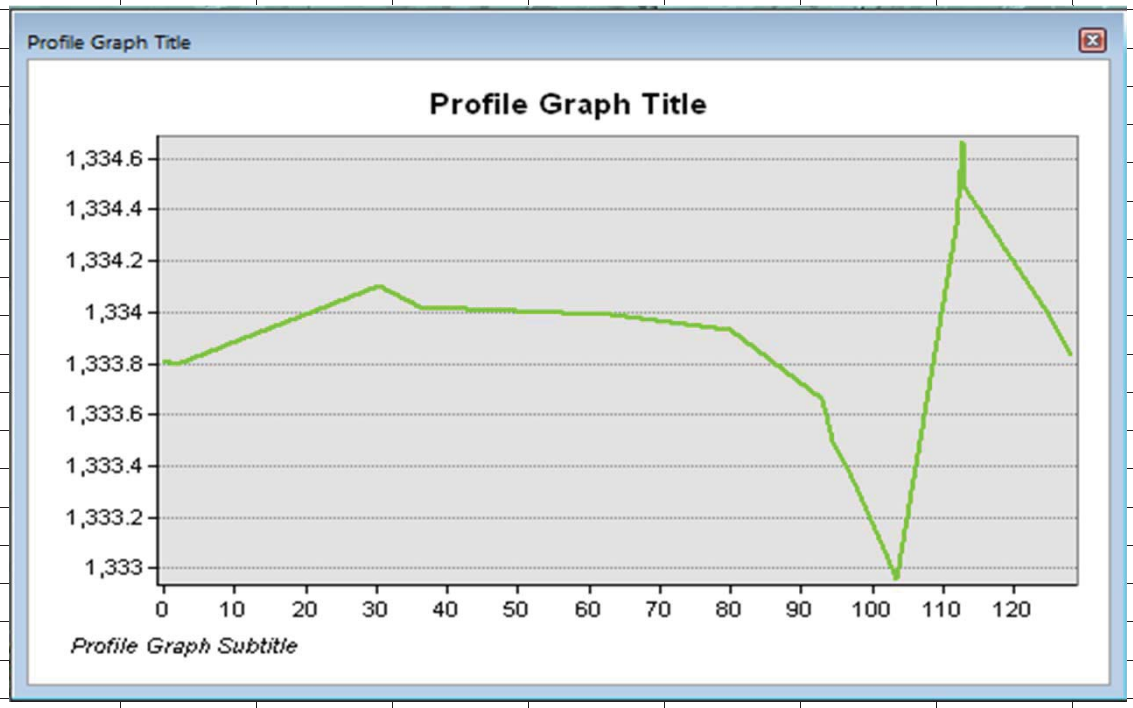
GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.70	ft
Critical Depth	0.47	ft
Channel Slope	0.00240	ft/ft
Critical Slope	0.02142	ft/ft

A4

Station (ft)	Elevation (ft)
0+93	1333.66
0+94	1333.5
0+97	1333.35
1+01	1333.08
1+04	1332.96
1+12	1334.34
1+13	1334.67

Note:
Elevation data obtained from FCDMC for Indian Bend Wash Mapping on 11/2/2007



A5

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.01500	ft/ft
Normal Depth	0.89	ft

Section Definitions

Station (ft)	Elevation (ft)
0+00	1335.78
0+13	1335.74
0+24	1335.68
0+26	1335.66
0+37	1335.60
0+47	1335.53
0+53	1335.18
0+61	1335.13
0+74	1335.04
0+80	1334.40
0+80	1334.40
0+80	1334.40
0+87	1334.85
0+92	1335.34
0+98	1335.31
1+02	1335.29
1+09	1335.29

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+00, 1335.78)	(1+09, 1335.29)	0.030

Options

Current Roughness Weighted Method	Pavlovskii's Method

A5

Options

Open Channel Weighting Method	Pavlovskii's Method
Closed Channel Weighting Method	Pavlovskii's Method

Results

Discharge		37.76	ft³/s
Elevation Range	1334.40 to 1335.78 ft		
Flow Area		13.19	ft²
Wetted Perimeter		40.66	ft
Hydraulic Radius		0.32	ft
Top Width		40.58	ft
Normal Depth		0.89	ft
Critical Depth		0.86	ft
Critical Slope		0.01957	ft/ft
Velocity		2.86	ft/s
Velocity Head		0.13	ft
Specific Energy		1.02	ft
Froude Number		0.89	
Flow Type	Subcritical		

GVF Input Data

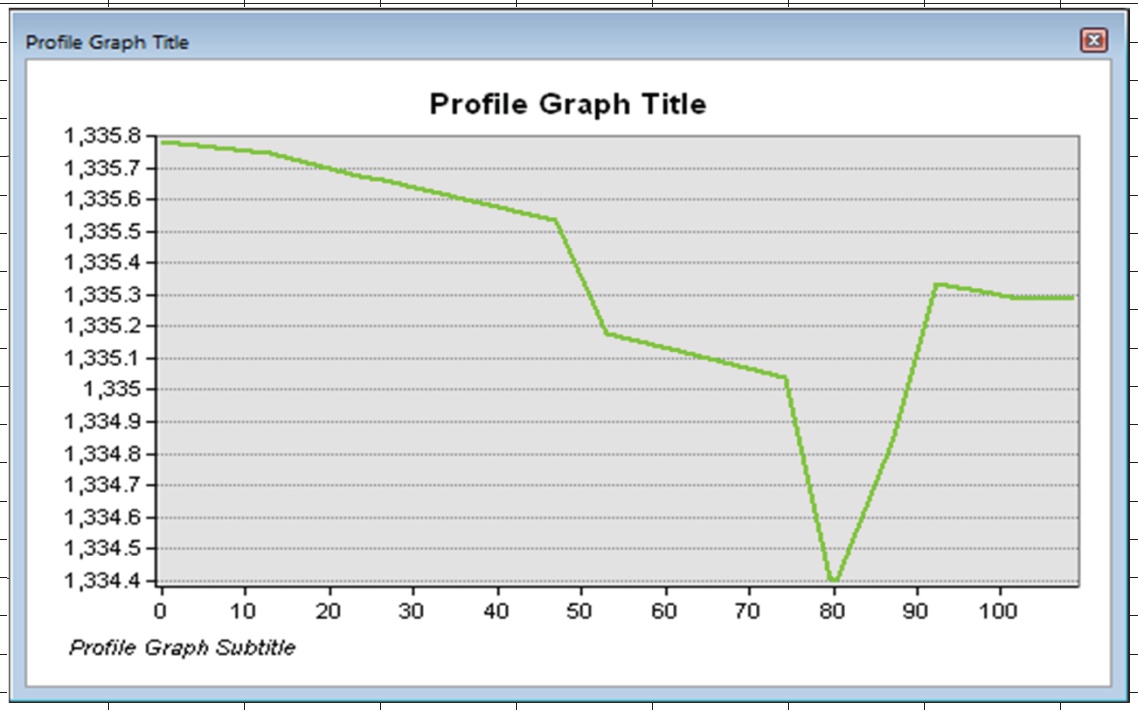
Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.89	ft
Critical Depth	0.86	ft
Channel Slope	0.01500	ft/ft
Critical Slope	0.01957	ft/ft

A5

Station (ft)	Elevation (ft)
0+00	1335.78
0+13	1335.74
0+24	1335.68
0+26	1335.66
0+37	1335.6
0+47	1335.53
0+53	1335.18
0+61	1335.13
0+74	1335.04
0+80	1334.4
0+80	1334.4
0+80	1334.4
0+87	1334.85
0+92	1335.34
0+98	1335.31
1+02	1335.29
1+09	1335.29



Note:

Elevation data obtained from FCDMC for Indian Bend Wash Mapping on 11/2/2007

A6

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Channel Slope	0.00350	ft/ft
Normal Depth	1.02	ft

Section Definitions

Station (ft)	Elevation (ft)
0+16	1345.08
0+17	1345.08
0+24	1344.90
0+27	1344.46
0+29	1344.18
0+31	1343.96
0+36	1343.44
0+54	1343.42
0+65	1343.42
0+65	1343.77
0+67	1343.79
0+80	1343.51
0+85	1343.12
0+87	1342.92
0+89	1342.92
0+96	1342.95
1+14	1343.67
1+15	1343.69
1+16	1343.70
1+43	1343.94

Roughness Segment Definitions

Start Station	Ending Station	Roughness Coefficient
(0+16, 1345.08)	(1+43, 1343.94)	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

Discharge		84.06	ft³/s
Elevation Range	1342.92 to 1345.08 ft		
Flow Area		49.50	ft²
Wetted Perimeter		112.19	ft
Hydraulic Radius		0.44	ft
Top Width		112.00	ft
Normal Depth		1.02	ft
Critical Depth		0.77	ft
Critical Slope		0.01882	ft/ft
Velocity		1.70	ft/s
Velocity Head		0.04	ft
Specific Energy		1.07	ft
Froude Number		0.45	
Flow Type	Subcritical		

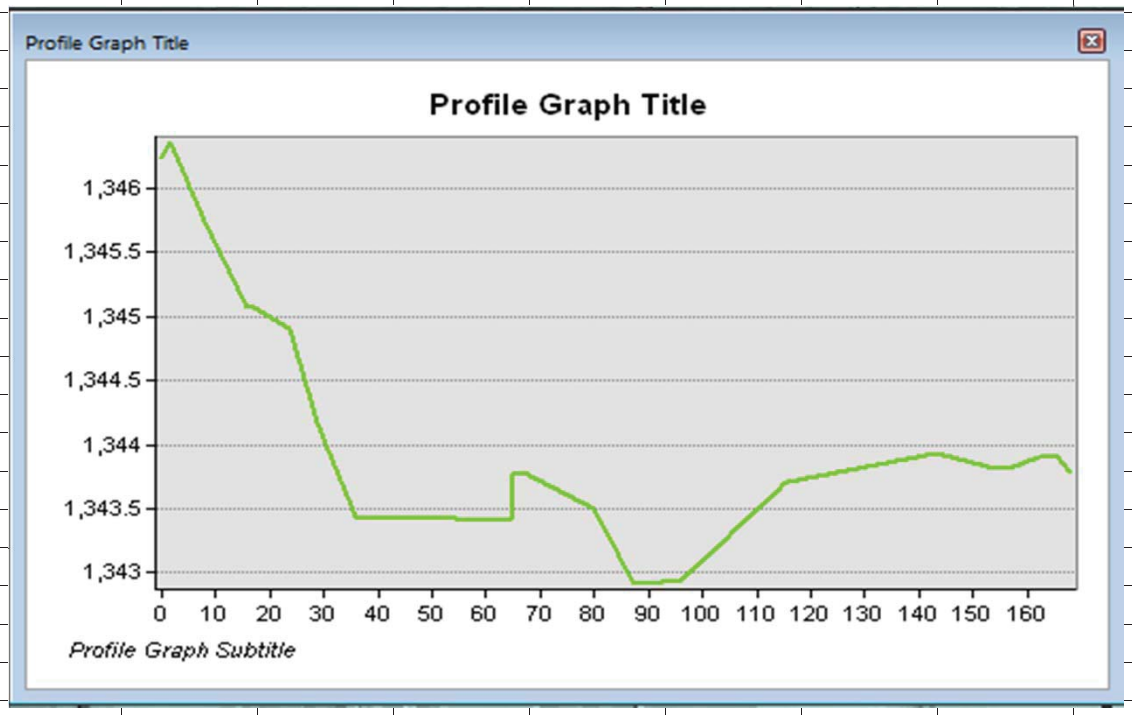
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.02	ft
Critical Depth	0.77	ft
Channel Slope	0.00350	ft/ft
Critical Slope	0.01882	ft/ft

