Preliminary Drainage Analysis

State Route 65 C&O Improvements

EA 03-1F1700
Project ID 0300001103

September 1, 2016

Prepared by:

MARK THOMAS & COMPANY, INC.
Providing Engineering, Surveying and Planning Services

This project report has been prepared under the direction of the following registered civil engineer. The registered civil engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

ANDREW TSENG-CHI LEE, REGISTERED CIVIL ENGINEER

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I. Caltrans Hydraulics Branch Unit Comment/Response Matrix

1. INTRODUCTION

A. Purpose

The purpose of this report is to identify drainage improvements needed to mitigate impacts from the proposed State Route (SR) 65 Widening project. This report documents the drainage design effort, defines the procedures, criteria, and methodology used in the analysis. This report serves as a scoping tool for the drainage improvements in the PA/ED phase.

B. Project Description

Caltrans in cooperation with Placer County Transportation Planning Agency (PCTPA), Placer County, and the Cities of Roseville, Rocklin, and Lincoln proposes to widen SR 65 north of Galleria Blvd/Stanford Ranch to Lincoln Blvd. In addition to the No Build Alternative, the project will consider two build alternatives, Carpool Lane and General Purpose Lane Alternatives.

The Carpool Lane Alternative proposes to add a 12-foot carpool/high occupancy vehicle (HOV) lane in the southbound direction of SR 65 in the median from north of Galleria Boulevard/Stanford Ranch Road interchange to Blue Oaks Boulevard interchange. A new carpool lane in the northbound direction of SR 65 from Galleria Boulevard/Stanford Ranch Road interchange to Blue Oaks Boulevard interchange will not be included in this project and is deferred to the future project when it will be included in the next MTP update. The carpool/HOV lanes would connect to the carpool/HOV lanes proposed from the I-80/SR 65 interchange project.

Other capacity improvements on SR 65 include adding one 12-foot general purpose lane in each direction of SR 65 from Galleria Boulevard interchange to Pleasant Grove Boulevard interchange and adding auxiliary lane in each direction of SR 65 from Galleria Boulevard interchange to Pleasant Grove Boulevard interchange, from Blue Oaks Boulevard interchange to Sunset Boulevard interchange, and from Placer Pkwy interchange to Twelve Bridges Drive.

Per recommendation from the VA study, this alternative will also include ramp metering modifications for the slip on-ramps to a 2+1 configuration (2 metered lanes plus 1 carpool preferential lane) and a 1+1 (1 metered lane plus 1 carpool preferential lane) for the loop on-ramps along SR 65 from Galleria Boulevard interchange to Lincoln Boulevard. Ramps to be modified include southbound Pleasant Grove Boulevard slip and loop on-ramps, Blue Oaks Boulevard slip and loop on-ramps, and Lincoln Boulevard slip on-ramp.

The General Purpose Lane Alternative proposes to add a 12-foot general purpose lane in southbound direction of SR 65 from north of Galleria Boulevard/Stanford Ranch Road interchange to Blue Oaks Boulevard interchange, and in northbound direction from Galleria Boulevard interchange to Pleasant Grove Boulevard interchange. For added capacity on southbound SR 65 as recommended by the VA study, this alternative also includes additional general purpose lane from Galleria Boulevard interchange to Pleasant Grove Boulevard interchange.

The alternative also include extending/adding auxiliary lanes and modifying slip and loop on-ramps for ramp metering as described in the Carpool Lane Alternative.

Both build alternatives will allow inside widening as future projects along SR 65 from north of Blue Oaks Boulevard interchange to Lincoln Blvd and will accommodate the I-80/SR 65 project and will take into consideration the carpool/HOV lane restrictions and weaving volumes from the carpool/HOV lanes proposed by the I-80/SR 65 project.

B1. Related Projects

Related projects in the project area that require coordination with this project include:

I-80/SR 65 Interchange Improvements Project - The proposed project consists of various modifications to I-80, SR 65, and the interchange at their junction. This project will terminate north of Galleria Boulevard/Stanford Ranch Road Interchange on SR 65 tying into the southern limits of SR 65 Widening project. The proposed improvements include adding a HOV direct connector in each direction between I-80 and SR 65, replacing eastbound I-80 to northbound SR 65 loop connector with a flyover connector, widening the East Roseville Viaduct, replacing the Taylor Road overcrossing, and widening southbound SR 65 to westbound I-80 and westbound I-80 to northbound SR 65 connectors with associated auxiliary lanes and ramp realignments. The interchange project will be constructed in phases and the coordination with SR65 Widening in 2020 construction year is required.

Whitney Ranch Parkway Interim Phase Project - The project is located in the City of Rocklin and Placer County along SR 65 between Sunset Boulevard and Twelve Bridges Drive. The project will provide direct connection to Whitney Ranch Parkway from SR 65 to serve the communities of Rocklin and western Placer County. The interim phase will construct the SR 65/Whitney Ranch Parkway interchange that includes a three-lane SR 65 overcrossing, two-lane connection to Whitney Ranch Parkway/University Avenue intersection, northbound on and off-ramps, and a southbound loop on-ramp. Additional improvements along SR 65 include auxiliary lane south of interchange to conform to the auxiliary lanes constructed with the SR 65/Sunset Boulevard interchange and provisions for ramp metering and an HOV preferential lane for each on-ramp. The construction contract of this project has recently been awarded. The project is estimated to be constructed by 2016.

Placer Parkway Phase I Project - The project is the Phase I of the Placer Parkway improvements that proposed to extend freeway access at SR 65 with the construction of a new roadway connection west to Foothills Boulevard North. The Phase I project will modify the Whitney Ranch Interchange into an L-9 partial cloverleaf interchange by adding a diagonal southbound off-ramp and on-ramp as well as an eastbound Placer Parkway to northbound SR 65 loop on-ramp. The project will also widen the existing overcrossing at SR 65 from three-lane structure to a six lane facility and extend Placer Parkway into a four lane facility. Ultimately, Placer Parkway improvement would construct a new transportation facility connecting SR 65 in the Lincoln/Roseville/Rocklin area to SR 99 in Sutter County.

C. Drainage Impacts

Several features of the SR 65 Widening project will have impacts to the existing drainage facilities, and these include:

- Inside widening between Galleria Blvd/Stanford Ranch Rd IC to Blue Oaks Blvd IC will remove and modify existing drainage systems in the median of SR 65. The median paving will create crown in the center of highway and redirect runoff from the new impervious surface at the median and sheet flow across pavement.
- Outside widening between Galleria Blvd/Stanford Ranch Rd IC to Blue Oaks Blvd IC will replace/reconnect existing AC gutters and ditches along the southbound and northbound of SR 65. Several cross culverts along SR 65 will be extended due to widening.

2. WATERSHED CHARACTERISTICS

A. Topography/Existing Drainage Patterns

The general topography of the land is gradually sloping grasslands. The existing drainage systems consist of cross culverts, bridge crossing over Pleasant Grove Creek, ditches both earthen and concrete / asphalt lined ditches, and roadway drainage systems with pipes and inlets. Within Caltrans right-of-way limits, two main watersheds were identified. The first watershed, which begins at Galleria Blvd/ Stanford Ranch Rd and extends north to Sunset Blvd interchange, drains towards Pleasant Grove Creek. The second watershed covers from north of Pleasant Grove Creek to the project limits at Lincoln Blvd and drains toward Orchard Creek. The existing watershed map can be found in **Appendix C**.

The conditions of existing cross culverts are unknown. Culvert inspection will be performed during PS&E phase of the project for improvement needs.

The drainage patterns will be maintained. Throughout the corridor, the runoff sheet flows across pavement and down to the toe ditch/gutter on both sides of the highway and is carried into cross culverts and ultimately discharging to either one of the creek crossings. Runoff within the median is collected through drop inlets, transported through a series of culverts, and discharged to the cross culverts on both sides of the highway.

Within median between Galleria Blvd/Stanford Ranch Rd IC to Blue Oaks Blvd IC, drainage runoff path will change slightly in conjunction with the proposed paving in the median and the construction of concrete barrier.

There are no proposed improvements outside of Caltrans right-of-way and the flow pattern of upstream off-site drainage areas flowing through cross culverts would be maintained. Impacts to downstream drainage systems are minimal and the volumetric impacts due to the increased runoff will need to be mitigated on-site or by local agencies through the proposed detention/infiltration facilities to reduce impacts to eastern Sutter County. The mitigations will be addressed in the Final Drainage Report.

B. Land Use

General plans from Cities of Roseville, Rocklin, Lincoln, and Placer County were reviewed to determine that the existing land use adjacent to the project site consists of a mixture of industrial and commercial parks, community commercial, and business professional and agricultural open space. No increase in runoff is anticipated from future revisions to land use since governing agencies are required to ensure no net increase in runoff to the State highway without receiving and Encroachment Permit from Caltrans that identifies all necessary mitigations required, along with a new/revised Cooperative Agreement.

C. Soil Type and Vegetation

Soils information for this project has been obtained from the US Department of Agriculture, Natural Resource Conservation Service. All the soils within the project area are hydrological Group D soils that have the highest runoff potential, very low infiltration rates when thoroughly wetted, and may be subject to erosion by water. The project surfaces will be a combination of pavement and shallow to medium grade gassy surfaces.

D. Creek Crossings

There are two major waterbodies that cross SR 65 within the project limits. Orchard Creek is the receiving water body that contributes from watershed areas in the northern portion (0.5 miles south of Placer Parkway to Lincoln Blvd). Orchard Creek and its tributaries cross SR65 through several cross culverts. Orchard Creek is a tributary to Auburn Ravine which ultimately discharges to the Sacramento River via the Natomas North Canal and the Natomas Cross Canal.

The other waterbody, Pleasant Grove Creek, is the receiving water body for the southern portion of the project (Galleria Blvd to 0.5 miles south of Placer Parkway). Pleasant Grove Creek crosses SR65 under Pleasant Grove Creek Bridges and discharges to the Sacramento River via the Pleasant Grove Canal and the Natomas Cross Canal.

The creek and its tributary crossings along with the cross culverts are shown on the water shed maps included in the **Appendix C**.

Pleasant Grove Creek is a 303(d) listed impaired water body and is listed in the TMDL downstream of the project limits. Pollutants of concern are oxygen dissolved, pyrethroids, and sediment toxicity.

The project crosses FEMA defined 100-year floodplain for:

- Pleasant Grove Creek Tributary 1
- Pleasant Grove Creek
- Orchard Creek Tributary 2
- Orchard Creek Tributary 2-1
- Orchard Creek North Branch

- Orchard Creek

FEMA floodplain maps were overlain on the Watershed Maps and can be found in **Appendix C**. The FEMA FIRMS shows the 100-year floodplain for the creeks above reaching upstream of SR 65 crossing. It is designated as Zone AE. Zone AE is described as the flood insurance rate zone that corresponds to 1-percent annual chance floodplain that was determined in the Flood Insurance Study by detailed methods.

3. HYDROLOGY

The hydrology for the SR 65 Widening project is based on the procedures presented in the current edition of the *Highway Design Manual (HDM),* California Department of Transportation and materials referenced in that document. Peak flows were calculated using the Rational Method as described in Section 819.2(1) of HDM.

A. Rainfall Data and Intensity

The project corridor spans for approximately 6.5 miles and the rainfall data were obtained from the Precipitation Frequency Data Server on National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 6, Version 2 for the centroid of each tributary. These values are provided in **Appendix D** and are summarized below:

Sub-Watershed	Latitude	Longitude	25 years Interval (5-min)
A	38.7777º	-121.2663º	2.81
B	38.7821º	-121.2752º	2.81
C	38.7868º	-121.2846º	2.82
D	38.7960º	-121.2976º	2.86

The centroid location that produced the highest intensity (Sub-Watershed area D as listed above) was used for the analysis of the entire corridor.

Intensity-Duration-Frequency (IDF) equations were calculated based on the FHA method, using the Hydraflow Express Extensions software for AutoCad Civil 3D.

For 25 year interval, $I_{25} = 7.8662 / (Tc + 1.1000)\wedge^{0.5620}$

For 100 year interval, $I_{100} = 10.5549 / (Tc + 1.2000)\wedge^{0.5633}$

IDF Tables, IDF Curve Coefficients and IDF Output Curves are included in the **Appendix D**.

B. Cross Drain Hydrology

The project is designed to direct runoff from watershed areas into the same, existing discharge points. By using this approach, the project minimizes the impact to the hydrology of the cross drain facilities. The project is proposed to maintain the existing water shed boundaries and only alter the boundaries where necessary during the final design. Any variation to the project during the final design that would increase the peak flow to the existing outfalls, the peak discharge would be mitigated onsite or concurrence from the downstream regulatory agencies will need to be obtained.

Referencing the Caltrans District 3 Hydraulic Preliminary Culvert Inventory, the table below (Table 1) includes existing cross drain facilities within the project limits. The Table 1 will be updated after a field investigation is completed during the Design phase. In this preliminary drainage report, the condition and quantity of existing culverts were not evaluated. The need for repair or rehabilitation will be determined in the design phase after each has been field verified.

Encroachments on existing FEMA Floodplains have been evaluated and the hydrologic and hydraulic analysis of the culverts involved demonstrated that they are capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway. The detailed analysis including Location Hydraulic Studies (LHS) can be founded in **Appendix H**. The capacity of the remaining culverts will be modeled and analyzed during the design phase.

Table 1: Existing Cross Drain Facilities

PM	Size	Type	Remarks
6.28	30	CMP	DI in median. LHS in Appendix H
6.71	72	RCP	“A5” STA 199+23 Double 72” RCP, DI in median. LHS in Appendix H
7.35	18	CMP	Crosses SB lane only, DI in median
7.65	7x6	RCB	Double 7x6 RCB. LHS in Appendix H
7.83	42	CMP	
8.03	48	CMP	FES inlet on SB side
8.21	18	CMP	Crosses SB lane only, DI in median
8.30	30	CMP	
8.42	18	CMP	Crosses NB lane only, DI in median
8.58	10x5	Bridge	“A5” STA 297+56 Double 10x5 RCB (Little Pleasant Grove Creek Bridge No. 19-0137. LHS in Appendix H
8.77		Bridge	Pleasant Grove Creek Bridge No. 19-0136. LHS in Appendix H
9.37	24	PVC	Crosses NB lane only, DI in median

PM	Size	Type	Remarks
9.44	24	RCP	Double 24” RCP
9.57	24	PVC	
9.79	18	PVC	Crosses NB lane only, DI in median
9.88	7x5	RCB	LHS in Appendix H
10.71	6x5	RCB	Double 6x5 RCB. LHS in Appendix H
11.40	7x5	RCB	LHS in Appendix H
11.66	10x5	Bridge	“A2” 597+30 Triple 10x5 RCB (Orchard Creek Bridge No. 19-0138). LHS in Appendix H
12.28	10x5	Bridge	Triple 10x5 RCB (Orchard Creek Bridge No. 19-0138). LHS in Appendix H
12.54	6x5	RCB	
12.55	72	CMP	
12.72	6X6	RCB	Double

The cross culverts located at “A5” STA 199+23.15 (double 72” RCP) and at “A5” 297+55.96 (10’ x 5’ RCB) will be extended on both sides of SR 65 (southbound and northbound) to accommodate the outside widening.

The bridge located at “A3” 597+30 (Orchard Creek Bridge No. 19-0138) will be extended on both sides of SR 65 (southbound and northbound) to accommodate the outside widening. The bridge is located within the limits of the Orchard Creek watershed.

Because of the extent of this project, off-site drainage and objectionable backwater studies will be performed during the final design phase. This report will be focusing on the onsite roadway drainage from the proposed highway widening. However, at each of the cross drainage inlets and outlets, analysis at the inlets and outlets of each cross culvert will be conducted (see Table 2) to compare the increased runoff from the proposed project with runoff of existing condition at those junctions. At each junction, the recurrence intervals used are 100-year. The cross drain watersheds will be further sub-divided, as necessary for each drainage structure/inlet within a cross drain watershed as long as the off-site runoff will be studied during the final design phase.

Table 2: Onsite Runoff Summary at the Cross Drain

Node	Location	Existing Conditions		Proposed Conditions	
		Area (Acres)	Q_{100} (cfs)	Area (Acres)	Q_{100} (cfs)
A1	“A5”168+27 NB	14.64	12.40	14.64	13.88
A2	“A5”168+27 SB	5.55	6.51	5.55	7.64
A3	"A5" 169+06 NB	4.31	4.89	4.31	6.39
B1	“A5” 199+23 NB	10.05	12.61	10.05	15.82

Node	Location	Existing Conditions		Proposed Conditions	
		Area (Acres)	Q_{100} (cfs)	Area (Acres)	Q_{100} (cfs)
B2	“A5” 199+23 SB	25.54	27.31	25.54	33.12
C1	“A5” 248+06 SB	23.45	30.94	23.45	34.78
C2	“A5” 248+06 NB	55.90	59.90	55.90	64.17
D1	"A5" 256+63 SB	0.95	1.50	0.95	1.35
D2	"B4" 264+93 SB	4.63	6.48	4.63	6.70
D3	"A5" 279+37 NB	2.44	4.18	2.44	5.31
E1	“A3” 445+50 NB	10.54	15.00	10.54	14.50
E2	“A3” 445+00 SB	25.98	14.99	25.98	15.87
E3	“A3”476+86 SB	10.72	16.92	10.72	15.89
E4	“A3”477+49 NB	32.65	29.84	32.65	38.18
H1	“A3” 584+55 NB	6.83	7.65	6.83	7.25
H2	“A3” 584+55 SB	15.40	10.32	15.40	10.58
J1	“A3” 630+65 NB	27.65	11.28	27.65	11.28
J2	“A3” 630+00 SB	44.39	20.32	44.39	19.70

4. ONSITE ROADWAY DRAINAGE

The analysis performed for this report includes the roadway improvements proposed along the SR 65 corridor from Stanford Ranch Rd Interchange to Lincoln Blvd. As discussed above, the Placer Parkway Phase I project is being studied as separate project and will be considered as existing condition and not part of the proposed improvements.

A. Shed Maps

Each of the drainage basins is divided into smaller color coded areas to distinguish impervious and pervious areas. To facilitate the run-off calculations, these coded areas are assigned with unique area numbers. Drainage gutters and ditches are also shown in the watershed map. The existing and proposed watershed maps for both alternatives (General Purpose Lane and Carpool Lane) can be found in **Appendix C**.

B. Recurrence Intervals

The recurrence interval of 25-year is used for roadway drainage inlets, and water spread calculation along the whole corridor. Bridges analysis will be based on the 100-year event without freeboard, or 50-year event with freeboard. Existing culverts will be analyzed on 100-year without causing the headwater to rise causing objectionable backwater depths or outlet velocities. When new culverts are proposed, they will be sized without causing the headwater elevation to rise above the inlet top of the culvert for the 10-year interval and also on 100-year flow without objectionable backwater depths.

C. Runoff Coefficient

The runoff coefficient (C value in the hydrology calculations) of 0.95 for paved areas and 0.38-0.44 for undeveloped areas, depending on the relief, soil infiltration, vegetal coverage and surface storage characteristics, as shown in Caltrans HDM, Figure 819.2A Runoff Coefficients for Undeveloped Areas. Per HDM section 819.2(1), modification to runoff coefficient is made for less frequent, higher intensity storms by multiplying the runoff coefficient by a frequency factor, C(f). The following values of C(f) given below is applied for 25 and 100 year storm events. Under no circumstances, may the product of C(f) times C exceed 1.0.

Frequency (years)	C(f)
25	1.1
100	1.25

D. Time of Concentration

The time of concentration for each drainage area is analyzed in accordance with HDM section 816.6. The minimum time of concentration used in the design is 5 minutes for paved and unpaved areas. For each point of concentration, the time of concentration is calculated from the path of the longer route. The longest route for each point of concentration is included in the Shed Maps (**Appendix C**)

E. Points of Concentration

The points of concentration have been identified at the cross culvert inlets and outlets, pavement and open channel low points, and superelevation reversal points. The points of concentration have been shown in the water shed and have been given a node designation. Drainage inlet will be proposed at the points of concentration where no inlet/outlet of cross culvert exists. System of drainage pipes will be laid out to carry and discharge the runoff. Points of concentration may also occur at gore paving; however for this preliminary report these locations were not verified. A field review after consulting with Caltrans maintenance Engineer is recommended for verifying potential points of concentration during final design.

F. Runoff Calculations

Existing and proposed drainage systems were developed using the rational method presented in the HDM. The following is a description of equations used for the calculation of the design discharge.

$Q = CiA$ *, where Q = Design discharge in cubic feet per second*
, where C = Coefficient of runoff
, where i = average rainfall intensity in inches per hour and for a duration equal to be the time of concentration
, where A = drainage area in acres

For areas were design discharge contain varying amounts of different cover, a weighted runoff coefficient for the entire basin can be determined as:

$$C = \frac{\mathrm{C}_1 A_1 + C_2 A_2 + \cdots}{\mathrm{A}_1 + A_2 + \cdots}$$

G. Gutter Spread and Capacity Calculations

The majority of roadway runoff sheet-flows off the roadway surface unconstrained. There are segments along the corridor where dike placement, HMA roadway gutter, and cut slope behind, or the superelevated roadway draining toward the proposed concrete barrier in the paved median at Blue Oaks Blvd Interchange cause the shoulder to double as gutter. The gutter spread calculations determined that the inside shoulder along the superelevated roadway on SB SR65 between Pleasant Grove Boulevard and Blue Oaks Boulevard is under capacity and series of drainage inlets and pipe systems will need to be proposed. The detailed analysis of gutter capacity are included in the Hydraflow calculations (see **Appendix E**).

5. OPEN CHANNELS

Existing conditions along the corridor show asphalt concrete gutters and earth ditches on both sides of SR 65 to convey onsite runoff to the cross culverts and eventually discharge to Pleasant Grove Creek or Orchard Creek. Proposed widening on both sides of SR 65 will require some of the asphalt concrete gutters or ditches to be reconstructed. Most of toe ditches are V-shaped with 2:1 or flatter side slopes. The need of trapezoidal shaped swales in place of V-shaped will be evaluated for water quality where applicable. The capacity calculations of open channels are in **Appendix F**.

6. STORM WATER QUALITY

The State requires that an area totaling the increase in impervious area be treated to the maximum extent practicable. The project will result in an increase of an impervious area of approximately 70 acres. The storm water quality guidance for the SR 65 Widening project is based on stormwater pollution prevention procedures developed by Caltrans.

A. Permanent Treatment BMPs

Permanent water quality measures were identified and possible storm water quality options are available throughout the corridor of SR 65. The proposed improvements allow some room for biofiltration swale options in lieu of V-shaped ditches. A separate Storm Water Data Report has been prepared and the potential permanent treatment BMPs included biofiltration strips and biofiltration swales.

B. Temporary Construction Site BMPs

During construction phase of the project, strategies to minimize erosion and control amount of sediment into storm water runoff will be included in the Storm Water Pollution Prevention Plan. Contractor will be required to implement the appropriate construction site BMPs.

7. CALTRANS DISTRICT 3 HYDROLOGIC/HYDRAULIC REVIEW

Caltrans District 3 Hydrology/Hydraulic Units has provided comments regarding the Preliminary Drainage Report (PDR) during the review period. The Design Team (Mark Thomas & Company and Placer County Transportation Planning Agency) has requested to defer addressing certain comments/tasks that might alter the scope of work until the Design phase of the project. Accepting the associated risk, the Design Team believes that the project description/scope of work included in the Environmental Document is sufficient to cover any revisions that may be required after a field investigation is conducted of the existing hydraulic facilities within the project limits. Any additional work that may be necessary would not alter the Environmental Study Limits nor the scope or extent of the permits covered in the Environmental Document.

Caltrans District 3 Hydraulics agreed to allow comments 1-8, 10-13, 14 (excluding the comment to note the Culvert Inventory was Preliminary), 16, and 18-29 to be addressed during the Design phase based on the statements provided by the Design Team. The Design Team has incorporated comments 9, 14 (only the portion of comment dealing with the Preliminary Culvert Inventory), 15, and 17. The Design Team also chose to address comment 10.

The intent of the PDR is to identify the scope of work at an early stage to ensure adequate funding; the Environmental Document will cover the scope of work and identify all necessary studies/permits for the project and note the required policies and procedure to be addressed or followed during the Design phase. The review comments address the intent of the PDR.

A copy of the review comments along with e-mail regarding the PDR comments that need to be addressed in the PDR and those that could wait until the Final Drainage Report are attached in the **Appendix I**.

8. REFERENCES

California Department of Transportation (HDM) 6th Edition

California Department of Transportation (2003) Storm Water Quality Handbooks

Federal Emergency Management Agency Flood Insurance Rate Map

National Oceanic and Atmospheric Administration, National Weather Services. NOAA ATLAS 6, Version 2.

Placer County General Plan (Updated 2013)

City of Roseville General Plan (Updated 2013)

City of Rocklin General Plan (Updated 2012)

City of Lincoln General Plan (Adopted 2008)

I-80/SR 65 Interchange Drainage Impact Summary Report (2015) by WRECO

Placer Parkway Phase I Draft Drainage Report (2015) by Civil Solutions

SR65 Widening Blue Oaks IC to Industrial Ave Roadway Drainage Report (1998) by Mark Thomas & Co.

Hydrology Report for Pleasant Grove Creek Bridge (1997) by Mark Thomas & Co

California Department of Transportation (1971). *In Placer County between 0.3 mile north of Andora Underpass in Roseville and First Street in Lincoln, Contract Number: 03-078934*.

California Department of Transportation (1986), *In Placer County in and near Roseville from 1.2 miles north of Taylor Rd to Pleasant Grove Creek Bridge, Contract Number: 03-242934.*

California Department of Transportation (1999), *In Placer County in and near Lincoln from 0.2 mile north of Blue Oaks Interchange to 0.2 mile north of Industrial Ave intersection, Contract Number: 03-4475U4*

California Department of Transportation (2001), *In Placer County in Rocklinand Roseville from 0.5 km south to 0.7 km north of the Blue Oaks Blvd off-ramp overcrossing, Contract Number: 03-369004.*

APPENDIX A

Geometric Approval Drawings (GADs)

- General Purpose Alternative
- Carpool Lane Alternative

STATE ROUTE 65 WIDENING
PRELIMINARY GEOMETRICS
GENERAL PURPOSE LANE ALTERNATIVE

03-PLA-65 EA 03-1F1700 PM 6.5/12.8

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DRAWN BY AMM
CKD. BY AL
DATE 10/30/15
SCALE 1"=200'

APPROVED ON ____
BY ____
RCE NO. ____

JOB NO. SA-13143
FILE NO.

SHEET NO. 1 OF 2

STATE ROUTE 65 WIDENING
PRELIMINARY GEOMETRICS
GENERAL PURPOSE LANE ALTERNATIVE

03-PLA-65　EA 03-1F1700　PM 6.5/12.8

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PLEASANT GROVE CREEK BRIDGE
"A3" LINE
BR. NO. 19-0136L/R

ROUTE 65
"A3" LINE
BETWEEN BLUE OAKS BLVD TO LINCOLN BLVD

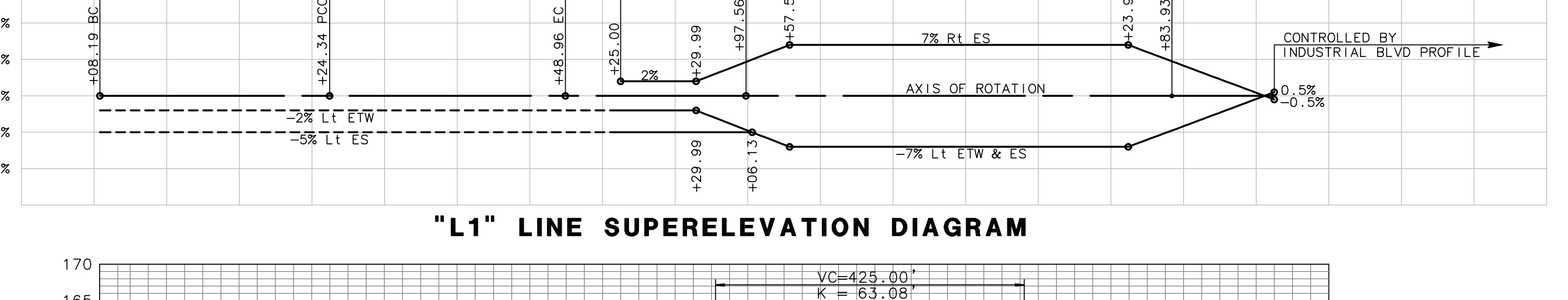
SOUTHBOUND SLIP ON-RAMP
"L1" LINE
(LOOKING IN DIRECTION OF TRAVEL)

CURVE DATA

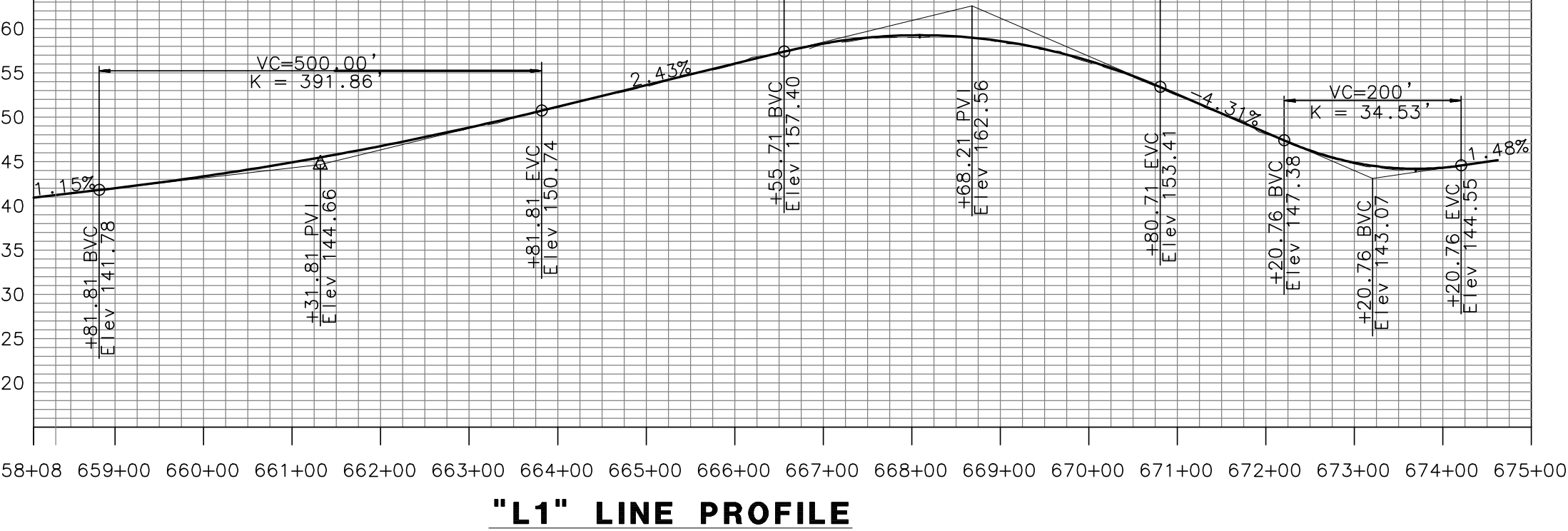
No. ⊛	R	Δ	T	L
C1	6499.48'	57°59'29"	3602.09'	6578.39'
C2	5825.28'	18°02'09"	221.41'	433.20'
C3	1100.00'	51°48'42"	534.27'	994.71'
C4	175.00'	237°39'30"	317.94'	725.89'
C5	6000.00'	01°08'00"	59.34'	118.68'
C6	3000.00'	06°00'08"	157.28'	314.28'
C7	3000.00'	03°11'29"	83.57'	167.10'
C8	825.00'	76°38'47"	652.09'	1103.63'
C9	3000.00'	03°11'29"	83.57'	167.10'
C10	168.00'	175°39'50"	4437.64'	515.07'
C11	522.39'	31°18'54"	146.42'	285.51'
C12	1000.00'	27°52'23"	248.15'	496.48'
C13	1050.00'	27°16'17"	254.72'	499.78'
C14	525.46'	31°59'34"	150.64'	293.40'
C15	174.00'	170°46'08"	2155.32'	518.60'
C16	3000.00'	08°05'07"	212.02'	423.34'
C17	6336.00'	02°42'46"	150.03'	300.00'
C18	3000.00'	03°11'29"	83.57'	167.10'
C19	1600.00'	44°39'39"	657.20'	1247.17'
C20	230.00'	149°37'03"	847.06'	600.60'
C21	3000.00'	03°11'29"	83.57'	167.10'
C22	6546.68'	02°37'35"	150.08'	300.10'
C23	147.00'	84°20'02"	133.14'	216.37'
C24	159.00'	161°09'09"	957.98'	447.21'
C25	300.00'	04°56'19"	129.37'	258.58'
C26	1525.49'	19°21'36"	260.23'	515.49'
C27	1525.53'	16°46'04"	224.83'	446.45'
C28	4999.99'	03°43'21"	1884.32'	3604.04'
C29	4932.26'	03°40'21"	158.13'	316.15'
C30	3000.00'	06°12'00"	162.47'	324.63'
C31	800.00'	41°59'46"	307.06'	586.38'

LINE DATA

No. ⊛	BEARING	DISTANCE
L1	N 57°56'07" W	9605.64'
L2	N 53°34'41" W	332.58'
L3	N 57°56'07" W	450.33'
L4	N 59°04'07" W	812.51'
L5	N 53°03'59" W	341.74'
L6	N 59°04'52" W	300.06'
L7	N 62°16'21" W	481.04'
L8	S 41°04'52" W	151.33'
L9	N 59°04'52" W	300.06'
L10	N 62°16'21" W	209.65'
L11	S 57°56'11" E	266.31'
L12	S 56°53'30" E	189.51'
L13	N 25°11'36" W	273.13'
L14	S 53°03'59" E	277.39'
L15	N 53°11'06" W	285.98'
L16	N 25°54'49" W	296.60'
L17	N 57°48'46" W	184.44'
L18	S 57°56'07" E	225.80'
L19	N 59°04'52" W	300.06'
L20	N 32°03'49" E	2466.59'
L21	N 45°20'18" W	452.14'
L22	N 89°59'57" W	94.69'
L23	S 00°03'28" W	735.01'
L24	N 30°19'28" W	194.31'
L25	N 78°22'57" E	137.46'
L26	S 17°17'00" E	180.26'
L27	N 29°51'38" W	299.97'
L28	N 73°14'01" E	671.17'
L29	N 30°19'28" W	194.31'
L30	N 00°03'22" E	6885.51'
L31	N 00°03'29" E	12511.56'
L32	N 15°29'07" W	248.59'
L33	N 57°28'53" W	248.59'



"L1" LINE SUPERELEVATION DIAGRAM



"L1" LINE PROFILE
SCALE H = 1":200'
V = 1":20'

STATE ROUTE 65 WIDENING
PRELIMINARY GEOMETRICS
CARPOOL LANE ALTERNATIVE

03-PLA-65 EA 03-1F1700 PM 6.5/12.8

MARK THOMAS & COMPANY
7300 FOLSOM BOULEVARD, SUITE 203
SACRAMENTO, CALIFORNIA 95826
(916) 381-9100 FAX:(916)381-9180

DRAWN BY AMM	APPROVED ON		JOB NO. SA-13143	SHEET NO. 1 OF 2
CKD. BY AL	BY		FILE NO.	
DATE 10/30/15	RCE NO.			
SCALE 1"=200'				

STATE ROUTE 65 WIDENING
PRELIMINARY GEOMETRICS
CARPOOL LANE ALTERNATIVE

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DRAWN BY AMM
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DATE 10/30/15
SCALE 1"=200'
APPROVED ON
BY
RCE NO.
JOB NO. SA-13143
FILE NO.
SHEET NO. 2 OF 2

PLEASANT GROVE CREEK BRIDGE
"A3" LINE
BR. NO. 19-0136L/R

ROUTE 65
"A3" LINE
BETWEEN BLUE OAKS BLVD TO LINCOLN BLVD

SOUTHBOUND SLIP ON-RAMP
"L1" LINE
(LOOKING IN DIRECTION OF TRAVEL)

CURVE DATA

No. ⊕	R	Δ	T	L
C1	6499.48'	57°59'29"	3602.09'	6578.39'
C2	5825.28'	18°02'09"	221.41'	433.20'
C3	1100.00'	51°48'42"	534.27'	994.71'
C4	175.00'	237°39'30"	317.94'	725.89'
C5	6000.00'	01°08'00"	59.34'	118.68'
C6	3000.00'	06°00'08"	157.28'	314.28'
C7	3000.00'	03°11'29"	83.57'	167.10'
C8	900.00'	35°33'41"	271.39'	527.18'
C9	3000.00'	03°11'29"	83.57'	167.10'
C10	170.00'	175°39'50"	4490.47'	521.21'
C11	522.39'	31°18'54"	146.42'	285.51'
C12	1000.00'	28°05'10"	250.13'	490.20'
C13	1050.00'	27°16'17"	254.72'	499.78'
C14	525.46'	31°59'34"	150.64'	293.40'
C15	174.00'	170°46'08"	2155.32'	518.60'
C16	3000.00'	08°05'07"	212.02'	423.34'
C17	6546.11'	02°37'40"	150.14'	300.22'
C18	3000.00'	03°11'29"	83.57'	167.10'
C19	1750.00'	45°32'03"	734.45'	1390.76'
C20	230.00'	149°37'03"	847.06'	600.60'
C21	3000.00'	03°11'29"	83.57'	167.10'
C22	6546.68'	02°37'35"	150.08'	300.10'
C23	147.00'	84°20'02"	133.14'	216.37'
C24	159.00'	161°09'09"	957.98'	447.21'
C25	300.00'	04°56'19"	129.37'	258.58'
C26	1525.49'	19°21'36"	260.23'	515.49'
C27	1525.53'	16°46'04"	224.83'	446.45'
C28	4999.99'	03°43'21"	1884.32'	3604.04'
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L5	N 53°03'59" W	341.74'
L6	N 59°04'52" W	300.06'
L7	N 62°16'21" W	444.51'
L8	S 41°40'55" W	156.26'
L9	N 59°04'52" W	300.06'
L10	N 62°16'21" W	315.51'
L11	S 57°56'11" E	266.31'
L12	N 56°53'30" W	189.51'
L13	N 25°11'36" W	273.51'
L14	N 53°16'46" W	431.55'
L15	N 53°11'06" W	285.98'
L16	N 25°54'49" W	296.60'
L17	N 57°48'46" W	184.44'
L18	S 57°56'07" E	225.80'
L19	N 59°04'52" W	300.06'
L20	N 32°03'49" E	2466.59'
L21	N 44°27'54" W	204.55'
L22	N 89°59'57" W	69.57'
L23	S 00°03'28" W	735.01'
L24	N 30°19'28" W	194.31'
L25	N 78°22'57" E	137.46'
L26	S 17°17'00" E	180.26'
L27	N 29°51'38" W	299.97'
L28	N 73°14'01" E	671.17'
L29	N 30°19'28" W	194.31'
L30	N 00°03'22" E	6885.51'
L31	N 00°03'29" E	12511.56'
L32	N 15°29'07" W	248.59'
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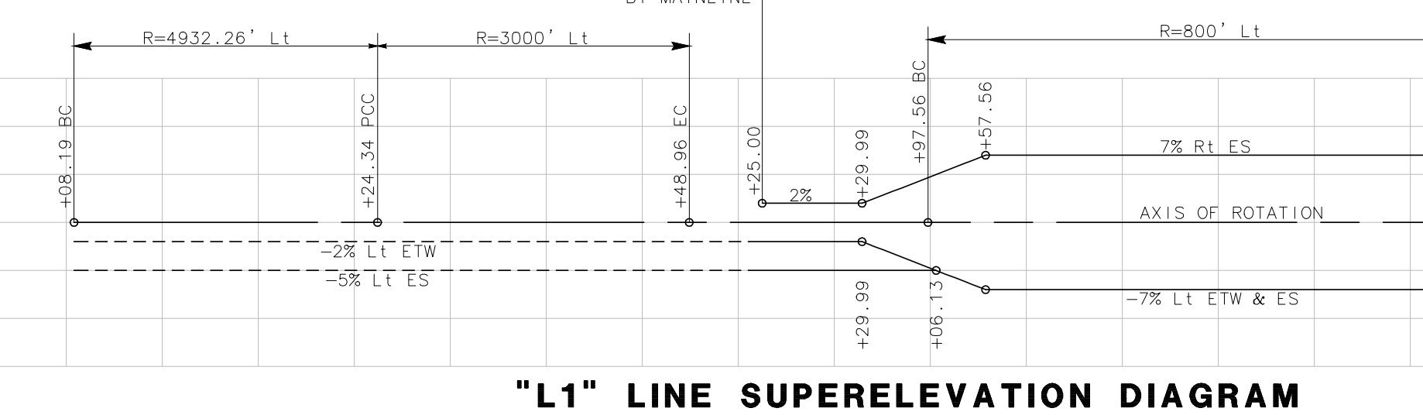
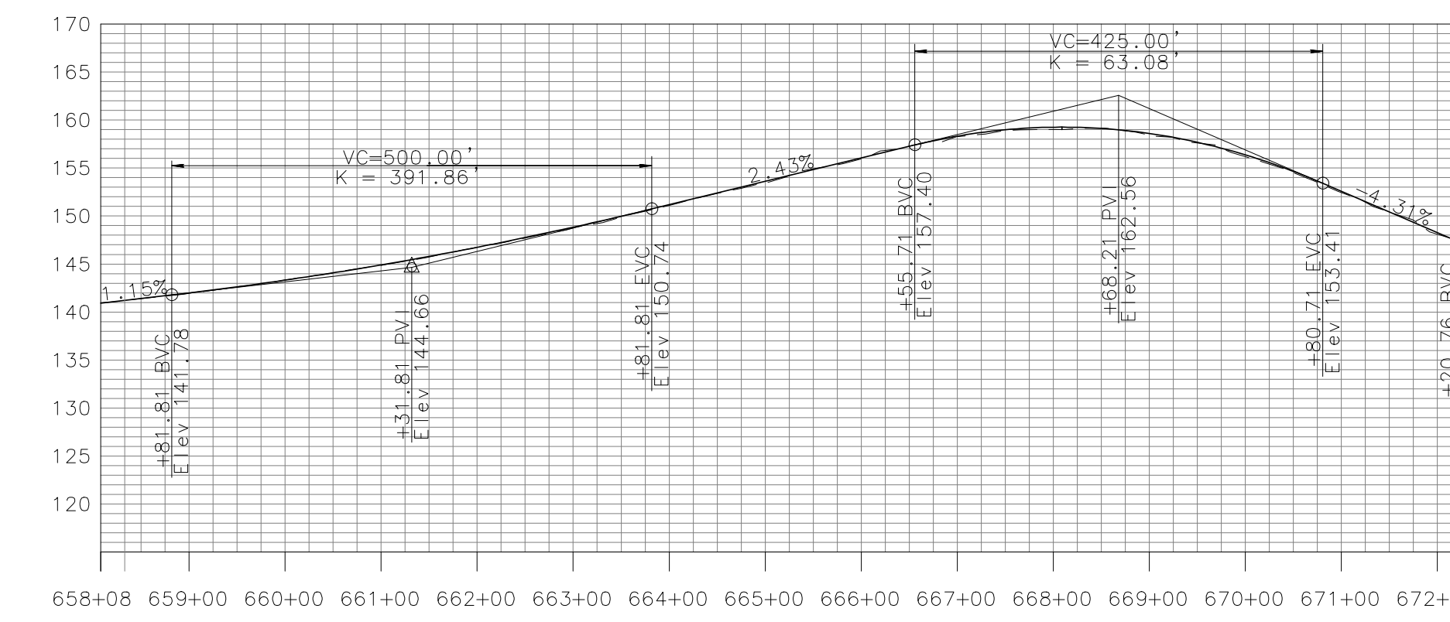


"L1" LINE SUPERELEVATION DIAGRAM



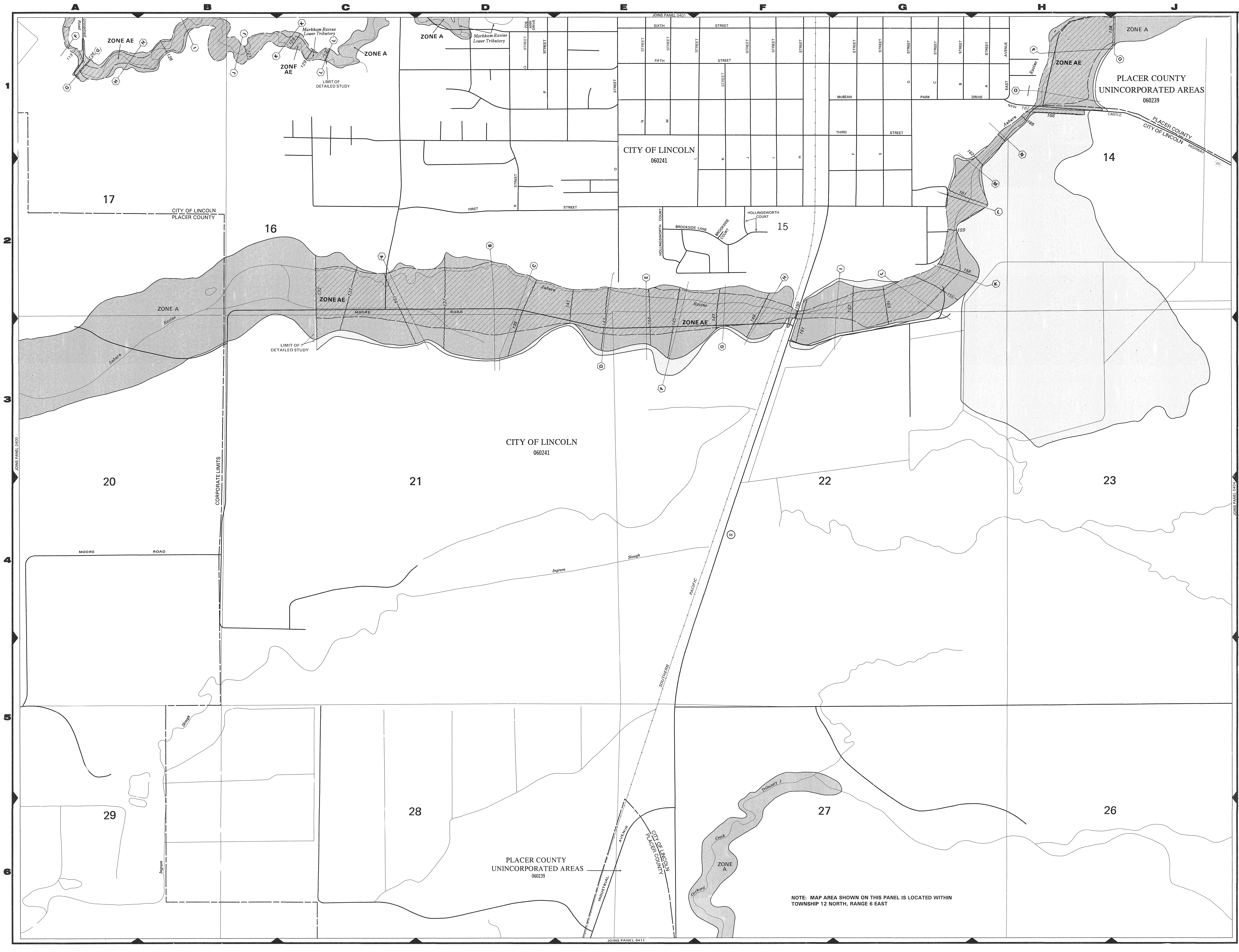
"L1" LINE PROFILE
SCALE H = 1":200'
V = 1":20'

APPENDIX B

FEMA Floodplain Maps

- B1 – Combined FEMA Floodplain Maps
- B2 – Concentrated Areas That Cross Project Limits

B1 – Combined FEMA Floodplain Maps



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 NORTH, RANGE 6 EAST

LEGEND

▨ SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

▨ FLOODWAY AREAS IN ZONE AE

▒ OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

☐ OTHER AREAS

ZONE X	Areas determined to be outside 500-year floodplain.
ZONE D	Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS†

▧	▧	▧
Identified 1983	Identified 1990	Otherwise Protected Areas

†Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

———	Floodplain Boundary
— — —	Floodway Boundary
— — —	Zone D Boundary
▬	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
~~513~~~~	Base Flood Elevation Line; Elevation in Feet*
D——D	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7×	Elevation Reference Mark
•M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE. A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 6.0 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
JUNE 8, 1998

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

N

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

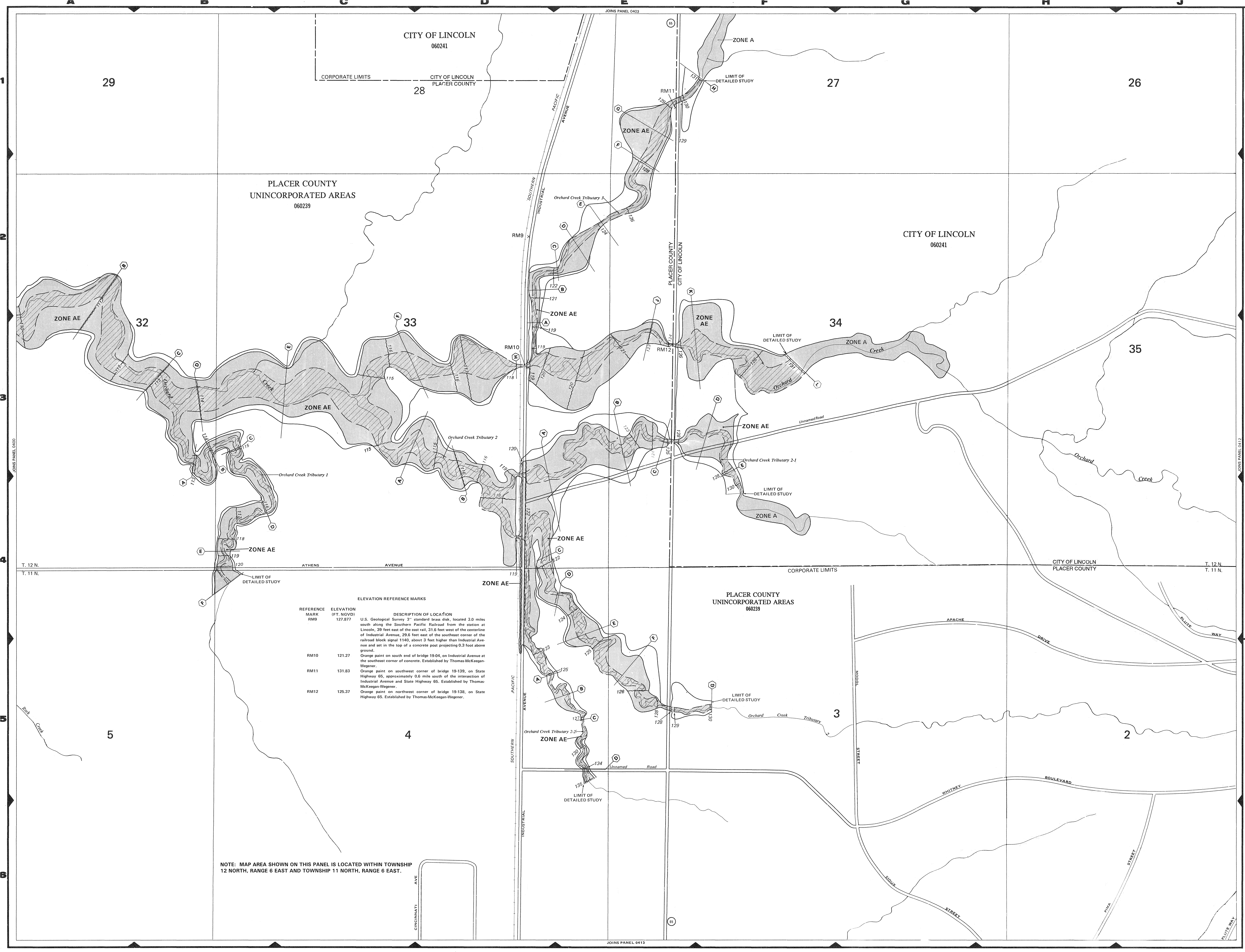
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN, CITY OF	060241	0403	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0403	F

MAP NUMBER
06061C0403 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM9	127.877	U.S. Geological Survey 3" standard brass disk, located 3.0 miles south along the Southern Pacific Railroad from the station at Lincoln, 39 feet east of the east rail, 31.6 feet west of the centerline of Industrial Avenue, 29.6 feet east of the southeast corner of the railroad block signal 1140, about 3 feet higher than Industrial Avenue and set in the top of a concrete post projecting 0.3 foot above ground.
RM10	121.27	Orange paint on south end of bridge 19-04, on Industrial Avenue at the southeast corner of concrete. Established by Thomas-McKeegan-Wegener.
RM11	131.83	Orange paint on southwest corner of bridge 19-139, on State Highway 65, approximately 0.6 mile south of the intersection of Industrial Avenue and State Highway 65. Established by Thomas-McKeegan-Wegener.
RM12	125.37	Orange paint on northwest corner of bridge 19-138, on State Highway 65. Established by Thomas-McKeegan-Wegener.

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 12 NORTH, RANGE 6 EAST AND TOWNSHIP 11 NORTH, RANGE 6 EAST.

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X	Areas determined to be outside 500-year floodplain.
ZONE D	Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS†

Identified 1983
Identified 1990
Otherwise Protected Areas

†Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

	Floodplain Boundary
	Floodway Boundary
	Zone D Boundary
	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
513	Base Flood Elevation Line; Elevation in Feet*
D — D	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7×	Elevation Reference Mark
•M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

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For adjoining panels, see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
JUNE 8, 1998

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

N

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

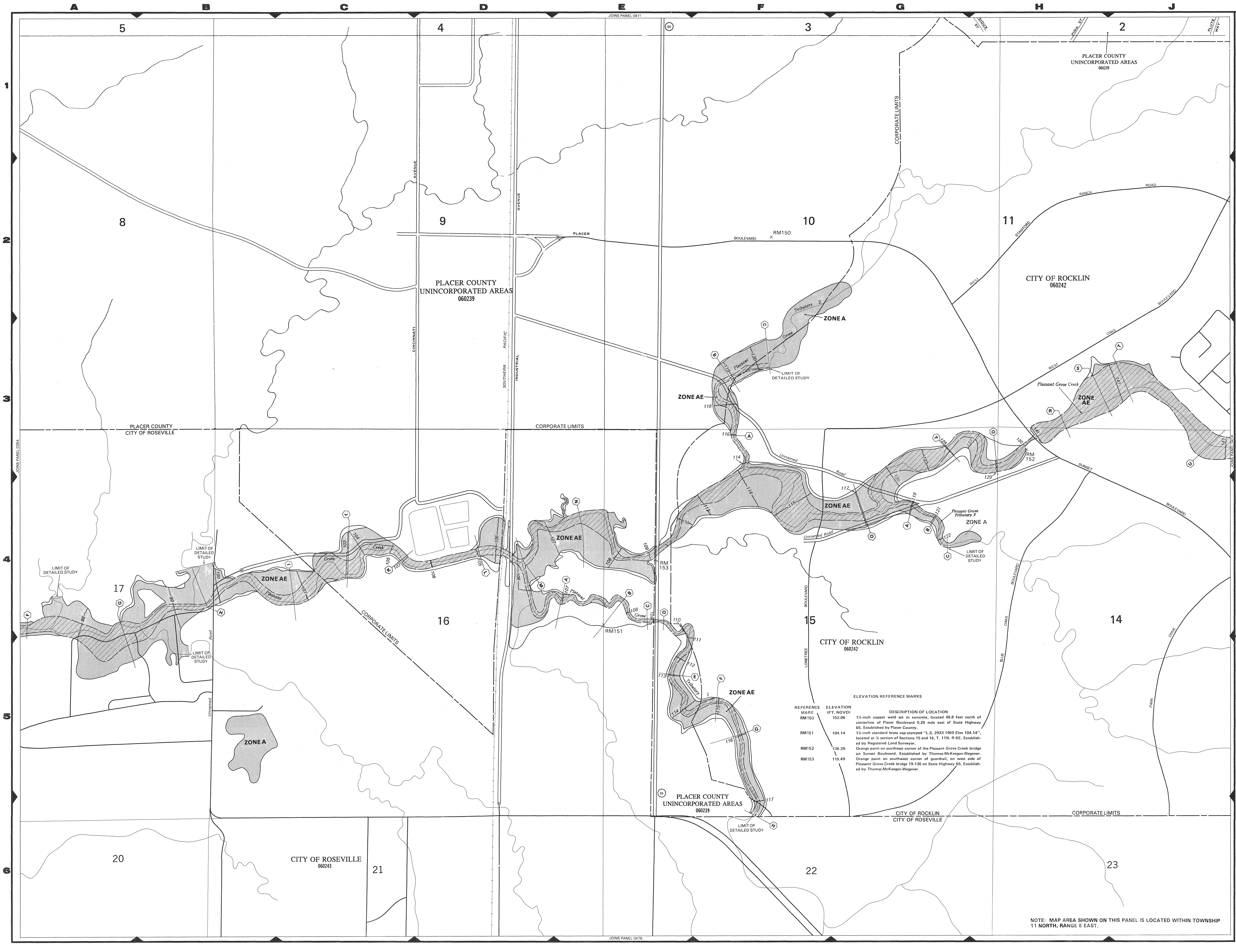
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN, CITY OF	060241	0411	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0411	F

MAP NUMBER
06061C0411 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT. NGVD)	DESCRIPTION OF LOCATION
RM150	152.06	1½-inch copper weld set in concrete, located 48.8 feet north of centerline of Placer Boulevard 0.28 mile east of State Highway 65. Established by Placer County.
RM151	104.14	1¼-inch standard brass cap stamped "L.S. 2933 1960 Elev 104.14", located at ¼ section of Sections 15 and 16, T. 11N. R 6E. Established by Registered Land Surveyor.
RM152	136.29	Orange paint on southeast corner of the Pleasant Grove Creek bridge on Sunset Boulevard. Established by Thomas-McKeegan-Wegener.
RM153	115.49	Orange paint on southwest corner of guardrail, on west side of Pleasant Grove Creek bridge 19-136 on State Highway 65. Established by Thomas-McKeegan-Wegener.

NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 NORTH, RANGE 6 EAST.

LEGEND

▨ SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

▨ FLOODWAY AREAS IN ZONE AE

▒ OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

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UNDEVELOPED COASTAL BARRIERS†

▨	▨	▨
Identified 1983	Identified 1990	Otherwise Protected Areas

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~~513~~~	Base Flood Elevation Line; Elevation in Feet*
(D)——(D)	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7×	Elevation Reference Mark
●M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

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JUNE 8, 1998

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N

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

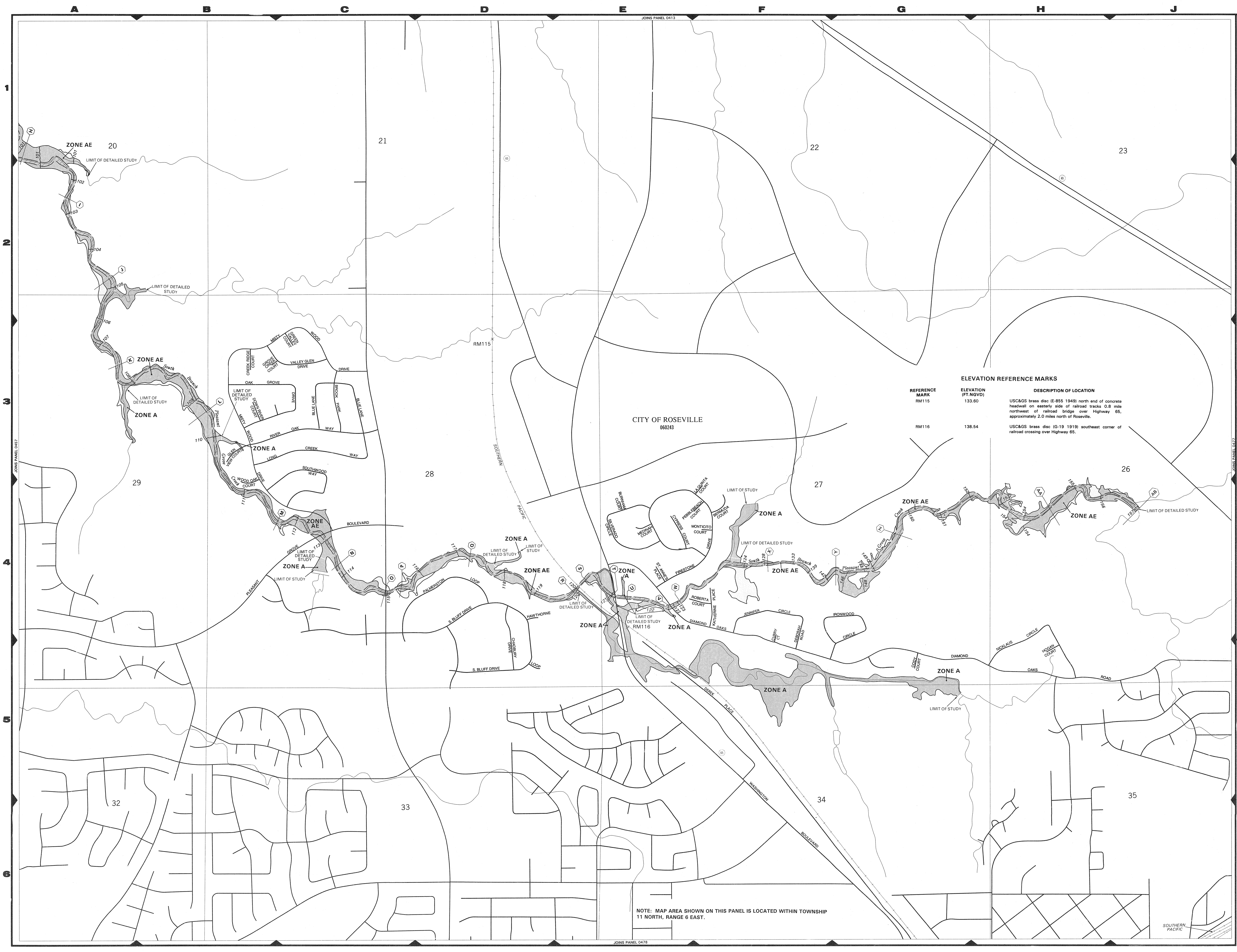
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ROCKLIN, CITY OF	060242	0413	F
ROSEVILLE, CITY OF	060243	0413	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0413	F

MAP NUMBER
06061C0413 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency



NOTE: MAP AREA SHOWN ON THIS PANEL IS LOCATED WITHIN TOWNSHIP 11 NORTH, RANGE 6 EAST.

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT.NGVD)	DESCRIPTION OF LOCATION
RM115	133.60	USC&GS brass disc (E-855 1949) north end of concrete headwall on easterly side of railroad tracks 0.8 mile northwest of railroad bridge over Highway 65, approximately 2.0 miles north of Roseville.
RM116	138.54	USC&GS brass disc (G-19 1919) southeast corner of railroad crossing over Highway 65.

LEGEND

▨ SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

▨ FLOODWAY AREAS IN ZONE AE

▨ OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

☐ OTHER AREAS

ZONE X	Areas determined to be outside 500-year floodplain.
ZONE D	Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS†

▨	▨	▨
Identified 1983	Identified 1990	Otherwise Protected Areas

†Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

———	Floodplain Boundary
— — —	Floodway Boundary
— — —	Zone D Boundary
▨	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
~~513~~~	Base Flood Elevation Line; Elevation in Feet*
(D)———(D)	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7ₓ	Elevation Reference Mark
•M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Coastal base flood elevations apply only landward of 0.0 NGVD, and include the effects of wave action; these elevations may also differ significantly from those developed by the National Weather Service for hurricane evacuation planning.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 6.0 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
JUNE 8, 1998

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE DATE shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

N

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

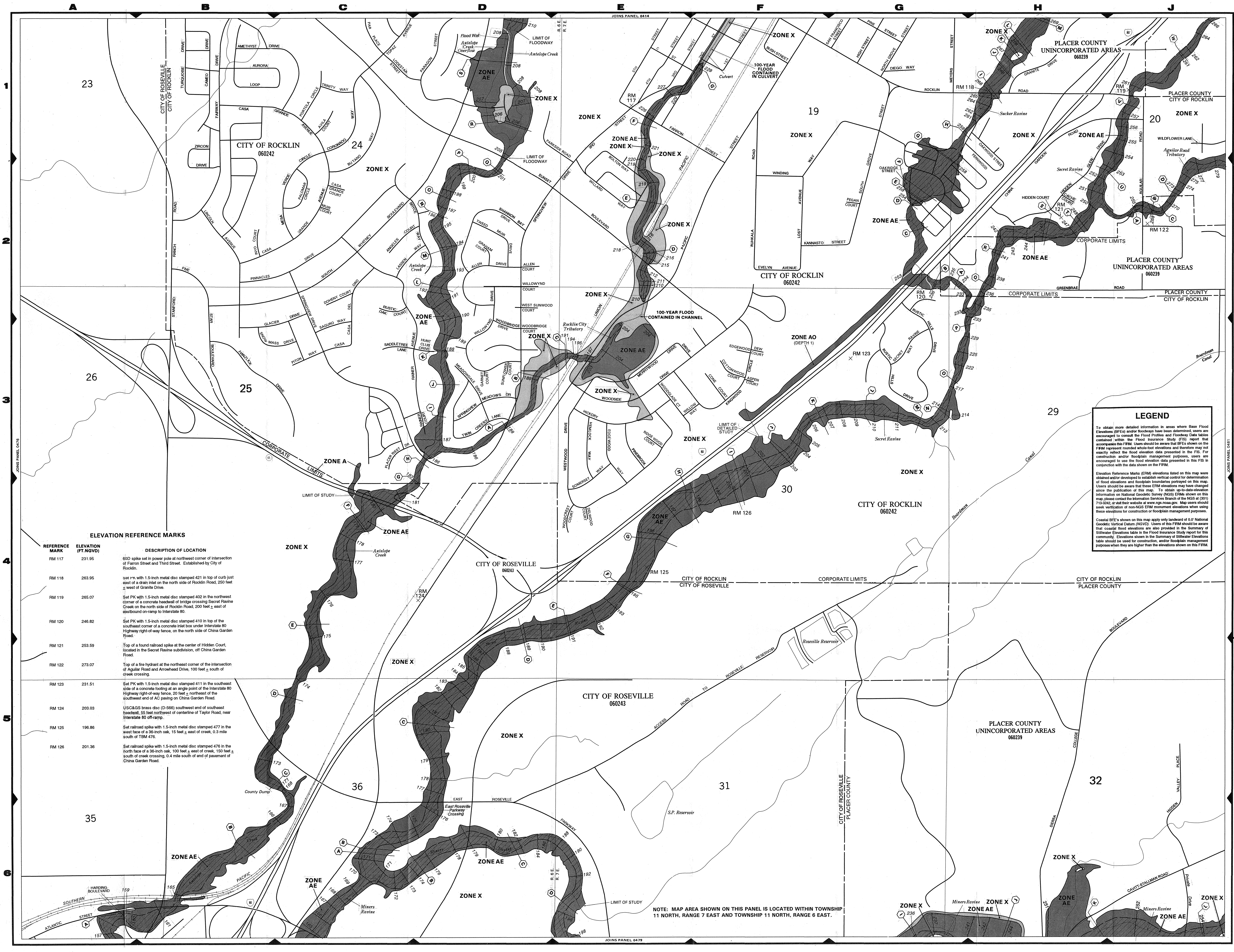
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ROSEVILLE, CITY OF	060243	0476	F

MAP NUMBER
06061C0476 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency



ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FT.NGVD)	DESCRIPTION OF LOCATION
RM 117	231.95	60D spike set in power pole at northwest corner of intersection of Farron Street and Third Street. Established by City of Rocklin.
RM 118	263.95	Set PK with 1.5-inch metal disc stamped 421 in top of curb just east of a drain inlet on the north side of Rocklin Road, 250 feet ± west of Granite Drive.
RM 119	265.07	Set PK with 1.5-inch metal disc stamped 402 in the northwest corner of a concrete headwall of bridge crossing Secret Ravine Creek on the north side of Rocklin Road, 200 feet ± east of eastbound on-ramp to Interstate 80.
RM 120	246.82	Set PK with 1.5-inch metal disc stamped 410 in top of the southeast corner of a concrete inlet box under Interstate 80 Highway right-of-way fence, on the north side of China Garden Road.
RM 121	253.59	Top of a found railroad spike at the center of Hidden Court, located in the Secret Ravine subdivision, off China Garden Road.
RM 122	273.07	Top of a fire hydrant at the northeast corner of the intersection of Aguilar Road and Arrowhead Drive, 100 feet ± south of creek crossing.
RM 123	231.51	Set PK with 1.5-inch metal disc stamped 411 in the southeast side of a concrete footing at an angle point of the Interstate 80 Highway right-of-way fence, 20 feet ± northeast of the southwest end of AC paving on China Garden Road.
RM 124	203.03	USC&GS brass disc (D-566) southwest end of southeast headwall, 55 feet northwest of centerline of Taylor Road, near Interstate 80 off-ramp.
RM 125	196.86	Set railroad spike with 1.5-inch metal disc stamped 477 in the west face of a 36-inch oak, 15 feet ± east of creek, 0.3 mile south of TBM 476.
RM 126	201.36	Set railroad spike with 1.5-inch metal disc stamped 476 in the north face of a 36-inch oak, 100 feet ± east of creek, 150 feet ± south of creek crossing, 0.4 mile south of end of pavement of China Garden Road.

LEGEND

To obtain more detailed information in areas where Base Flood Elevations (BFEs) and/or floodways have been determined, users are encouraged to consult the Flood Profiles and Floodway Data tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations and therefore may not exactly reflect the flood elevation data presented in the FIS. For construction and/or floodplain management purposes, users are encouraged to use the flood elevation data presented in this FIS in conjunction with the data shown on the FIRM.

Elevation Reference Marks (ERM) elevations listed on this map were obtained and/or developed to establish vertical control for determination of flood elevations and floodplain boundaries portrayed on this map. Users should be aware that these ERM elevations may have changed since the publication of this map. To obtain up-to-date-elevation information on National Geodetic Survey (NGS) ERMs shown on this map, please contact the Information Services Branch of the NGS at (301) 713-3242, or visit their website at www.ngs.noaa.gov. Map users should seek verification of non-NGS ERM monument elevations when using these elevations for construction or floodplain management purposes.

Coastal BFE's shown on this map apply only landward of 0.0' National Geodetic Vertical Datum *(NGVD)*. Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this community. Elevations shown in the Summary of Stillwater Elevations table should be used for construction, and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A	No base flood elevations determined.
ZONE AE	Base flood elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding; velocities also determined.
ZONE A99	To be protected from 100-year flood by Federal flood protection system under construction; no base flood elevations determined.
ZONE V	Coastal flood with velocity hazard (wave action); no base flood elevations determined.
ZONE VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X	Areas determined to be outside 500-year floodplain.
ZONE D	Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS†

Identified 1983 — Identified 1990 — Otherwise Protected Areas

†Coastal barrier areas are normally located within or adjacent to special flood hazard areas.

———	Floodplain Boundary
— — —	Floodway Boundary
— - —	Zone D Boundary
▬	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
~~513~~~	Base Flood Elevation Line; Elevation in Feet*
(D)———(D)	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*
RM 7×	Elevation Reference Mark
•M1.5	River Mile

*Referenced to the National Geodetic Vertical Datum of 1929

NOTES

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas. The community map repository should be consulted for more detailed data on BFEs, and for any information on floodway delineations, prior to use of this map for property purchase or construction purposes.

Areas of Special Flood Hazard (100-year flood) include Zones A, AE, A1-A30, AH, AO, A99, V, VE and V1-V30.

Certain areas not in Special Flood Hazard Areas may be protected by flood control structures.

Boundaries of the floodways were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the Federal Emergency Management Agency.

Floodway widths in some areas may be too narrow to show to scale. Refer to Floodway Data Table where floodway width is shown at 1/20 inch.

Corporate limits shown are current as of the date of this map. The user should contact appropriate community officials to determine if corporate limits have changed subsequent to the issuance of this map.

For community map revision history prior to countywide mapping, see section 6.0 of the Flood Insurance Study Report.

For adjoining panels, see separately printed Map Index.

MAP REPOSITORY
Refer to Repository Listing on Index Map

EFFECTIVE DATE OF
COUNTYWIDE FLOOD INSURANCE RATE MAP:
JUNE 8, 1998

EFFECTIVE DATE (S) OF REVISION (S) TO THIS PANEL:

Map revised Novembe 21, 2001 to change base flood elevations, to add special flood hazard areas, to change special flood hazard areas, to reflect updated topographic information, and to change floodway.

To determine if flood insurance is available, contact an insurance agent or call the National Flood Insurance Program at (800) 638-6620.

APPROXIMATE SCALE IN FEET
500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

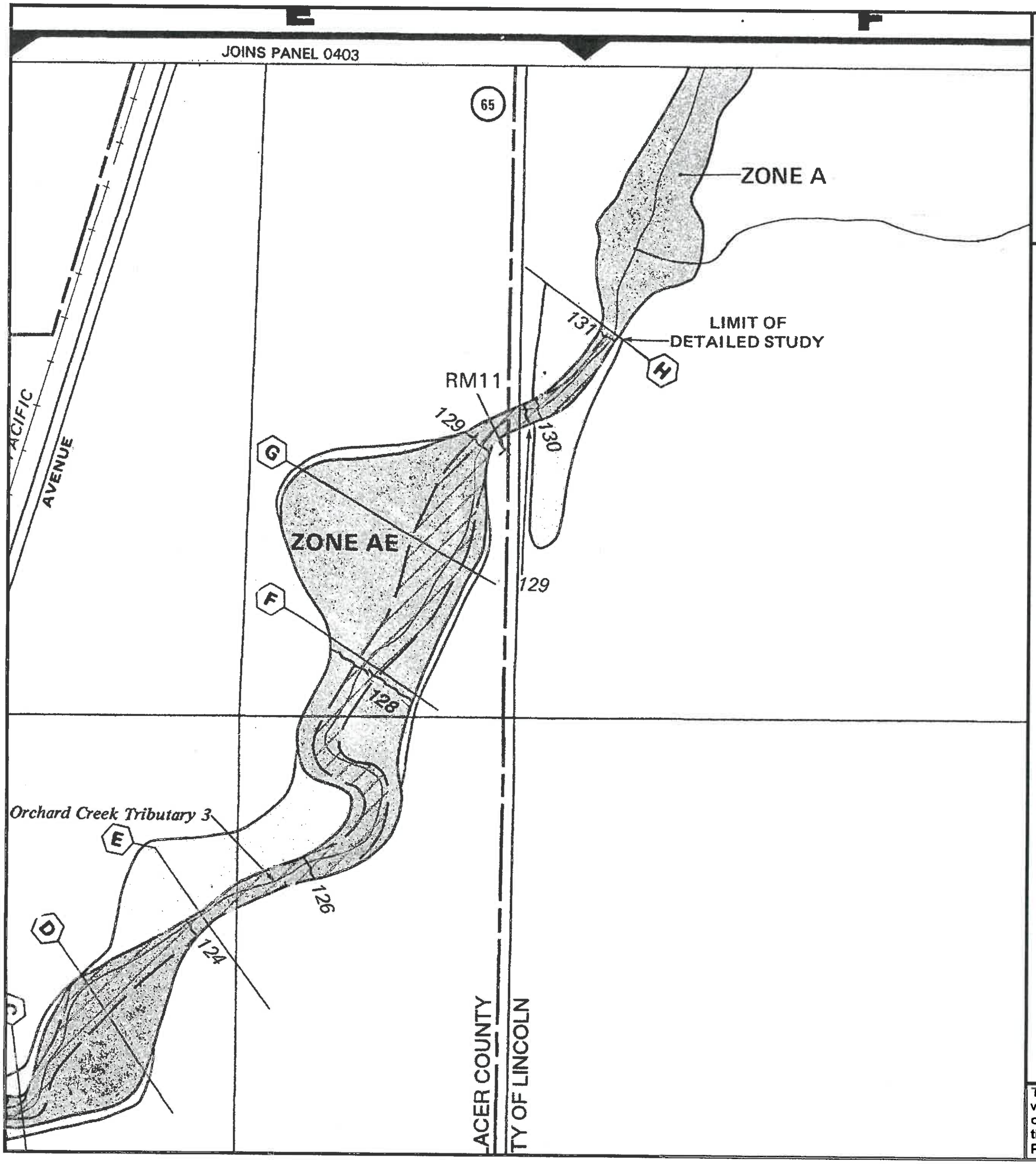
COMMUNITY	NUMBER	PANEL	SUFFIX
ROCKLIN, CITY OF	060242	0477	G
ROSEVILLE, CITY OF	060243	0477	G
PLACER COUNTY UNINCORPORATED AREAS	060239	0477	G

MAP NUMBER
06061C0477 G

MAP REVISED:
NOVEMBER 21, 2001

Federal Emergency Management Agency

B2 – Concentrated Areas That Cross Project Limits



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

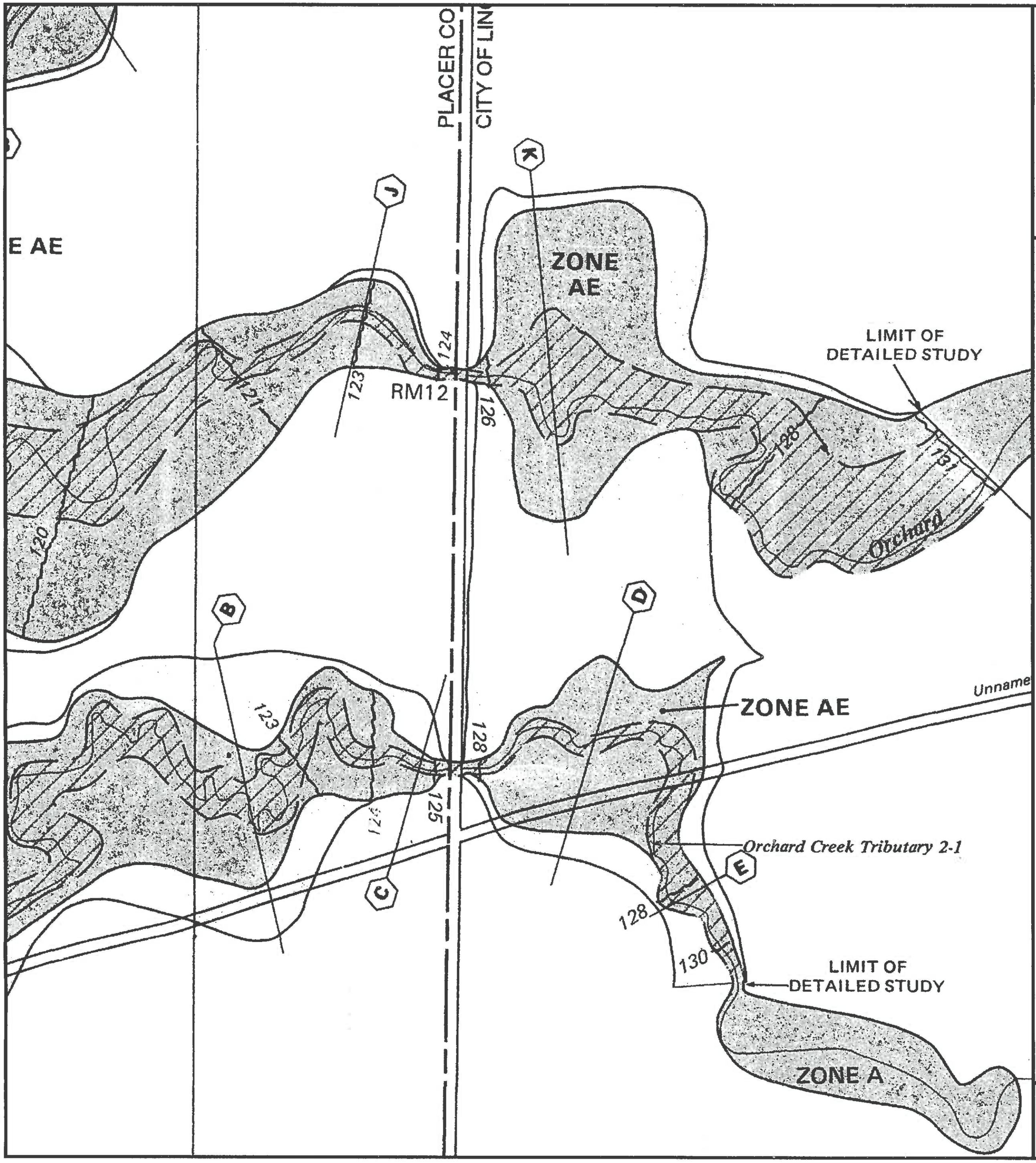
COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN, CITY OF	060241	0411	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0411	F

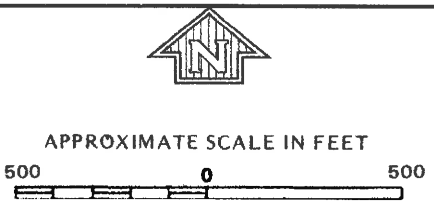
MAP NUMBER
06061C0411 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency

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





NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN, CITY OF	060241	0411	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0411	F