A6		
Station (ft)	**Elevation (ft)**	
0+16	1345.08	
0+17	1345.08	
0+24	1344.9	
0+27	1344.46	
0+29	1344.18	
0+31	1343.96	
0+36	1343.44	
0+54	1343.42	
0+65	1343.42	
0+65	1343.77	
0+67	1343.79	
0+80	1343.51	
0+85	1343.12	
0+87	1342.92	
0+89	1342.92	
0+96	1342.95	
1+14	1343.67	
1+15	1343.69	
1+16	1343.7	
1+43	1343.94	
Note:		
Elevation data obtained from FCDMC		
for Indian Bend Wash Mapping		
on 11/2/2007		

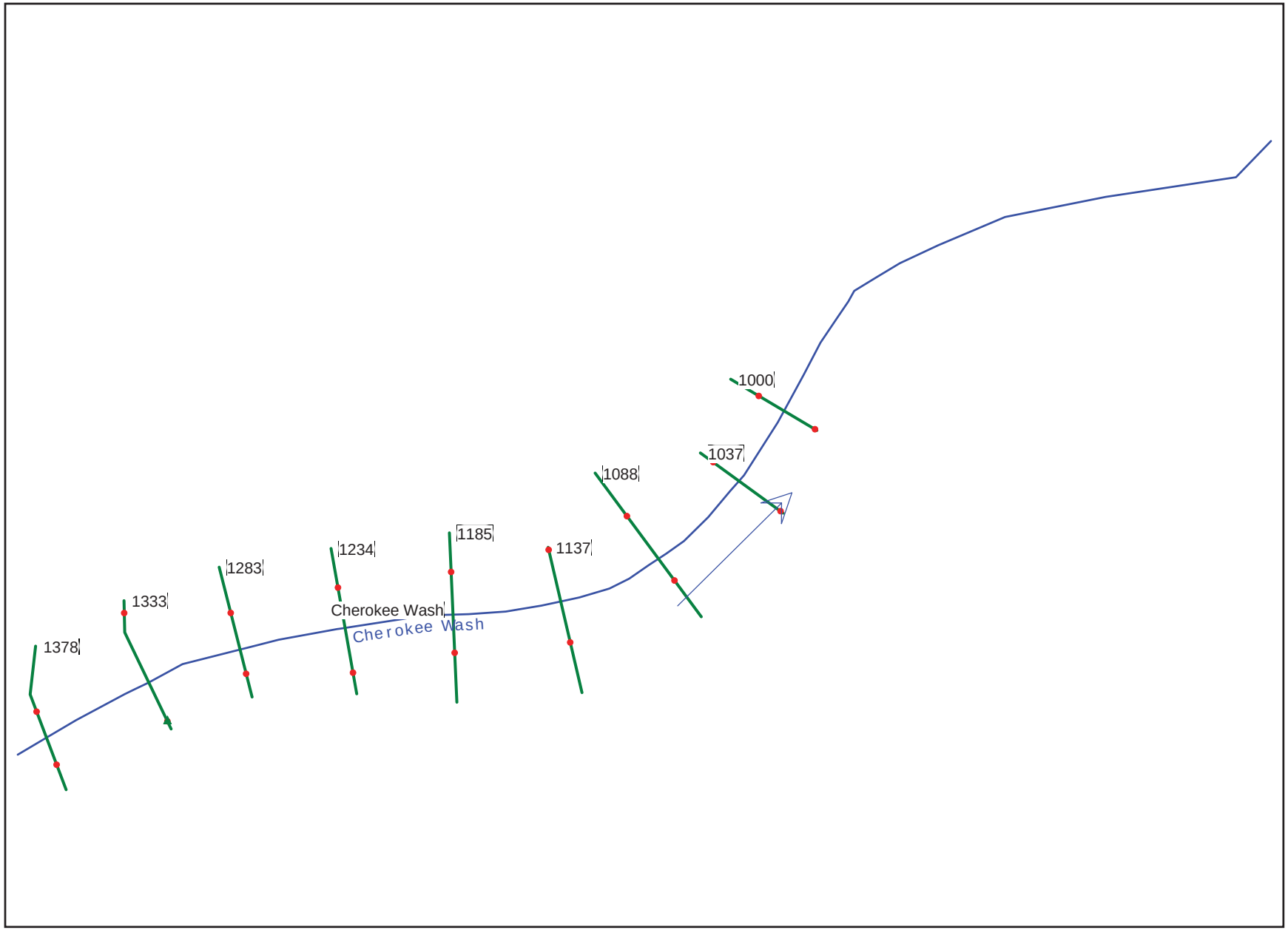


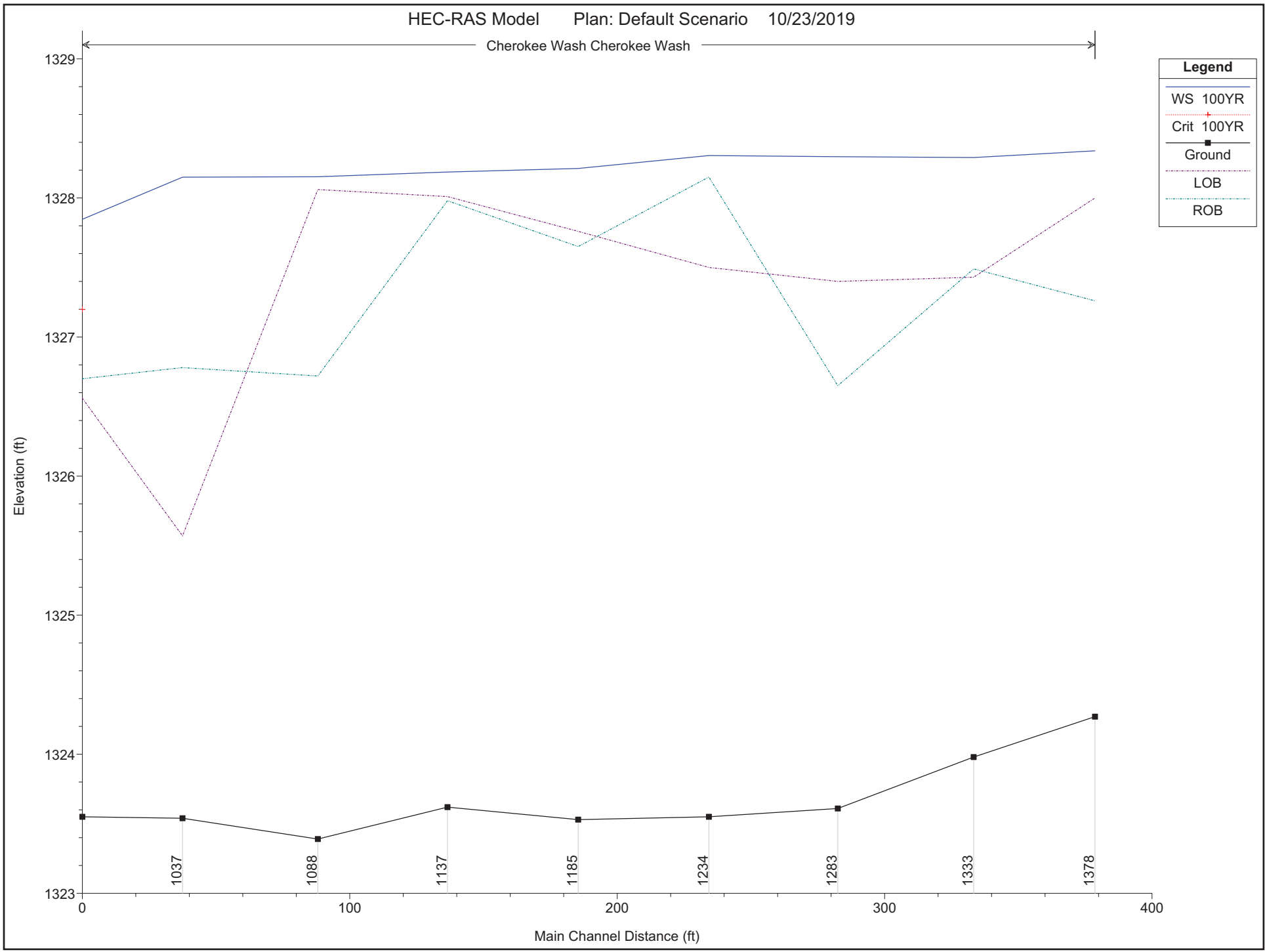
APPENDIX D

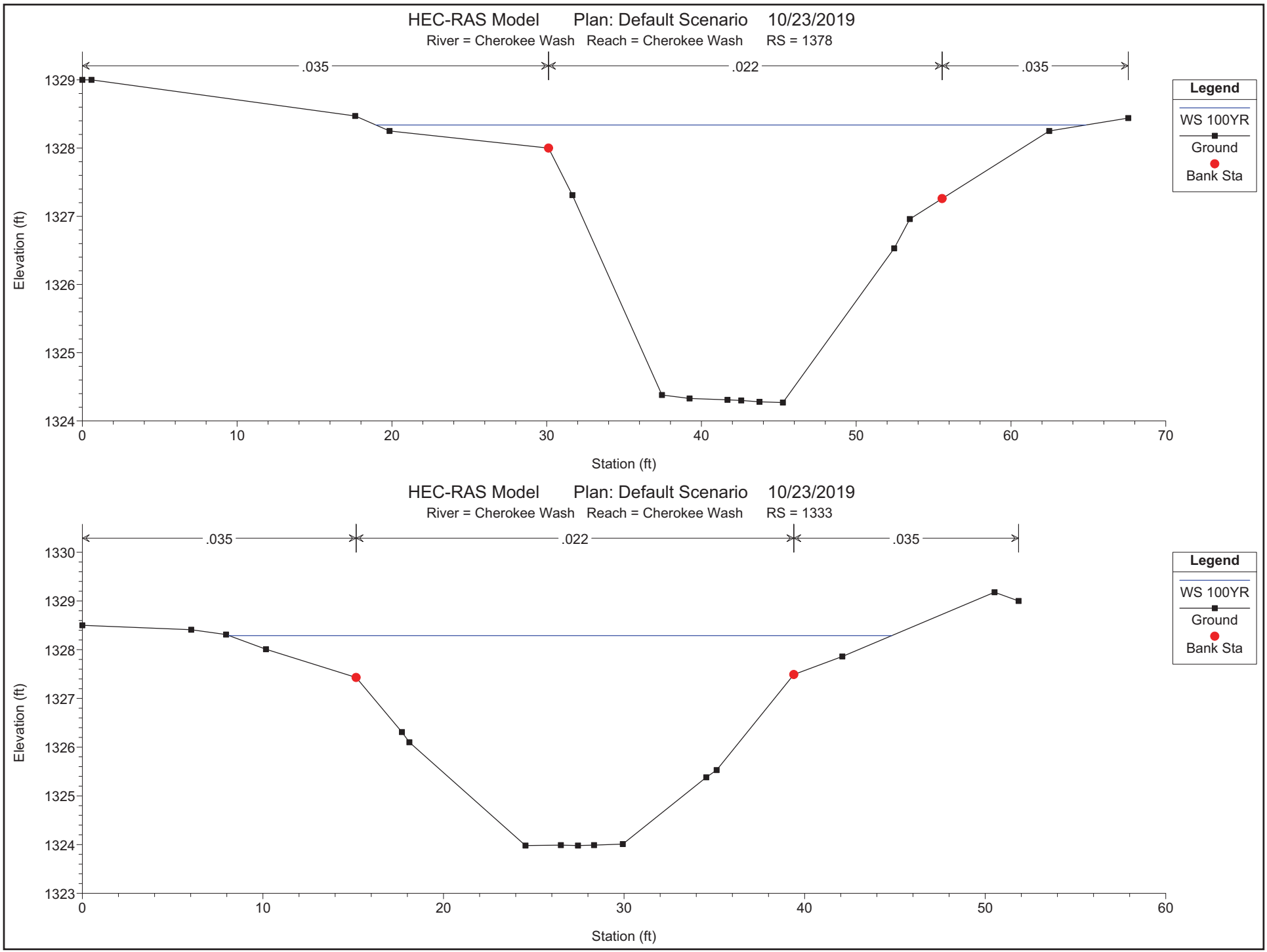
HEC-RAS Analysis for Cherokee Wash at the Site