MAP NUMBER
06061C0411 F

EFFECTIVE DATE:
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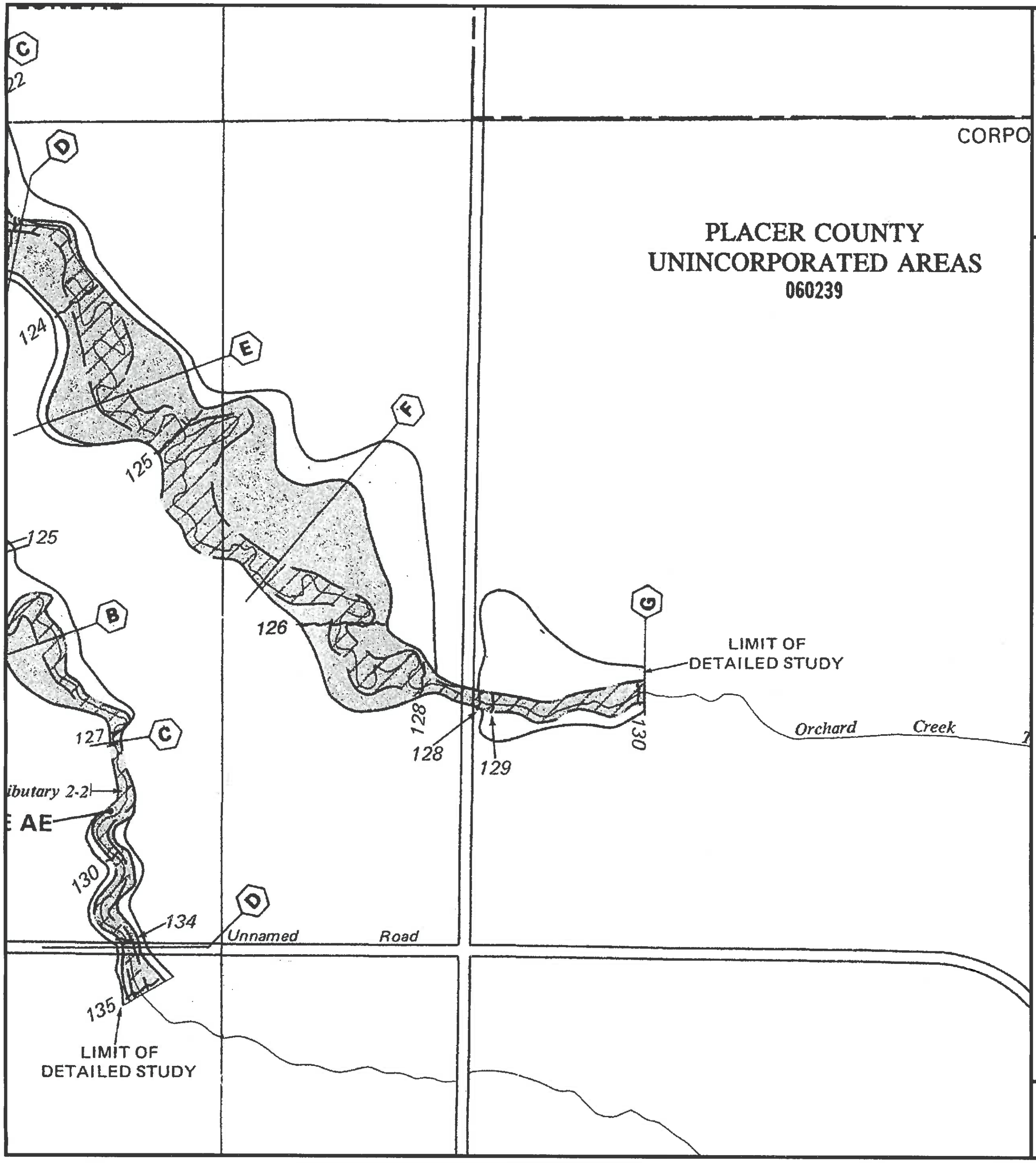
Federal Emergency Management Agency



APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LINCOLN, CITY OF	060241	0411	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0411	F

MAP NUMBER
06061C0411 F

EFFECTIVE DATE:
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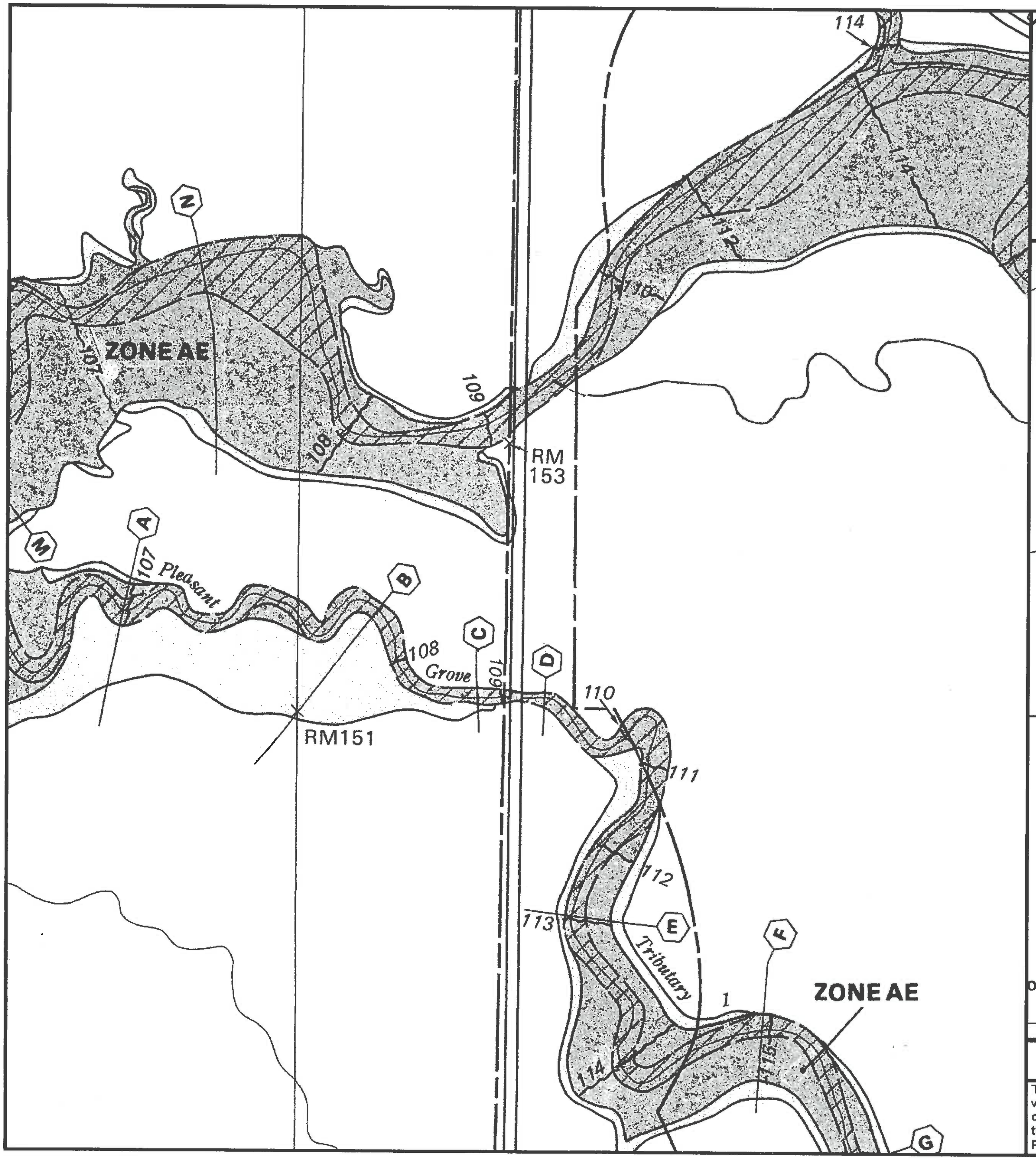

658-6620.

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

PLACER COUNTY,
CALIFORNIA AND
INCORPORATED AREAS

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ROCKLIN, CITY OF	060242	0413	F
ROSEVILLE, CITY OF	060243	0413	F
PLACER COUNTY UNINCORPORATED AREAS	060239	0413	F

MAP NUMBER
06061C0413 F

EFFECTIVE DATE:
JUNE 8, 1998

Federal Emergency Management Agency

OWNSHIP

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APPENDIX C

Existing and Proposed Watershed Maps

- C1 – Existing Watershed Map
- C2 – Proposed Watershed Maps – General Purpose Alternative
- C3 – Proposed Watershed Maps – Carpool Lane Alternative

C1 – Existing Watershed

STATE ROUTE 65 WIDENING

WATERSHED MAP (EXISTING)

03-PLA-65 PM 6.5/12.8

MARK THOMAS & COMPANY
7300 FOLSOM BOULEVARD, SUITE 203
SACRAMENTO, CALIFORNIA 95826
(916) 381-9100 FAX:(916)381-9180

DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'

APPROVED ON
BY
RCE NO.

JOB NO. SA-13143
FILE NO.

SHEET NO. 1 OF 3

WATERSHED MAP (PLEASANT GROVE CREEK WATERSHED)

SECTION	ID	C	AREA SQ. FT	AREA ACRES
A	1	0.95	405,558.47	9.31
	2	0.56	60,686.21	1.39
	3	0.56	157,751.92	3.62
	4	0.56	26,863.41	0.62
	5	0.56	69,383.79	1.59
	6	0.56	87,031.40	2.00
	7	0.56	112,609.14	2.59
	8	0.56	121,762.67	2.80
B	9	0.56	450,504.44	10.34
	10	0.95	171,196.87	3.93
	11	0.56	81,241.37	1.87
	12	0.95	135,606.07	3.11
	13	0.56	258,814.76	5.94
C	14	0.56	68,799.27	1.58
	15	0.56	106,651.10	2.45
	16	0.56	139,694.97	3.21
	17	0.56	73,109.97	1.68
	18	0.56	163,814.26	3.76
	19	0.56	29,191.92	0.67
	20	0.95	848,670.02	19.48
	21	0.56	245,313.52	5.63
	22	0.56	82,008.11	1.88
	23	0.56	130,988.61	3.01
	24	0.95	103,398.27	2.37
	25	0.56	477,524.03	10.96
D	26	0.56	75,101.80	1.72
	27	0.56	219,877.36	5.05
	28	0.56	198,712.33	4.56
	29	0.56	40,664.02	0.93
	30	0.56	98,357.32	2.26
	31	0.56	60,273.04	1.38
	32	0.56	2,807.04	0.06
	33	0.56	145,658.84	3.34
	34	0.56	115,548.78	2.65
	35	0.95	1,045,237.44	24.00
	36	0.56	81,934.49	1.88
	37	0.56	12,945.64	0.30
	38	0.56	243,959.32	5.60
	39	0.56	121,414.79	2.79
	40	0.56	401,261.33	9.21
	41	0.56	207,338.79	4.76
	42	0.56	531,492.08	12.20
	43	0.56	90,221.31	2.07
	44	0.56	189,731.69	4.36

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
←	SHEET FLOW DIRECTION
- - ← - -	LONGEST TRAVEL PATH

STATE ROUTE 65 WIDENING

WATERSHED MAP (EXISTING)

03-PLA-65 PM 6.5/12.8

MARK THOMAS & COMPANY
7300 FOLSOM BOULEVARD, SUITE 203
SACRAMENTO, CALIFORNIA 95826
(916) 381-9100 FAX:(916)381-9180

DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'

APPROVED ON
BY
RCE NO.

JOB NO. SA-13143
FILE NO.

SHEET NO. 2 OF 3

WATERSHED MAP (PLEASANT GROVE CREEK WATERSHED)

SECTION	ID	C	AREA	
			SQ. FT	ACRES
D	35	0.95	1,045,237.44	24.00
	40	0.56	401,261.33	9.21
	42	0.56	531,492.08	12.20
	43	0.56	90,221.31	2.07
E	45	0.56	221,461.87	5.08
	46	0.56	340,288.21	7.81
	47	0.56	365,368.14	8.39
	48	0.56	131,215.46	3.01
	49	0.56	112,373.83	2.58
	50	0.56	64,509.36	1.48
	51	0.95	939,652.85	21.57
	52	0.56	75,535.67	1.73
	53	0.56	33,073.15	0.76
	54	0.56	128,586.32	2.95
F	55	0.56	112,140.15	2.57
	56	0.95	238,903.28	5.48
	57	0.56	224,198.08	5.15
	58	0.95	220,617.75	5.06
	59	0.56	311,257.32	7.15
	60	0.56	196,441.22	4.51

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
↜	SHEET FLOW DIRECTION
- ← -	LONGEST TRAVEL PATH

STATE ROUTE 65 WIDENING

WATERSHED MAP (EXISTING)

03-PLA-65 PM 6.5/12.8

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DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'

APPROVED ON
BY
RCE NO.

JOB NO. SA-13143
FILE NO.

SHEET NO. 3 OF 3

WATERSHED MAP (ORCHARD CREEK WATERSHED)

			AREA	
SECTION	ID	C	SQ. FT	ACRES
G	61	0.56	163,004.21	3.74
	62	0.56	161,784.71	3.71
	63	0.56	82,912.99	1.90
	64	0.56	111,646.71	2.56
	65	0.56	84,062.96	1.93
	66	0.56	78,182.03	1.79
	67	0.95	898,253.80	20.62
	68	0.56	220,060.94	5.05
	69	0.56	82,320.79	1.89
	70	0.56	112,502.42	2.58
	71	0.56	149,932.18	3.44
	72	0.56	149,756.53	3.44
	73	0.56	156,967.23	3.60
H	74	0.56	132,816.36	3.05
	75	0.95	95,517.88	2.19
	76	0.56	145,206.93	3.33
	77	0.95	105,725.39	2.43
	78	0.56	191,679.66	4.40
I	79	0.56	439,533.00	10.09
	80	0.56	177,534.22	4.08
	81	0.56	246,134.76	5.65
	82	0.56	306,325.11	7.03
	83	0.95	680,848.30	15.63
	84	0.56	109,112.27	2.50
	85	0.56	66,170.07	1.52
	86	0.56	125,073.92	2.87
	87	0.56	126,966.02	2.91
	88	0.56	184,011.06	4.22
	89	0.56	44,398.31	1.02
	90	0.56	50,712.70	1.16
J	91	0.56	314,390.04	7.22
	92	0.95	206,638.46	4.74
	93	0.56	204,676.62	4.70
	94	0.95	311,214.11	7.14
	95	0.56	474,389.84	10.89
	96	0.56	105,898.44	2.43
	97	0.56	316,613.86	7.27

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
	SHEET FLOW DIRECTION
←- -	LONGEST TRAVEL PATH

C2 – Proposed Watershed – General Purpose Lane Alternative

STATE ROUTE 65 WIDENING
WATERSHED MAP (PROPOSED)
GENERAL PURPOSE LANE ALTERNATIVE

03-PLA-65 PM 6.5/12.8

MARK THOMAS & COMPANY
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DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'

APPROVED ON
BY
RCE NO.

JOB NO. SA-13143
FILE NO.

SHEET NO. 1 OF 3

WATERSHED MAP (PLEASANT GROVE CREEK WATERSHED)

STATE ROUTE 65 WIDENING
WATERSHED MAP (PROPOSED)
GENERAL PURPOSE LANE ALTERNATIVE

03-PLA-65 PM 6.5/12.8

MARK THOMAS & COMPANY
7300 FOLSOM BOULEVARD, SUITE 203
SACRAMENTO, CALIFORNIA 95826
(916) 381-9100 FAX:(916)381-9180

DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'
APPROVED ON
BY
RCE NO.
JOB NO. SA-13143
FILE NO.
SHEET NO. 2 OF 3

WATERSHED MAP (PLEASANT GROVE CREEK WATERSHED)

			AREA	
SECTION	ID	C	SQ.FT	ACRES
E	36	0.38	199,571.61	4.58
	37	0.38	349,243.59	8.02
	38	0.38	342,158.87	7.85
	39	0.38	131,215.46	3.01
	40	0.38	112,373.83	2.58
	41	0.38	64,509.36	1.48
	42	0.95	945,103.26	21.70
	43	0.38	75,535.67	1.73
	44	0.38	33,504.50	0.77
F	45	0.38	128,586.32	2.95
	46	0.38	311,215.02	7.14
	47	0.95	255,982.93	5.88
	48	0.38	112,140.15	2.57
	49	0.95	238,915.51	5.48
	50	0.38	224,198.08	5.15
	51	0.38	196,440.56	4.51

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
	SHEET FLOW DIRECTION
- ◄—	LONGEST TRAVEL PATH

STATE ROUTE 65 WIDENING
WATERSHED MAP (PROPOSED)
GENERAL PURPOSE LANE ALTERNATIVE

03-PLA-65 PM 6.5/12.8

MARK THOMAS & COMPANY
7300 FOLSOM BOULEVARD, SUITE 203
SACRAMENTO, CALIFORNIA 95826
(916) 381-9100 FAX:(916)381-9180

DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'
APPROVED ON
BY
RCE NO.
JOB NO. SA-13143
FILE NO.
SHEET NO. 3 OF 3

WATERSHED MAP (ORCHARD CREEK WATERSHED)

			AREA	
SECTION	ID	C	SQ.FT	ACRES
G	52	0.38	163,004.21	3.74
	53	0.38	161,784.71	3.71
	54	0.38	82,912.99	1.90
	55	0.38	111,646.71	2.56
	56	0.38	84,062.96	1.93
	57	0.38	78,182.03	1.79
	58	0.95	898,253.80	20.62
	59	0.38	220,060.94	5.05
	60	0.38	82,320.78	1.89
	61	0.38	112,502.42	2.58
	62	0.38	149,932.18	3.44
	63	0.38	149,756.53	3.44
	64	0.38	156,967.23	3.60
H	65	0.38	116,755.13	2.68
	66	0.95	110,373.73	2.53
	67	0.38	147,160.98	3.38
	68	0.95	110,367.76	2.53
	69	0.38	186,324.29	4.28
I	70	0.38	415,718.45	9.54
	71	0.38	177,534.22	4.08
	72	0.38	246,134.76	5.65
	73	0.38	292,875.55	6.72
	74	0.95	718,168.42	16.49
	75	0.38	109,112.27	2.50
	76	0.38	661,70.07	1.52
	77	0.38	125,073.92	2.87
	78	0.38	126,966.02	2.91
	79	0.38	184,124.79	4.23
	80	0.38	44,398.31	1.02
	81	0.38	50712.70	1.16
J	82	0.38	303,134.80	6.96
	83	0.95	219,221.84	5.03
	84	0.38	204,326.50	4.69
	85	0.95	311,214.11	7.14
	86	0.38	474,389.84	10.89
	87	0.38	108,484.46	2.49
	88	0.38	316,613.86	7.27

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
↜	SHEET FLOW DIRECTION
– ◄—	LONGEST TRAVEL PATH

C3 – Proposed Watershed Map – Carpool Lane Alternative

STATE ROUTE 65 WIDENING
WATERSHED MAP (PROPOSED)
HOV LANE ALTERNATIVE

03–PLA–65　PM 6.5/12.8

MARK THOMAS & COMPANY
7300 FOLSOM BOULEVARD, SUITE 203
SACRAMENTO, CALIFORNIA 95826
(916) 381–9100 FAX:(916)381–9180

DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'

APPROVED ON
BY
RCE NO.

JOB NO. SA–13143
FILE NO.

SHEET NO. 1 OF 3

WATERSHED MAP (PLEASANT GROVE CREEK WATERSHED)

SECTION	ID	C	AREA	
			SQ. FT	ACRES
A	1	0.95	598,894.45	13.75
	2	0.38	59,048.39	1.36
	3A	0.38	25,561.79	0.59
	3B	0.38	46,359.98	1.06
	3C	0.38	44,843.55	1.03
	4	0.38	90,648.84	2.08
	5	0.38	99,934.35	2.29
	6	0.38	76,356.94	1.75
B	7	0.38	362,966.25	8.33
	8	0.95	522,991.40	12.01
	9	0.38	226,616.52	5.20
C	10	0.38	108,345.91	2.49
	11	0.38	129,756.97	2.98
	12	0.38	70,525.53	1.62
	13	0.38	184,259.73	4.23
	14	0.95	1,026,610.89	23.57
	15	0.38	79,920.29	1.83
	16	0.38	118,348.24	2.72
	17	0.38	241,844.47	5.55
	18	0.95	478,718.54	10.99
D	19	0.38	98,357.32	2.26
	20	0.38	214,603.78	4.93
	21	0.38	198,517.09	4.56
	22	0.38	40,664.02	0.93
	23	0.38	55,989.17	1.29
	24	0.38	2,807.04	0.06
	25	0.38	147,093.45	3.38
	26	0.38	115,548.78	2.65
	27	0.95	1,230,411.46	28.35
	28	0.38	81,723.56	1.88
	29	0.38	241,712.66	5.55
	30	0.38	121,414.79	2.79
	31	0.38	502,716.12	11.54
	32	0.38	193,381.85	4.44
	33	0.38	187,308.03	4.30
	34	0.38	397,429.12	9.12
	35	0.38	66,405.53	1.52

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
←	SHEET FLOW DIRECTION
- ←	LONGEST TRAVEL PATH

WATERSHED MAP (PLEASANT GROVE CREEK WATERSHED)

SECTION	ID	C	AREA	
			SQ.FT	ACRES
E	36	0.38	199,571.61	4.58
	37	0.38	349,243.59	8.02
	38	0.38	342,158.87	7.85
	39	0.38	131,215.46	3.01
	40	0.38	112,373.83	2.58
	41	0.38	64,509.36	1.48
	42	0.95	945,103.26	21.70
	43	0.38	75,535.67	1.73
	44	0.38	33,504.50	0.77
F	45	0.38	128,586.32	2.95
	46	0.38	311,215.02	7.14
	47	0.95	255,982.93	5.88
	48	0.38	112,140.15	2.57
	49	0.95	238,915.51	5.48
	50	0.38	224,198.08	5.15
	51	0.38	196,440.56	4.51

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
	SHEET FLOW DIRECTION
- ◄—	LONGEST TRAVEL PATH

STATE ROUTE 65 WIDENING
WATERSHED MAP (PROPOSED)
HOV LANE ALTERNATIVE

03-PLA-65 PM 6.5/12.8

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DRAWN BY AMM
CKD. BY AL
DATE 6/9/2016
SCALE 1"=200'
APPROVED ON
BY
RCE NO.
JOB NO. SA-13143
FILE NO.
SHEET NO. 2 OF 3

			AREA	
SECTION	ID	C	SQ.FT	ACRES
G	52	0.38	163,004.21	3.74
	53	0.38	161,784.71	3.71
	54	0.38	82,912.99	1.90
	55	0.38	111,646.71	2.56
	56	0.38	84,062.96	1.93
	57	0.38	78,182.03	1.79
	58	0.95	898,253.80	20.62
	59	0.38	220,060.94	5.05
	60	0.38	82,320.78	1.89
	61	0.38	112,502.42	2.58
	62	0.38	149,932.18	3.44
	63	0.38	149,756.53	3.44
	64	0.38	156,967.23	3.60
H	65	0.38	116,755.13	2.68
	66	0.95	110,373.73	2.53
	67	0.38	147,160.98	3.38
	68	0.95	110,367.76	2.53
	69	0.38	186,324.29	4.28
I	70	0.38	415,718.45	9.54
	71	0.38	177,534.22	4.08
	72	0.38	246,134.76	5.65
	73	0.38	292,875.55	6.72
	74	0.95	718,168.42	16.49
	75	0.38	109,112.27	2.50
	76	0.38	661,70.07	1.52
	77	0.38	125,073.92	2.87
	78	0.38	126,966.02	2.91
	79	0.38	184,124.79	4.23
	80	0.38	44,398.31	1.02
	81	0.38	50712.70	1.16
J	82	0.38	303,134.80	6.96
	83	0.95	219,221.84	5.03
	84	0.38	204,326.50	4.69
	85	0.95	311,214.11	7.14
	86	0.38	474,389.84	10.89
	87	0.38	108,484.46	2.49
	88	0.38	316,613.86	7.27

LEGEND

A1	CROSS DRAIN NODE
△#	SUBWATERSHED AREA ID
←	SHEET FLOW DIRECTION
– ◄	LONGEST TRAVEL PATH

WATERSHED MAP (ORCHARD CREEK WATERSHED)

STATE ROUTE 65 WIDENING
WATERSHED MAP (PROPOSED)
HOV LANE ALTERNATIVE

03-PLA-65 PM 6.5/12.8

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DRAWN BY AMM
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DATE 6/9/2016
SCALE 1"=200'

APPROVED ON
BY
RCE NO.

JOB NO. SA-13143
FILE NO.

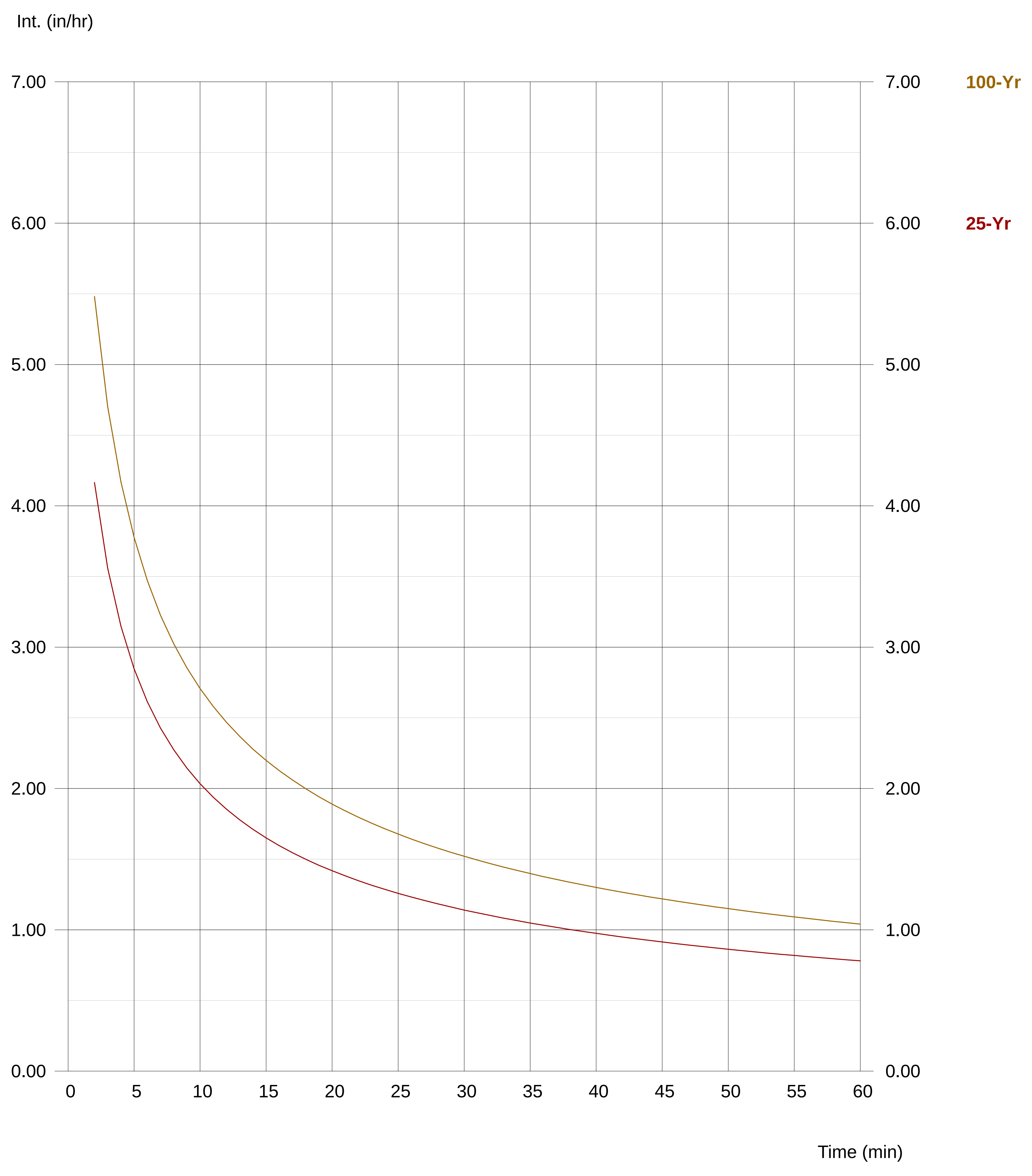
SHEET NO. 3 OF 3

APPENDIX D

Rainfall Intensity/ IDF Curve

Hydraflow IDF Curves

IDF file: IDF Curve (25 and 100 Yr Storm).IDF



Hydraflow IDF Report

Return Period (Yrs)	Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	0.0000	0.0000	0.0000	--------
3	0.0000	0.0000	0.0000	--------
5	0.0000	0.0000	0.0000	--------
10	0.0000	0.0000	0.0000	--------
25	7.8662	1.1000	0.5620	--------
50	0.0000	0.0000	0.0000	--------
100	10.5549	1.2000	0.5633	--------

V:\PCTPA-SA-13143-SR 65 Widening\Reports\Drainage Report\Revised Drainage Analysis\IDF Curve (25 and 100 Yr Storm).IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	2.85	2.03	1.65	1.42	1.26	1.14	1.05	0.97	0.91	0.86	0.82	0.78
50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
100	3.78	2.71	2.20	1.89	1.68	1.52	1.40	1.30	1.22	1.15	1.09	1.04

Tc = time in minutes. Min Tc =

NOAA Atlas 14, Volume 6, Version 2
Location name: Roseville, California, US*
Latitude: 38.7777°, Longitude: -121.2663°
Elevation: 224 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.25** (1.10-1.43)	**1.54** (1.34-1.75)	**1.93** (1.69-2.23)	**2.29** (1.98-2.66)	**2.81** (2.33-3.42)	**3.25** (2.63-4.06)	**3.73** (2.92-4.81)	**4.26** (3.22-5.69)	**5.04** (3.61-7.10)	**5.70** (3.91-8.39)
10-min	**0.894** (0.786-1.03)	**1.10** (0.966-1.26)	**1.39** (1.21-1.60)	**1.64** (1.42-1.91)	**2.02** (1.67-2.45)	**2.33** (1.88-2.91)	**2.67** (2.09-3.44)	**3.05** (2.30-4.08)	**3.61** (2.59-5.09)	**4.08** (2.80-6.01)
15-min	**0.720** (0.636-0.828)	**0.884** (0.776-1.02)	**1.12** (0.980-1.29)	**1.32** (1.15-1.54)	**1.62** (1.35-1.98)	**1.88** (1.52-2.35)	**2.15** (1.68-2.78)	**2.46** (1.86-3.29)	**2.91** (2.08-4.10)	**3.29** (2.26-4.84)
30-min	**0.498** (0.438-0.570)	**0.610** (0.536-0.702)	**0.772** (0.676-0.888)	**0.912** (0.792-1.06)	**1.12** (0.930-1.36)	**1.30** (1.05-1.62)	**1.49** (1.16-1.92)	**1.70** (1.28-2.27)	**2.01** (1.44-2.83)	**2.27** (1.56-3.34)
60-min	**0.341** (0.300-0.391)	**0.419** (0.368-0.481)	**0.529** (0.463-0.609)	**0.626** (0.543-0.729)	**0.769** (0.638-0.935)	**0.888** (0.718-1.11)	**1.02** (0.798-1.31)	**1.16** (0.879-1.56)	**1.38** (0.987-1.94)	**1.56** (1.07-2.29)
2-hr	**0.248** (0.218-0.284)	**0.299** (0.263-0.344)	**0.372** (0.326-0.428)	**0.436** (0.378-0.508)	**0.531** (0.441-0.646)	**0.610** (0.493-0.763)	**0.697** (0.546-0.900)	**0.794** (0.600-1.06)	**0.936** (0.670-1.32)	**1.06** (0.724-1.55)
3-hr	**0.208** (0.183-0.238)	**0.249** (0.219-0.285)	**0.307** (0.269-0.354)	**0.358** (0.311-0.417)	**0.434** (0.360-0.528)	**0.498** (0.402-0.622)	**0.567** (0.444-0.731)	**0.643** (0.486-0.860)	**0.756** (0.542-1.07)	**0.851** (0.584-1.25)
6-hr	**0.152** (0.134-0.175)	**0.182** (0.160-0.209)	**0.223** (0.195-0.257)	**0.258** (0.224-0.301)	**0.311** (0.258-0.378)	**0.354** (0.286-0.443)	**0.401** (0.314-0.518)	**0.453** (0.342-0.606)	**0.528** (0.379-0.744)	**0.591** (0.406-0.870)
12-hr	**0.107** (0.094-0.123)	**0.128** (0.113-0.147)	**0.157** (0.138-0.181)	**0.182** (0.158-0.212)	**0.218** (0.181-0.265)	**0.247** (0.200-0.309)	**0.278** (0.218-0.359)	**0.312** (0.236-0.417)	**0.360** (0.258-0.508)	**0.400** (0.274-0.588)
24-hr	**0.076** (0.069-0.086)	**0.092** (0.084-0.104)	**0.115** (0.103-0.130)	**0.133** (0.119-0.152)	**0.159** (0.137-0.188)	**0.180** (0.152-0.217)	**0.201** (0.166-0.249)	**0.224** (0.180-0.286)	**0.256** (0.197-0.341)	**0.282** (0.209-0.389)
2-day	**0.050** (0.045-0.057)	**0.062** (0.056-0.070)	**0.078** (0.071-0.089)	**0.091** (0.082-0.104)	**0.109** (0.094-0.129)	**0.123** (0.104-0.149)	**0.137** (0.113-0.170)	**0.152** (0.122-0.194)	**0.172** (0.132-0.229)	**0.188** (0.139-0.259)
3-day	**0.039** (0.036-0.044)	**0.050** (0.045-0.056)	**0.063** (0.057-0.071)	**0.074** (0.066-0.084)	**0.088** (0.076-0.104)	**0.099** (0.084-0.120)	**0.111** (0.091-0.137)	**0.122** (0.098-0.155)	**0.137** (0.105-0.183)	**0.149** (0.110-0.205)
4-day	**0.033** (0.030-0.037)	**0.042** (0.038-0.047)	**0.053** (0.048-0.061)	**0.063** (0.056-0.072)	**0.075** (0.065-0.089)	**0.084** (0.071-0.102)	**0.094** (0.077-0.116)	**0.103** (0.082-0.131)	**0.115** (0.088-0.153)	**0.125** (0.092-0.172)
7-day	**0.023** (0.021-0.026)	**0.030** (0.027-0.034)	**0.038** (0.034-0.043)	**0.045** (0.040-0.051)	**0.054** (0.046-0.063)	**0.060** (0.051-0.072)	**0.066** (0.054-0.082)	**0.072** (0.058-0.092)	**0.080** (0.061-0.106)	**0.086** (0.064-0.118)
10-day	**0.018** (0.017-0.021)	**0.024** (0.021-0.027)	**0.031** (0.028-0.035)	**0.036** (0.032-0.041)	**0.043** (0.037-0.050)	**0.048** (0.040-0.057)	**0.052** (0.043-0.065)	**0.057** (0.046-0.073)	**0.063** (0.048-0.084)	**0.067** (0.050-0.093)
20-day	**0.012** (0.011-0.014)	**0.016** (0.014-0.018)	**0.020** (0.018-0.023)	**0.024** (0.021-0.027)	**0.028** (0.024-0.033)	**0.031** (0.026-0.037)	**0.034** (0.028-0.042)	**0.037** (0.030-0.047)	**0.041** (0.031-0.054)	**0.043** (0.032-0.060)
30-day	**0.010** (0.009-0.011)	**0.013** (0.011-0.014)	**0.016** (0.014-0.018)	**0.019** (0.017-0.021)	**0.022** (0.019-0.026)	**0.024** (0.021-0.030)	**0.027** (0.022-0.033)	**0.029** (0.023-0.037)	**0.032** (0.024-0.042)	**0.034** (0.025-0.047)
45-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.011)	**0.013** (0.012-0.015)	**0.015** (0.013-0.017)	**0.017** (0.015-0.021)	**0.019** (0.016-0.023)	**0.021** (0.017-0.026)	**0.023** (0.018-0.029)	**0.025** (0.019-0.033)	**0.026** (0.020-0.037)
60-day	**0.007** (0.007-0.008)	**0.009** (0.008-0.010)	**0.011** (0.010-0.013)	**0.013** (0.012-0.015)	**0.015** (0.013-0.018)	**0.017** (0.014-0.020)	**0.018** (0.015-0.023)	**0.020** (0.016-0.025)	**0.022** (0.017-0.029)	**0.023** (0.017-0.031)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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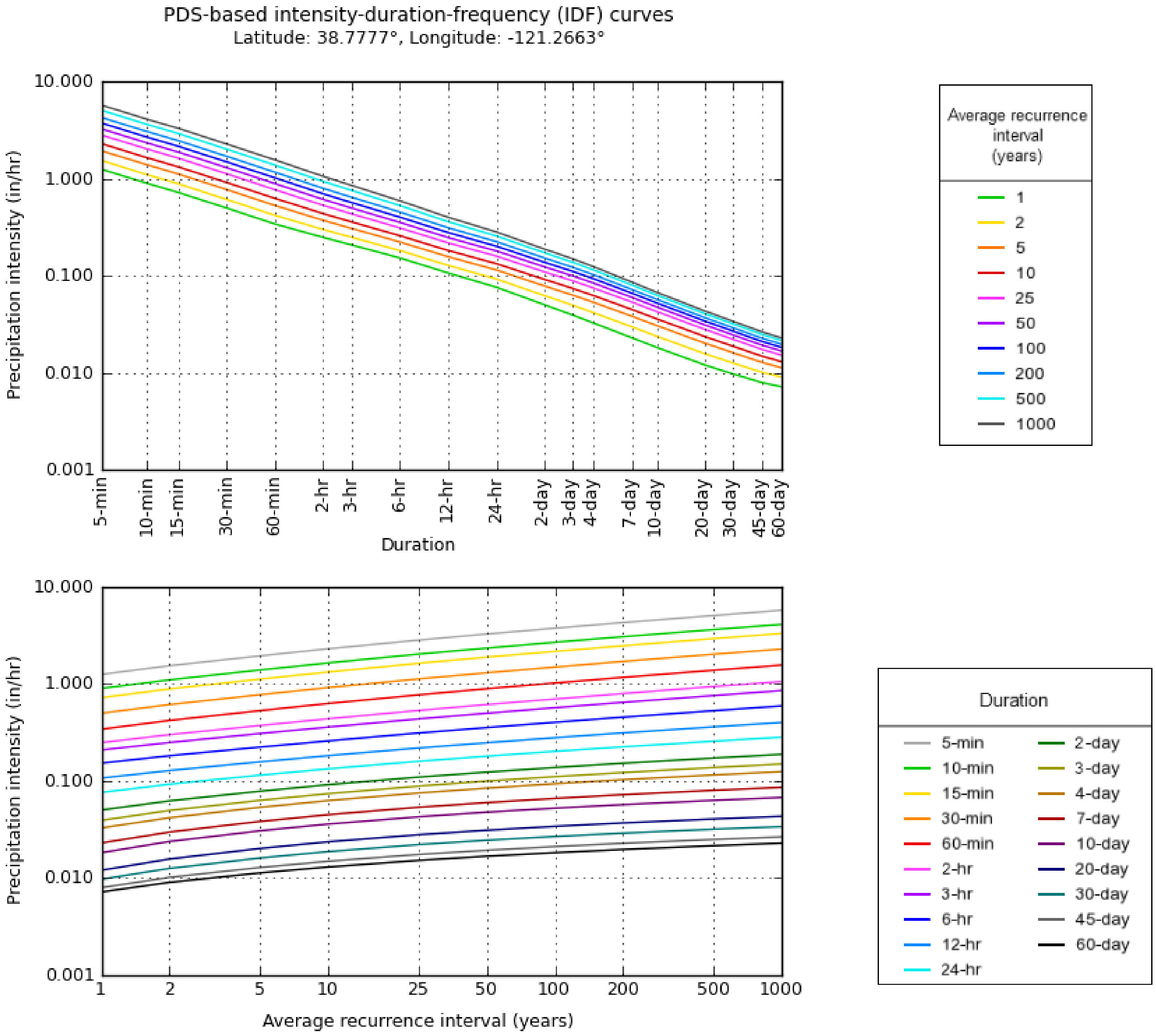
PF graphical



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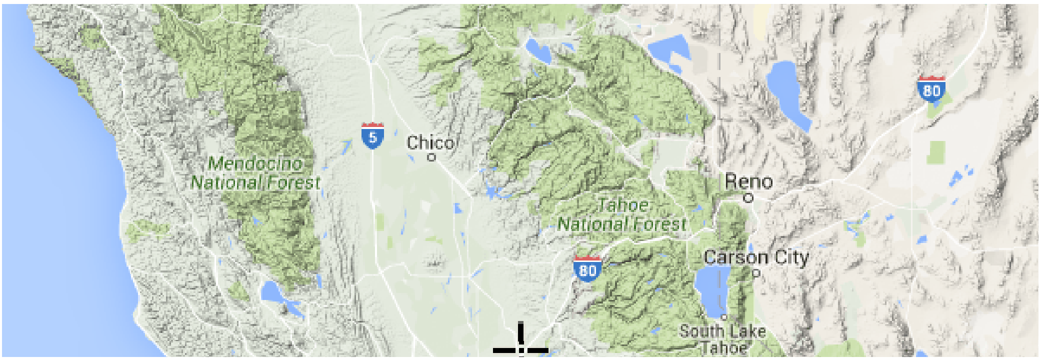
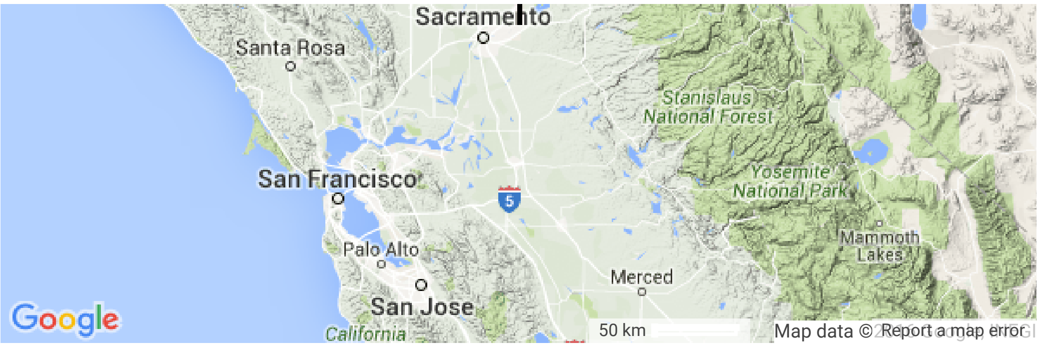
Maps & aerials