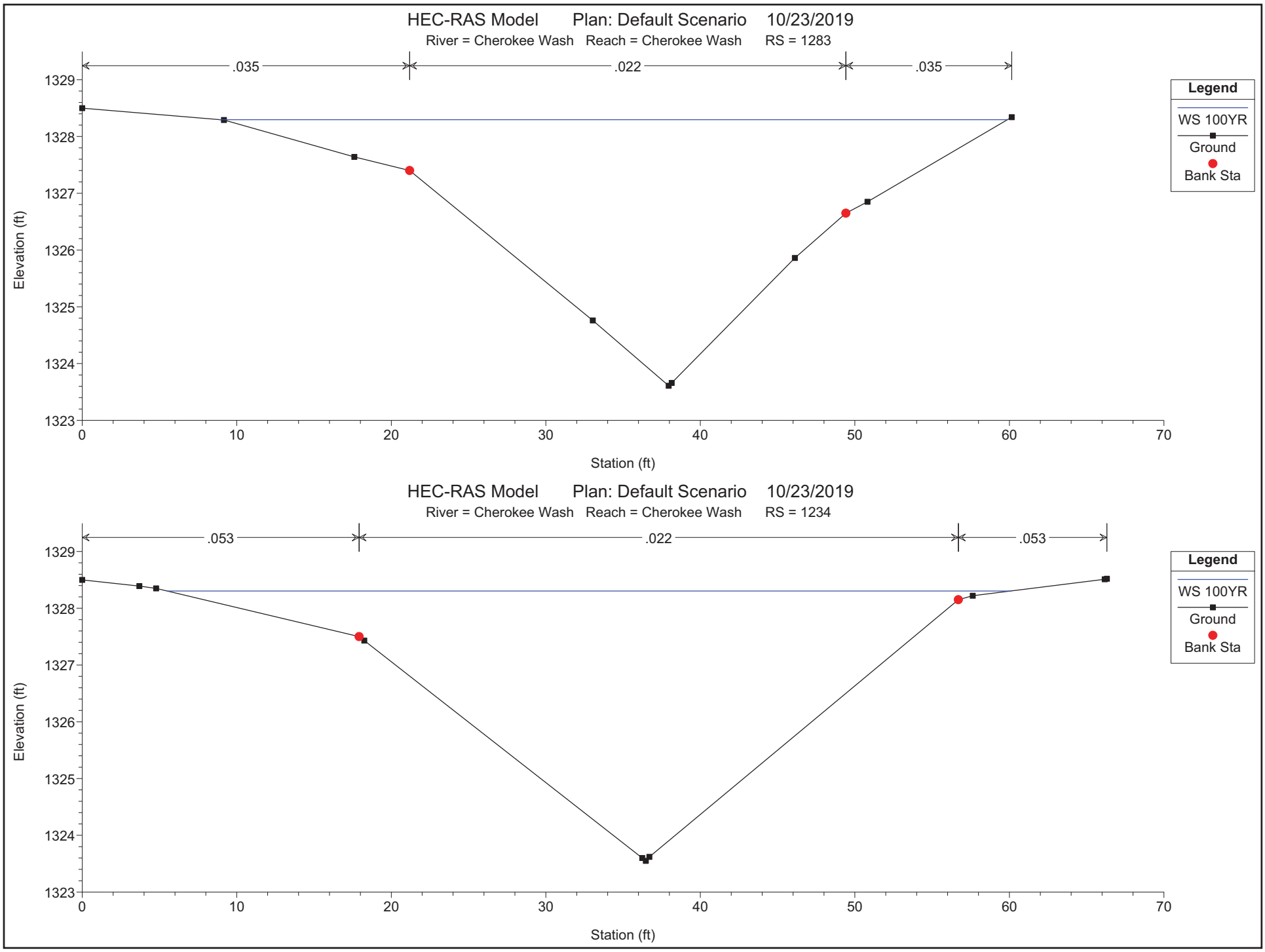
CVL CONSULTANTS

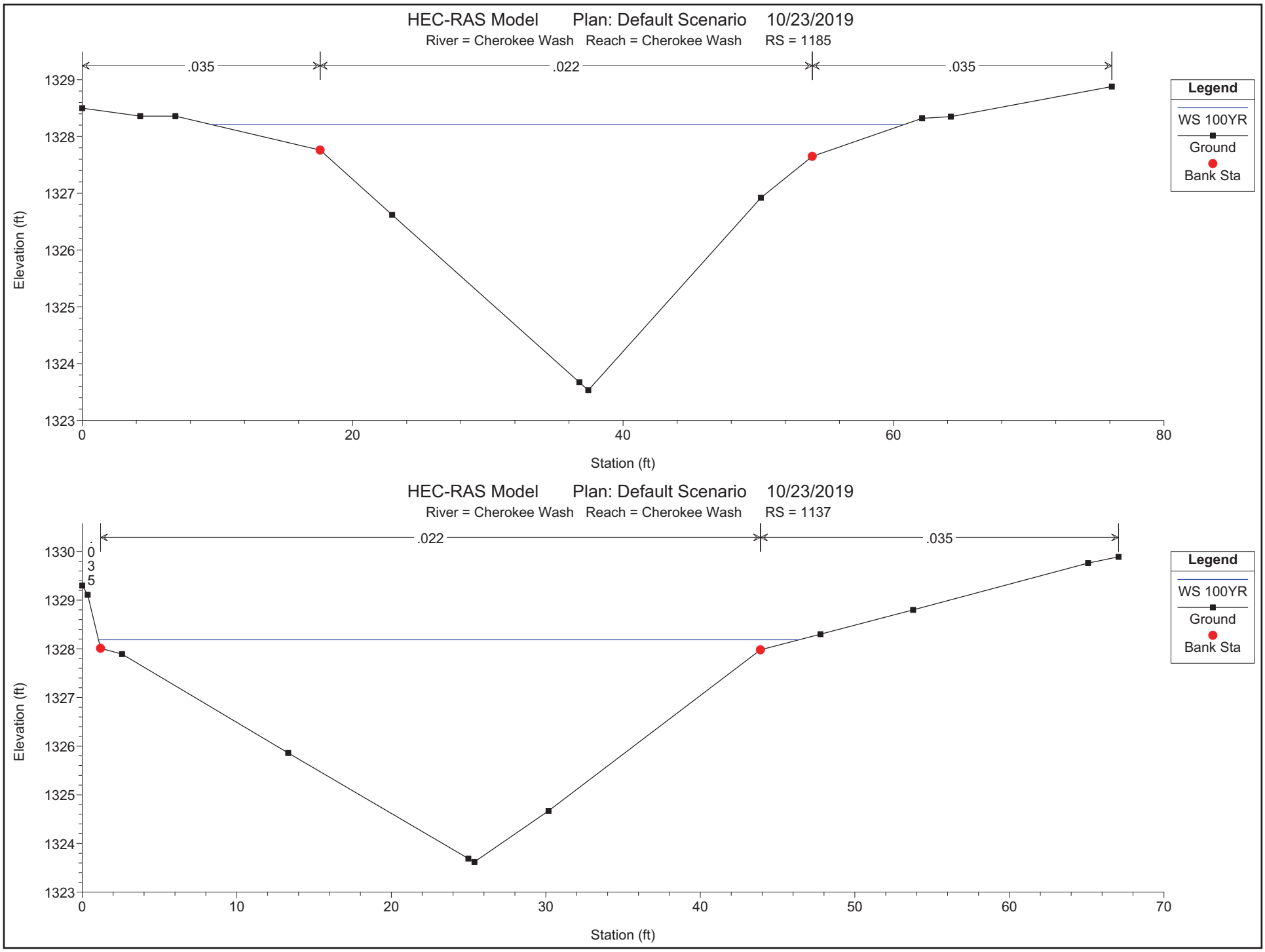
Existing Condition

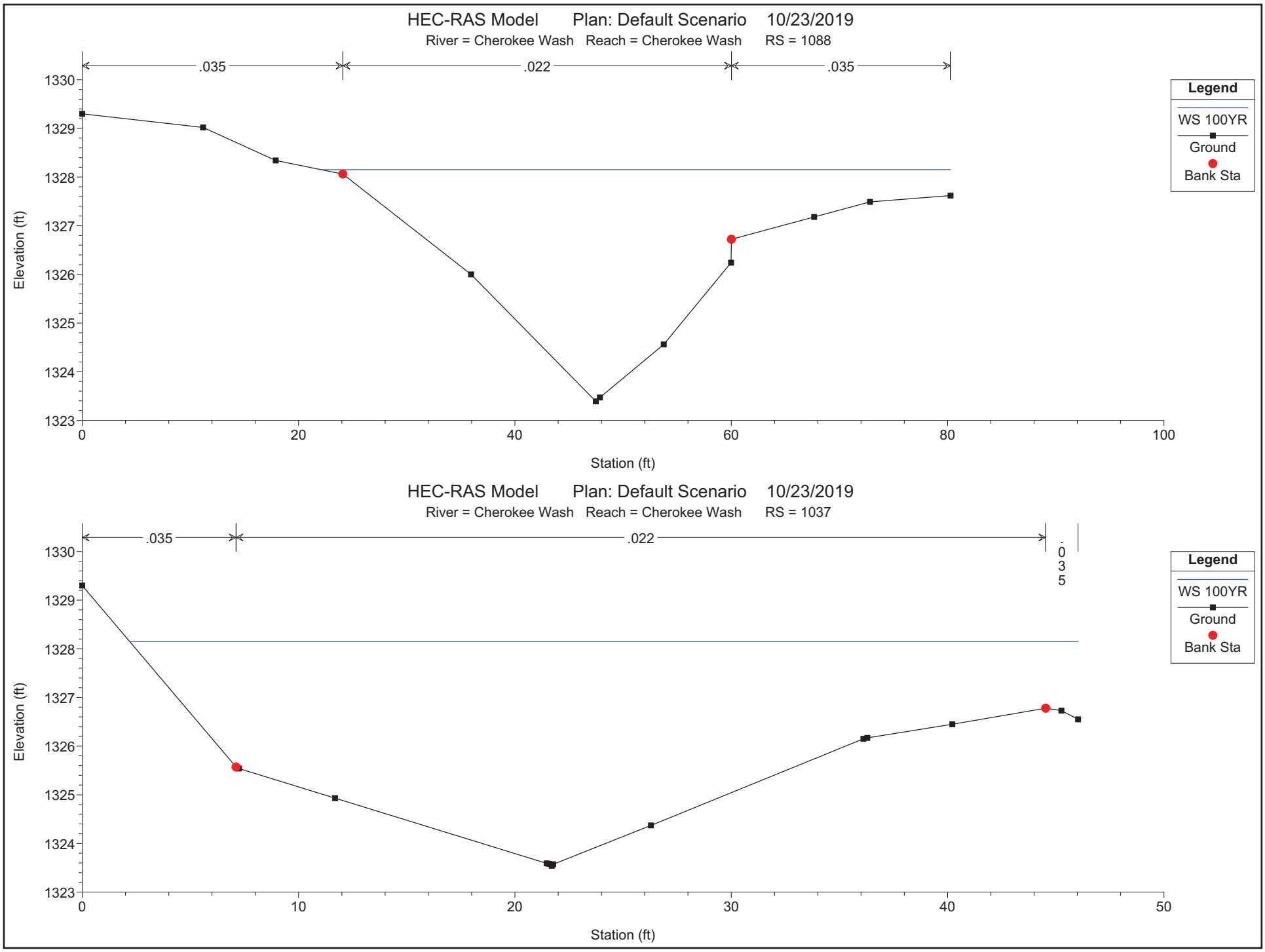

1000
1037
1088
1137
1185
1234
1283
1333
1378
Cherokee Wash
Cherokee Wash


HEC-RAS Model Plan: Default Scenario 10/23/2019
Cherokee Wash Cherokee Wash
Legend
WS 100YR
Crit 100YR
Ground
LOB
ROB
Elevation (ft)
1329
1328
1327
1326
1325
1324
1323
1037
1088
1137
1185
1234
1283
1333
1378
0
100
200
300
400
Main Channel Distance (ft)


HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1378
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1333
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

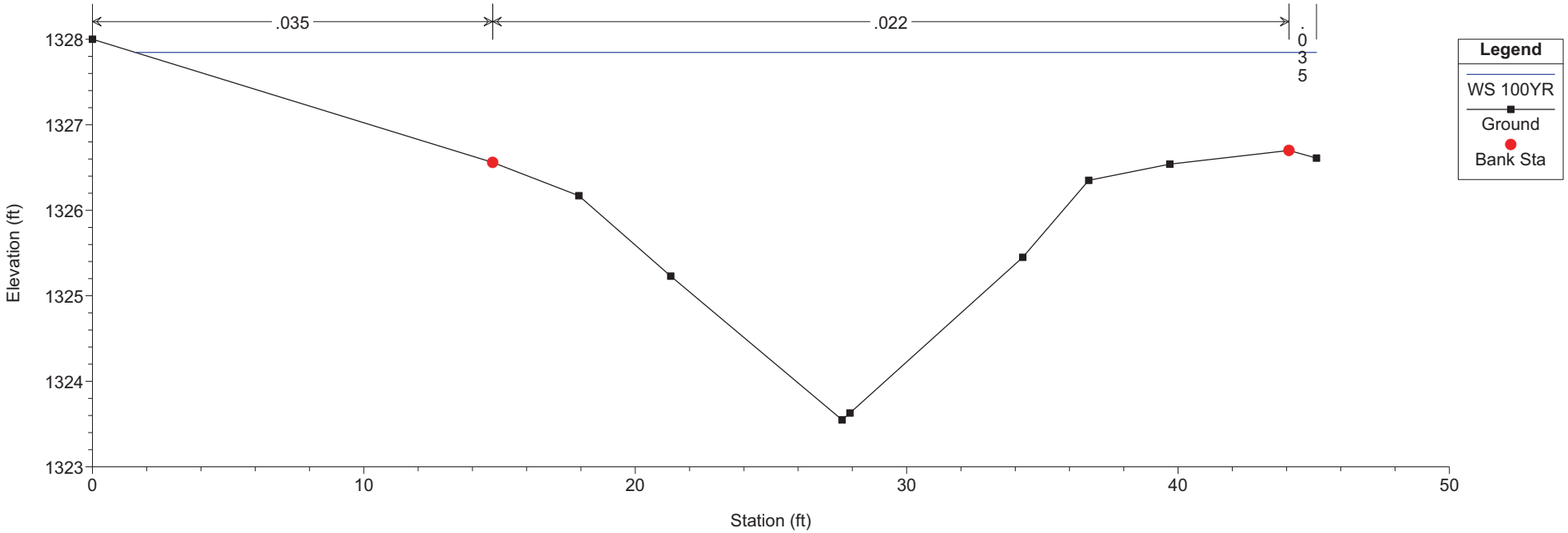

HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1283
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1234
.053
.022
.053