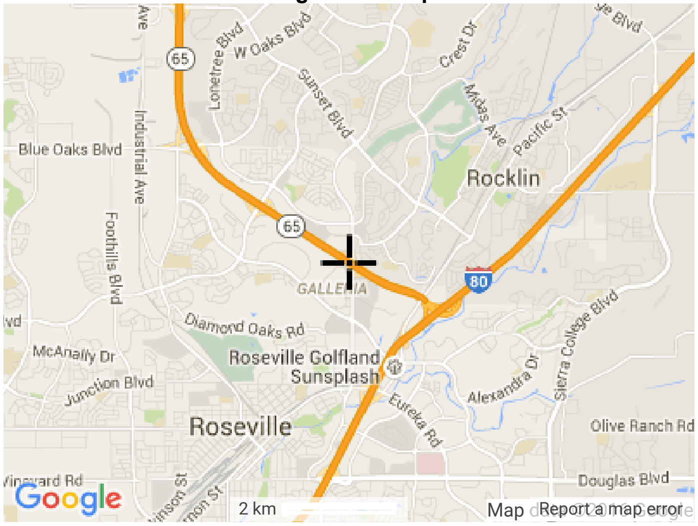
Small scale terrain



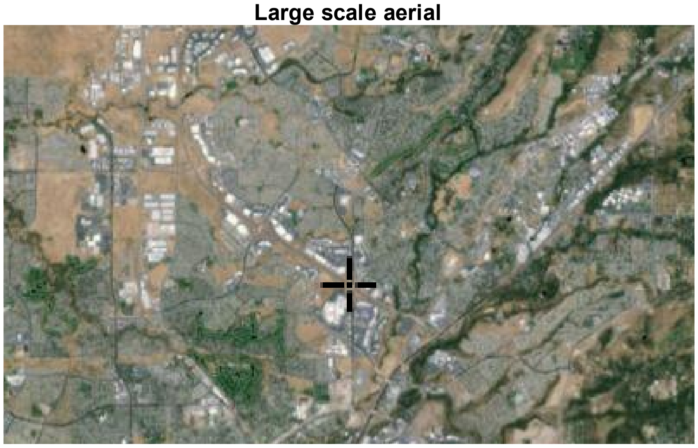


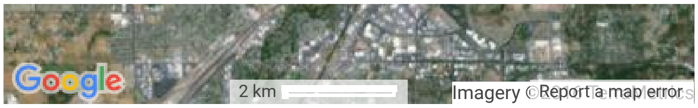
Large scale terrain

Large scale map



Large scale aerial





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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

NOAA Atlas 14, Volume 6, Version 2
Location name: Roseville, California, US*
Latitude: 38.7821°, Longitude: -121.2752°
Elevation: 204 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.25** (1.10-1.43)	**1.54** (1.36-1.75)	**1.93** (1.70-2.22)	**2.29** (1.99-2.66)	**2.81** (2.34-3.42)	**3.25** (2.63-4.06)	**3.73** (2.92-4.80)	**4.25** (3.22-5.69)	**5.03** (3.60-7.09)	**5.69** (3.89-8.38)
10-min	**0.894** (0.792-1.02)	**1.10** (0.966-1.25)	**1.39** (1.22-1.60)	**1.64** (1.43-1.91)	**2.02** (1.68-2.45)	**2.33** (1.88-2.91)	**2.67** (2.09-3.44)	**3.05** (2.30-4.07)	**3.61** (2.58-5.08)	**4.07** (2.79-6.01)
15-min	**0.720** (0.636-0.824)	**0.884** (0.780-1.01)	**1.12** (0.984-1.28)	**1.32** (1.15-1.54)	**1.62** (1.35-1.97)	**1.88** (1.52-2.34)	**2.15** (1.69-2.78)	**2.46** (1.86-3.28)	**2.90** (2.08-4.10)	**3.28** (2.25-4.84)
30-min	**0.498** (0.440-0.568)	**0.610** (0.540-0.698)	**0.772** (0.680-0.886)	**0.914** (0.794-1.06)	**1.12** (0.934-1.36)	**1.30** (1.05-1.62)	**1.49** (1.16-1.92)	**1.70** (1.28-2.27)	**2.01** (1.44-2.83)	**2.27** (1.55-3.34)
60-min	**0.341** (0.301-0.389)	**0.418** (0.369-0.479)	**0.529** (0.465-0.607)	**0.626** (0.544-0.727)	**0.769** (0.640-0.933)	**0.888** (0.719-1.11)	**1.02** (0.798-1.31)	**1.16** (0.878-1.55)	**1.37** (0.983-1.94)	**1.55** (1.06-2.29)
2-hr	**0.248** (0.219-0.283)	**0.299** (0.264-0.342)	**0.372** (0.327-0.426)	**0.436** (0.379-0.506)	**0.530** (0.442-0.644)	**0.610** (0.494-0.762)	**0.697** (0.546-0.898)	**0.793** (0.599-1.06)	**0.934** (0.669-1.32)	**1.05** (0.722-1.55)
3-hr	**0.207** (0.183-0.237)	**0.248** (0.219-0.284)	**0.307** (0.270-0.352)	**0.358** (0.312-0.416)	**0.434** (0.361-0.527)	**0.498** (0.403-0.621)	**0.567** (0.444-0.731)	**0.643** (0.486-0.860)	**0.756** (0.541-1.07)	**0.851** (0.583-1.25)
6-hr	**0.152** (0.135-0.174)	**0.181** (0.160-0.207)	**0.222** (0.196-0.255)	**0.258** (0.225-0.300)	**0.310** (0.258-0.377)	**0.354** (0.286-0.442)	**0.401** (0.314-0.517)	**0.452** (0.342-0.605)	**0.528** (0.378-0.745)	**0.591** (0.405-0.871)
12-hr	**0.107** (0.094-0.122)	**0.128** (0.113-0.146)	**0.157** (0.138-0.180)	**0.182** (0.158-0.211)	**0.217** (0.181-0.264)	**0.247** (0.200-0.308)	**0.278** (0.218-0.358)	**0.311** (0.235-0.416)	**0.359** (0.257-0.507)	**0.399** (0.273-0.588)
24-hr	**0.076** (0.069-0.085)	**0.092** (0.083-0.104)	**0.114** (0.103-0.129)	**0.133** (0.119-0.151)	**0.159** (0.137-0.187)	**0.179** (0.152-0.216)	**0.201** (0.166-0.248)	**0.224** (0.179-0.285)	**0.255** (0.196-0.340)	**0.281** (0.208-0.387)
2-day	**0.050** (0.045-0.056)	**0.062** (0.056-0.070)	**0.078** (0.070-0.088)	**0.091** (0.082-0.104)	**0.109** (0.094-0.129)	**0.123** (0.104-0.148)	**0.137** (0.113-0.169)	**0.151** (0.121-0.193)	**0.171** (0.131-0.228)	**0.187** (0.138-0.257)
3-day	**0.039** (0.035-0.044)	**0.049** (0.045-0.056)	**0.063** (0.057-0.071)	**0.074** (0.066-0.084)	**0.088** (0.076-0.104)	**0.099** (0.084-0.120)	**0.110** (0.091-0.136)	**0.122** (0.097-0.155)	**0.137** (0.105-0.182)	**0.148** (0.110-0.204)
4-day	**0.033** (0.030-0.037)	**0.042** (0.038-0.047)	**0.053** (0.048-0.060)	**0.063** (0.056-0.071)	**0.075** (0.065-0.088)	**0.084** (0.071-0.101)	**0.093** (0.077-0.115)	**0.102** (0.082-0.130)	**0.115** (0.088-0.153)	**0.124** (0.092-0.171)
7-day	**0.023** (0.021-0.026)	**0.030** (0.027-0.033)	**0.038** (0.034-0.043)	**0.045** (0.040-0.051)	**0.053** (0.046-0.063)	**0.060** (0.050-0.072)	**0.066** (0.054-0.081)	**0.072** (0.058-0.092)	**0.080** (0.061-0.106)	**0.086** (0.063-0.118)
10-day	**0.018** (0.016-0.020)	**0.024** (0.021-0.027)	**0.031** (0.028-0.035)	**0.036** (0.032-0.041)	**0.043** (0.037-0.050)	**0.047** (0.040-0.057)	**0.052** (0.043-0.065)	**0.057** (0.046-0.072)	**0.063** (0.048-0.083)	**0.067** (0.050-0.093)
20-day	**0.012** (0.011-0.013)	**0.016** (0.014-0.018)	**0.020** (0.018-0.023)	**0.024** (0.021-0.027)	**0.028** (0.024-0.033)	**0.031** (0.026-0.037)	**0.034** (0.028-0.042)	**0.037** (0.029-0.047)	**0.040** (0.031-0.054)	**0.043** (0.032-0.059)
30-day	**0.010** (0.009-0.011)	**0.013** (0.011-0.014)	**0.016** (0.014-0.018)	**0.019** (0.017-0.021)	**0.022** (0.019-0.026)	**0.024** (0.021-0.029)	**0.027** (0.022-0.033)	**0.029** (0.023-0.037)	**0.032** (0.024-0.042)	**0.034** (0.025-0.046)
45-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.011)	**0.013** (0.012-0.014)	**0.015** (0.013-0.017)	**0.017** (0.015-0.021)	**0.019** (0.016-0.023)	**0.021** (0.017-0.026)	**0.023** (0.018-0.029)	**0.025** (0.019-0.033)	**0.026** (0.020-0.036)
60-day	**0.007** (0.006-0.008)	**0.009** (0.008-0.010)	**0.011** (0.010-0.013)	**0.013** (0.012-0.015)	**0.015** (0.013-0.018)	**0.017** (0.014-0.020)	**0.018** (0.015-0.022)	**0.020** (0.016-0.025)	**0.021** (0.016-0.029)	**0.023** (0.017-0.031)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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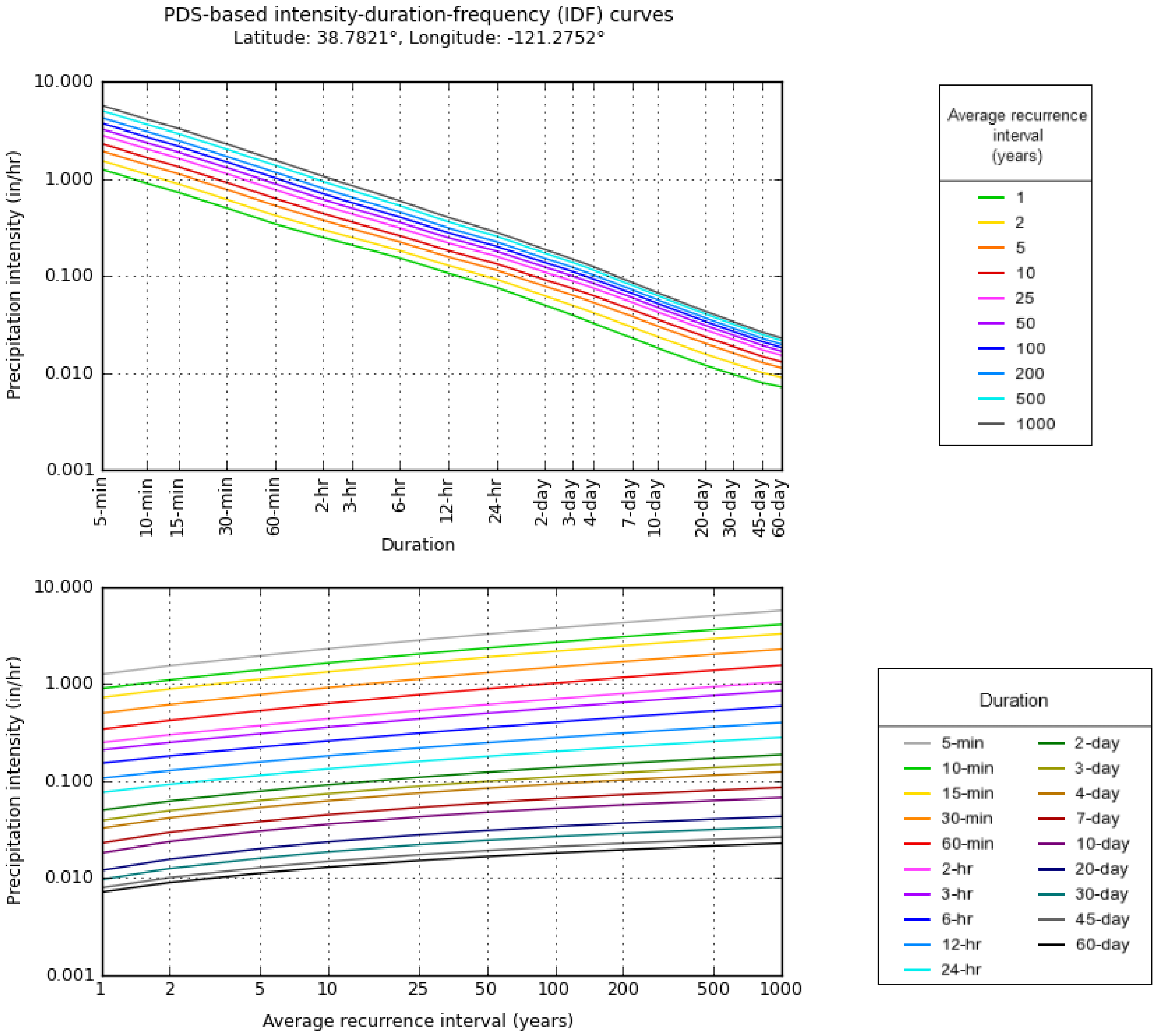
PF graphical



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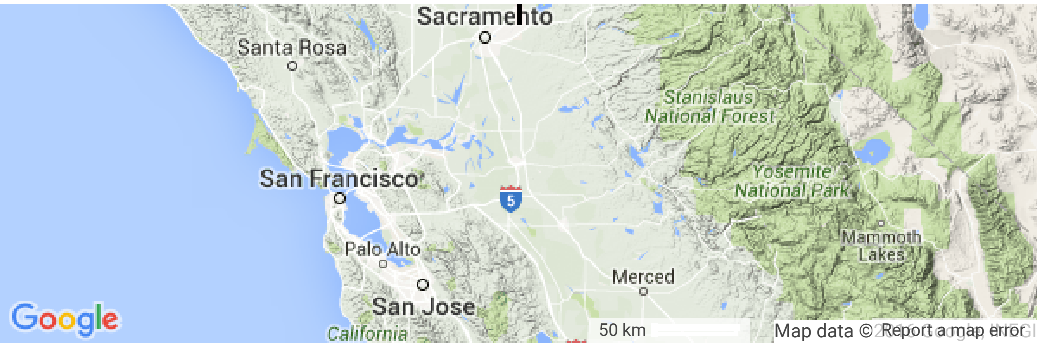
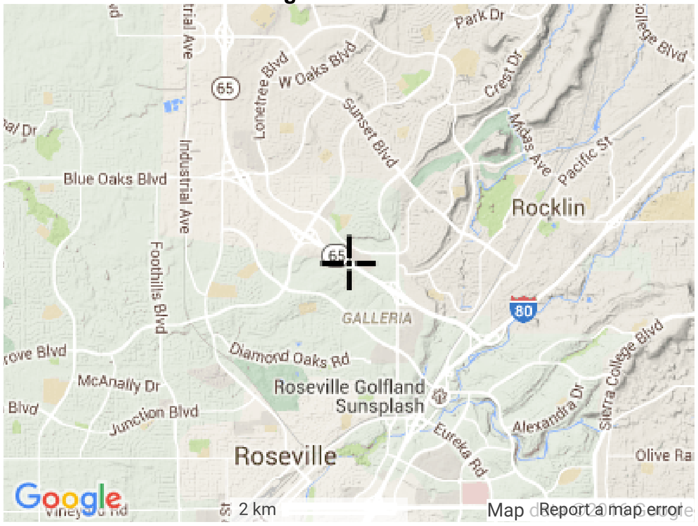
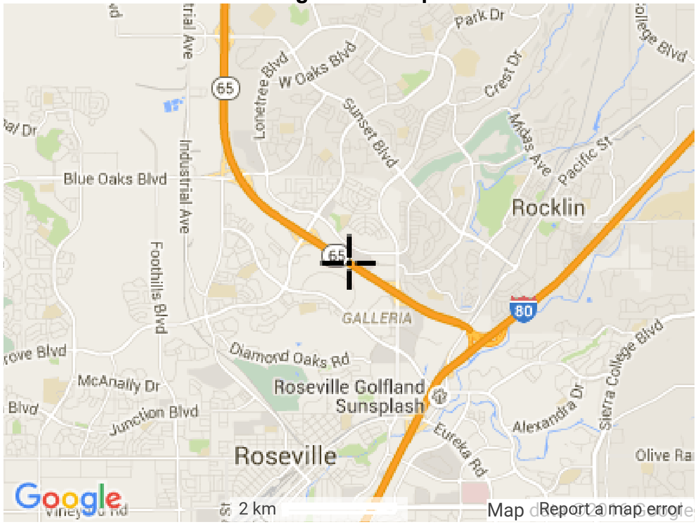
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

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National Oceanic and Atmospheric Administration
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1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

NOAA Atlas 14, Volume 6, Version 2
Location name: Roseville, California, US*
Latitude: 38.7868°, Longitude: -121.2846°
Elevation: 169 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.26** (1.12-1.43)	**1.54** (1.36-1.75)	**1.94** (1.72-2.23)	**2.30** (2.00-2.66)	**2.82** (2.35-3.42)	**3.26** (2.64-4.07)	**3.74** (2.94-4.82)	**4.27** (3.23-5.71)	**5.06** (3.62-7.14)	**5.72** (3.92-8.45)
10-min	**0.900** (0.798-1.03)	**1.10** (0.978-1.26)	**1.39** (1.23-1.60)	**1.65** (1.43-1.91)	**2.02** (1.69-2.45)	**2.34** (1.90-2.92)	**2.68** (2.11-3.46)	**3.07** (2.32-4.10)	**3.63** (2.60-5.12)	**4.10** (2.81-6.06)
15-min	**0.724** (0.644-0.828)	**0.888** (0.788-1.02)	**1.12** (0.988-1.29)	**1.33** (1.16-1.54)	**1.63** (1.36-1.98)	**1.88** (1.53-2.35)	**2.16** (1.70-2.79)	**2.47** (1.87-3.30)	**2.92** (2.09-4.13)	**3.31** (2.26-4.88)
30-min	**0.500** (0.444-0.570)	**0.614** (0.544-0.702)	**0.776** (0.684-0.890)	**0.918** (0.800-1.06)	**1.13** (0.940-1.37)	**1.30** (1.06-1.63)	**1.50** (1.17-1.93)	**1.71** (1.29-2.28)	**2.02** (1.45-2.85)	**2.29** (1.57-3.38)
60-min	**0.343** (0.304-0.391)	**0.421** (0.372-0.481)	**0.532** (0.469-0.609)	**0.629** (0.548-0.729)	**0.773** (0.644-0.937)	**0.893** (0.723-1.11)	**1.02** (0.803-1.32)	**1.17** (0.884-1.56)	**1.39** (0.991-1.96)	**1.57** (1.07-2.31)
2-hr	**0.250** (0.221-0.284)	**0.301** (0.266-0.344)	**0.374** (0.330-0.428)	**0.438** (0.382-0.508)	**0.533** (0.444-0.646)	**0.612** (0.496-0.764)	**0.700** (0.548-0.902)	**0.796** (0.602-1.06)	**0.938** (0.672-1.32)	**1.06** (0.724-1.56)
3-hr	**0.209** (0.185-0.238)	**0.250** (0.221-0.285)	**0.308** (0.272-0.353)	**0.360** (0.313-0.417)	**0.436** (0.363-0.528)	**0.499** (0.404-0.622)	**0.568** (0.446-0.732)	**0.645** (0.487-0.862)	**0.758** (0.542-1.07)	**0.853** (0.584-1.26)
6-hr	**0.153** (0.136-0.175)	**0.182** (0.161-0.208)	**0.223** (0.197-0.256)	**0.259** (0.226-0.300)	**0.311** (0.259-0.378)	**0.355** (0.287-0.443)	**0.402** (0.315-0.518)	**0.453** (0.342-0.606)	**0.529** (0.378-0.746)	**0.592** (0.405-0.873)
12-hr	**0.107** (0.095-0.122)	**0.128** (0.113-0.146)	**0.157** (0.139-0.180)	**0.182** (0.159-0.211)	**0.218** (0.182-0.265)	**0.248** (0.200-0.309)	**0.279** (0.218-0.359)	**0.312** (0.236-0.417)	**0.360** (0.258-0.509)	**0.400** (0.274-0.590)
24-hr	**0.076** (0.069-0.085)	**0.092** (0.084-0.104)	**0.115** (0.104-0.130)	**0.133** (0.119-0.152)	**0.159** (0.138-0.188)	**0.180** (0.153-0.217)	**0.202** (0.167-0.249)	**0.225** (0.180-0.286)	**0.257** (0.197-0.341)	**0.282** (0.209-0.389)
2-day	**0.050** (0.045-0.056)	**0.062** (0.056-0.070)	**0.078** (0.071-0.088)	**0.091** (0.082-0.104)	**0.109** (0.094-0.129)	**0.123** (0.104-0.148)	**0.137** (0.113-0.169)	**0.152** (0.122-0.193)	**0.172** (0.132-0.228)	**0.187** (0.139-0.258)
3-day	**0.039** (0.035-0.044)	**0.049** (0.045-0.056)	**0.063** (0.057-0.071)	**0.074** (0.066-0.084)	**0.088** (0.076-0.104)	**0.099** (0.084-0.119)	**0.110** (0.091-0.136)	**0.121** (0.097-0.154)	**0.137** (0.105-0.181)	**0.148** (0.110-0.204)
4-day	**0.033** (0.030-0.037)	**0.042** (0.038-0.047)	**0.053** (0.048-0.060)	**0.062** (0.056-0.071)	**0.075** (0.065-0.088)	**0.084** (0.071-0.101)	**0.093** (0.077-0.115)	**0.102** (0.082-0.130)	**0.114** (0.088-0.152)	**0.124** (0.092-0.170)
7-day	**0.023** (0.021-0.026)	**0.030** (0.027-0.033)	**0.038** (0.034-0.043)	**0.045** (0.040-0.051)	**0.053** (0.046-0.063)	**0.059** (0.050-0.072)	**0.066** (0.054-0.081)	**0.072** (0.057-0.091)	**0.079** (0.061-0.106)	**0.085** (0.063-0.117)
10-day	**0.018** (0.016-0.020)	**0.024** (0.021-0.027)	**0.030** (0.027-0.034)	**0.036** (0.032-0.041)	**0.042** (0.037-0.050)	**0.047** (0.040-0.057)	**0.052** (0.043-0.064)	**0.057** (0.045-0.072)	**0.062** (0.048-0.083)	**0.067** (0.050-0.092)
20-day	**0.012** (0.011-0.013)	**0.016** (0.014-0.018)	**0.020** (0.018-0.023)	**0.023** (0.021-0.027)	**0.028** (0.024-0.033)	**0.031** (0.026-0.037)	**0.034** (0.028-0.042)	**0.037** (0.029-0.047)	**0.040** (0.031-0.053)	**0.043** (0.032-0.059)
30-day	**0.010** (0.009-0.011)	**0.012** (0.011-0.014)	**0.016** (0.014-0.018)	**0.019** (0.017-0.021)	**0.022** (0.019-0.026)	**0.024** (0.021-0.029)	**0.027** (0.022-0.033)	**0.029** (0.023-0.037)	**0.032** (0.024-0.042)	**0.034** (0.025-0.046)
45-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.011)	**0.013** (0.012-0.014)	**0.015** (0.013-0.017)	**0.017** (0.015-0.020)	**0.019** (0.016-0.023)	**0.021** (0.017-0.026)	**0.023** (0.018-0.029)	**0.025** (0.019-0.033)	**0.026** (0.019-0.036)
60-day	**0.007** (0.006-0.008)	**0.009** (0.008-0.010)	**0.011** (0.010-0.013)	**0.013** (0.012-0.015)	**0.015** (0.013-0.018)	**0.017** (0.014-0.020)	**0.018** (0.015-0.022)	**0.020** (0.016-0.025)	**0.021** (0.016-0.028)	**0.023** (0.017-0.031)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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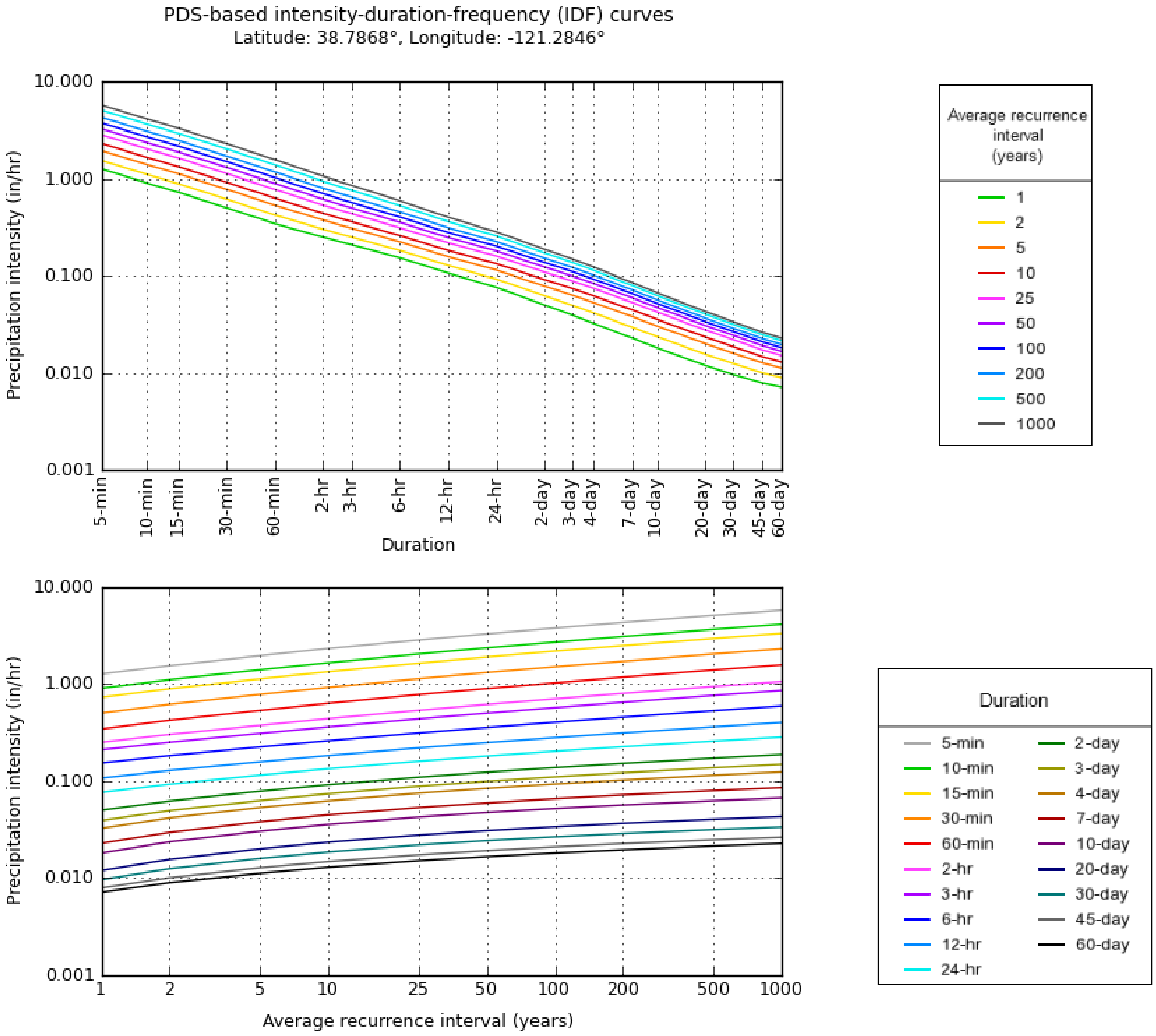
PF graphical



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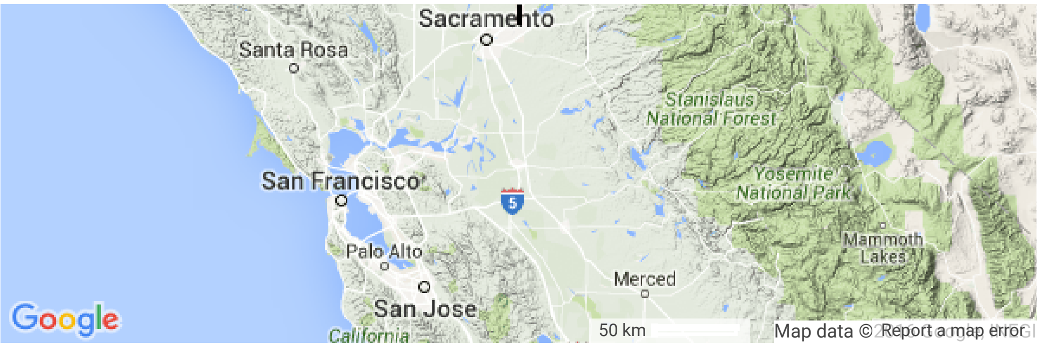
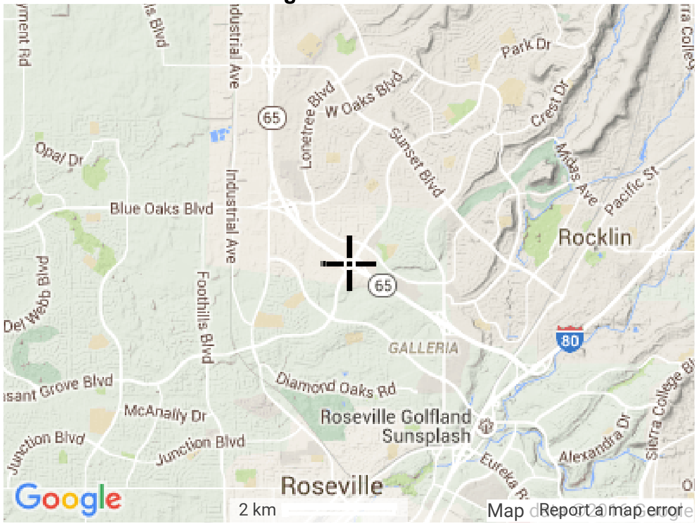
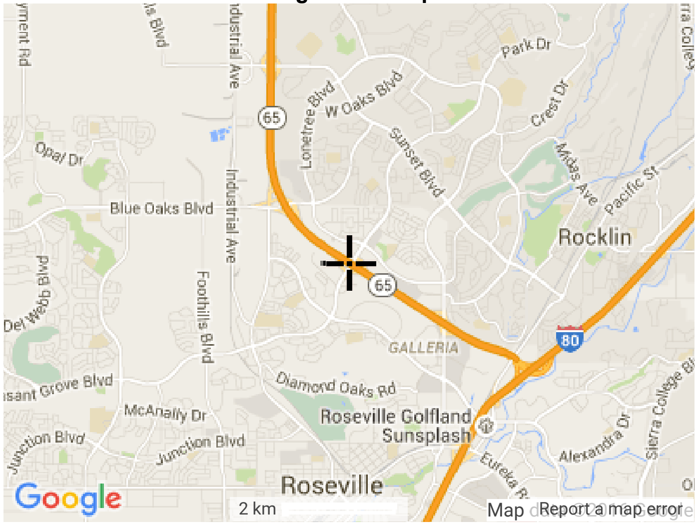


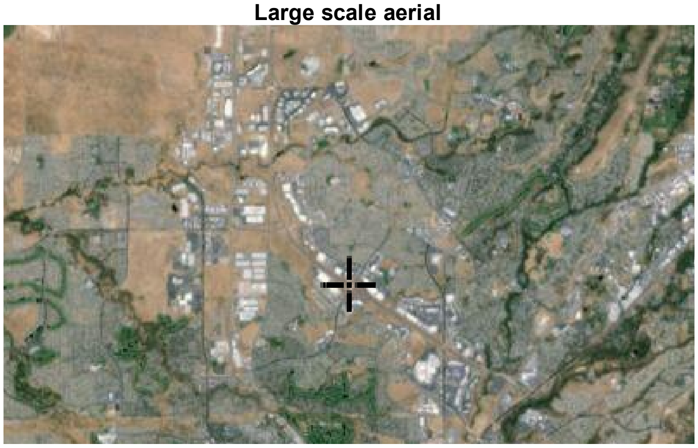
Large scale terrain



Large scale map



Large scale aerial



NOAA Atlas 14, Volume 6, Version 2
Location name: Rocklin, California, US*
Latitude: 38.7960°, Longitude: -121.2976°
Elevation: 121 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**1.26** (1.13-1.43)	**1.55** (1.38-1.76)	**1.96** (1.74-2.23)	**2.32** (2.03-2.68)	**2.86** (2.39-3.44)	**3.30** (2.68-4.10)	**3.79** (2.98-4.87)	**4.33** (3.28-5.80)	**5.15** (3.67-7.28)	**5.83** (3.97-8.64)
10-min	**0.906** (0.810-1.03)	**1.11** (0.990-1.26)	**1.40** (1.25-1.60)	**1.66** (1.46-1.91)	**2.05** (1.71-2.47)	**2.36** (1.92-2.94)	**2.72** (2.13-3.50)	**3.11** (2.35-4.16)	**3.69** (2.63-5.21)	**4.18** (2.85-6.19)
15-min	**0.732** (0.652-0.828)	**0.896** (0.800-1.02)	**1.13** (1.00-1.29)	**1.34** (1.18-1.54)	**1.65** (1.38-1.99)	**1.91** (1.55-2.37)	**2.19** (1.72-2.82)	**2.50** (1.89-3.35)	**2.97** (2.12-4.21)	**3.37** (2.30-5.00)
30-min	**0.506** (0.452-0.572)	**0.620** (0.552-0.704)	**0.784** (0.696-0.892)	**0.928** (0.814-1.07)	**1.14** (0.954-1.38)	**1.32** (1.07-1.64)	**1.52** (1.19-1.95)	**1.73** (1.31-2.32)	**2.06** (1.47-2.91)	**2.33** (1.59-3.46)
60-min	**0.346** (0.309-0.392)	**0.424** (0.378-0.481)	**0.536** (0.475-0.610)	**0.634** (0.556-0.731)	**0.780** (0.653-0.942)	**0.903** (0.733-1.12)	**1.04** (0.814-1.33)	**1.19** (0.896-1.59)	**1.41** (1.00-1.99)	**1.59** (1.09-2.36)
2-hr	**0.252** (0.224-0.285)	**0.303** (0.270-0.344)	**0.376** (0.334-0.429)	**0.442** (0.387-0.508)	**0.538** (0.450-0.649)	**0.618** (0.502-0.768)	**0.706** (0.554-0.908)	**0.804** (0.608-1.07)	**0.948** (0.678-1.34)	**1.07** (0.730-1.59)
3-hr	**0.210** (0.187-0.238)	**0.251** (0.224-0.285)	**0.310** (0.275-0.353)	**0.362** (0.318-0.417)	**0.439** (0.367-0.530)	**0.503** (0.408-0.625)	**0.572** (0.450-0.737)	**0.650** (0.491-0.869)	**0.764** (0.545-1.08)	**0.860** (0.586-1.27)
6-hr	**0.154** (0.137-0.174)	**0.183** (0.163-0.208)	**0.224** (0.199-0.256)	**0.260** (0.228-0.300)	**0.313** (0.262-0.378)	**0.357** (0.290-0.443)	**0.404** (0.317-0.519)	**0.455** (0.344-0.609)	**0.531** (0.379-0.751)	**0.594** (0.405-0.881)
12-hr	**0.107** (0.095-0.121)	**0.128** (0.114-0.145)	**0.158** (0.140-0.180)	**0.183** (0.161-0.211)	**0.219** (0.184-0.265)	**0.249** (0.202-0.309)	**0.280** (0.220-0.360)	**0.314** (0.237-0.419)	**0.362** (0.258-0.512)	**0.401** (0.273-0.594)
24-hr	**0.075** (0.069-0.085)	**0.092** (0.084-0.104)	**0.115** (0.104-0.130)	**0.134** (0.120-0.152)	**0.160** (0.139-0.189)	**0.181** (0.154-0.218)	**0.203** (0.168-0.251)	**0.226** (0.181-0.287)	**0.258** (0.198-0.342)	**0.283** (0.210-0.390)
2-day	**0.050** (0.045-0.056)	**0.062** (0.056-0.069)	**0.078** (0.071-0.088)	**0.091** (0.082-0.104)	**0.109** (0.094-0.128)	**0.123** (0.104-0.148)	**0.137** (0.113-0.169)	**0.152** (0.122-0.193)	**0.171** (0.132-0.228)	**0.187** (0.139-0.257)
3-day	**0.039** (0.035-0.043)	**0.049** (0.045-0.055)	**0.062** (0.056-0.070)	**0.073** (0.066-0.083)	**0.088** (0.076-0.103)	**0.099** (0.084-0.119)	**0.110** (0.091-0.135)	**0.121** (0.097-0.154)	**0.136** (0.104-0.181)	**0.148** (0.109-0.203)
4-day	**0.032** (0.029-0.036)	**0.041** (0.037-0.046)	**0.053** (0.048-0.059)	**0.062** (0.055-0.070)	**0.074** (0.064-0.087)	**0.083** (0.070-0.100)	**0.092** (0.076-0.114)	**0.101** (0.081-0.129)	**0.114** (0.087-0.151)	**0.123** (0.091-0.169)
7-day	**0.023** (0.021-0.025)	**0.029** (0.027-0.033)	**0.038** (0.034-0.042)	**0.044** (0.040-0.050)	**0.053** (0.046-0.062)	**0.059** (0.050-0.071)	**0.065** (0.054-0.080)	**0.071** (0.057-0.090)	**0.079** (0.060-0.105)	**0.085** (0.063-0.116)
10-day	**0.018** (0.016-0.020)	**0.023** (0.021-0.026)	**0.030** (0.027-0.034)	**0.035** (0.032-0.040)	**0.042** (0.036-0.049)	**0.047** (0.040-0.056)	**0.051** (0.042-0.063)	**0.056** (0.045-0.071)	**0.062** (0.047-0.082)	**0.066** (0.049-0.091)
20-day	**0.012** (0.011-0.013)	**0.015** (0.014-0.017)	**0.020** (0.018-0.022)	**0.023** (0.021-0.026)	**0.027** (0.024-0.032)	**0.030** (0.026-0.037)	**0.033** (0.028-0.041)	**0.036** (0.029-0.046)	**0.040** (0.031-0.053)	**0.042** (0.031-0.058)
30-day	**0.010** (0.009-0.011)	**0.012** (0.011-0.014)	**0.016** (0.014-0.018)	**0.018** (0.016-0.021)	**0.022** (0.019-0.025)	**0.024** (0.020-0.029)	**0.026** (0.022-0.032)	**0.028** (0.023-0.036)	**0.031** (0.024-0.041)	**0.033** (0.025-0.046)
45-day	**0.008** (0.007-0.009)	**0.010** (0.009-0.011)	**0.013** (0.011-0.014)	**0.015** (0.013-0.017)	**0.017** (0.015-0.020)	**0.019** (0.016-0.023)	**0.021** (0.017-0.026)	**0.022** (0.018-0.028)	**0.024** (0.019-0.033)	**0.026** (0.019-0.036)
60-day	**0.007** (0.006-0.008)	**0.009** (0.008-0.010)	**0.011** (0.010-0.012)	**0.013** (0.011-0.015)	**0.015** (0.013-0.018)	**0.016** (0.014-0.020)	**0.018** (0.015-0.022)	**0.019** (0.016-0.025)	**0.021** (0.016-0.028)	**0.022** (0.017-0.031)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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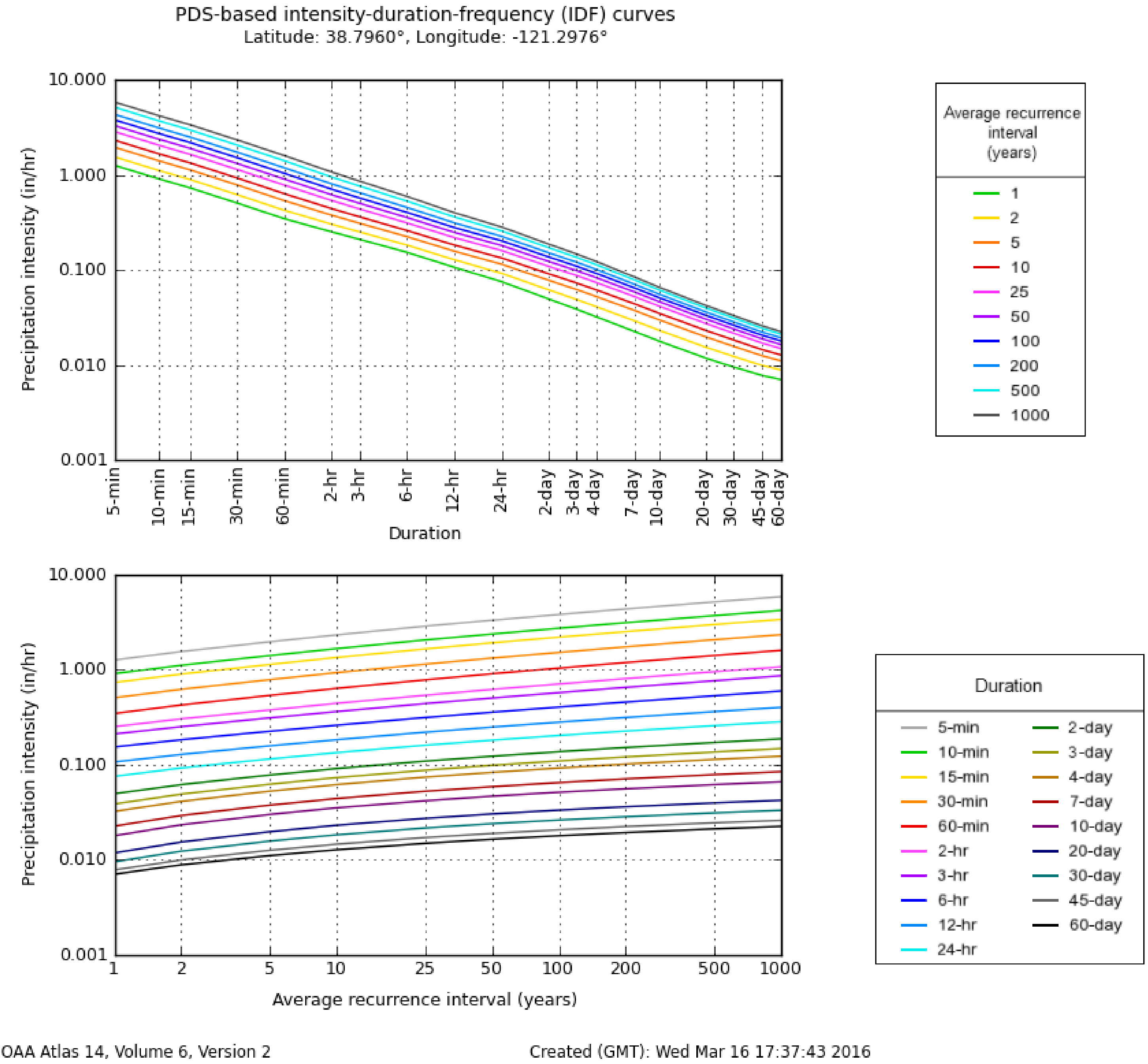
PF graphical