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
Station (ft)


HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1185
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
1329
1328
1327
1326
1325
1324
1323
0
20
40
60
80
Station (ft)
HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1137
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
1330
1329
1328
1327
1326
1325
1324
1323
0
10
20
30
40
50
60
70
Station (ft)


HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1088
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
Station (ft)
HEC-RAS Model Plan: Default Scenario 10/23/2019
River = Cherokee Wash Reach = Cherokee Wash RS = 1037
.035
.022
.035
Legend
WS 100YR
Ground
Bank Sta
Elevation (ft)
Station (ft)

HEC-RAS Model Plan: Default Scenario 10/23/2019

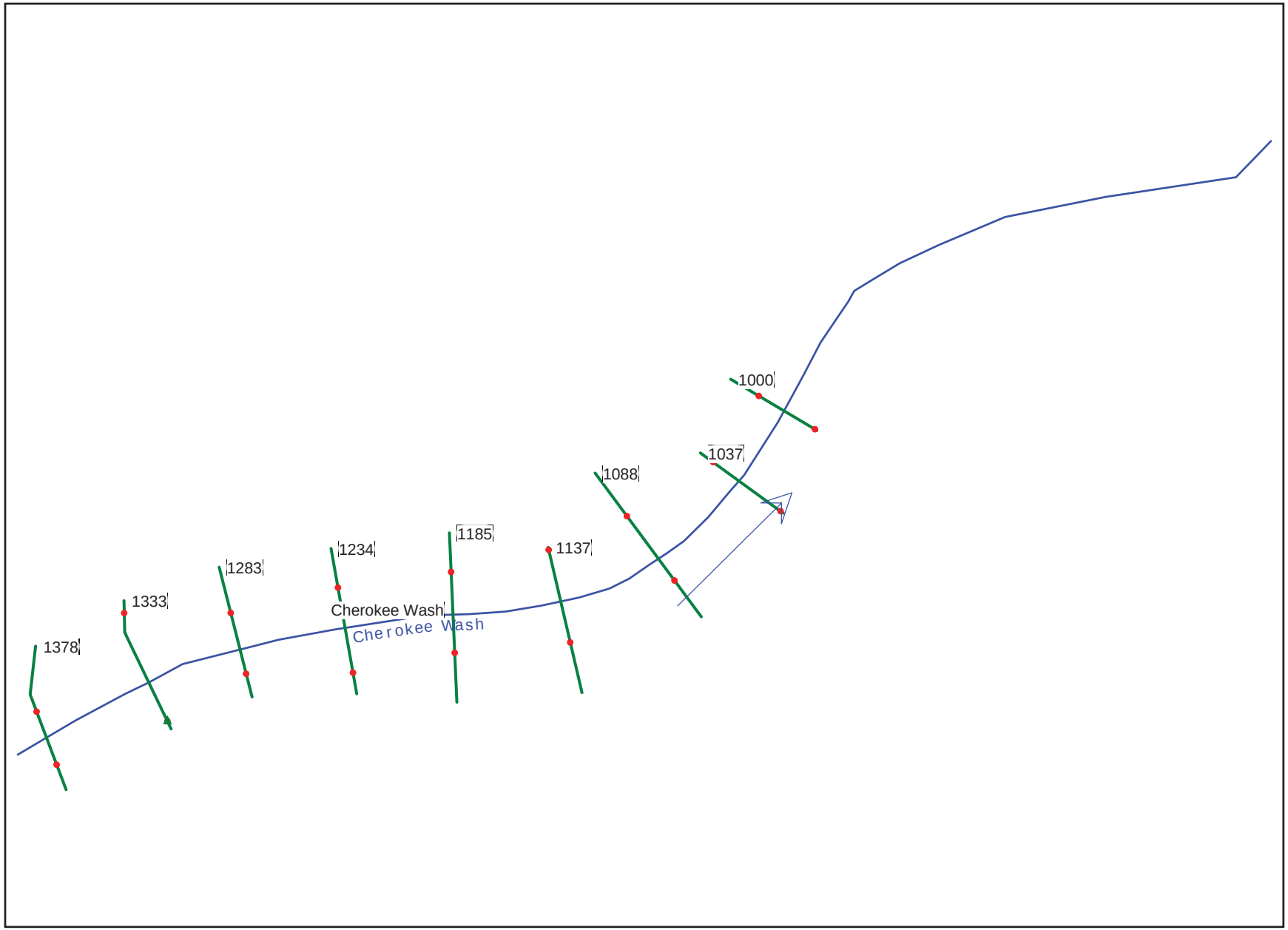
River = Cherokee Wash Reach = Cherokee Wash RS = 1000

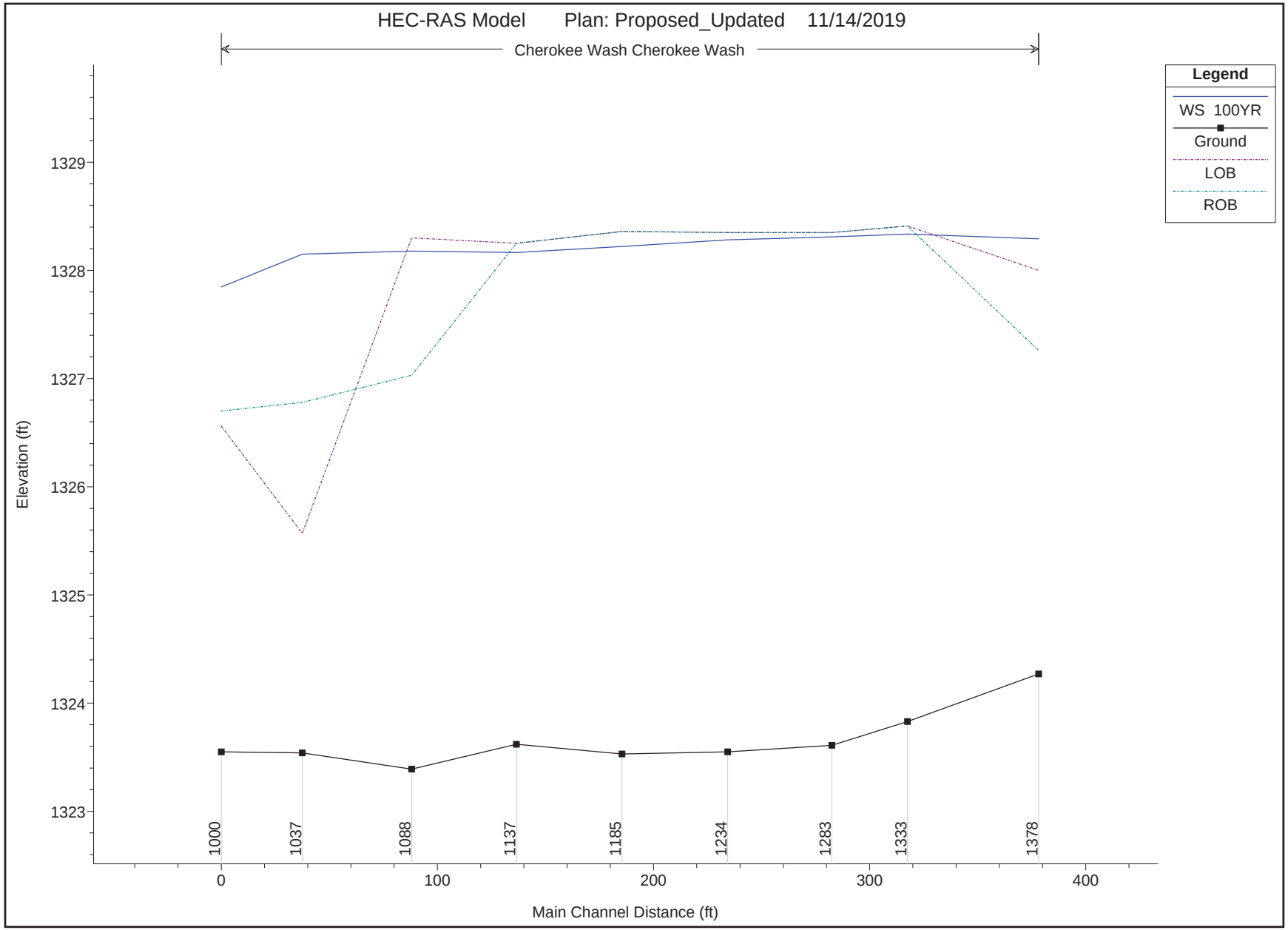


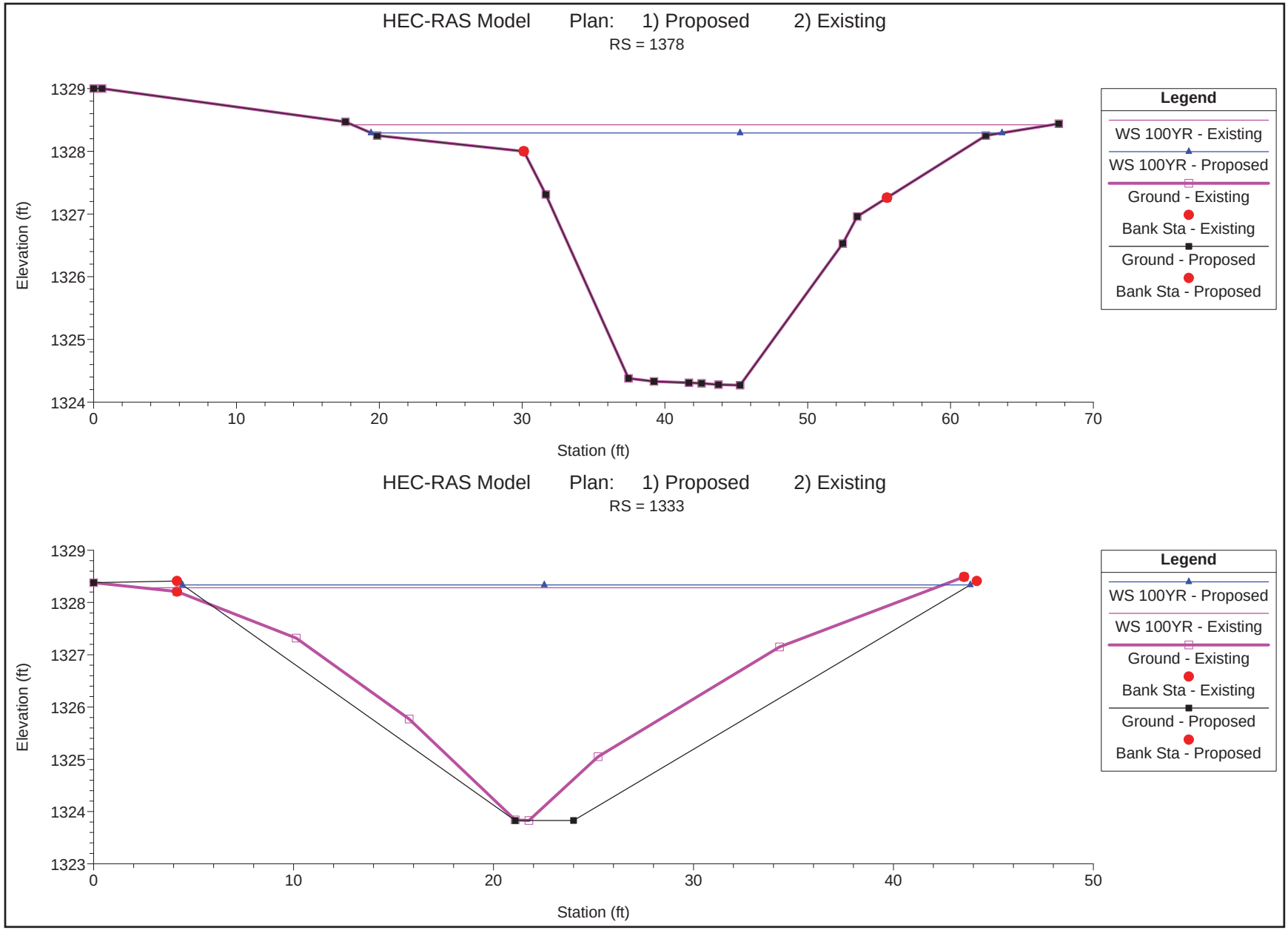
HEC-RAS Plan: Default Scenario River: Cherokee Wash Reach: Cherokee Wash Profile: 100YR

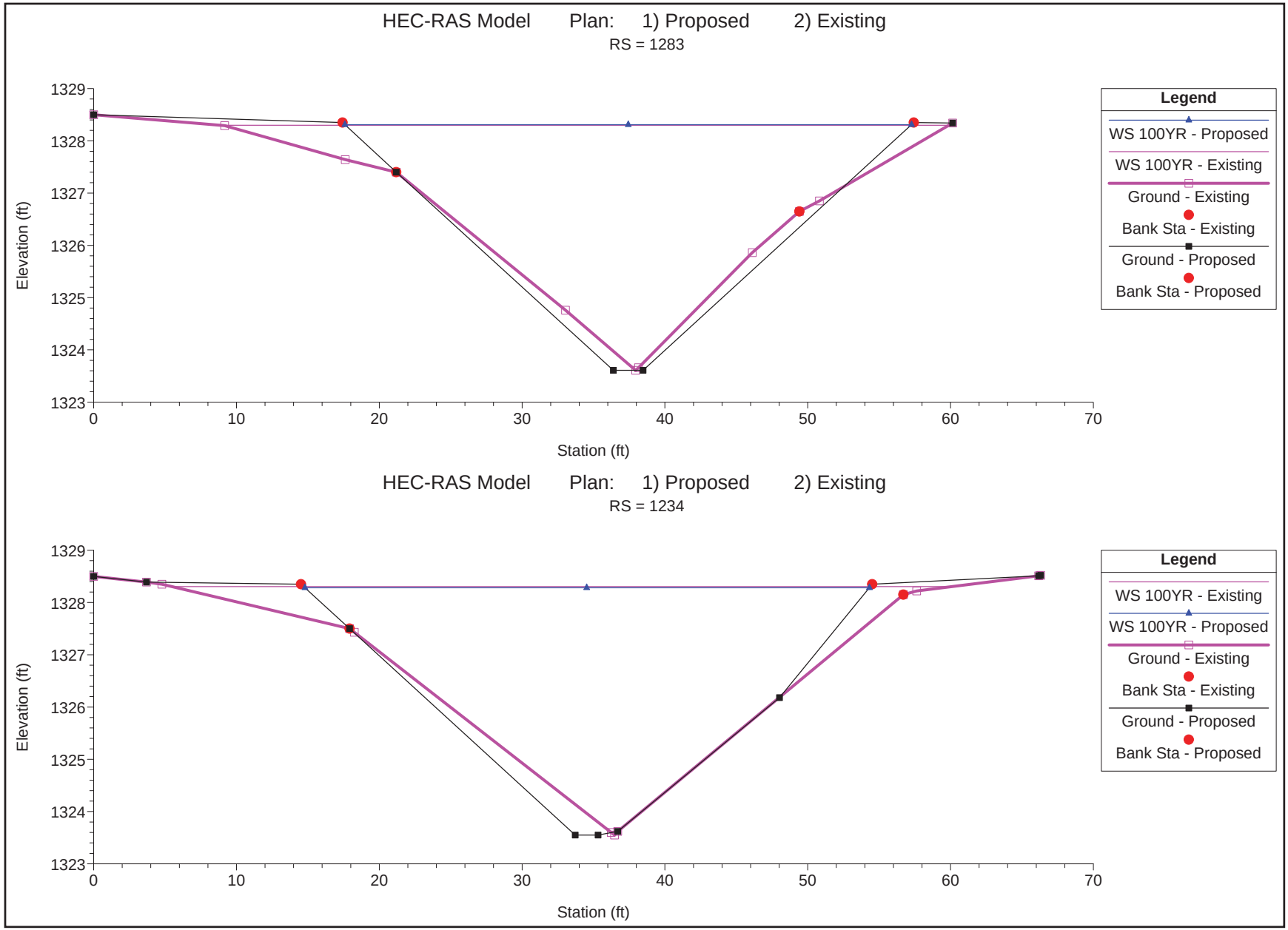
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Cherokee Wash	1378	100YR	378.00	1324.27	1328.34		1328.75	0.001550	5.16	78.62	45.90	0.54
Cherokee Wash	1333	100YR	378.00	1323.98	1328.29		1328.68	0.001324	5.02	79.78	36.73	0.50
Cherokee Wash	1283	100YR	378.00	1323.61	1328.30		1328.59	0.001062	4.41	96.62	51.01	0.45
Cherokee Wash	1234	100YR	378.00	1323.55	1328.30		1328.52	0.000873	3.72	106.24	54.63	0.41
Cherokee Wash	1185	100YR	378.00	1323.53	1328.21		1328.47	0.001077	4.06	96.34	51.28	0.45
Cherokee Wash	1137	100YR	378.00	1323.62	1328.19		1328.40	0.001006	3.75	101.14	45.33	0.43
Cherokee Wash	1088	100YR	378.00	1323.39	1328.15		1328.36	0.000845	3.71	114.48	58.21	0.40
Cherokee Wash	1037	100YR	378.00	1323.54	1328.15		1328.31	0.000526	3.24	122.71	43.84	0.33
Cherokee Wash	1000	100YR	378.00	1323.55	1327.85	1327.20	1328.25	0.001902	5.18	80.07	43.53	0.59