PDS-based intensity-duration-frequency (IDF) curves
Latitude: 38.7960°, Longitude: -121.2976°

NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Mar 16 17:37:43 2016

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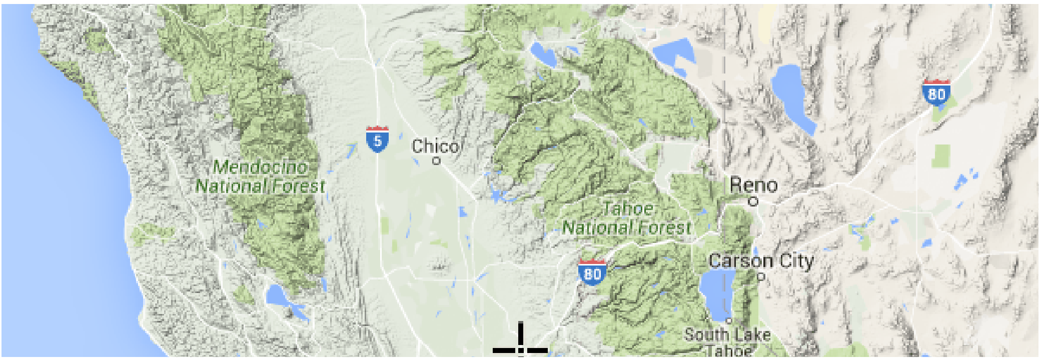
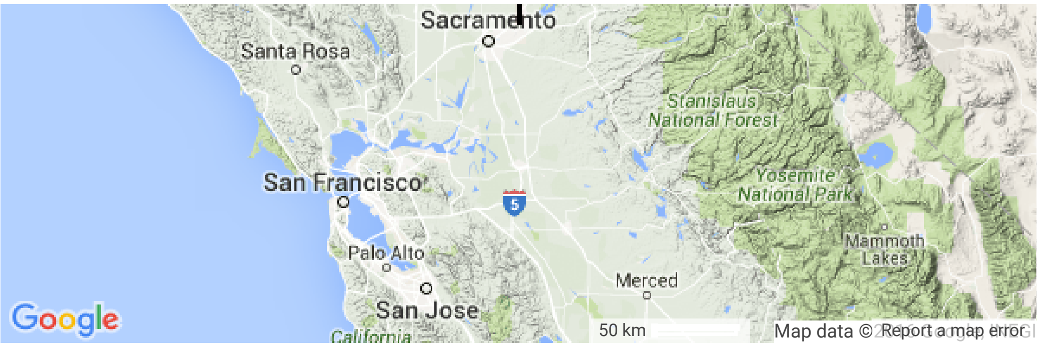
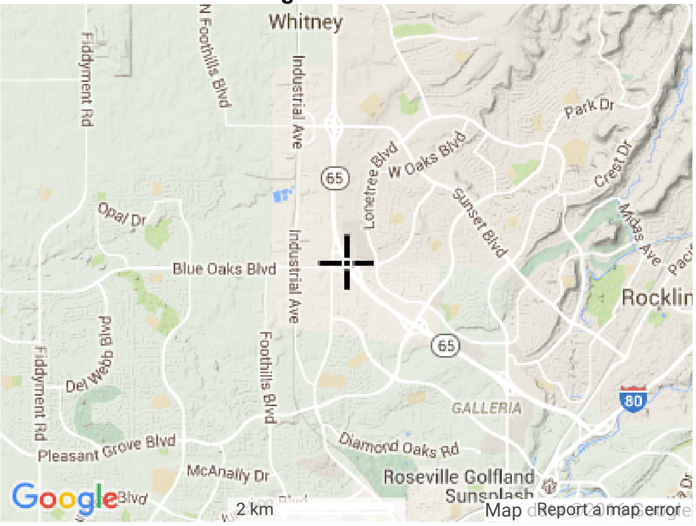
Maps & aerials

Small scale terrain

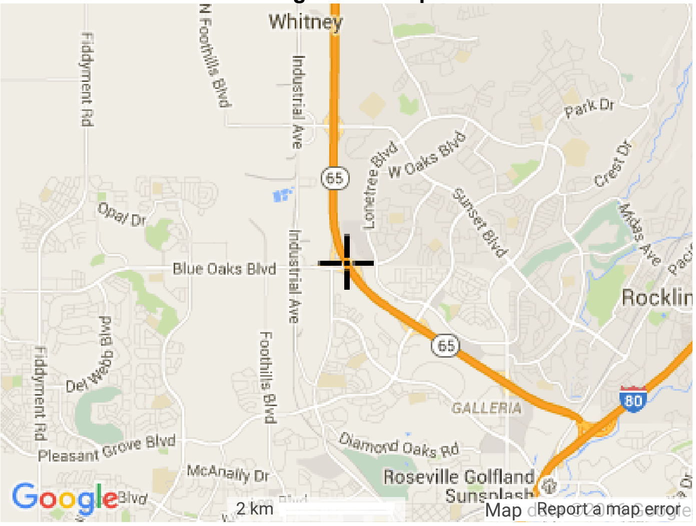




Large scale terrain



Large scale map



Large scale aerial

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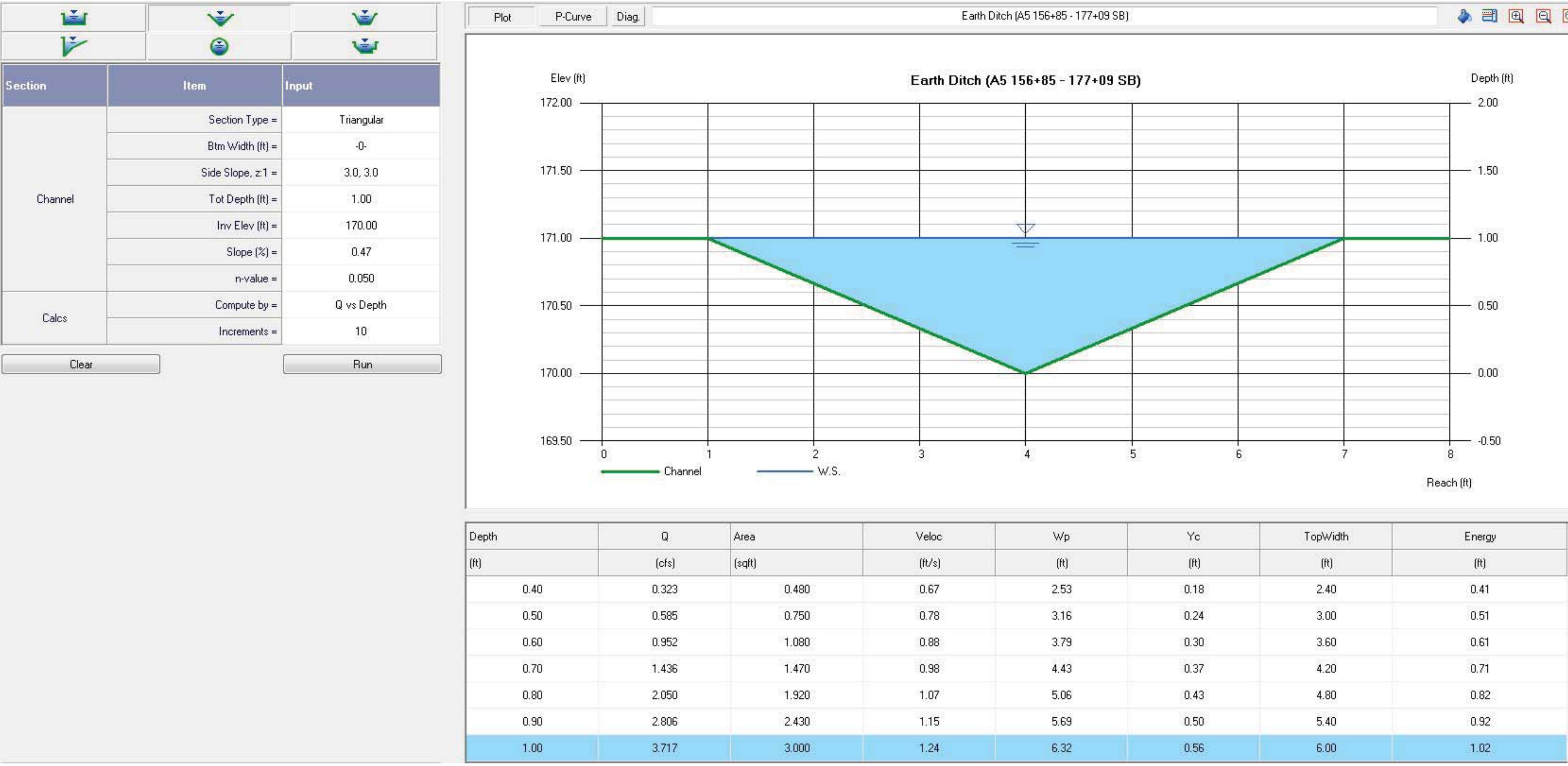
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

APPENDIX E

Hydraflow Calculations

- E1 – Hydraflow Calculations – Subwatershed A
- E2 – Hydraflow Calculations – Subwatershed B
- E3 – Hydraflow Calculations – Subwatershed C
- E4 – Hydraflow Calculations – Subwatershed D
- E5 – Hydraflow Calculations – Subwatershed E
- E6 – Hydraflow Calculations – Subwatershed H
- E7 – Hydraflow Calculations – Subwatershed J

E1 – Hydraflow Calculations – Subwatershed A



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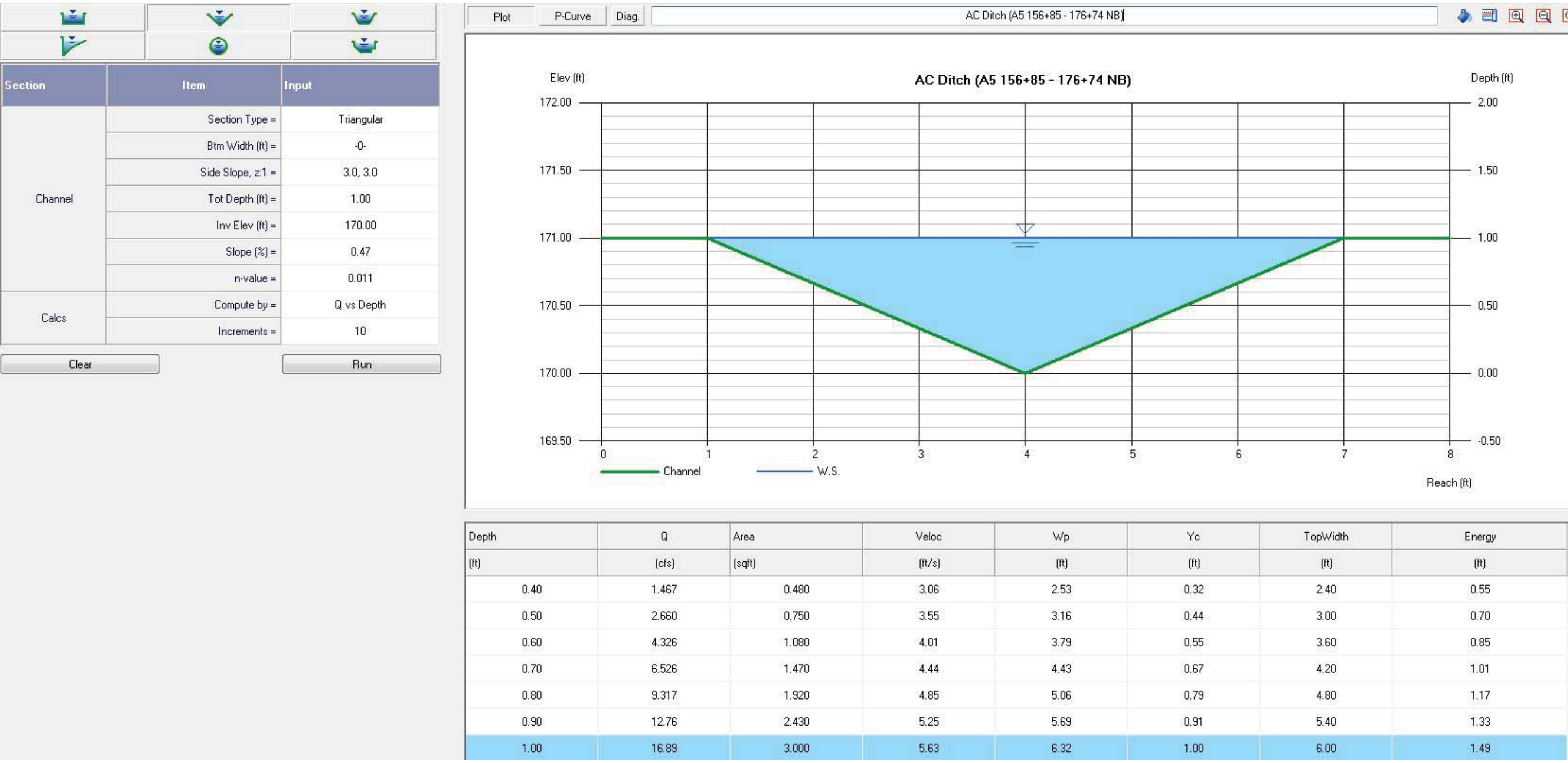
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.47
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.40	0.323	0.480	0.67	2.53	0.18	2.40	0.41
0.50	0.585	0.750	0.78	3.16	0.24	3.00	0.51
0.60	0.952	1.080	0.88	3.79	0.30	3.60	0.61
0.70	1.436	1.470	0.98	4.43	0.37	4.20	0.71
0.80	2.050	1.920	1.07	5.06	0.43	4.80	0.82
0.90	2.806	2.430	1.15	5.69	0.50	5.40	0.92
1.00	3.717	3.000	1.24	6.32	0.56	6.00	1.02



AC Ditch (A5 156+85 - 176+74 NB)

Section	Item	Input
Channel	Section Type =	Triangular
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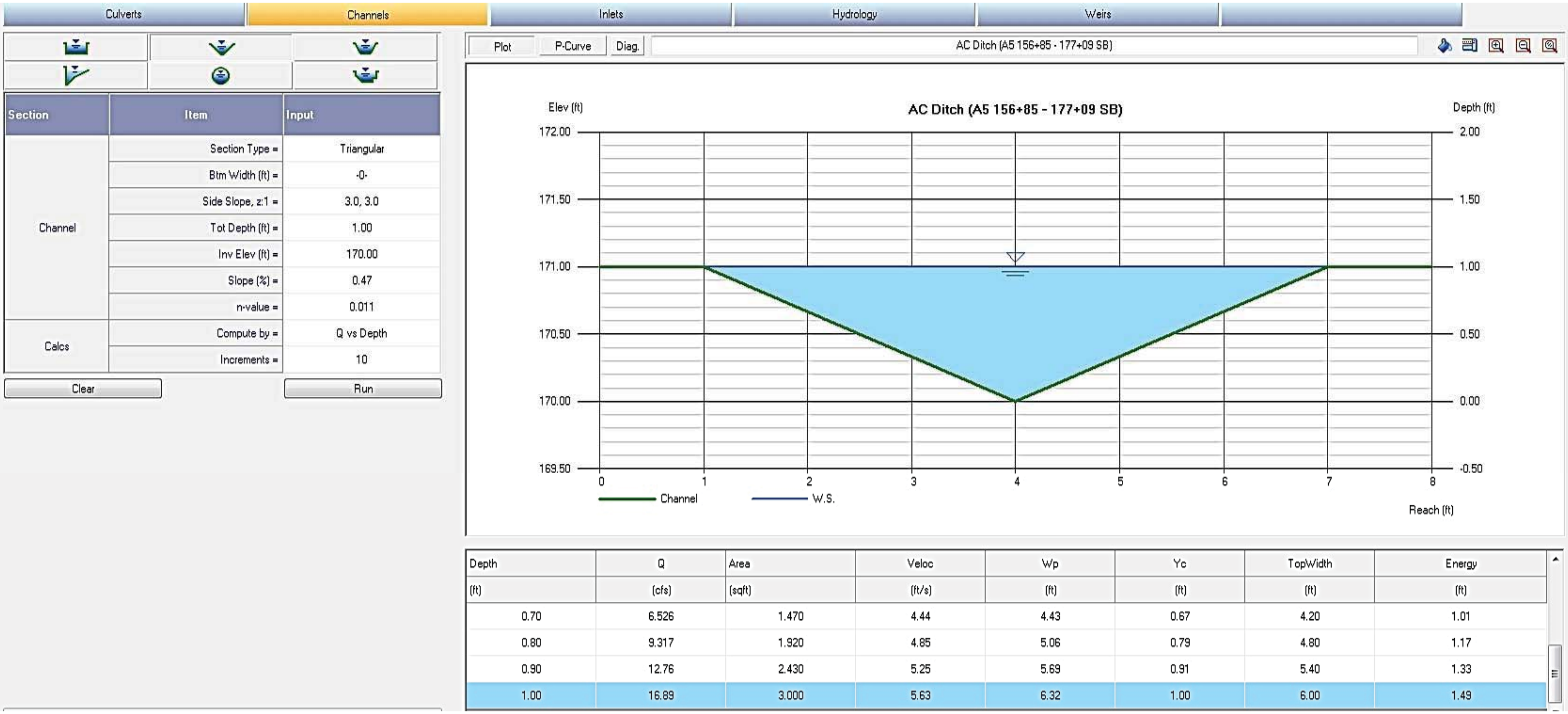
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.47
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.40	1.467	0.480	3.06	2.53	0.32	2.40	0.55
0.50	2.660	0.750	3.55	3.16	0.44	3.00	0.70
0.60	4.326	1.080	4.01	3.79	0.55	3.60	0.85
0.70	6.526	1.470	4.44	4.43	0.67	4.20	1.01
0.80	9.317	1.920	4.85	5.06	0.79	4.80	1.17
0.90	12.76	2.430	5.25	5.69	0.91	5.40	1.33
1.00	16.89	3.000	5.63	6.32	1.00	6.00	1.49

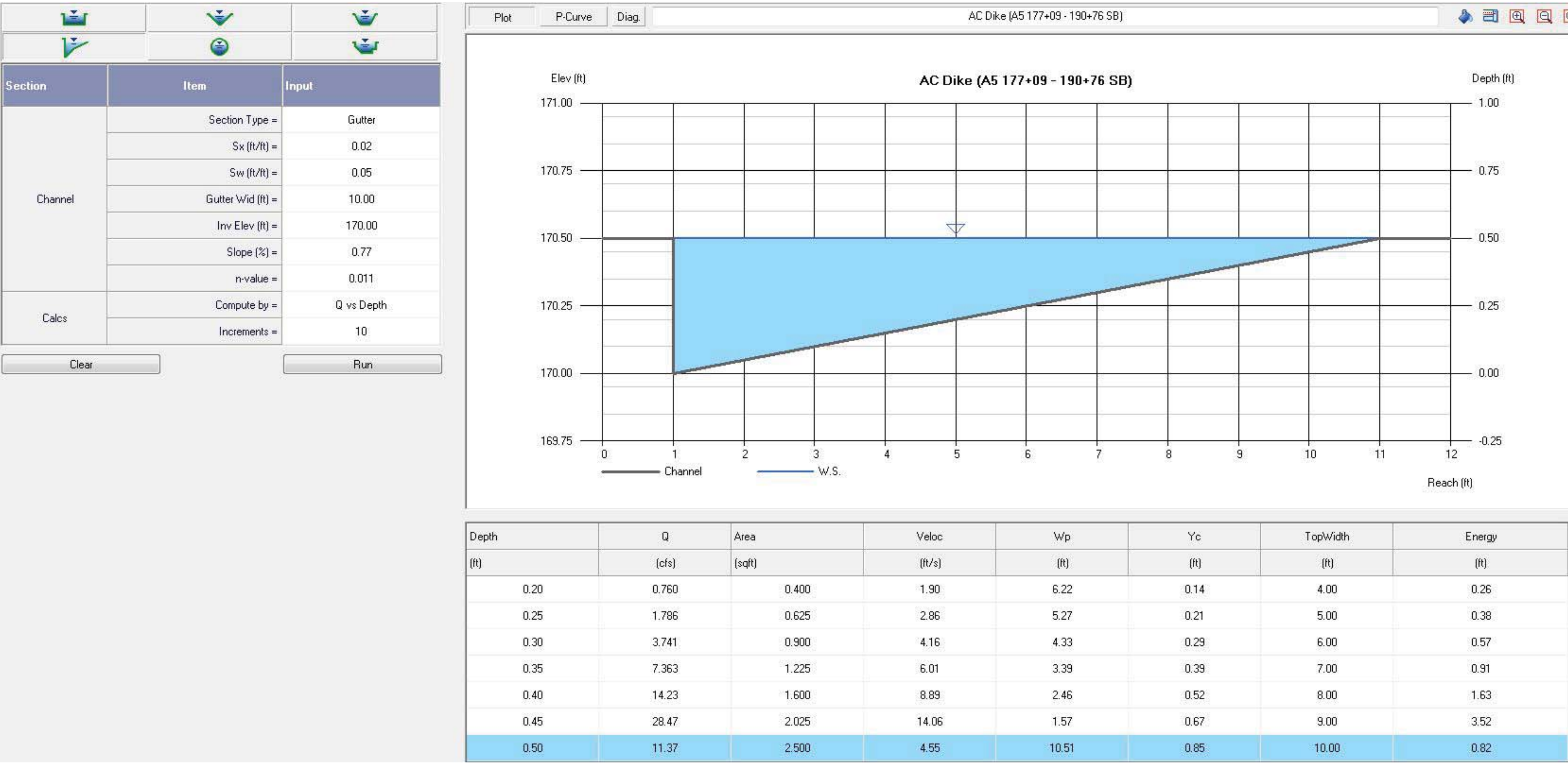


AC Ditch (A5 156+85 - 177+09 SB)

Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.47
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

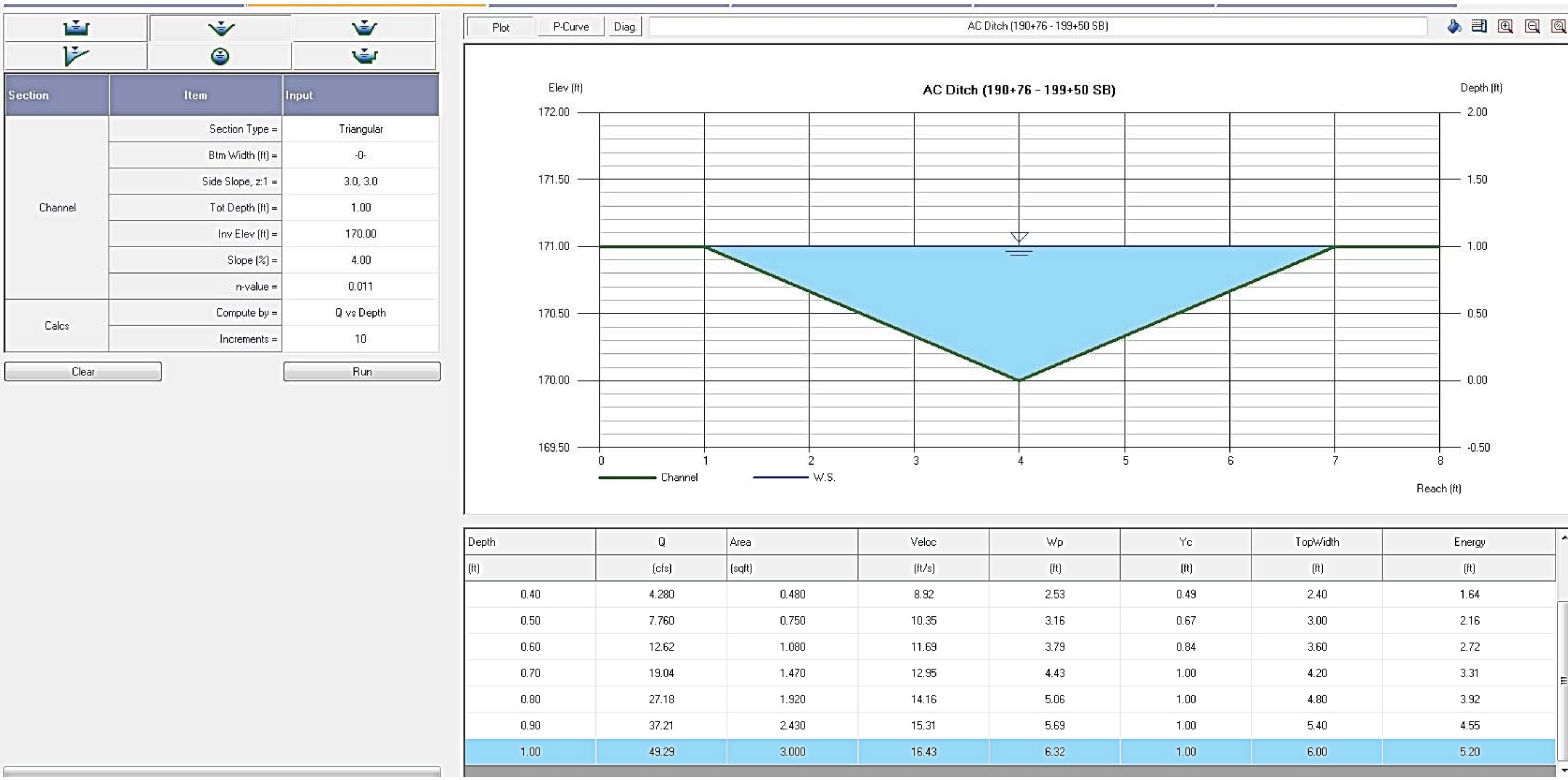
Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.70	6.526	1.470	4.44	4.43	0.67	4.20	1.01
0.80	9.317	1.920	4.85	5.06	0.79	4.80	1.17
0.90	12.76	2.430	5.25	5.69	0.91	5.40	1.33
1.00	16.89	3.000	5.63	6.32	1.00	6.00	1.49

E2 – Hydraflow Calculations – Subwatershed B



Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.05
	Gutter Wid (ft) =	10.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.77
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.20	0.760	0.400	1.90	6.22	0.14	4.00	0.26
0.25	1.786	0.625	2.86	5.27	0.21	5.00	0.38
0.30	3.741	0.900	4.16	4.33	0.29	6.00	0.57
0.35	7.363	1.225	6.01	3.39	0.39	7.00	0.91
0.40	14.23	1.600	8.89	2.46	0.52	8.00	1.63
0.45	28.47	2.025	14.06	1.57	0.67	9.00	3.52
0.50	11.37	2.500	4.55	10.51	0.85	10.00	0.82



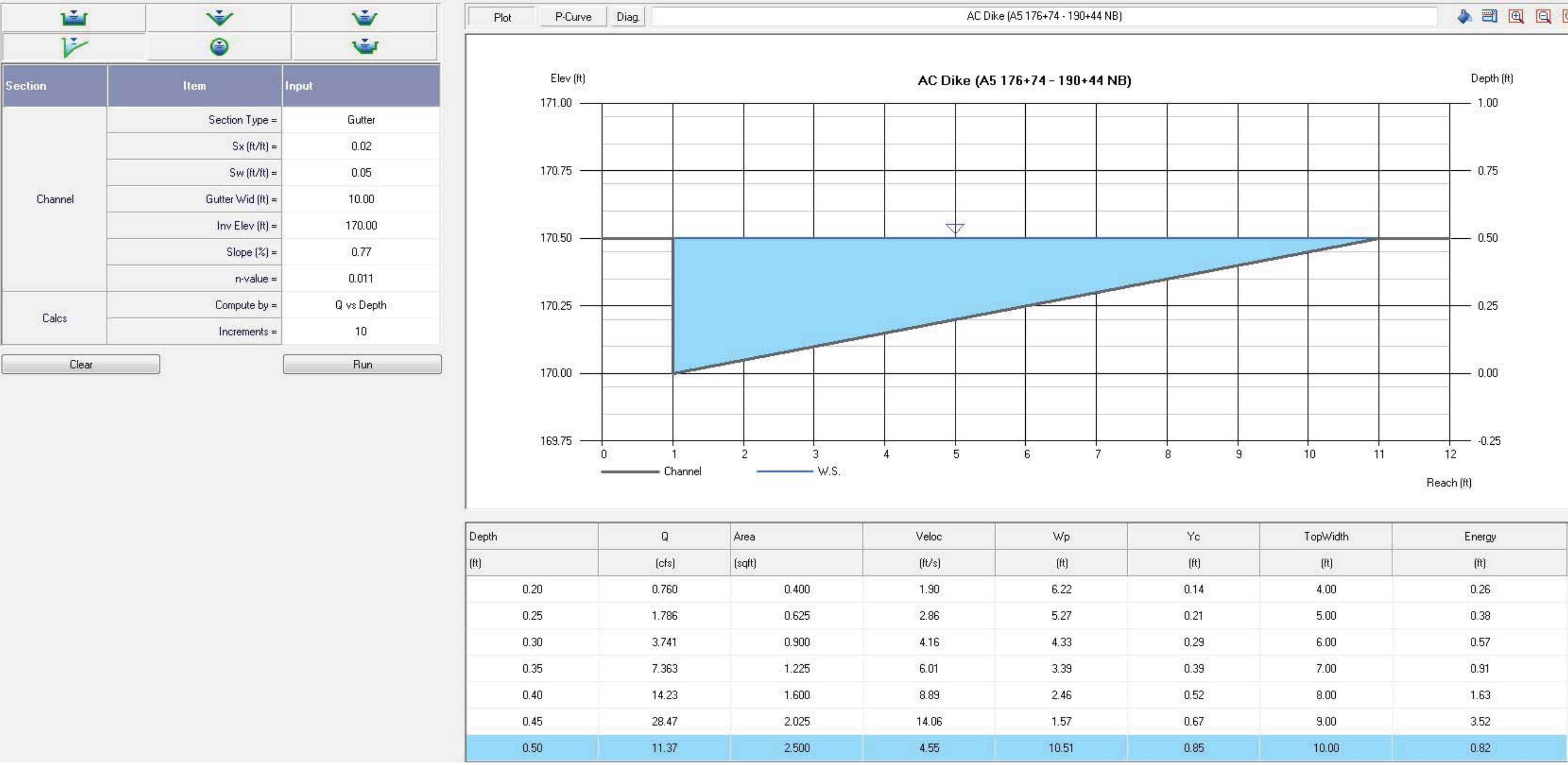
Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	4.00
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.40	4.280	0.480	8.92	2.53	0.49	2.40	1.64
0.50	7.760	0.750	10.35	3.16	0.67	3.00	2.16
0.60	12.62	1.080	11.69	3.79	0.84	3.60	2.72
0.70	19.04	1.470	12.95	4.43	1.00	4.20	3.31
0.80	27.18	1.920	14.16	5.06	1.00	4.80	3.92
0.90	37.21	2.430	15.31	5.69	1.00	5.40	4.55
1.00	49.29	3.000	16.43	6.32	1.00	6.00	5.20

Earth Ditch (A5 199+50 - 207+19, P5 207+13 - 219+02 SB)

Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	163.70
	Slope (%) =	2.00
	n-value =	0.050
Calcs	Compute by =	Known Depth
	Depth (ft) =	2.00

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
2.00	69.80	21.59	3.23	32.07	1.82	31.40	2.16



Section	Item	Input
Channel	Section Type =	Gutter
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	Sw (ft/ft) =	0.05
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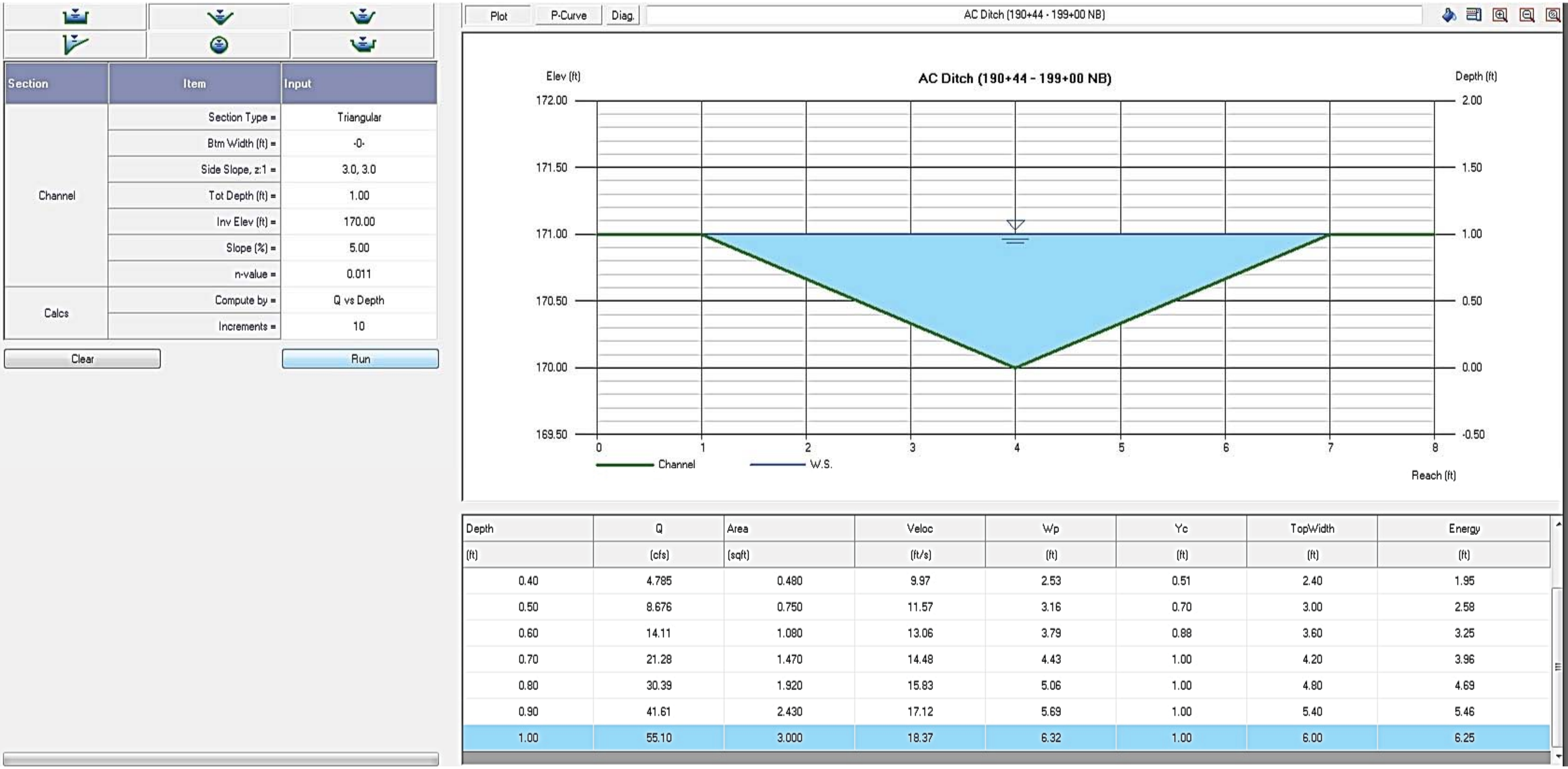
	Inv Elev (ft) =	170.00
	Slope (%) =	0.77
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.20	0.760	0.400	1.90	6.22	0.14	4.00	0.26
0.25	1.786	0.625	2.86	5.27	0.21	5.00	0.38
0.30	3.741	0.900	4.16	4.33	0.29	6.00	0.57
0.35	7.363	1.225	6.01	3.39	0.39	7.00	0.91
0.40	14.23	1.600	8.89	2.46	0.52	8.00	1.63
0.45	28.47	2.025	14.06	1.57	0.67	9.00	3.52
0.50	11.37	2.500	4.55	10.51	0.85	10.00	0.82