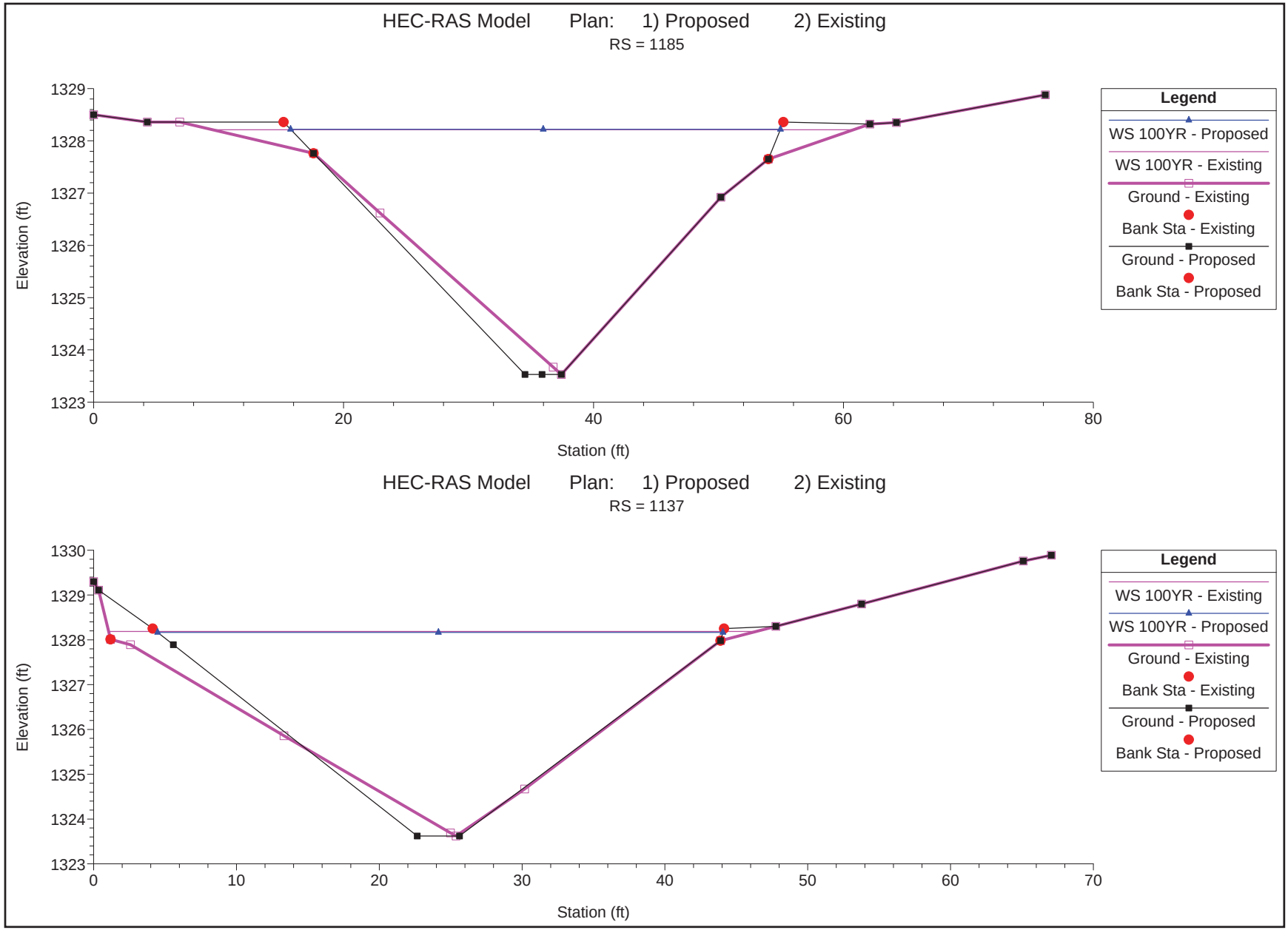
Proposed Condition

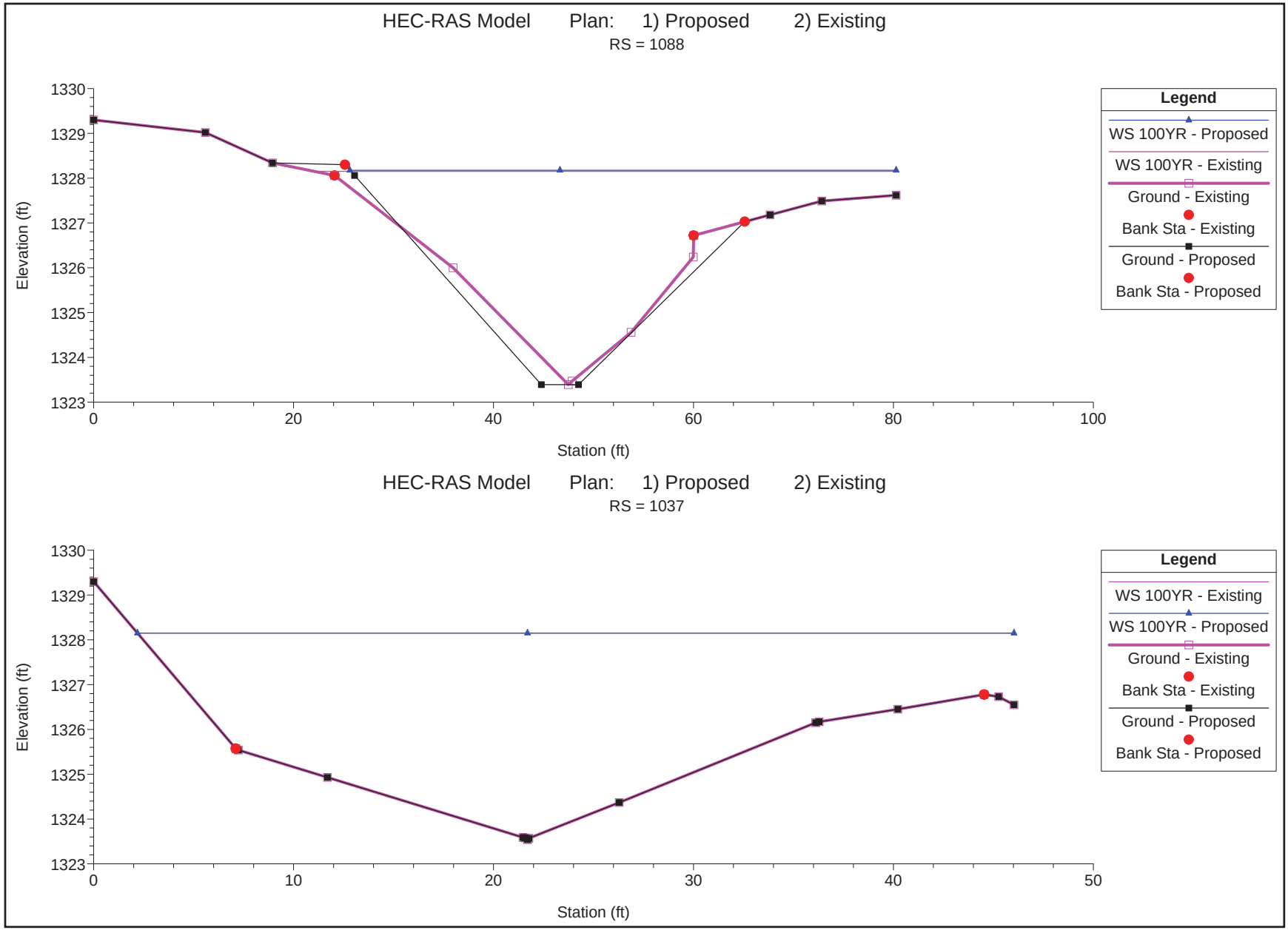

1000
1037
1088
1137
1185
1234
1283
1333
1378
Cherokee Wash
Cherokee Wash

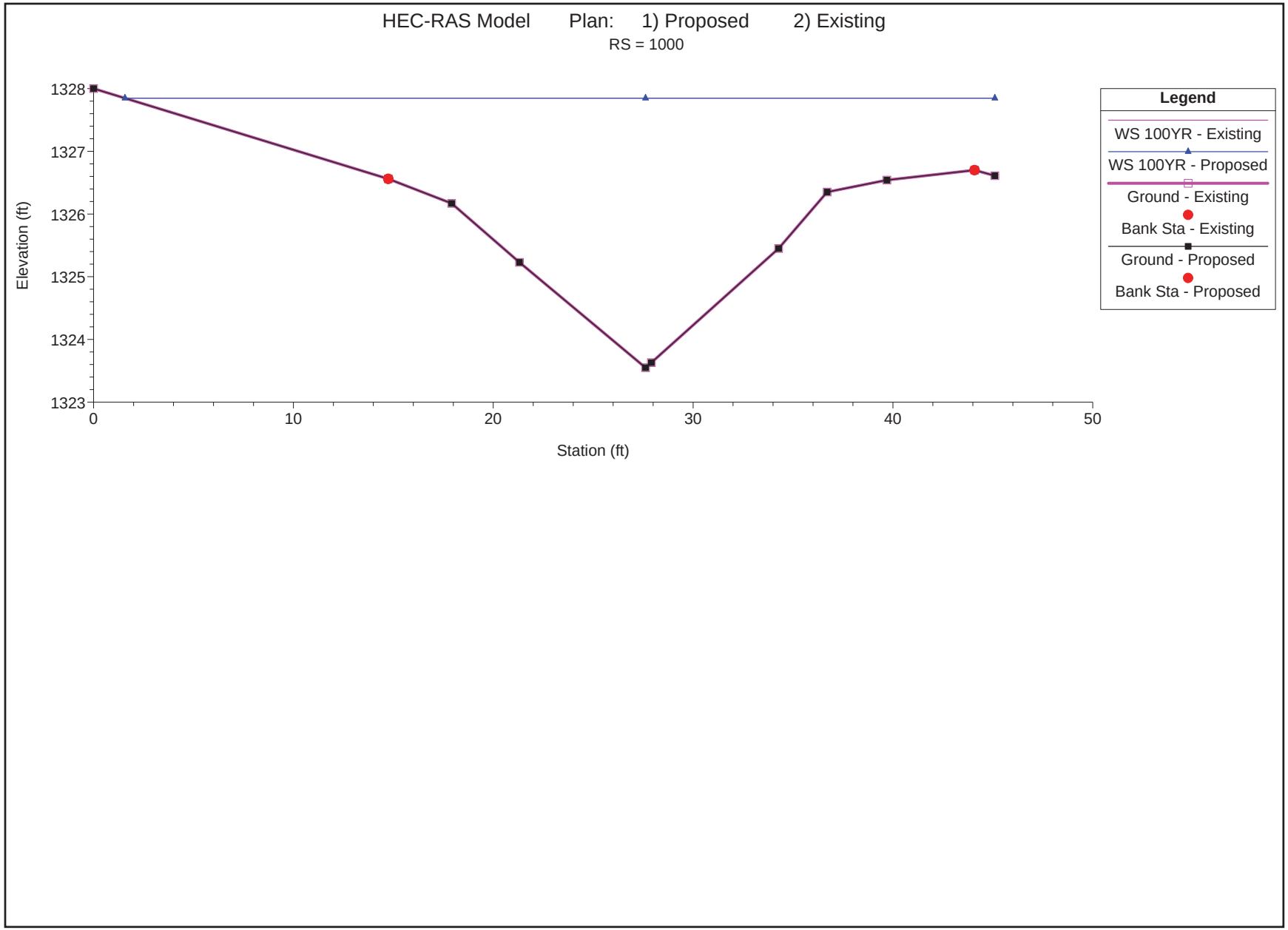

HEC-RAS Model Plan: Proposed_Updated 11/14/2019
Cherokee Wash Cherokee Wash
Legend
WS 100YR
Ground
LOB
ROB
Elevation (ft)
1329
1328
1327
1326
1325
1324
1323
1000
1037
1088
1137
1185
1234
1283
1333
1378
0
100
200
300
400
Main Channel Distance (ft)


HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1378
Elevation (ft)
Station (ft)
Legend
WS 100YR - Existing
WS 100YR - Proposed
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed
HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1333
Elevation (ft)
Station (ft)
Legend
WS 100YR - Proposed
WS 100YR - Existing
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed


HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1283
Elevation (ft)
Station (ft)
1329
1328
1327
1326
1325
1324
1323
0
10
20
30
40
50
60
70
Legend
WS 100YR - Proposed
WS 100YR - Existing
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed
HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1234
Elevation (ft)
Station (ft)
Legend
WS 100YR - Existing
WS 100YR - Proposed
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed


HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1185
Elevation (ft)
Station (ft)
1329
1328
1327
1326
1325
1324
1323
0
20
40
60
80
Legend
WS 100YR - Proposed
WS 100YR - Existing
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed
HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1137
Elevation (ft)
Station (ft)
1330
1329
1328
1327
1326
1325
1324
1323
0
10
20
30
40
50
60
70
Legend
WS 100YR - Existing
WS 100YR - Proposed
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed


HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1088
Elevation (ft)
1330
1329
1328
1327
1326
1325
1324
1323
0
20
40
60
80
100
Station (ft)
Legend
WS 100YR - Proposed
WS 100YR - Existing
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed
HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1037
Elevation (ft)
1330
1329
1328
1327
1326
1325
1324
1323
0
10
20
30
40
50
Station (ft)
Legend
WS 100YR - Existing
WS 100YR - Proposed
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed


HEC-RAS Model Plan: 1) Proposed 2) Existing
RS = 1000
Elevation (ft)
1328
1327
1326
1325
1324
1323
0
10
20
30
40
50
Station (ft)
Legend
WS 100YR - Existing
WS 100YR - Proposed
Ground - Existing
Bank Sta - Existing
Ground - Proposed
Bank Sta - Proposed

HEC-RAS Plan: Proposed River: Cherokee Wash Reach: Cherokee Wash Profile: 100YR

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Cherokee Wash	1378	100YR	378.00	1324.27	1328.29		1328.72	0.001643	5.25	76.52	44.18	0.55
Cherokee Wash	1333	100YR	378.00	1323.83	1328.34	1327.01	1328.58	0.001100	3.96	95.34	41.34	0.45
Cherokee Wash	1283	100YR	378.00	1323.61	1328.31		1328.54	0.001008	3.85	98.20	39.68	0.43
Cherokee Wash	1234	100YR	378.00	1323.55	1328.28		1328.49	0.000837	3.64	103.73	39.52	0.40
Cherokee Wash	1185	100YR	378.00	1323.53	1328.22		1328.44	0.000946	3.79	99.70	39.20	0.42
Cherokee Wash	1137	100YR	378.00	1323.62	1328.17		1328.40	0.001012	3.86	98.00	39.58	0.43
Cherokee Wash	1088	100YR	378.00	1323.39	1328.18		1328.34	0.000591	3.26	124.72	54.64	0.34
Cherokee Wash	1037	100YR	378.00	1323.54	1328.15		1328.31	0.000526	3.24	122.73	43.84	0.33
Cherokee Wash	1000	100YR	378.00	1323.55	1327.85	1327.20	1328.25	0.001901	5.18	80.08	43.53	0.59

PLATE 1

Drainage Map

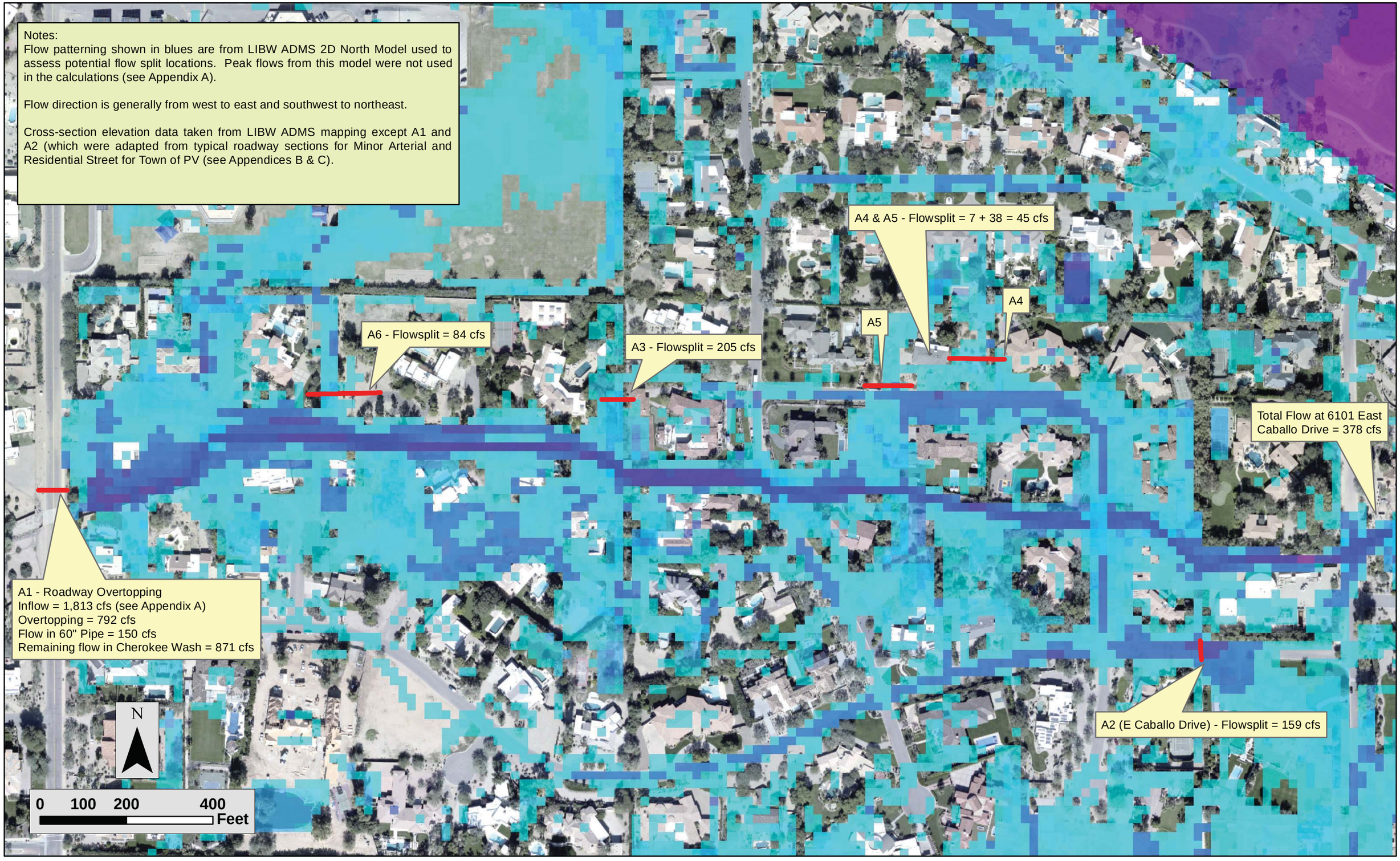


Plate 1 - Drainage Map

PLATE 2

HEC-RAS Map

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Plate 2	HEC-RAS MAP 6101 E CABALLO LANE PARADISE VALLEY, ARIZONA	NO.	REVISION	DATE

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CVL Project #: 1-01-03268801