Section	Item	Input
Channel	Section Type =	Triangular
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	Side Slope, z:1 =	3.0, 3.0
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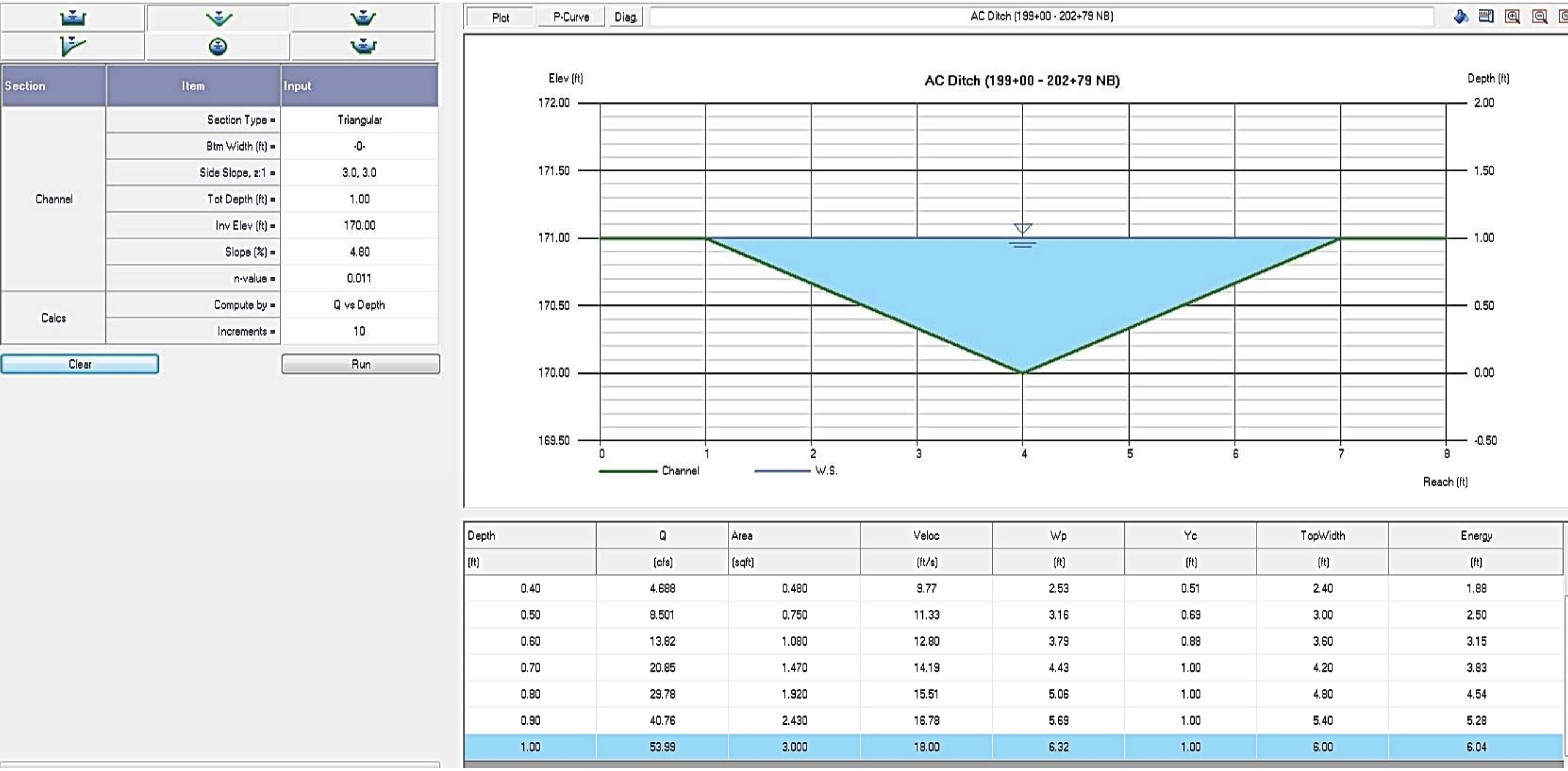
	Inv Elev (ft) =	170.00
	Slope (%) =	5.00
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.40	4.785	0.480	9.97	2.53	0.51	2.40	1.95
0.50	8.676	0.750	11.57	3.16	0.70	3.00	2.58
0.60	14.11	1.080	13.06	3.79	0.88	3.60	3.25
0.70	21.28	1.470	14.48	4.43	1.00	4.20	3.96
0.80	30.39	1.920	15.83	5.06	1.00	4.80	4.69
0.90	41.61	2.430	17.12	5.69	1.00	5.40	5.46
1.00	55.10	3.000	18.37	6.32	1.00	6.00	6.25

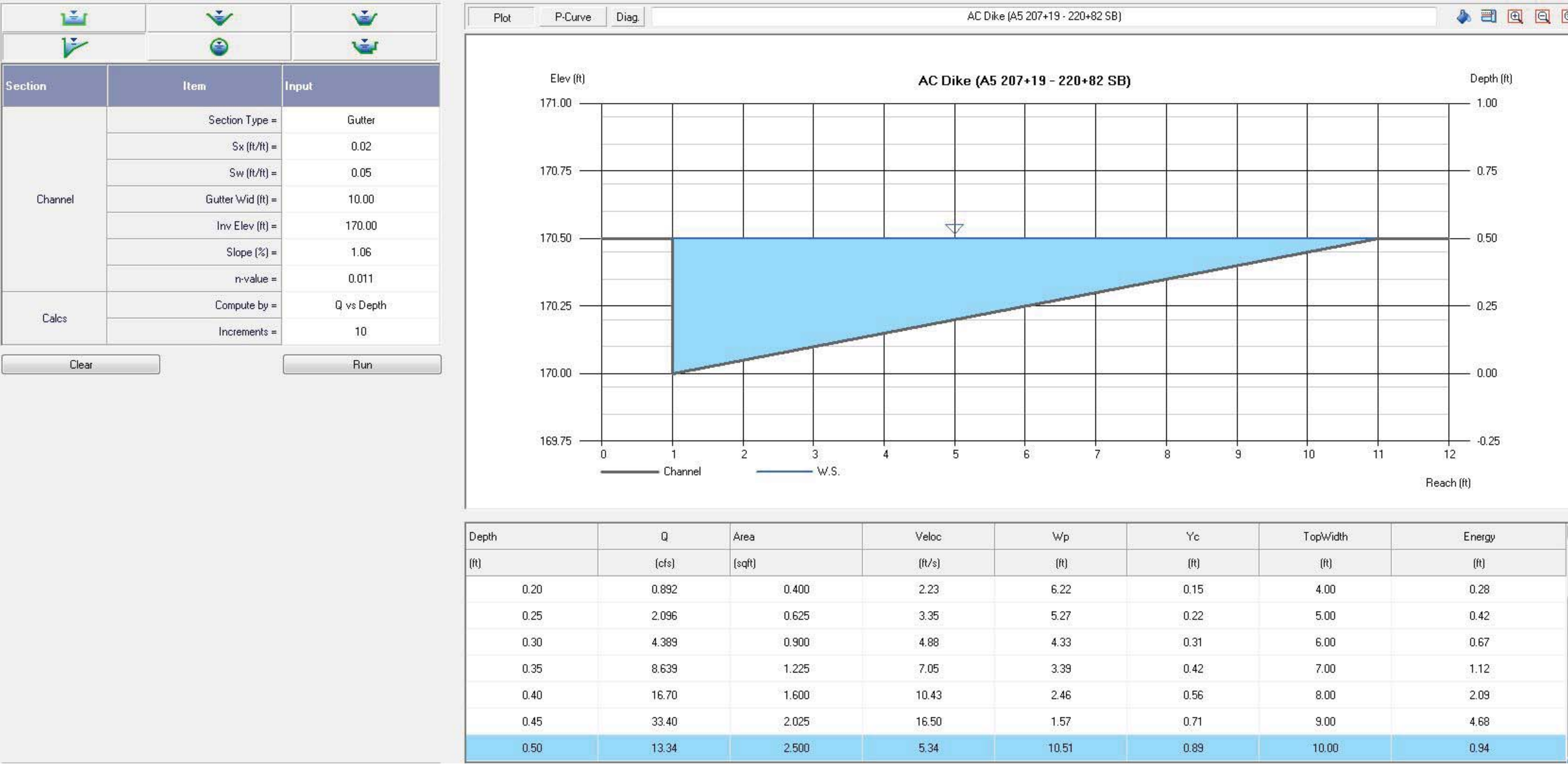


Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	4.80
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

AC Ditch (199+00 - 202+79 NB)

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.40	4.688	0.480	9.77	2.53	0.51	2.40	1.88
0.50	8.501	0.750	11.33	3.16	0.69	3.00	2.50
0.60	13.82	1.080	12.80	3.79	0.88	3.60	3.15
0.70	20.85	1.470	14.19	4.43	1.00	4.20	3.83
0.80	29.78	1.920	15.51	5.06	1.00	4.80	4.54
0.90	40.76	2.430	16.78	5.69	1.00	5.40	5.28
1.00	53.99	3.000	18.00	6.32	1.00	6.00	6.04

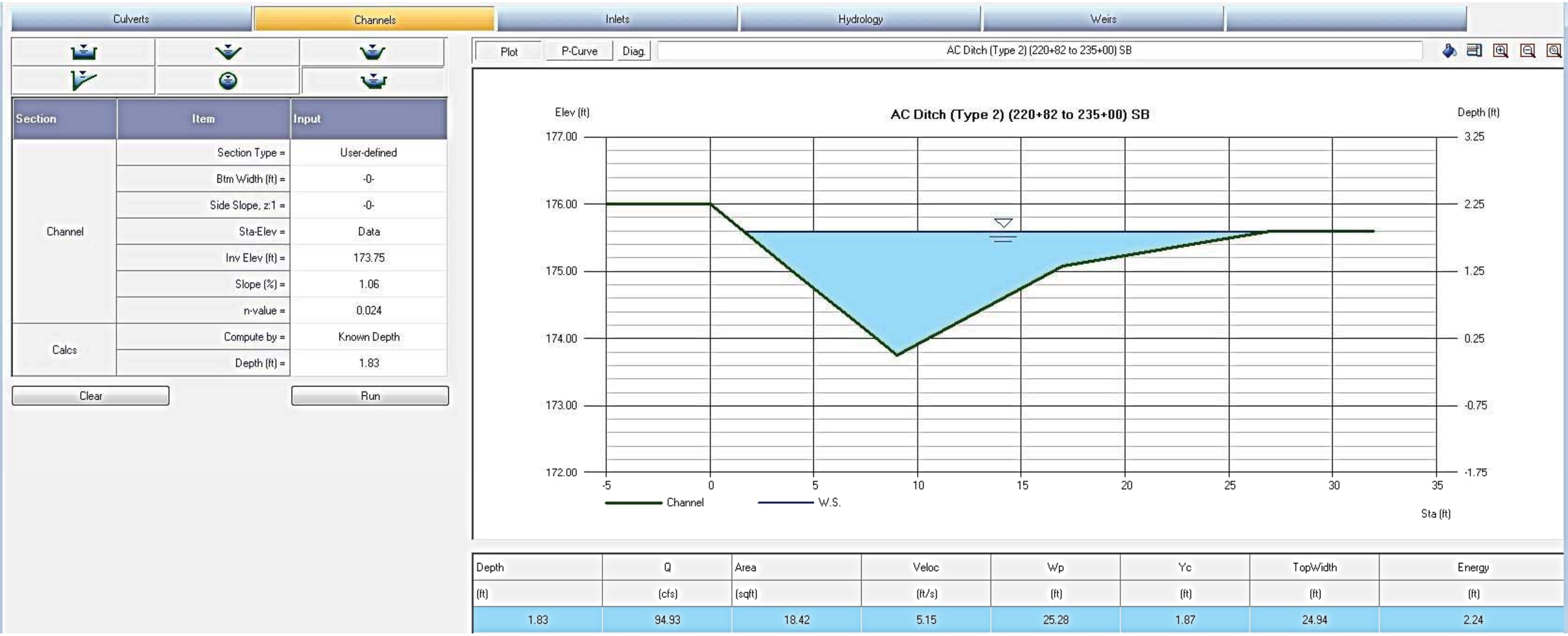
E3 – Hydraflow Calculations – Subwatershed C



Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.05
	Gutter Wid (ft) =	10.00
	Inv Elev (ft) =	170.00
	Slope (%) =	1.06
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

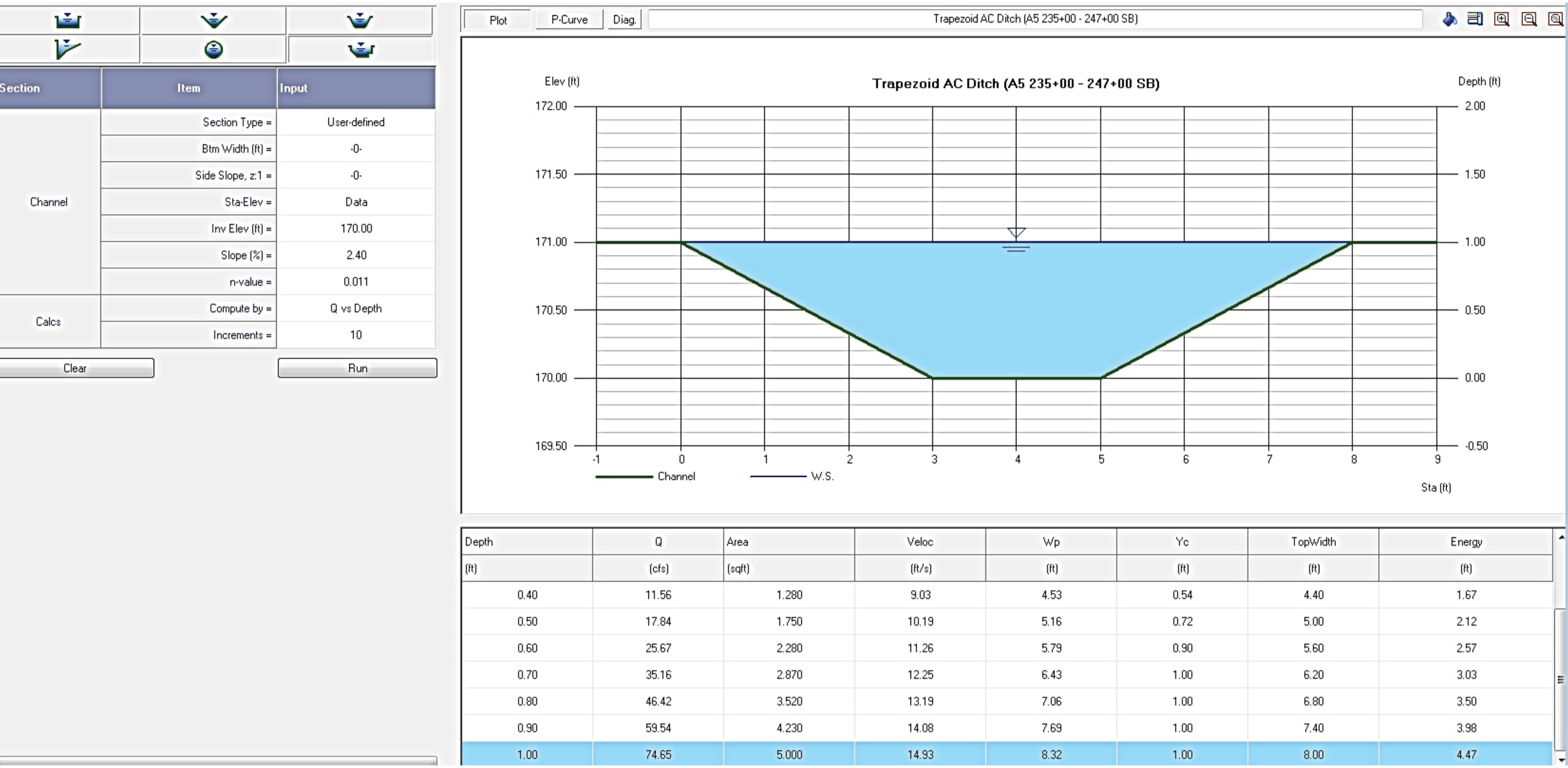
AC Dike (A5 207+19 - 220+82 SB)

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.20	0.892	0.400	2.23	6.22	0.15	4.00	0.28
0.25	2.096	0.625	3.35	5.27	0.22	5.00	0.42
0.30	4.389	0.900	4.88	4.33	0.31	6.00	0.67
0.35	8.639	1.225	7.05	3.39	0.42	7.00	1.12
0.40	16.70	1.600	10.43	2.46	0.56	8.00	2.09
0.45	33.40	2.025	16.50	1.57	0.71	9.00	4.68
0.50	13.34	2.500	5.34	10.51	0.89	10.00	0.94



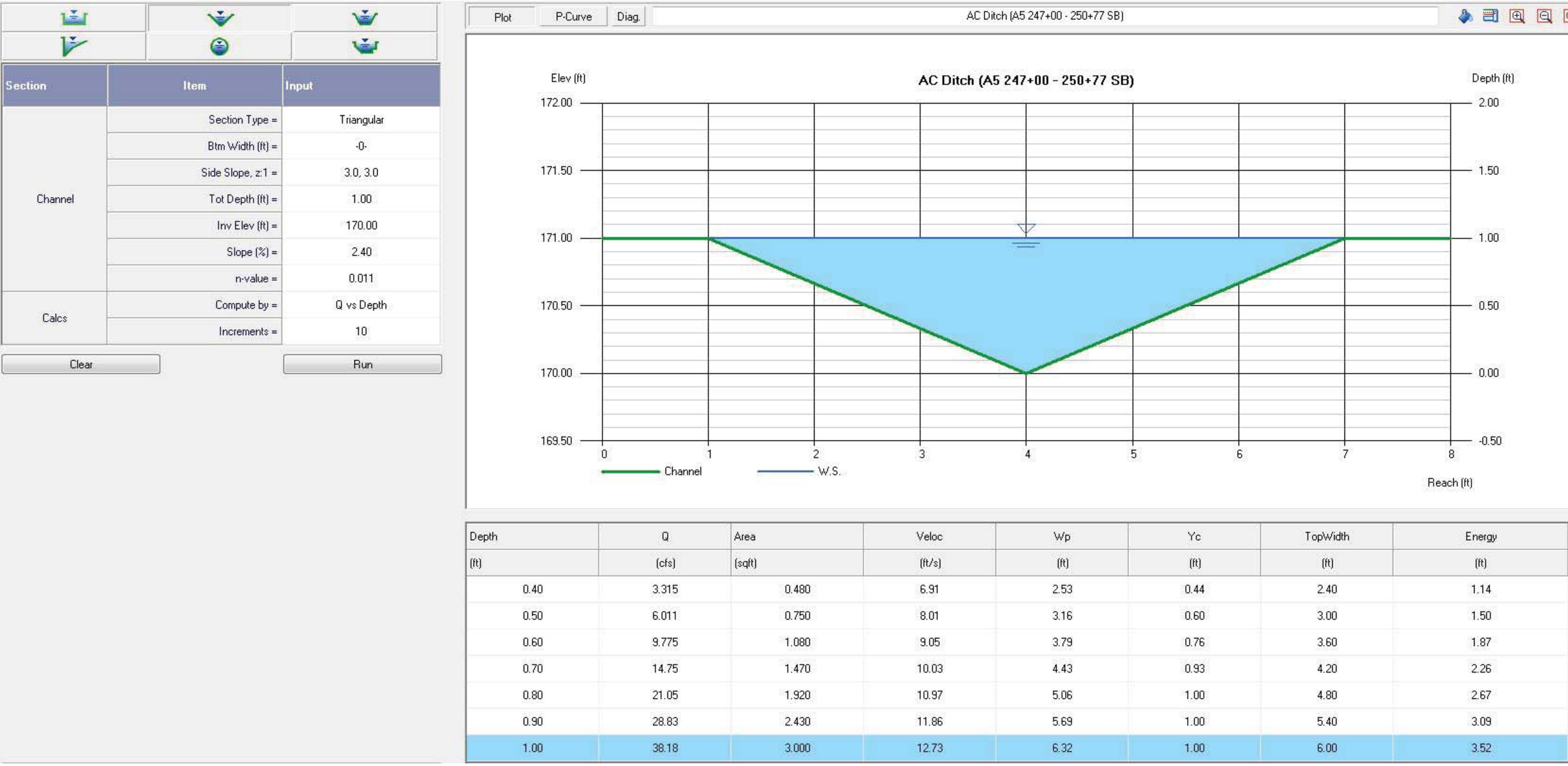
Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	173.75
	Slope (%) =	1.06
	n-value =	0.024
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.83

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.83	94.93	18.42	5.15	25.28	1.87	24.94	2.24



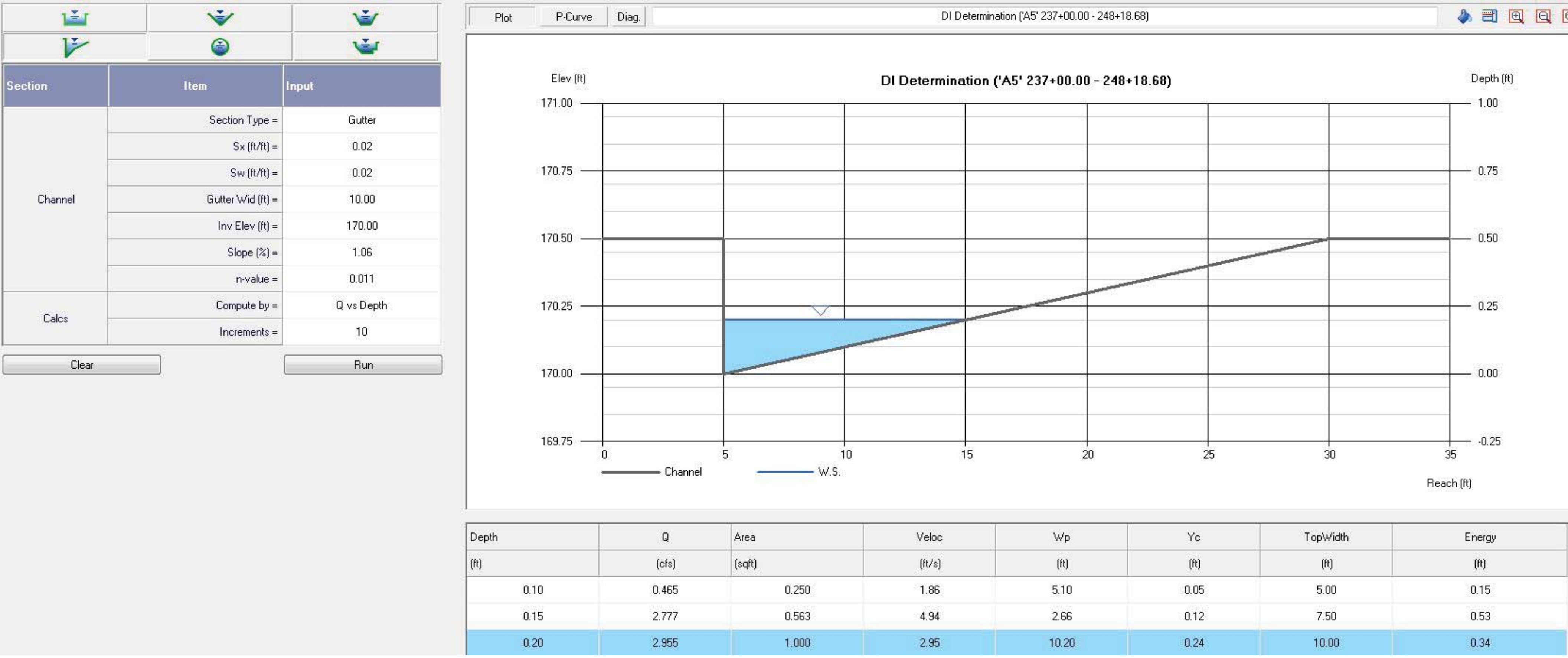
Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	170.00
	Slope (%) =	2.40
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.40	11.56	1.280	9.03	4.53	0.54	4.40	1.67
0.50	17.84	1.750	10.19	5.16	0.72	5.00	2.12
0.60	25.67	2.280	11.26	5.79	0.90	5.60	2.57
0.70	35.16	2.870	12.25	6.43	1.00	6.20	3.03
0.80	46.42	3.520	13.19	7.06	1.00	6.80	3.50
0.90	59.54	4.230	14.08	7.69	1.00	7.40	3.98
1.00	74.65	5.000	14.93	8.32	1.00	8.00	4.47



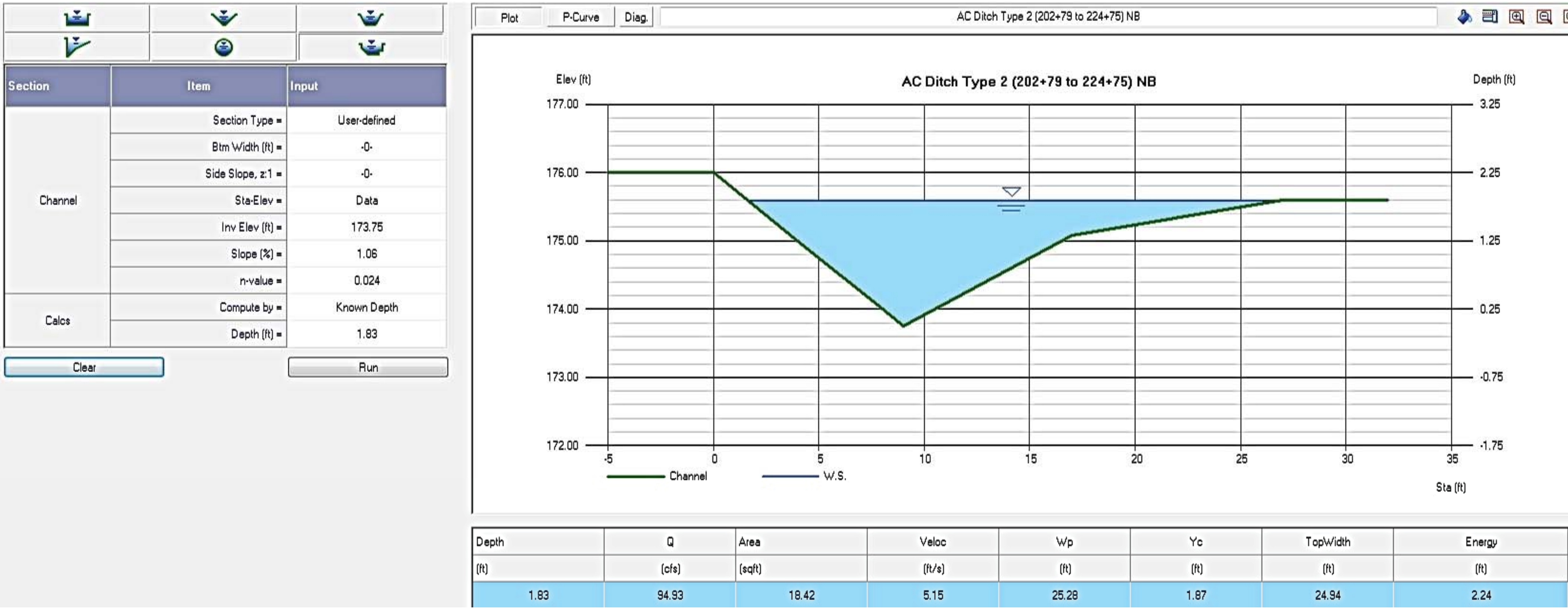
Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	2.40
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.40	3.315	0.480	6.91	2.53	0.44	2.40	1.14
0.50	6.011	0.750	8.01	3.16	0.60	3.00	1.50
0.60	9.775	1.080	9.05	3.79	0.76	3.60	1.87
0.70	14.75	1.470	10.03	4.43	0.93	4.20	2.26
0.80	21.05	1.920	10.97	5.06	1.00	4.80	2.67
0.90	28.83	2.430	11.86	5.69	1.00	5.40	3.09
1.00	38.18	3.000	12.73	6.32	1.00	6.00	3.52



Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.02
	Gutter Wid (ft) =	10.00
	Inv Elev (ft) =	170.00
	Slope (%) =	1.06
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

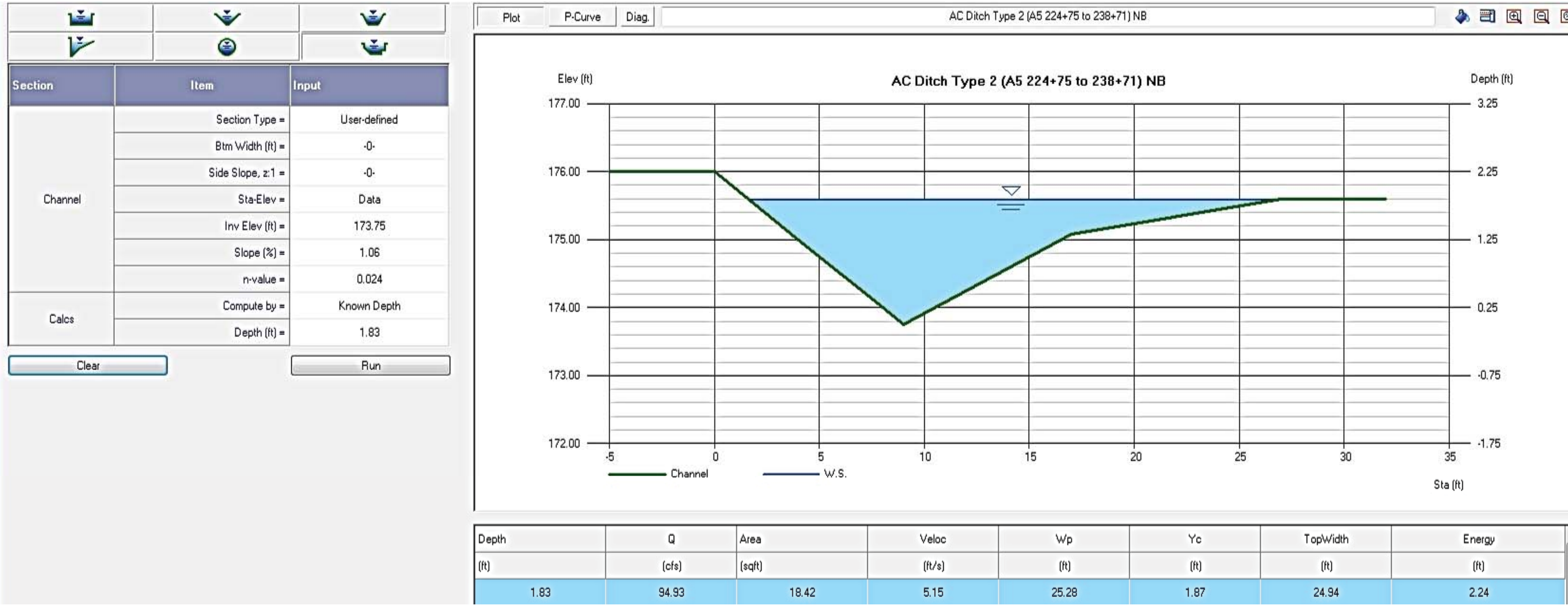
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.10	0.465	0.250	1.86	5.10	0.05	5.00	0.15
0.15	2.777	0.563	4.94	2.66	0.12	7.50	0.53
0.20	2.955	1.000	2.95	10.20	0.24	10.00	0.34



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	173.75
	Slope (%) =	1.06
	n-value =	0.024
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.83

AC Ditch Type 2 (202+79 to 224+75) NB

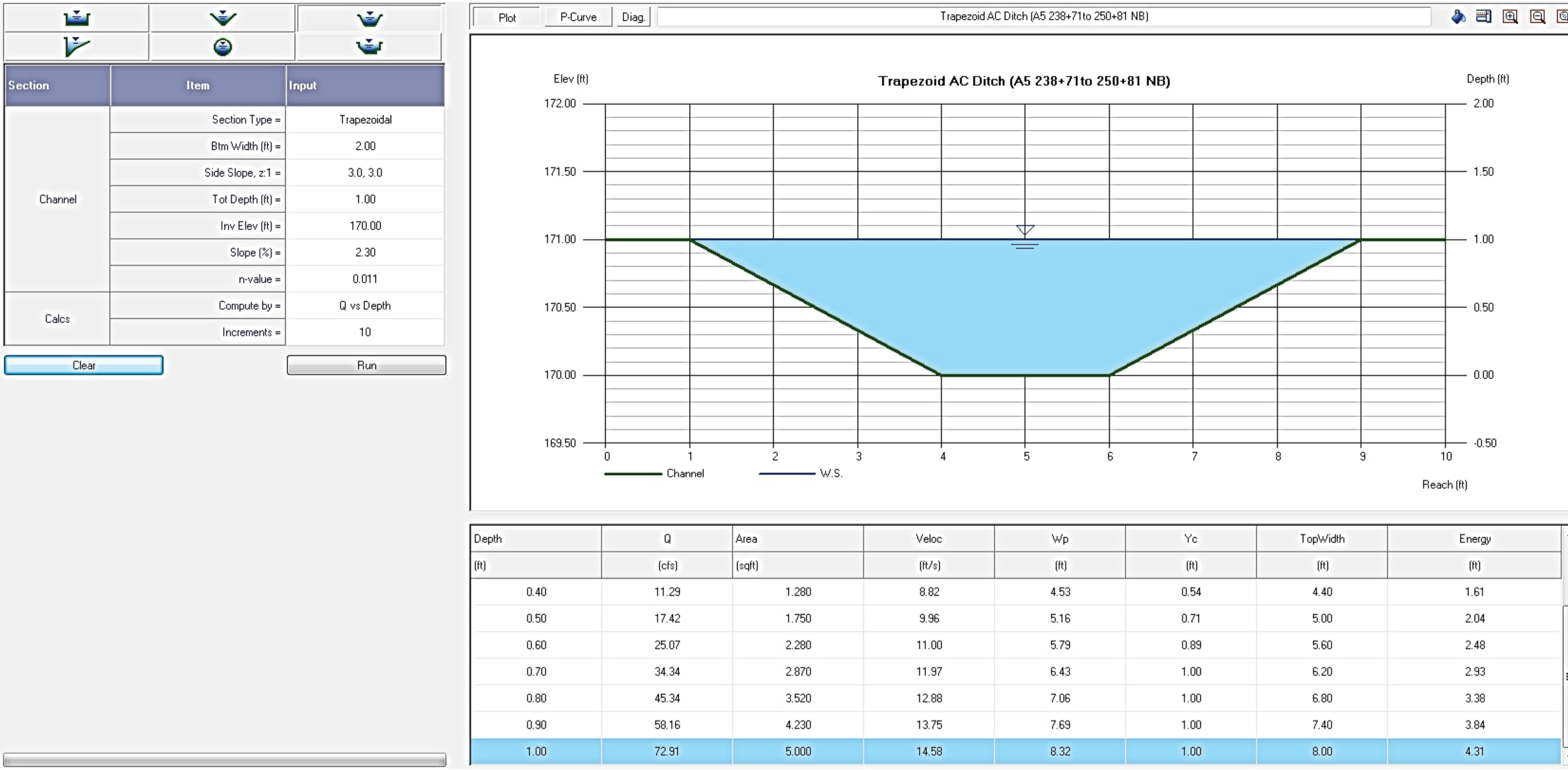
Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.83	94.93	18.42	5.15	25.28	1.87	24.94	2.24



AC Ditch Type 2 (A5 224+75 to 238+71) NB

Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	173.75
	Slope (%) =	1.06
	n-value =	0.024
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.83

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.83	94.93	18.42	5.15	25.28	1.87	24.94	2.24

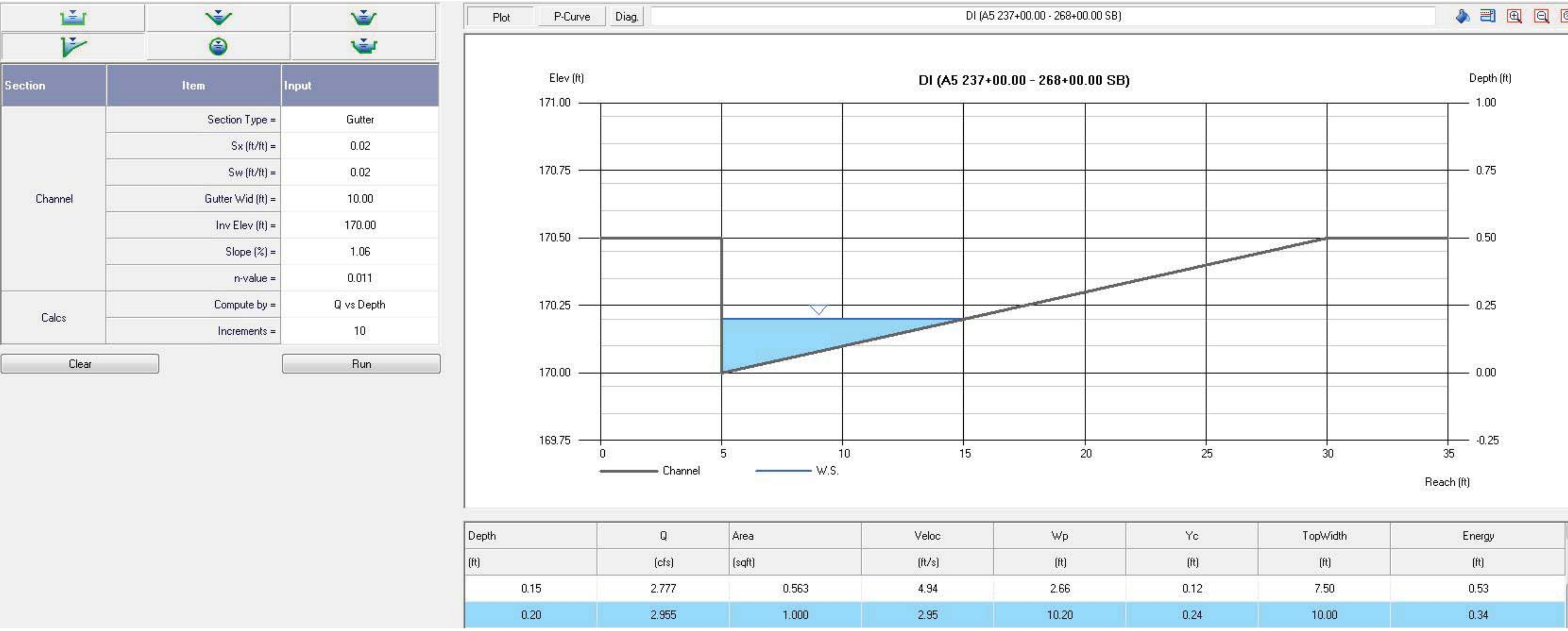


Section	Item	Input
Channel	Section Type =	Trapezoidal
	Btm Width (ft) =	2.00
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	2.30
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Trapezoid AC Ditch (A5 238+71to 250+81 NB)

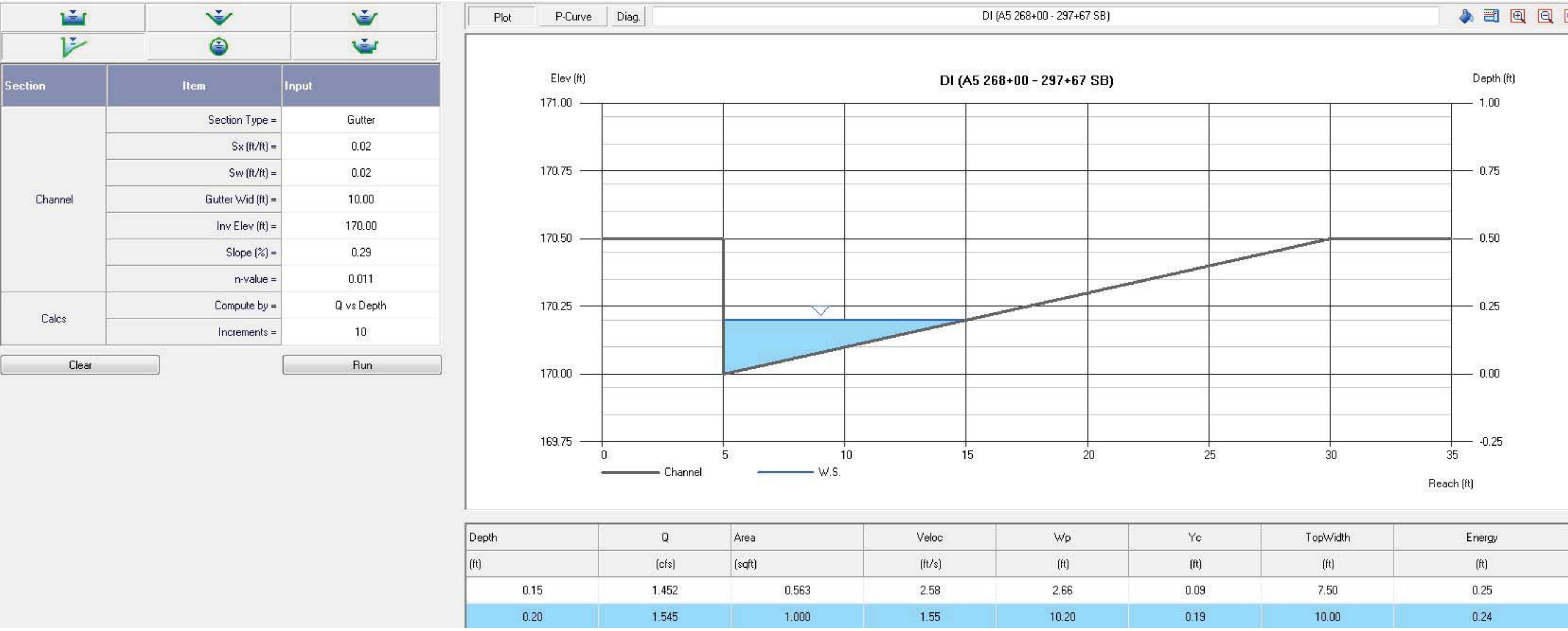
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.40	11.29	1.280	8.82	4.53	0.54	4.40	1.61
0.50	17.42	1.750	9.96	5.16	0.71	5.00	2.04
0.60	25.07	2.280	11.00	5.79	0.89	5.60	2.48
0.70	34.34	2.870	11.97	6.43	1.00	6.20	2.93
0.80	45.34	3.520	12.88	7.06	1.00	6.80	3.38
0.90	58.16	4.230	13.75	7.69	1.00	7.40	3.84
1.00	72.91	5.000	14.58	8.32	1.00	8.00	4.31