PROJECT NO. 1-01-03268-01

DRAINAGE EASEMENT EXHIBIT

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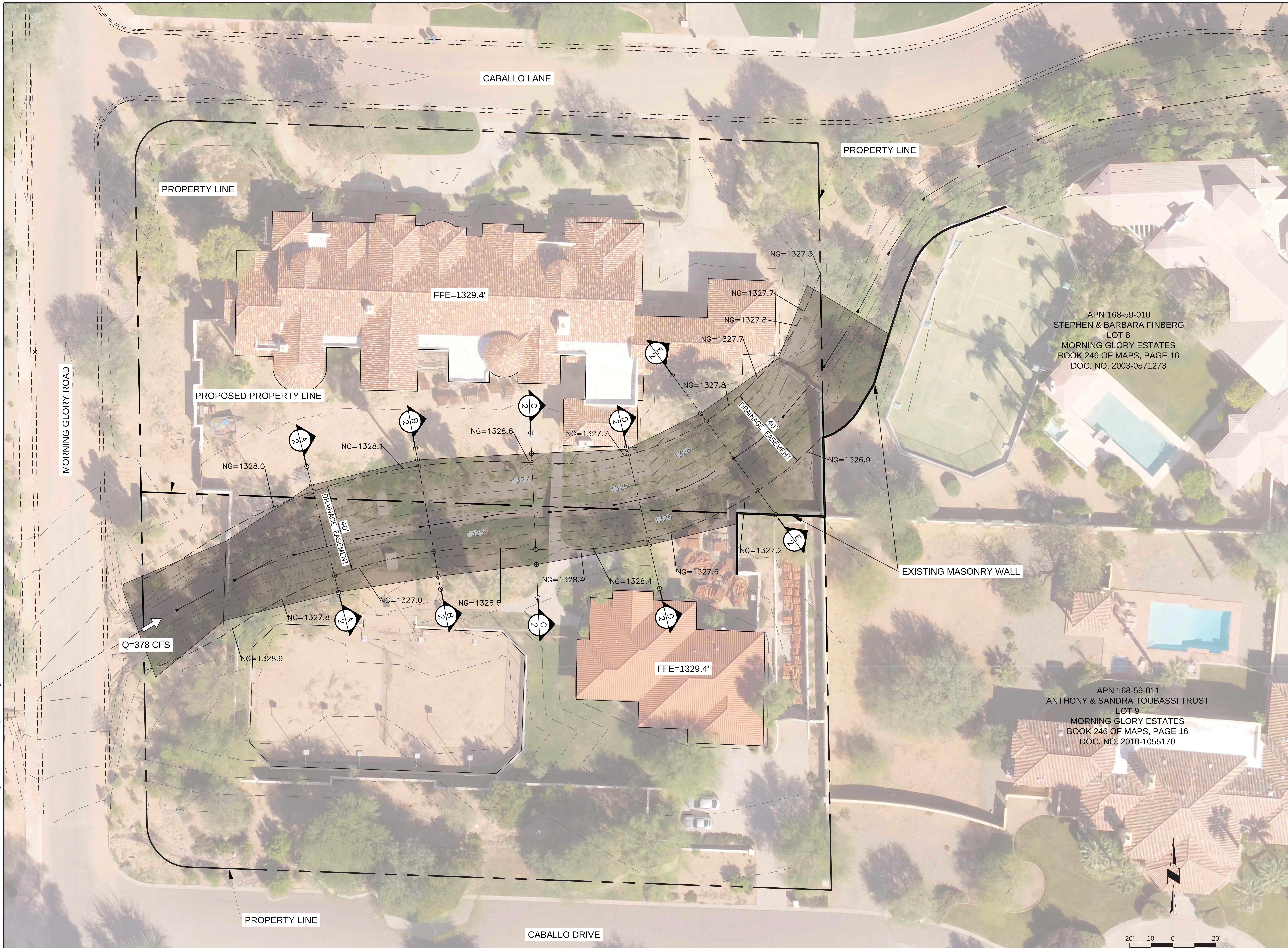

NOTE:
EXISTING WASH IS NOT A NATURAL WASH
PER TOWN'S STORM DRAINAGE DESIGN MANUAL.

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DRAINAGE EASEMENT EXHIBIT

EXISTING CONDITION - PLAN VIEW

SHEET 1 OF 3

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CVL Project #: 1-01-0326801

PROJECT NO. 1-01-03268-01

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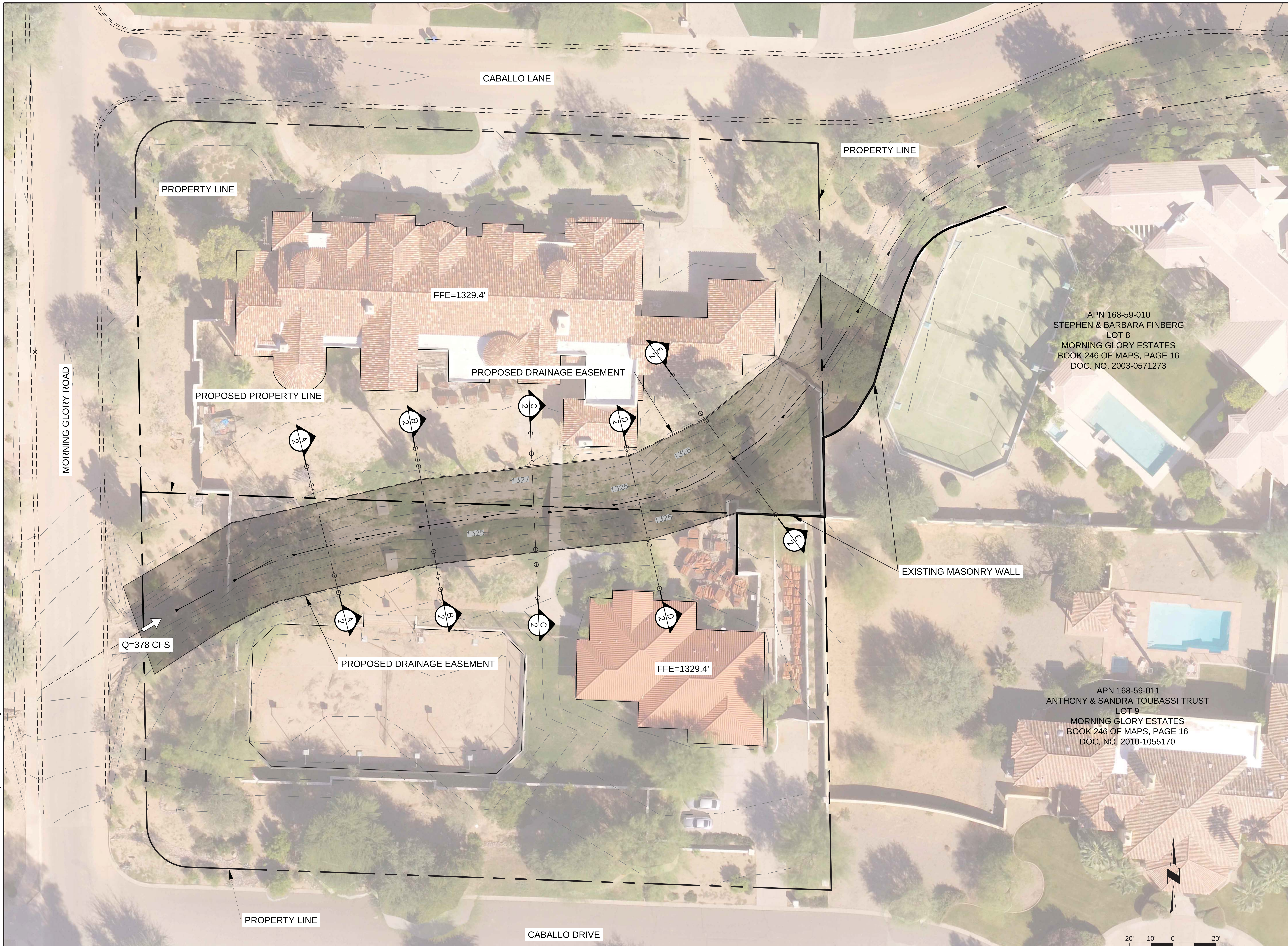
DRAINAGE EASEMENT EXHIBIT

PROPOSED CONDITION - PLAN VIEW



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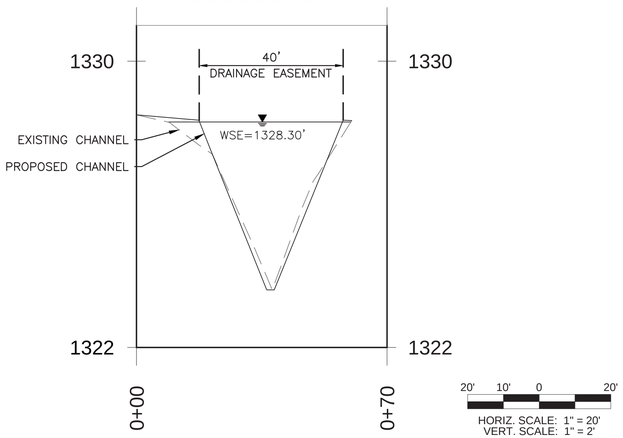
CROSS-SECTION A-A



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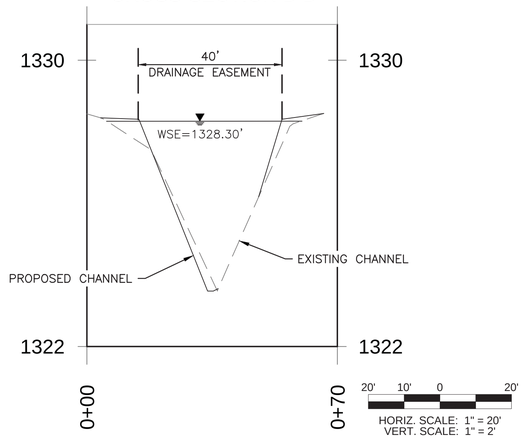

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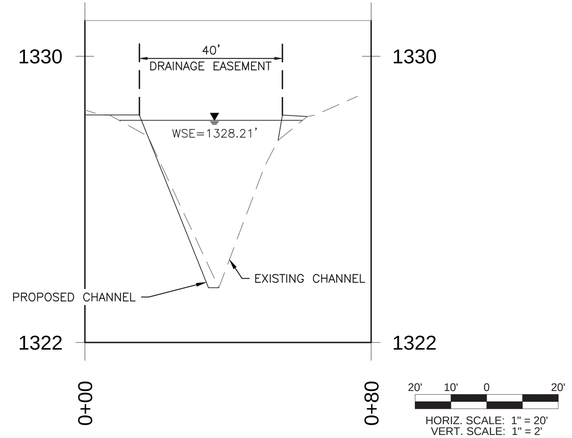

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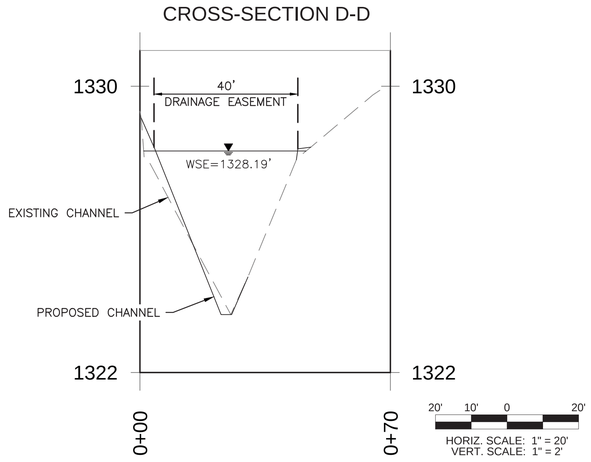

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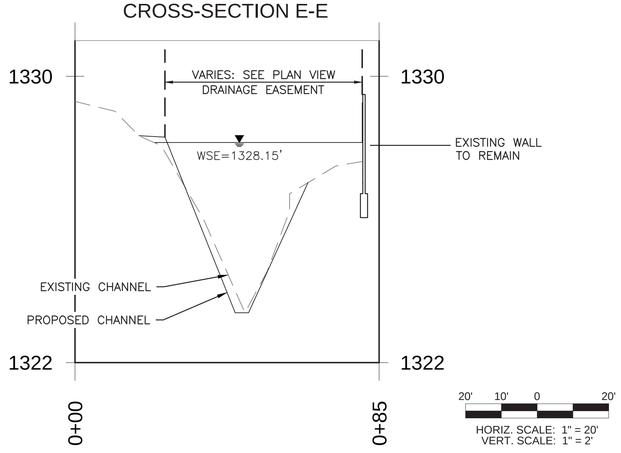

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DRAINAGE EASEMENT EXHIBIT

CROSS SECTION VIEW

SHEET 3 OF 3

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CVL Project #: 1-01-0326801

PROJECT NO. 1-01-03268-01

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