E4 – Hydraflow Calculations – Subwatershed D



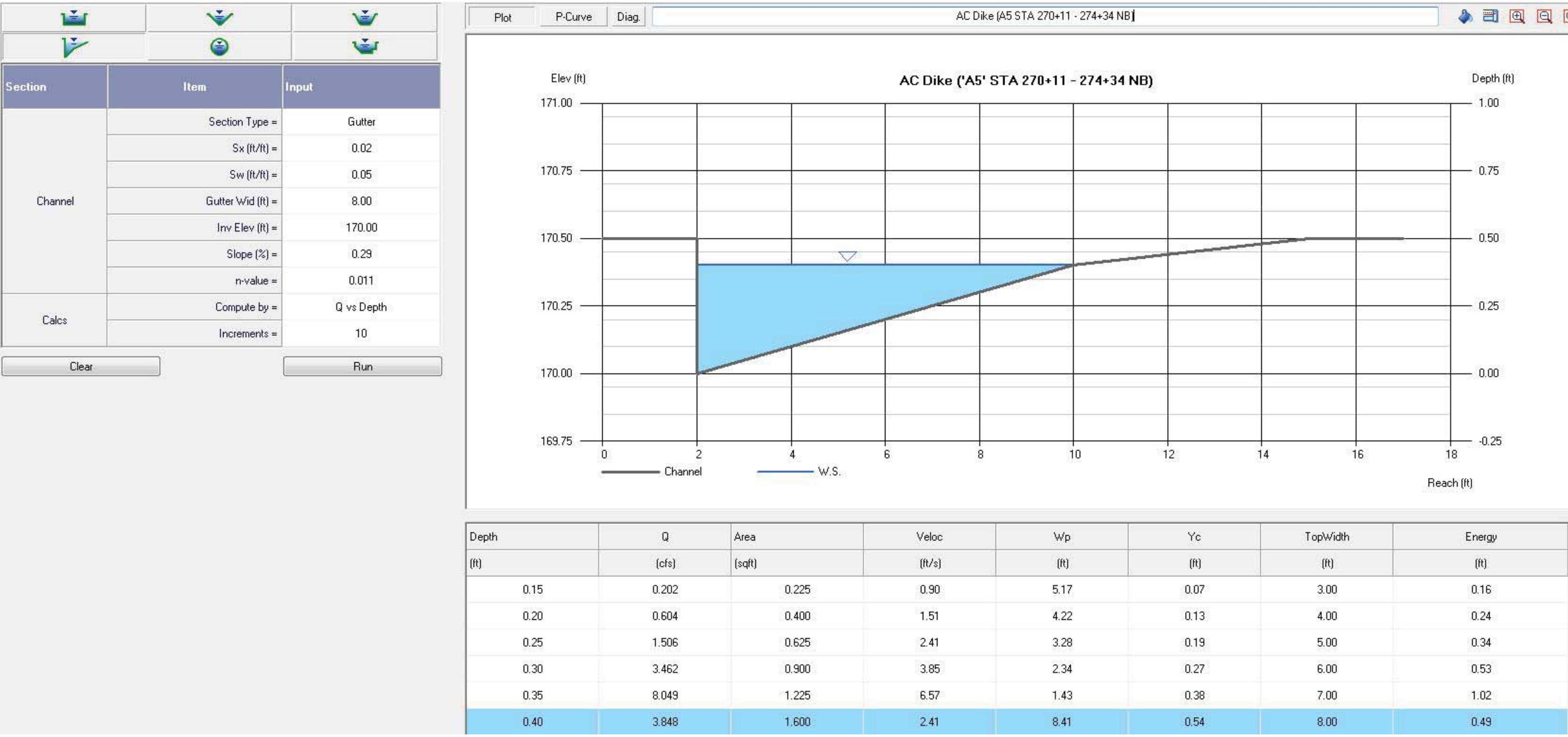
Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.02
	Gutter Wid (ft) =	10.00
	Inv Elev (ft) =	170.00
	Slope (%) =	1.06
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.15	2.777	0.563	4.94	2.66	0.12	7.50	0.53
0.20	2.955	1.000	2.95	10.20	0.24	10.00	0.34



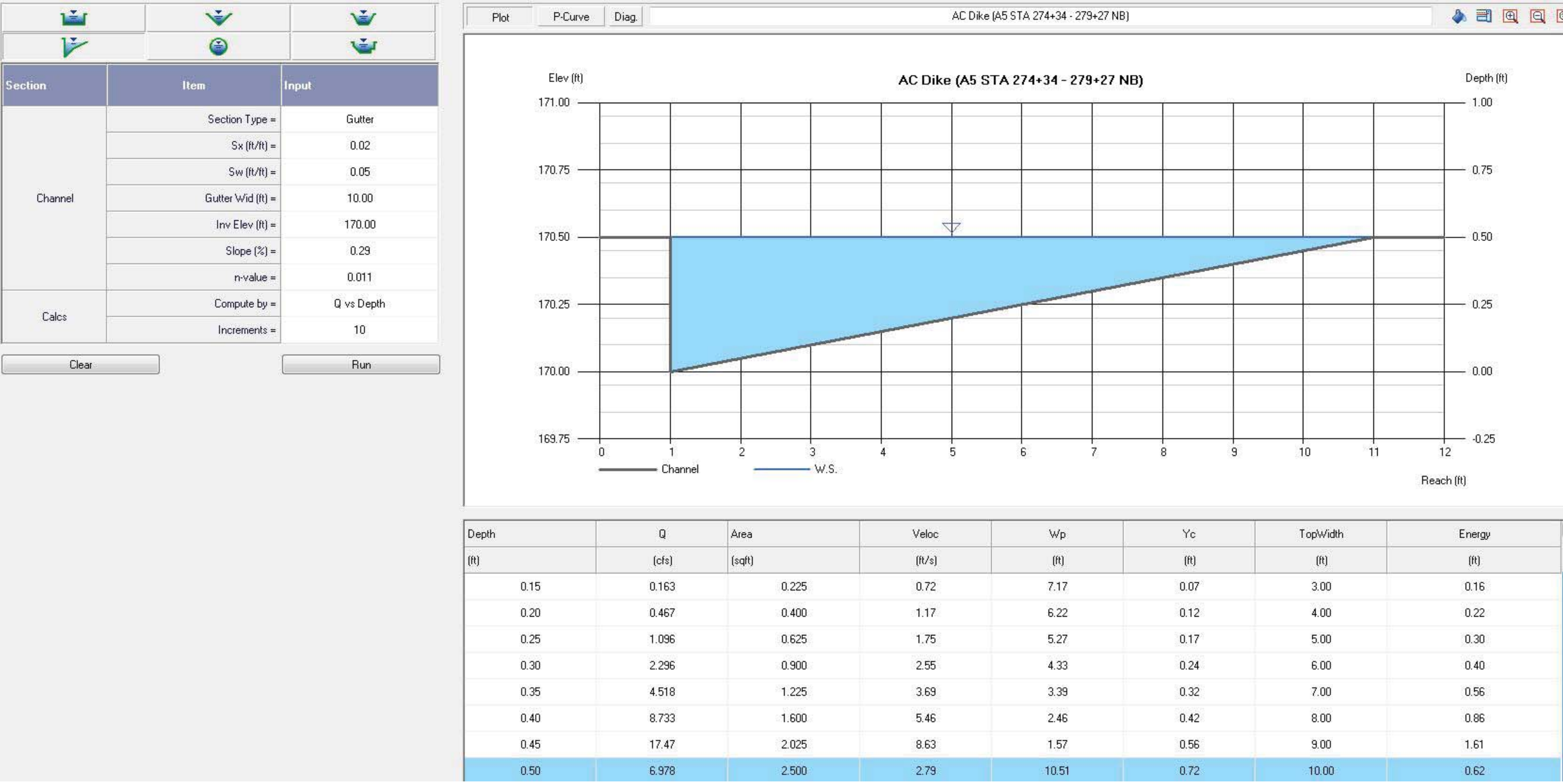
Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.02
	Gutter Wid (ft) =	10.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.29
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.15	1.452	0.563	2.58	2.66	0.09	7.50	0.25
0.20	1.545	1.000	1.55	10.20	0.19	10.00	0.24



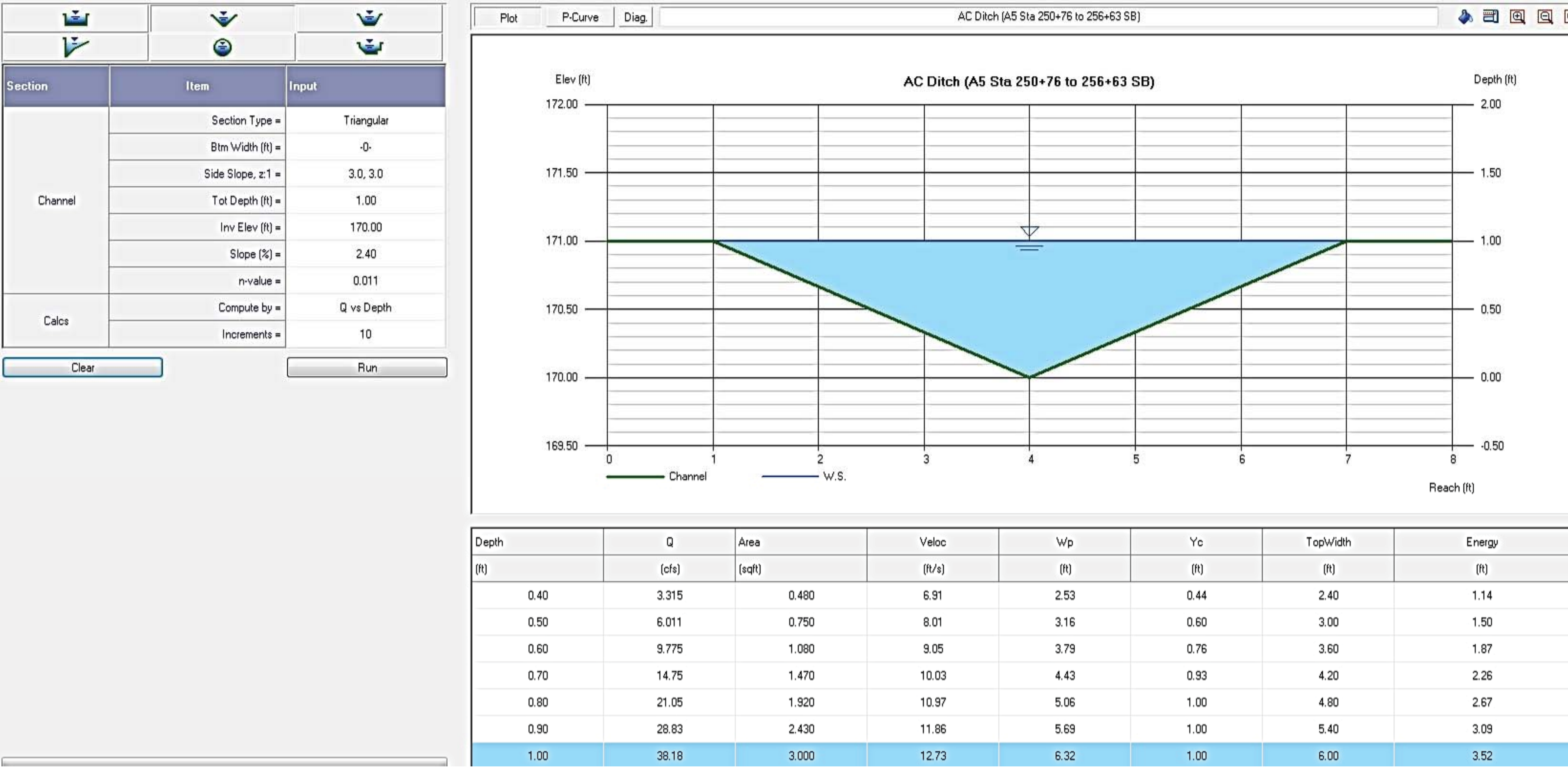
Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.05
	Gutter Wid (ft) =	8.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.29
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.15	0.202	0.225	0.90	5.17	0.07	3.00	0.16
0.20	0.604	0.400	1.51	4.22	0.13	4.00	0.24
0.25	1.506	0.625	2.41	3.28	0.19	5.00	0.34
0.30	3.462	0.900	3.85	2.34	0.27	6.00	0.53
0.35	8.049	1.225	6.57	1.43	0.38	7.00	1.02
0.40	3.848	1.600	2.41	8.41	0.54	8.00	0.49



Section	Item	Input
Channel	Section Type =	Gutter
	Sx (ft/ft) =	0.02
	Sw (ft/ft) =	0.05
	Gutter Wid (ft) =	10.00
	Inv Elev (ft) =	170.00
	Slope (%) =	0.29
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

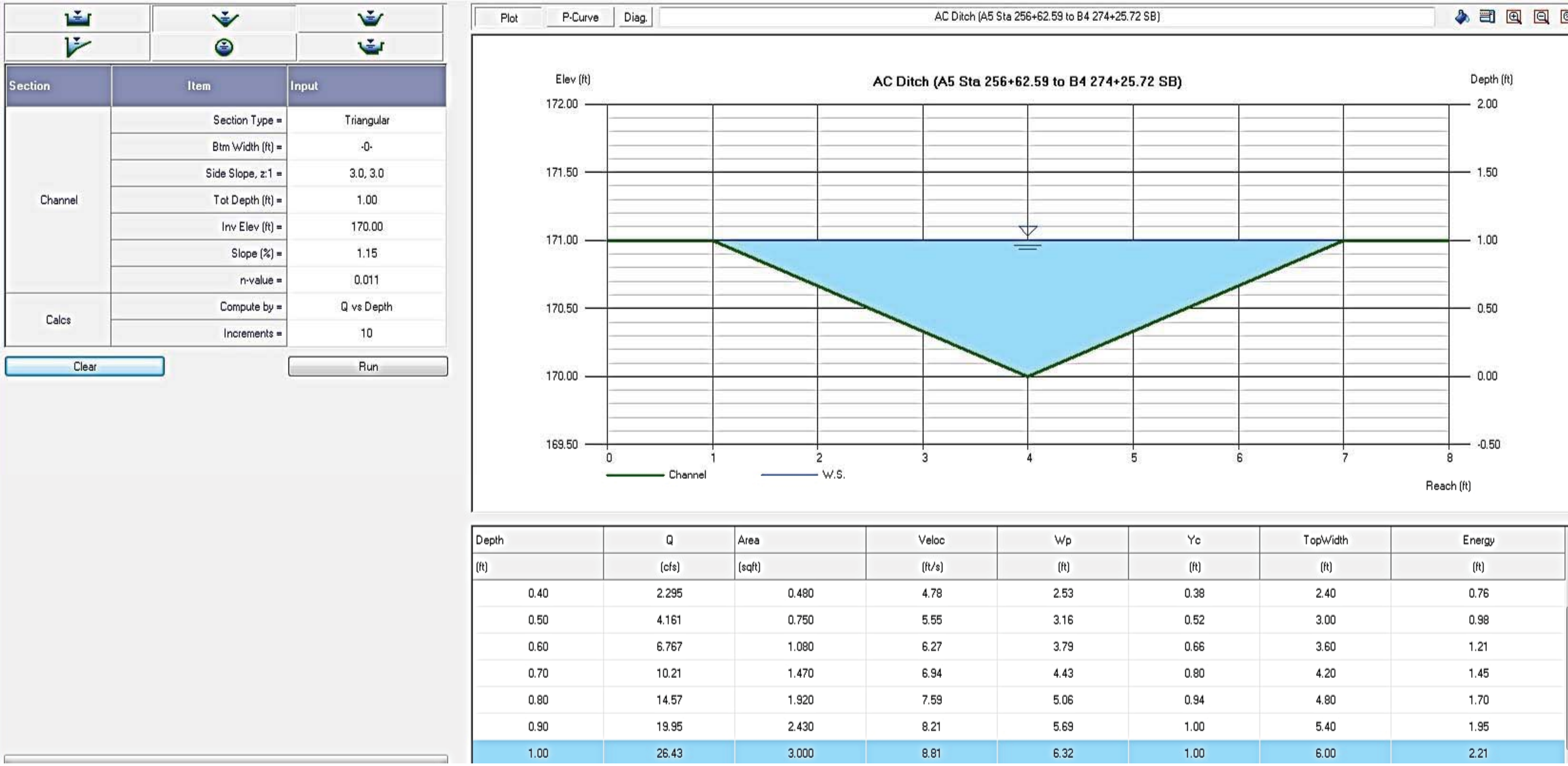
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.15	0.163	0.225	0.72	7.17	0.07	3.00	0.16
0.20	0.467	0.400	1.17	6.22	0.12	4.00	0.22
0.25	1.096	0.625	1.75	5.27	0.17	5.00	0.30
0.30	2.296	0.900	2.55	4.33	0.24	6.00	0.40
0.35	4.518	1.225	3.69	3.39	0.32	7.00	0.56
0.40	8.733	1.600	5.46	2.46	0.42	8.00	0.86
0.45	17.47	2.025	8.63	1.57	0.56	9.00	1.61
0.50	6.978	2.500	2.79	10.51	0.72	10.00	0.62



Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	2.40
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

AC Ditch (A5 Sta 250+76 to 256+63 SB)

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.40	3.315	0.480	6.91	2.53	0.44	2.40	1.14
0.50	6.011	0.750	8.01	3.16	0.60	3.00	1.50
0.60	9.775	1.080	9.05	3.79	0.76	3.60	1.87
0.70	14.75	1.470	10.03	4.43	0.93	4.20	2.26
0.80	21.05	1.920	10.97	5.06	1.00	4.80	2.67
0.90	28.83	2.430	11.86	5.69	1.00	5.40	3.09
1.00	38.18	3.000	12.73	6.32	1.00	6.00	3.52

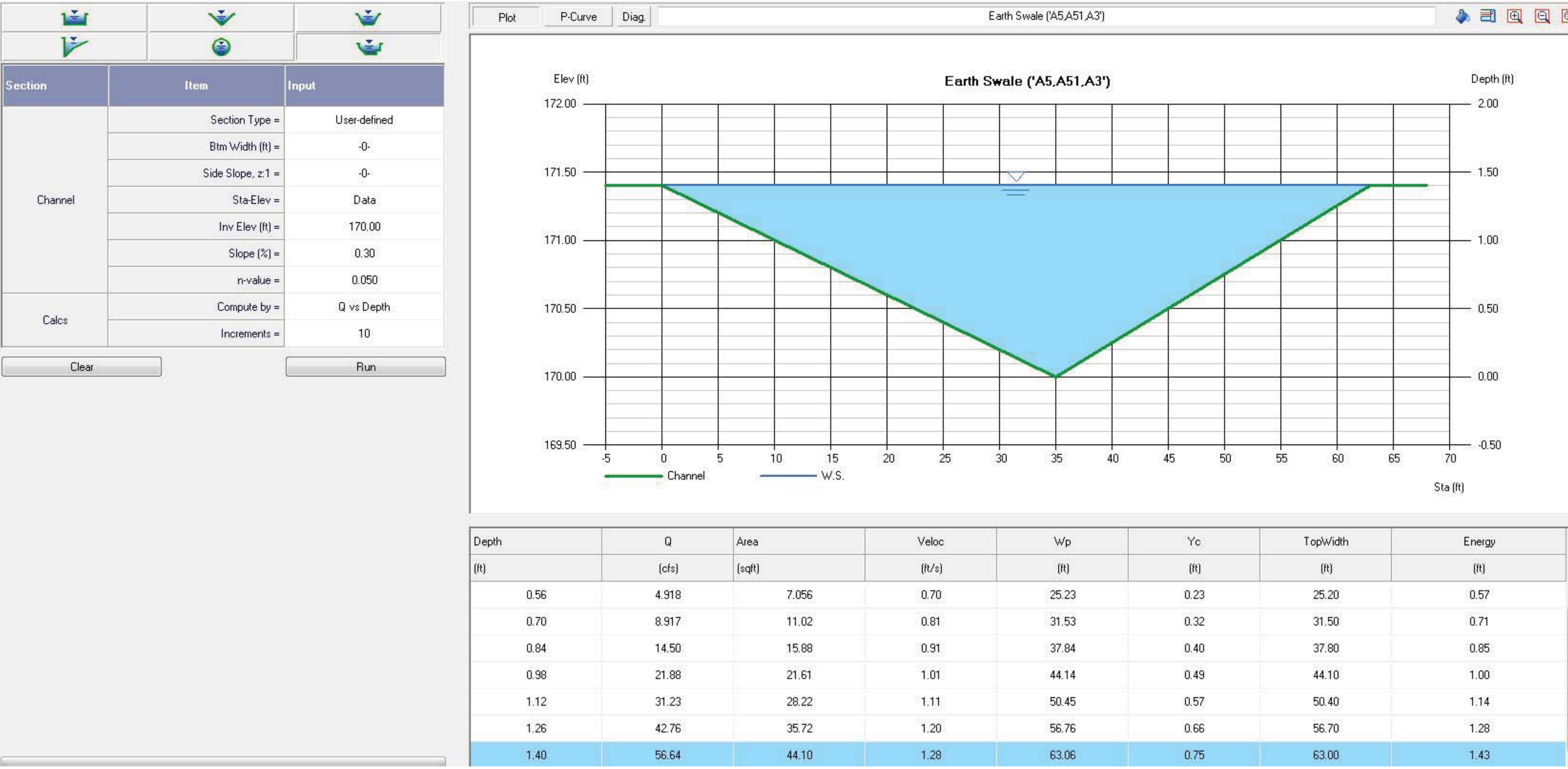


Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	3.0, 3.0
	Tot Depth (ft) =	1.00
	Inv Elev (ft) =	170.00
	Slope (%) =	1.15
	n-value =	0.011
Calcs	Compute by =	Q vs Depth
	Increments =	10

AC Ditch (A5 Sta 256+62.59 to B4 274+25.72 SB)

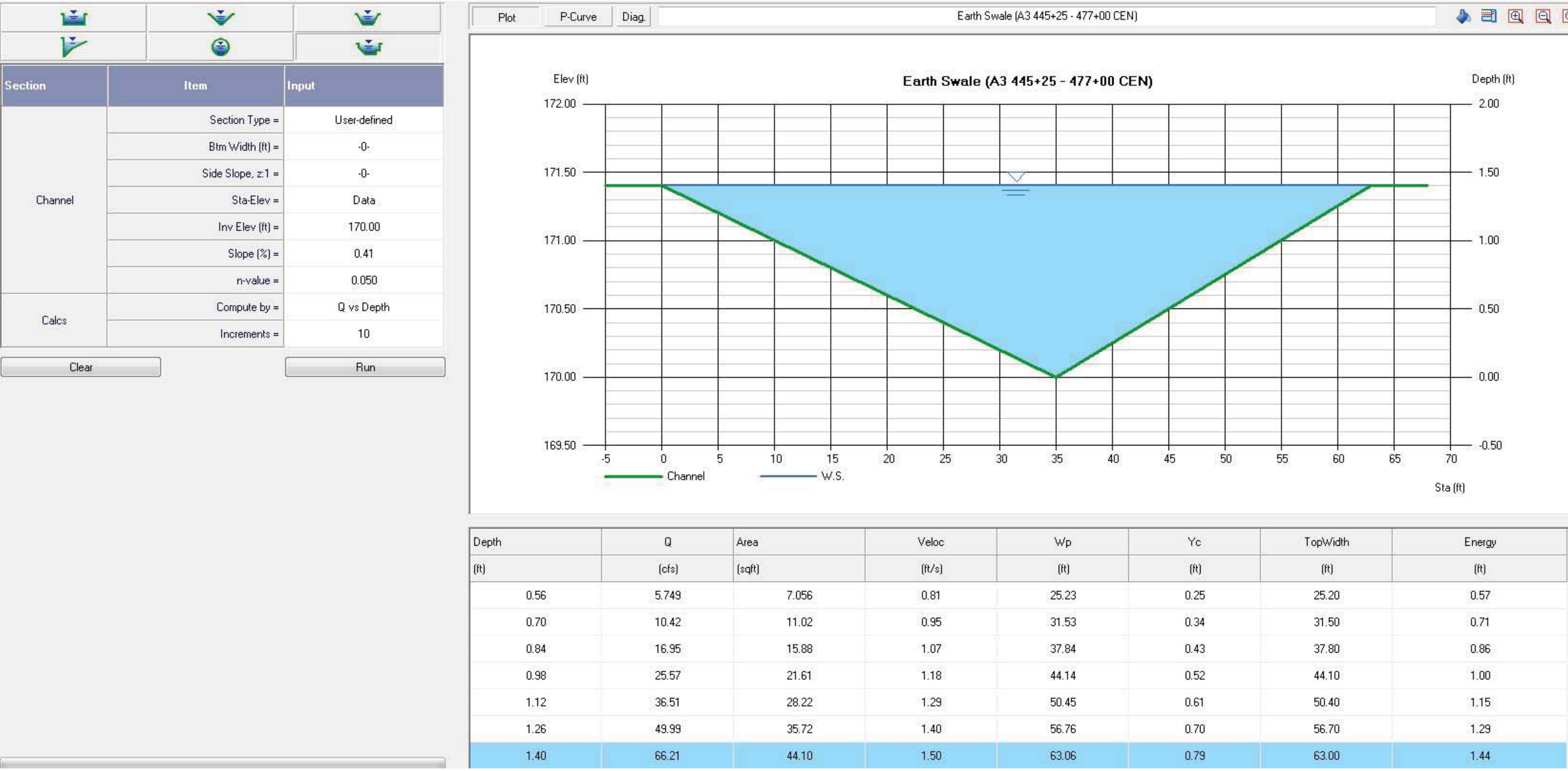
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.40	2.295	0.480	4.78	2.53	0.38	2.40	0.76
0.50	4.161	0.750	5.55	3.16	0.52	3.00	0.98
0.60	6.767	1.080	6.27	3.79	0.66	3.60	1.21
0.70	10.21	1.470	6.94	4.43	0.80	4.20	1.45
0.80	14.57	1.920	7.59	5.06	0.94	4.80	1.70
0.90	19.95	2.430	8.21	5.69	1.00	5.40	1.95
1.00	26.43	3.000	8.81	6.32	1.00	6.00	2.21

E5 – Hydraflow Calculations – Subwatershed E



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	170.00
	Slope (%) =	0.30
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

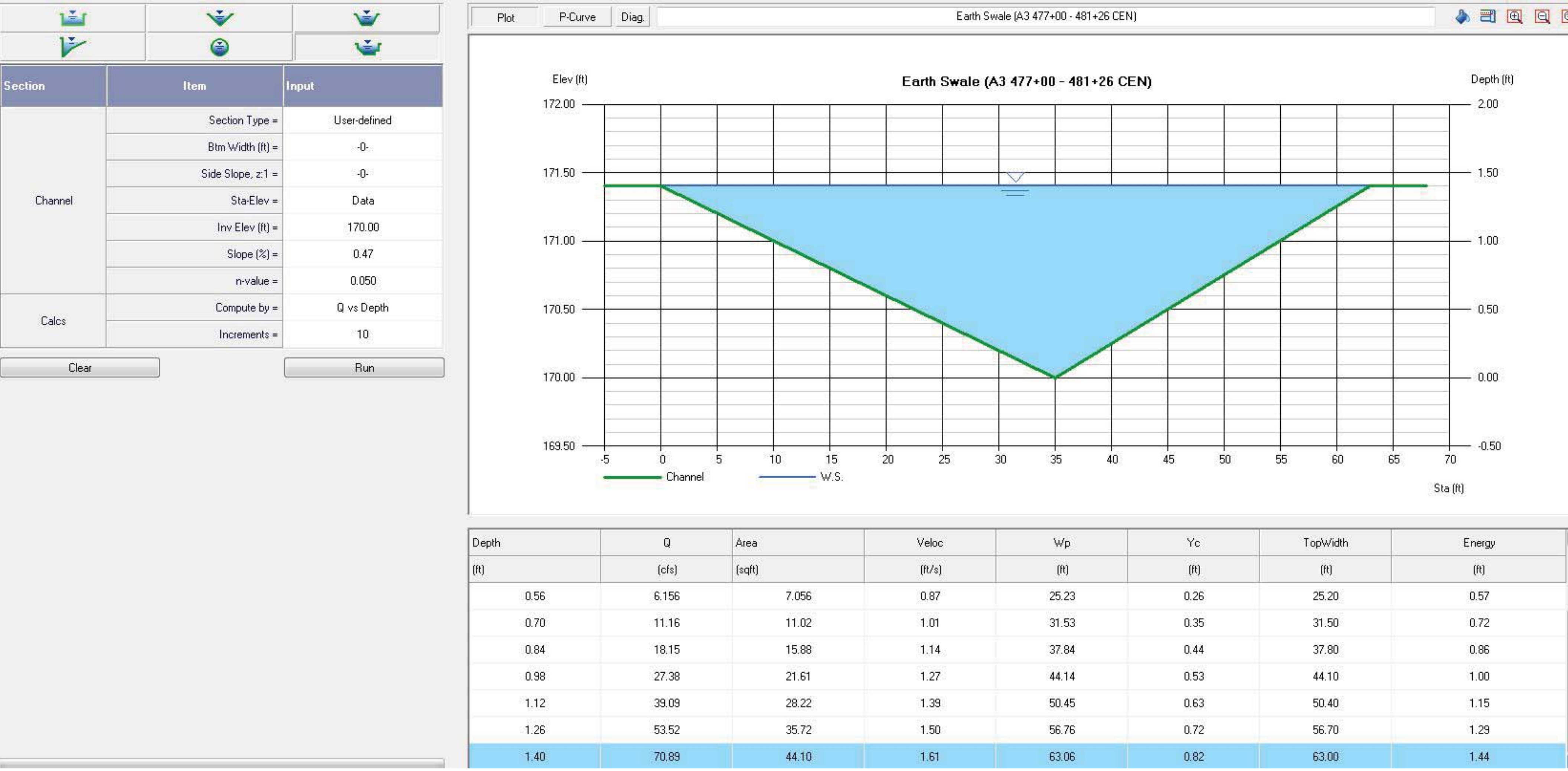
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.56	4.918	7.056	0.70	25.23	0.23	25.20	0.57
0.70	8.917	11.02	0.81	31.53	0.32	31.50	0.71
0.84	14.50	15.88	0.91	37.84	0.40	37.80	0.85
0.98	21.88	21.61	1.01	44.14	0.49	44.10	1.00
1.12	31.23	28.22	1.11	50.45	0.57	50.40	1.14
1.26	42.76	35.72	1.20	56.76	0.66	56.70	1.28
1.40	56.64	44.10	1.28	63.06	0.75	63.00	1.43



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	170.00
	Slope (%) =	0.41
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Earth Swale (A3 445+25 - 477+00 CEN)

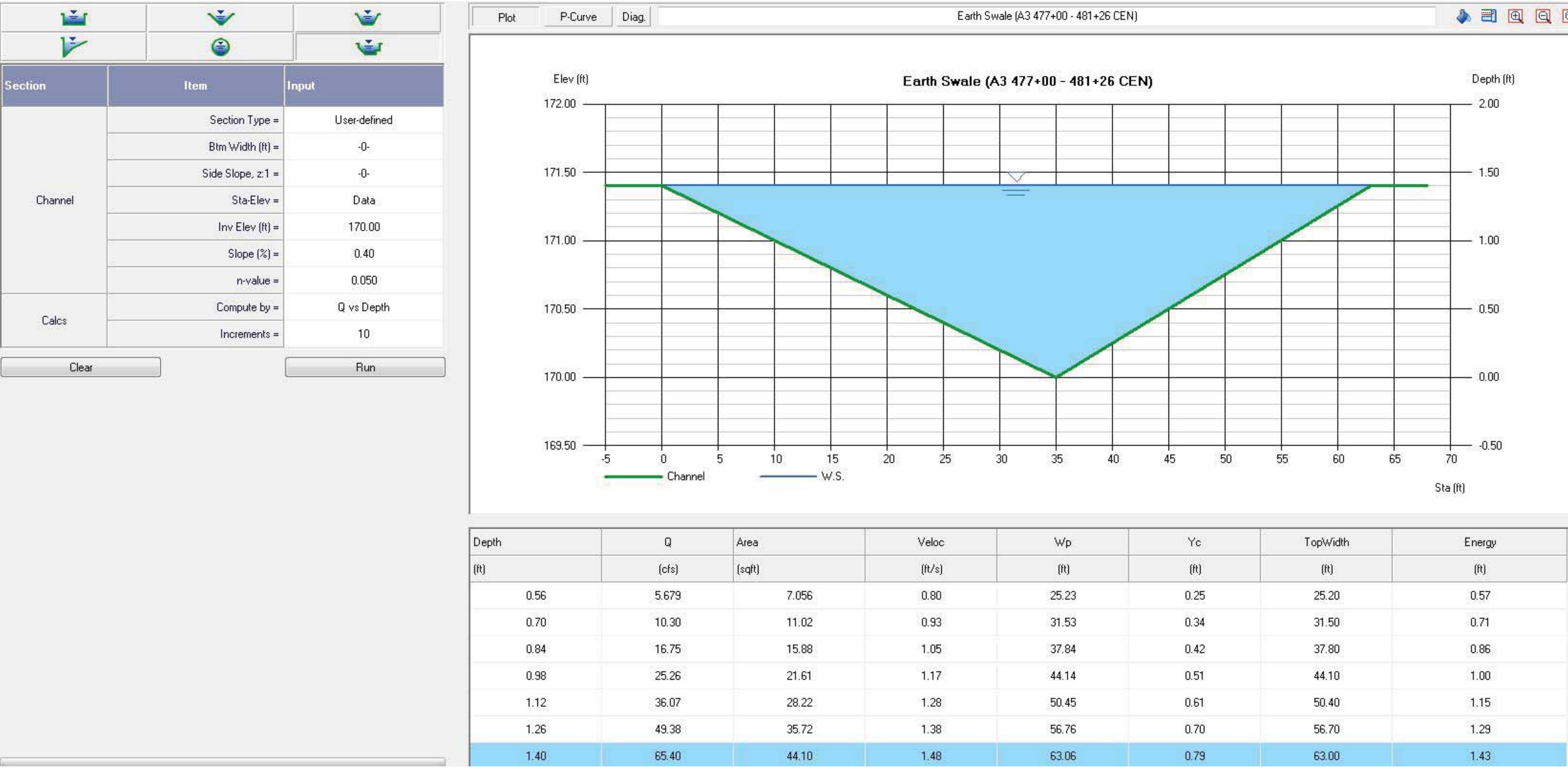
Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.56	5.749	7.056	0.81	25.23	0.25	25.20	0.57
0.70	10.42	11.02	0.95	31.53	0.34	31.50	0.71
0.84	16.95	15.88	1.07	37.84	0.43	37.80	0.86
0.98	25.57	21.61	1.18	44.14	0.52	44.10	1.00
1.12	36.51	28.22	1.29	50.45	0.61	50.40	1.15
1.26	49.99	35.72	1.40	56.76	0.70	56.70	1.29
1.40	66.21	44.10	1.50	63.06	0.79	63.00	1.44



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	170.00
	Slope (%) =	0.47
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

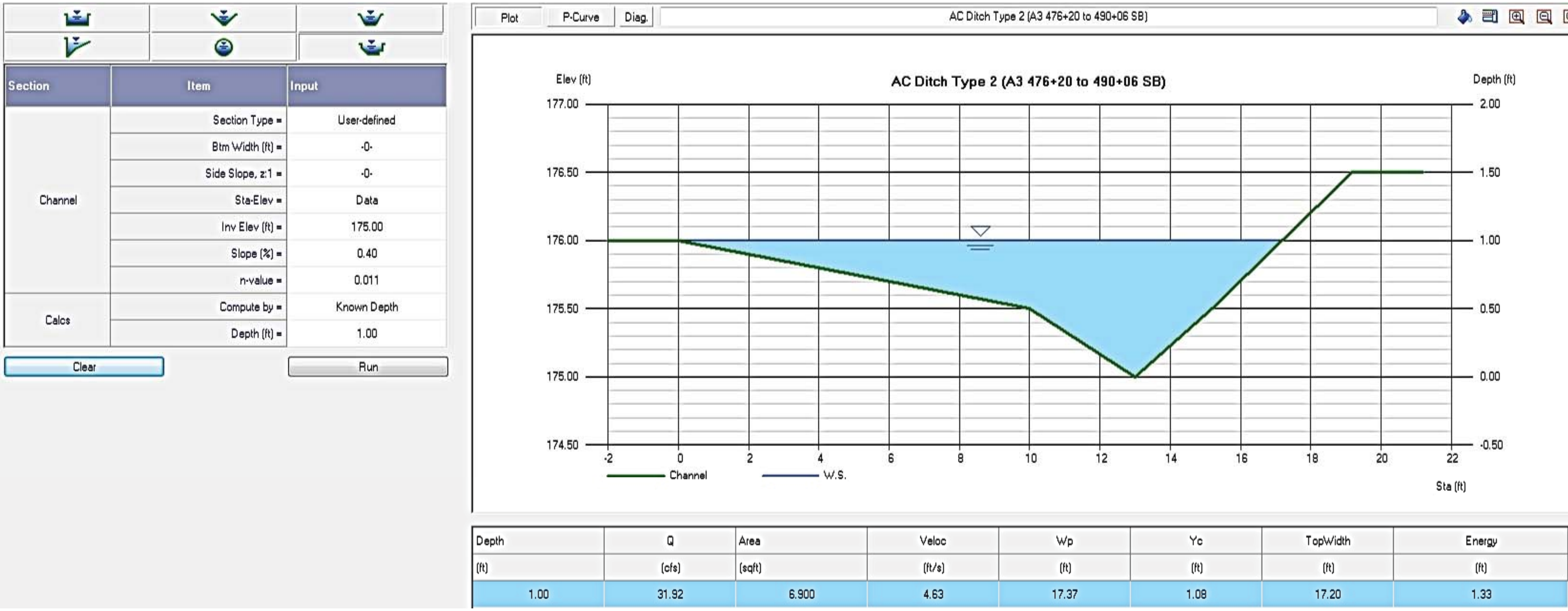
Earth Swale (A3 477+00 - 481+26 CEN)

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.56	6.156	7.056	0.87	25.23	0.26	25.20	0.57
0.70	11.16	11.02	1.01	31.53	0.35	31.50	0.72
0.84	18.15	15.88	1.14	37.84	0.44	37.80	0.86
0.98	27.38	21.61	1.27	44.14	0.53	44.10	1.00
1.12	39.09	28.22	1.39	50.45	0.63	50.40	1.15
1.26	53.52	35.72	1.50	56.76	0.72	56.70	1.29
1.40	70.89	44.10	1.61	63.06	0.82	63.00	1.44



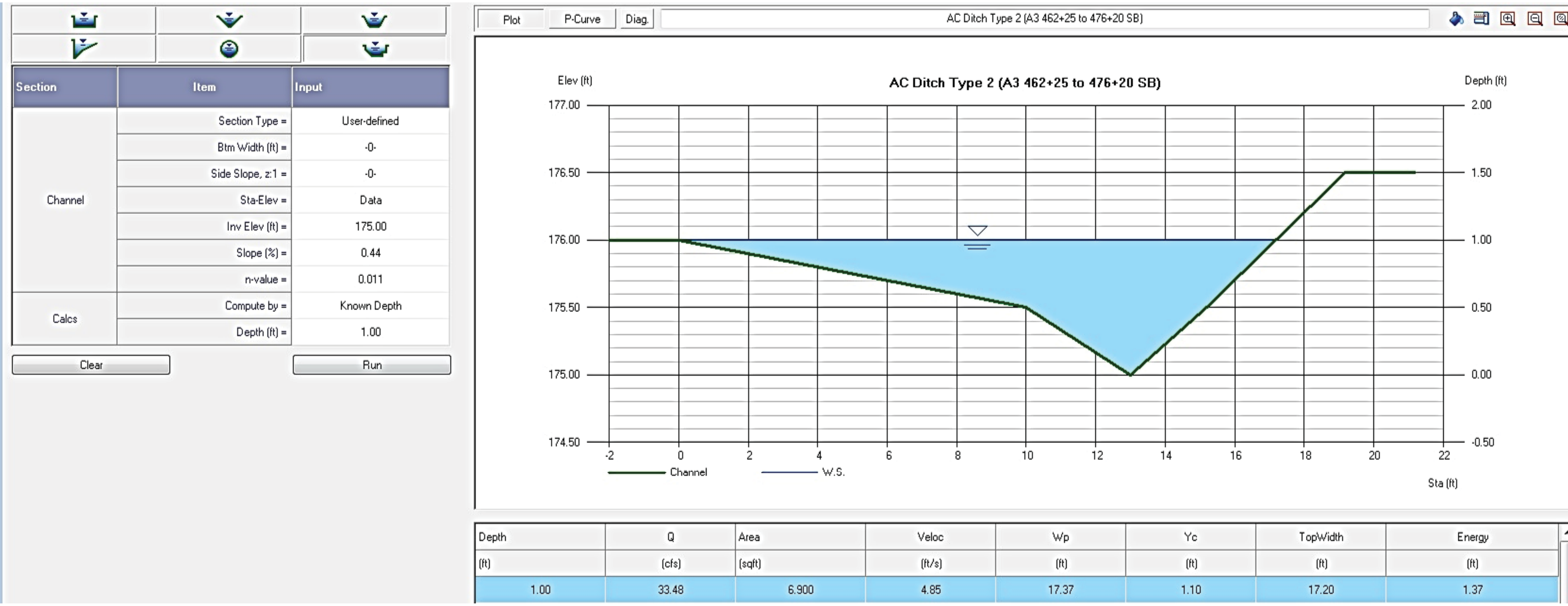
Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	170.00
	Slope (%) =	0.40
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.56	5.679	7.056	0.80	25.23	0.25	25.20	0.57
0.70	10.30	11.02	0.93	31.53	0.34	31.50	0.71
0.84	16.75	15.88	1.05	37.84	0.42	37.80	0.86
0.98	25.26	21.61	1.17	44.14	0.51	44.10	1.00
1.12	36.07	28.22	1.28	50.45	0.61	50.40	1.15
1.26	49.38	35.72	1.38	56.76	0.70	56.70	1.29
1.40	65.40	44.10	1.48	63.06	0.79	63.00	1.43



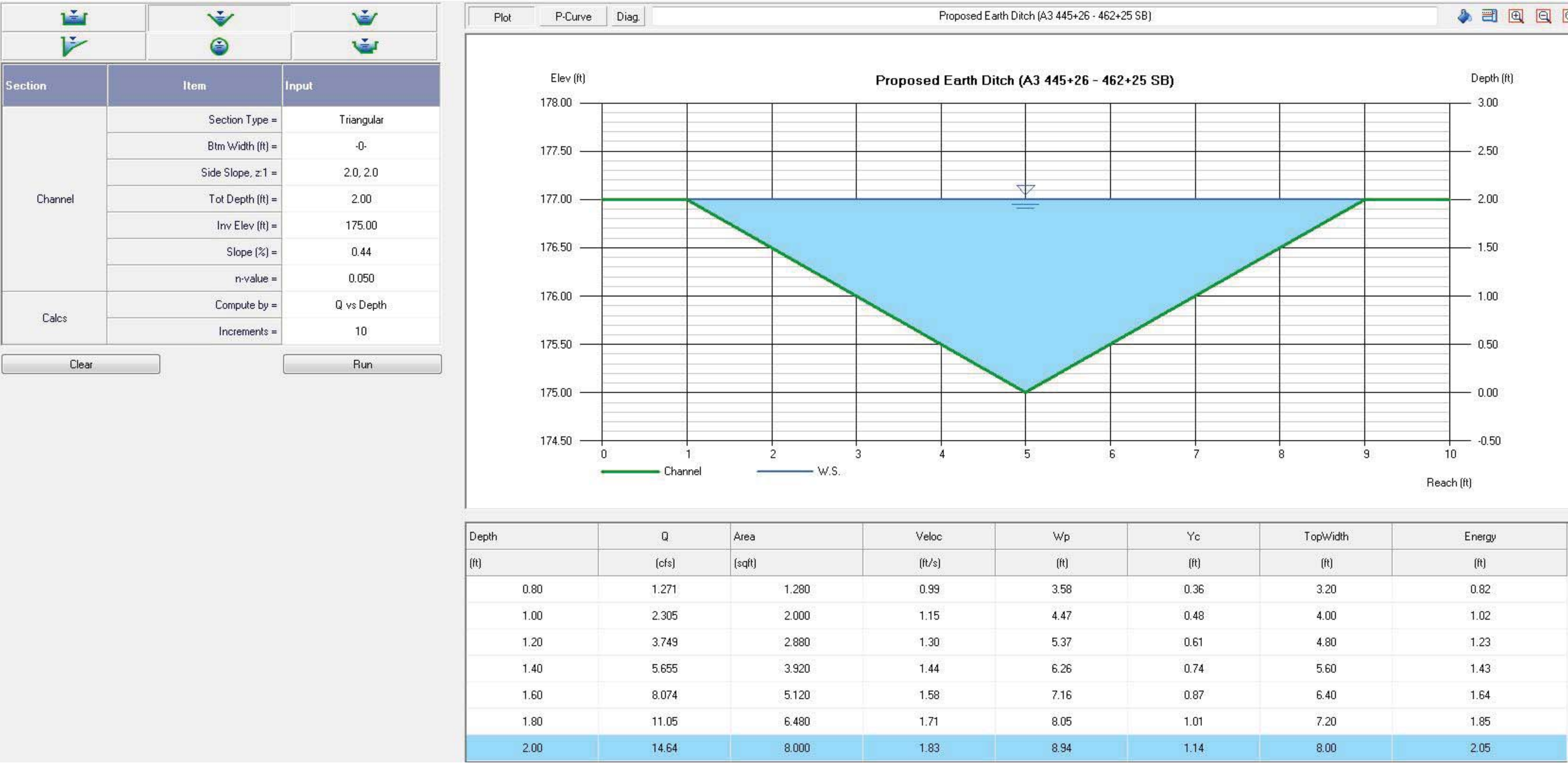
Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	175.00
	Slope (%) =	0.40
	n-value =	0.011
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.00

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.00	31.92	6.900	4.63	17.37	1.08	17.20	1.33



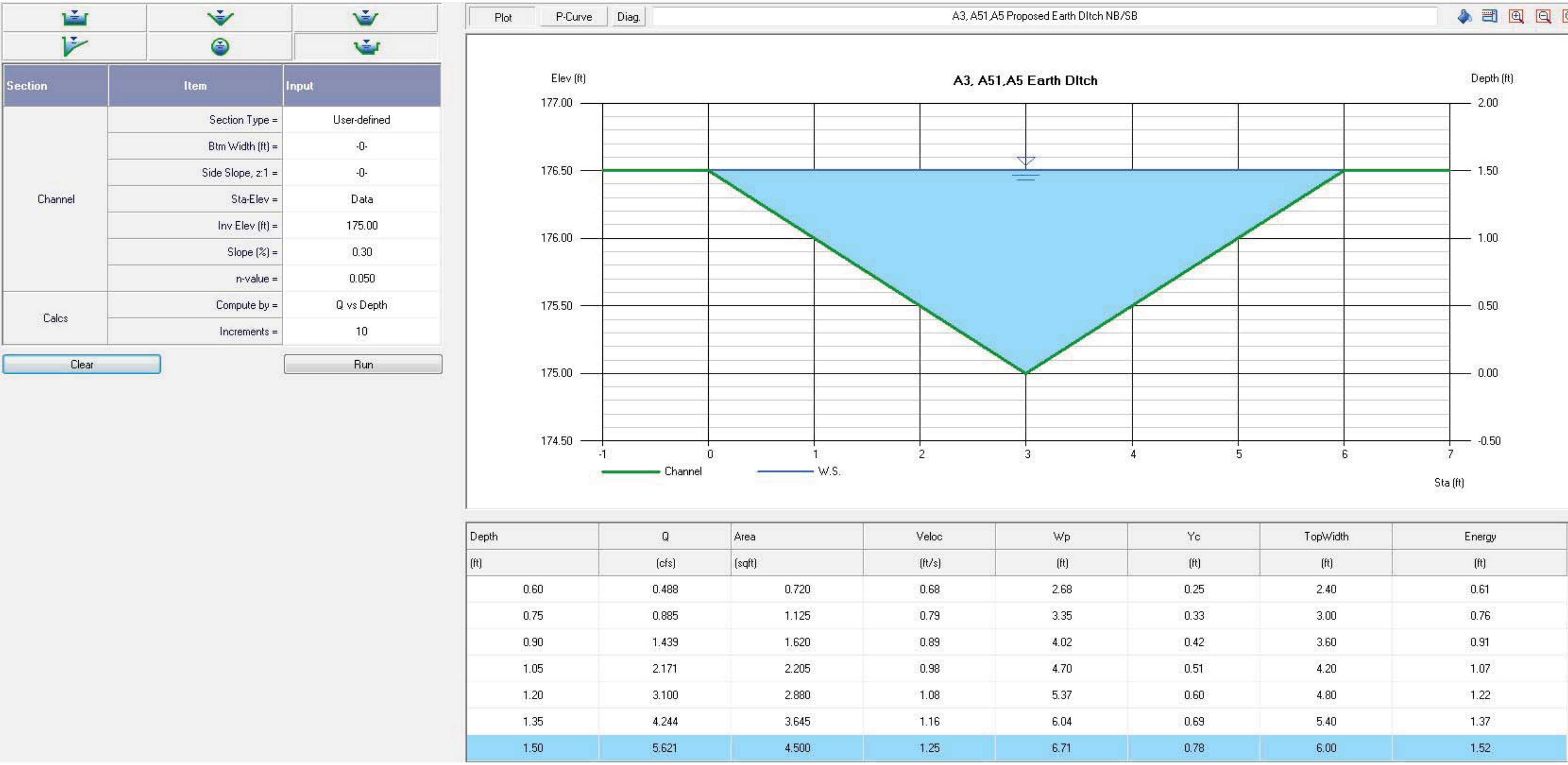
Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	175.00
	Slope (%) =	0.44
	n-value =	0.011
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.00

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.00	33.48	6.900	4.85	17.37	1.10	17.20	1.37



Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	2.0, 2.0
	Tot Depth (ft) =	2.00
	Inv Elev (ft) =	175.00
	Slope (%) =	0.44
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.80	1.271	1.280	0.99	3.58	0.36	3.20	0.82
1.00	2.305	2.000	1.15	4.47	0.48	4.00	1.02
1.20	3.749	2.880	1.30	5.37	0.61	4.80	1.23
1.40	5.655	3.920	1.44	6.26	0.74	5.60	1.43
1.60	8.074	5.120	1.58	7.16	0.87	6.40	1.64
1.80	11.05	6.480	1.71	8.05	1.01	7.20	1.85
2.00	14.64	8.000	1.83	8.94	1.14	8.00	2.05

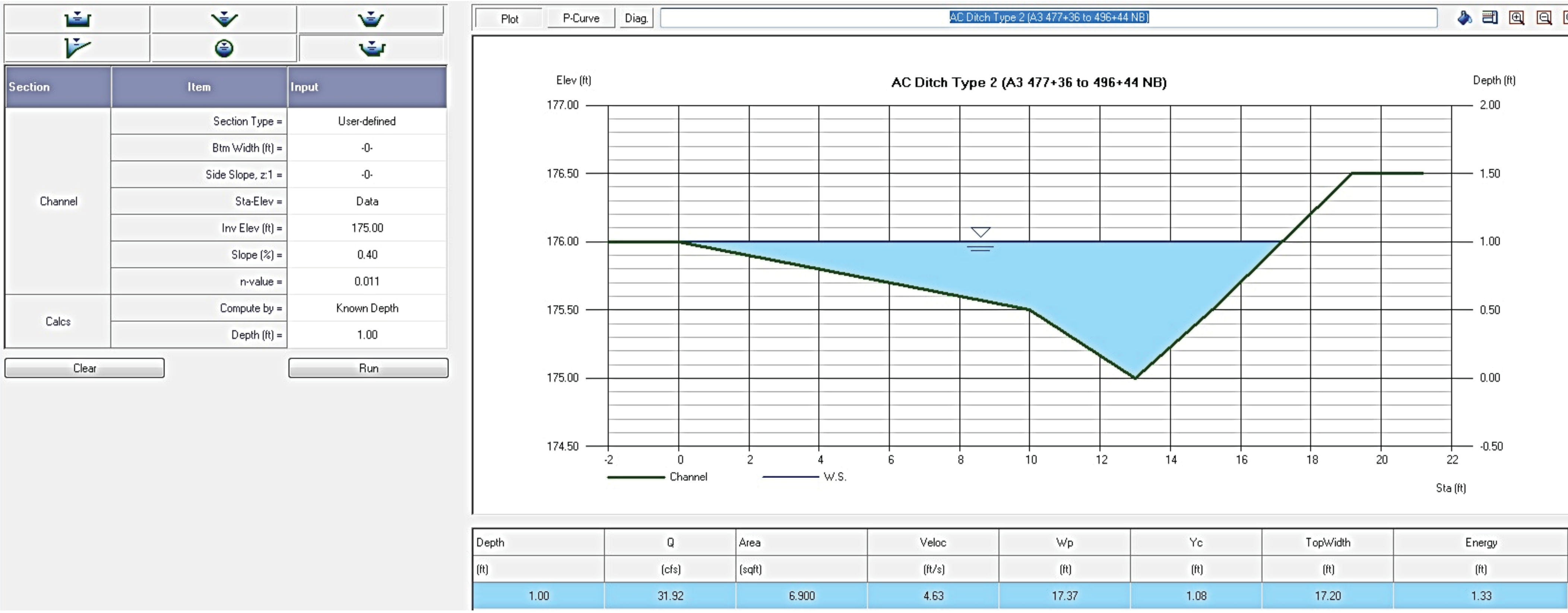


A3, A51,A5 Proposed Earth DItch NB/SB

A3, A51,A5 Earth DItch

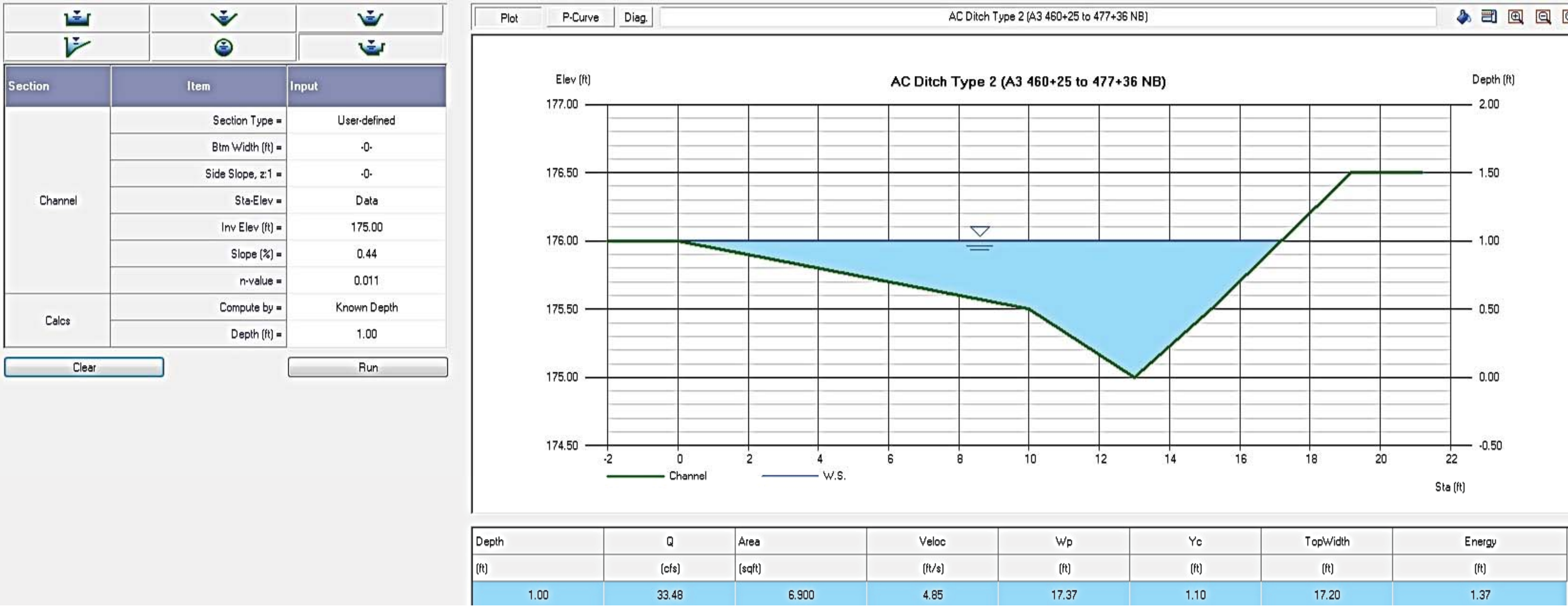
Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	175.00
	Slope (%) =	0.30
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.60	0.488	0.720	0.68	2.68	0.25	2.40	0.61
0.75	0.885	1.125	0.79	3.35	0.33	3.00	0.76
0.90	1.439	1.620	0.89	4.02	0.42	3.60	0.91
1.05	2.171	2.205	0.98	4.70	0.51	4.20	1.07
1.20	3.100	2.880	1.08	5.37	0.60	4.80	1.22
1.35	4.244	3.645	1.16	6.04	0.69	5.40	1.37
1.50	5.621	4.500	1.25	6.71	0.78	6.00	1.52



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	175.00
	Slope (%) =	0.40
	n-value =	0.011
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.00

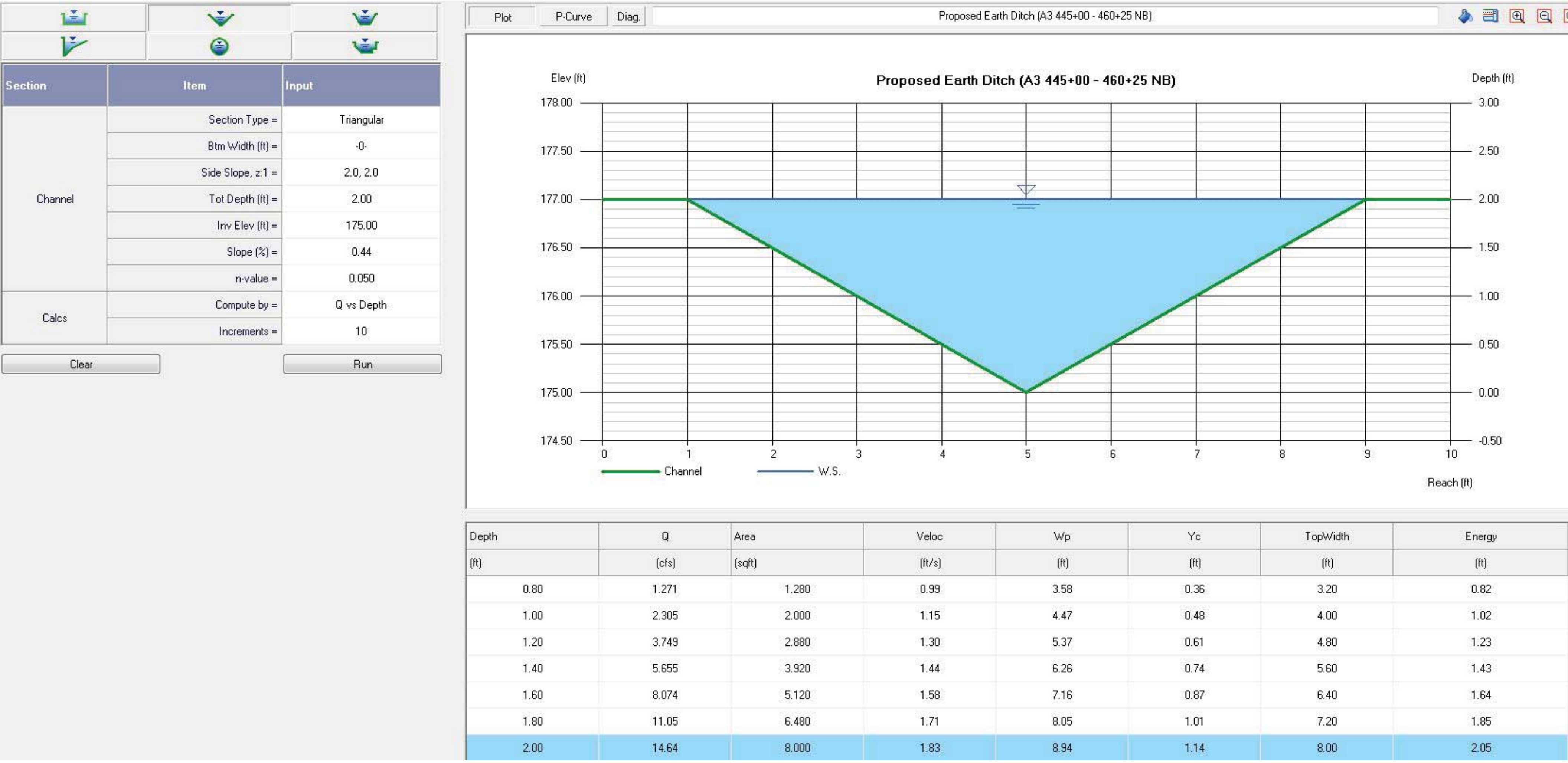
Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.00	31.92	6.900	4.63	17.37	1.08	17.20	1.33



AC Ditch Type 2 (A3 460+25 to 477+36 NB)

Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	175.00
	Slope (%) =	0.44
	n-value =	0.011
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.00

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.00	33.48	6.900	4.85	17.37	1.10	17.20	1.37

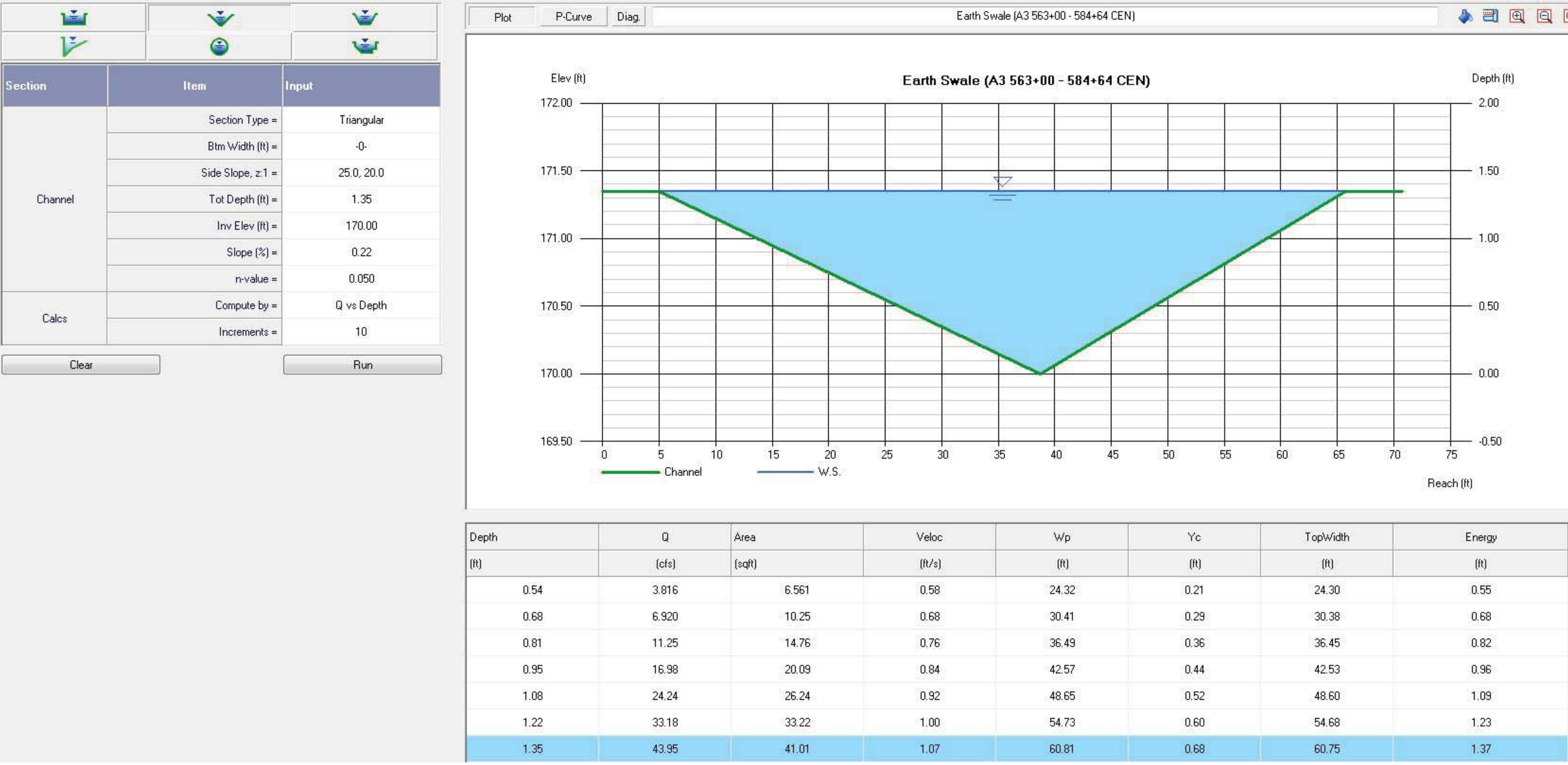


Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	2.0, 2.0
	Tot Depth (ft) =	2.00
	Inv Elev (ft) =	175.00
	Slope (%) =	0.44
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Proposed Earth Ditch (A3 445+00 - 460+25 NB)

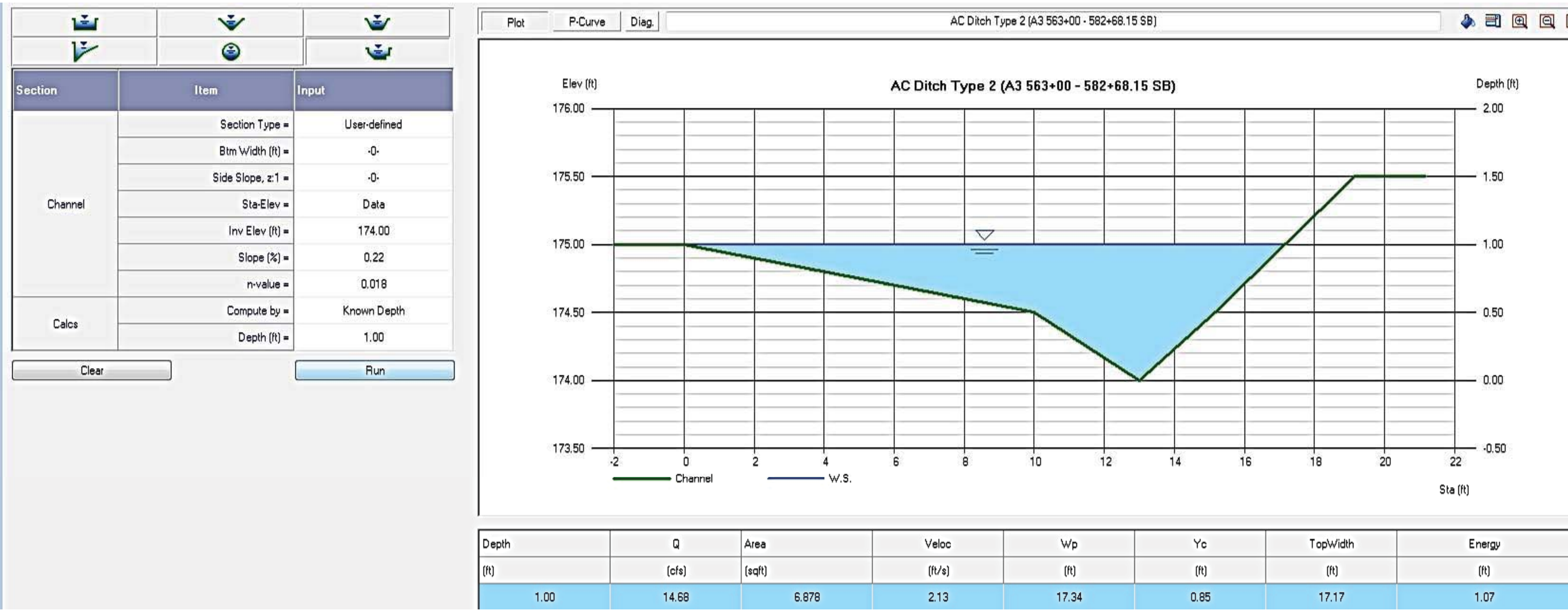
Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
0.80	1.271	1.280	0.99	3.58	0.36	3.20	0.82
1.00	2.305	2.000	1.15	4.47	0.48	4.00	1.02
1.20	3.749	2.880	1.30	5.37	0.61	4.80	1.23
1.40	5.655	3.920	1.44	6.26	0.74	5.60	1.43
1.60	8.074	5.120	1.58	7.16	0.87	6.40	1.64
1.80	11.05	6.480	1.71	8.05	1.01	7.20	1.85
2.00	14.64	8.000	1.83	8.94	1.14	8.00	2.05

E6 – Hydraflow Calculations – Subwatershed H



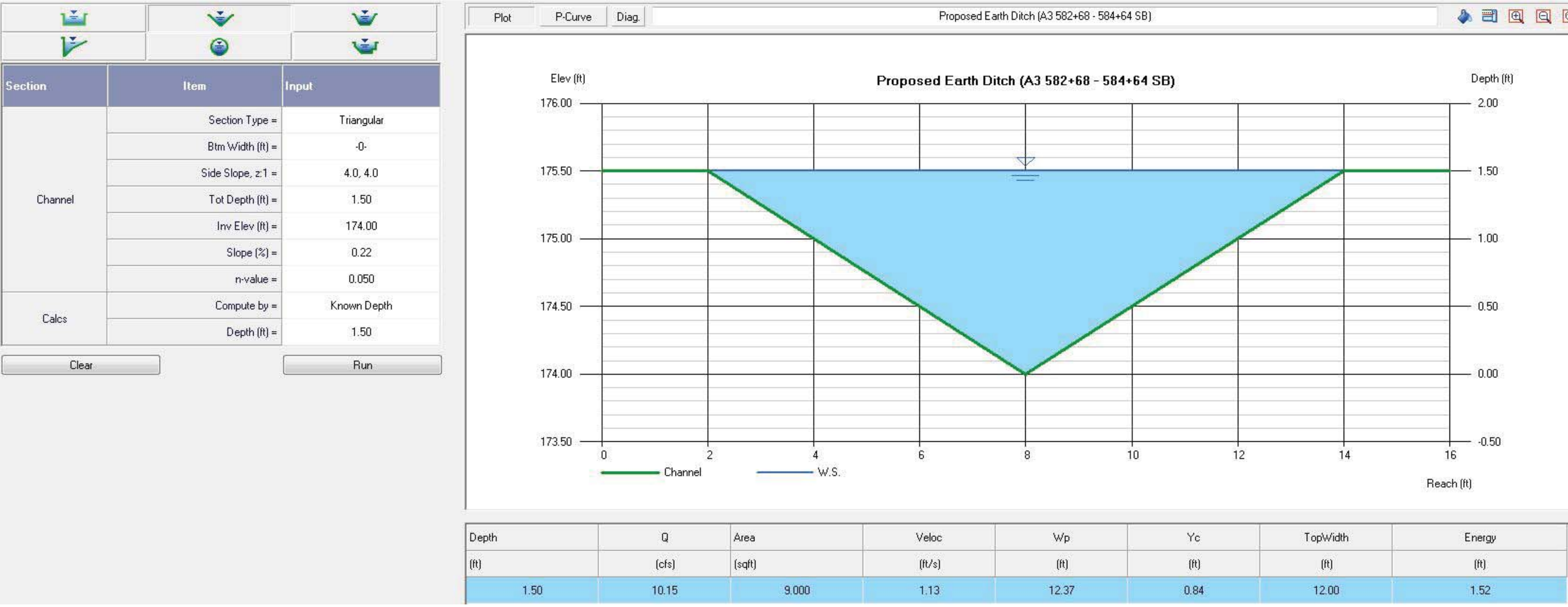
Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	25.0, 20.0
	Tot Depth (ft) =	1.35
	Inv Elev (ft) =	170.00
	Slope (%) =	0.22
	n-value =	0.050
Calcs	Compute by =	Q vs Depth
	Increments =	10

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
0.54	3.816	6.561	0.58	24.32	0.21	24.30	0.55
0.68	6.920	10.25	0.68	30.41	0.29	30.38	0.68
0.81	11.25	14.76	0.76	36.49	0.36	36.45	0.82
0.95	16.98	20.09	0.84	42.57	0.44	42.53	0.96
1.08	24.24	26.24	0.92	48.65	0.52	48.60	1.09
1.22	33.18	33.22	1.00	54.73	0.60	54.68	1.23
1.35	43.95	41.01	1.07	60.81	0.68	60.75	1.37



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	174.00
	Slope (%) =	0.22
	n-value =	0.018
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.00

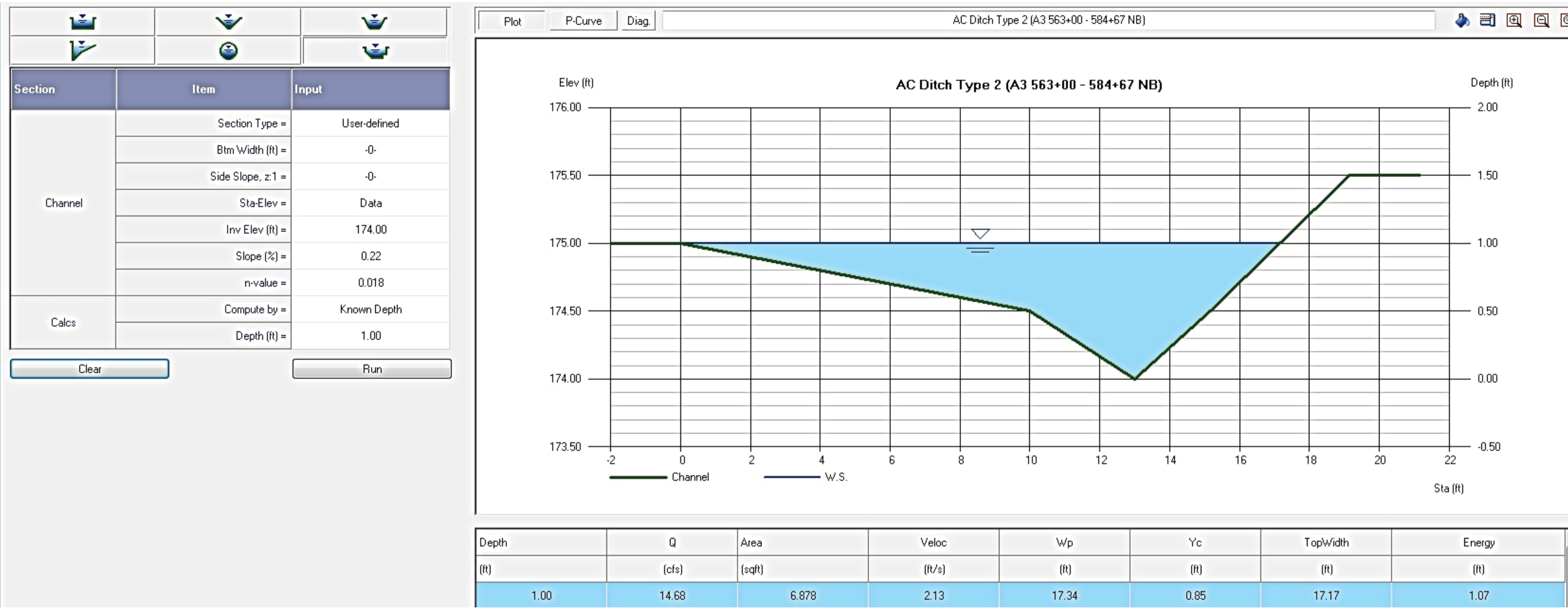
Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
1.00	14.68	6.878	2.13	17.34	0.85	17.17	1.07



Proposed Earth Ditch (A3 582+68 - 584+64 SB)

Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	4.0, 4.0
	Tot Depth (ft) =	1.50
	Inv Elev (ft) =	174.00
	Slope (%) =	0.22
	n-value =	0.050
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.50

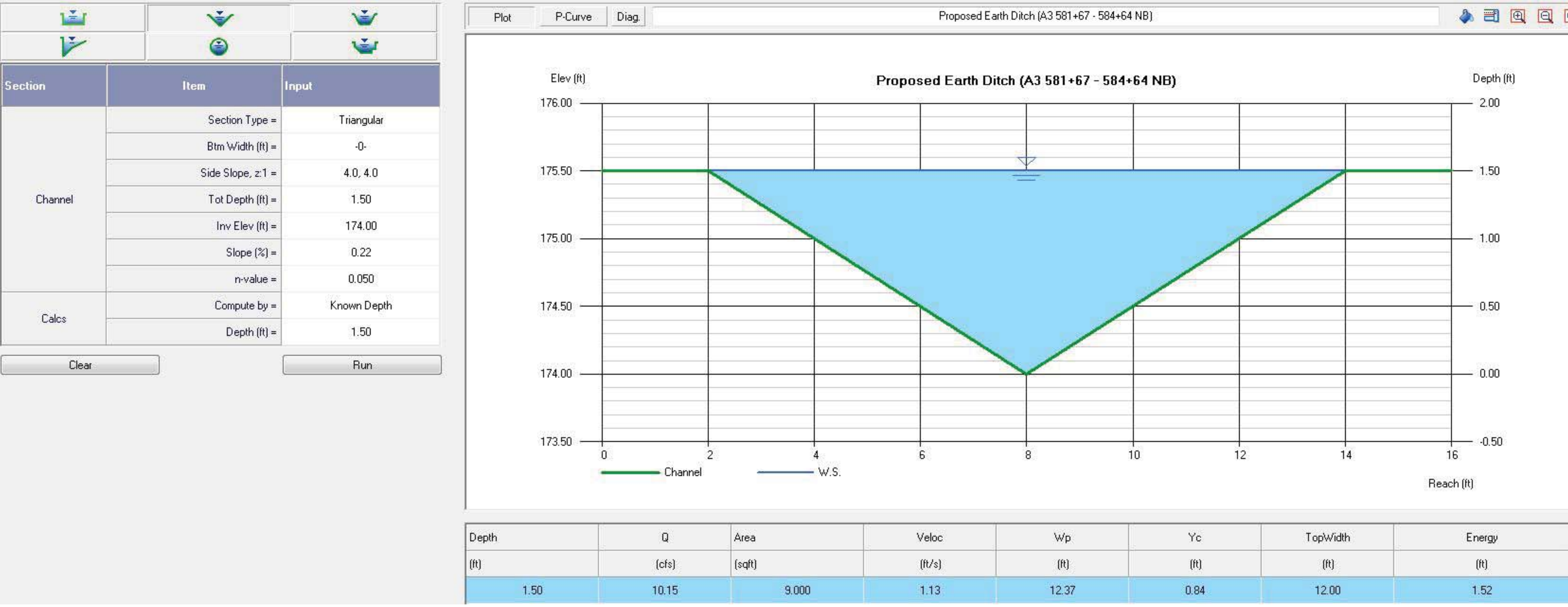
Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.50	10.15	9.000	1.13	12.37	0.84	12.00	1.52



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	174.00
	Slope (%) =	0.22
	n-value =	0.018
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.00

AC Ditch Type 2 (A3 563+00 - 584+67 NB)

Depth (ft)	Q (cfs)	Area (sqft)	Veloc (ft/s)	Wp (ft)	Yc (ft)	TopWidth (ft)	Energy (ft)
1.00	14.68	6.878	2.13	17.34	0.85	17.17	1.07

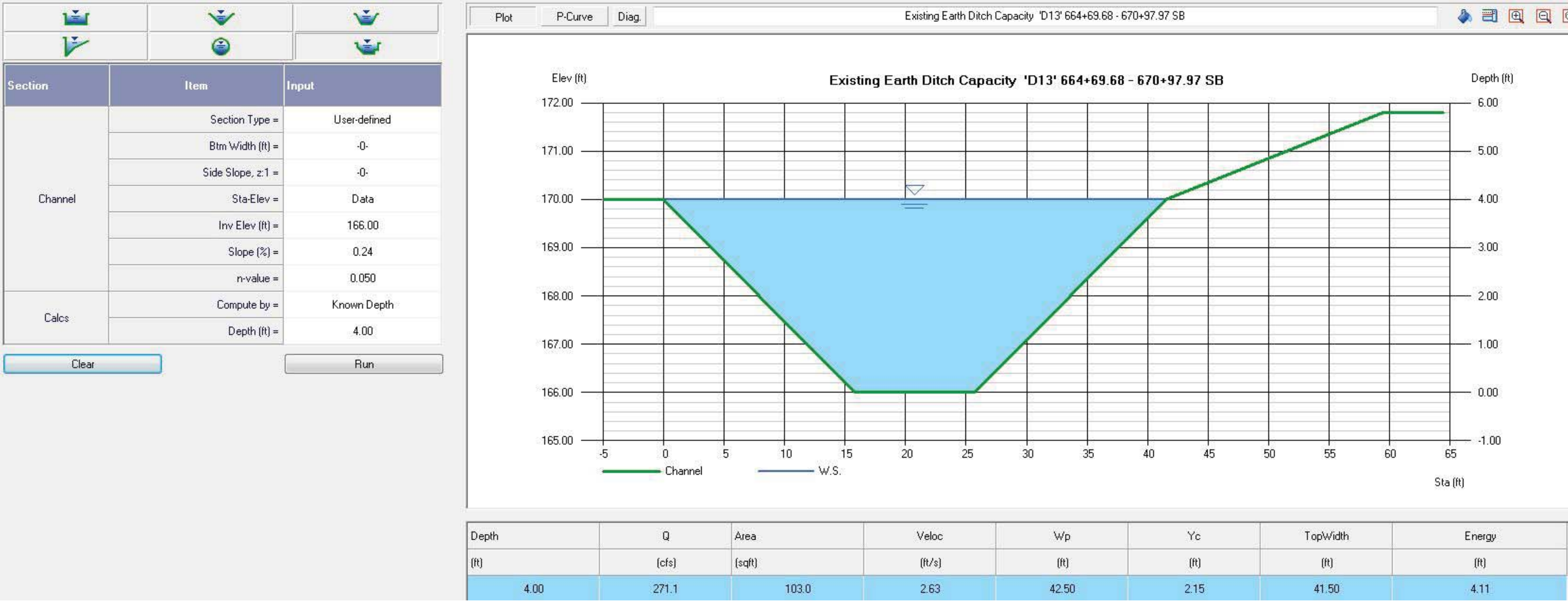


Proposed Earth Ditch (A3 581+67 - 584+64 NB)

Section	Item	Input
Channel	Section Type =	Triangular
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	4.0, 4.0
	Tot Depth (ft) =	1.50
	Inv Elev (ft) =	174.00
	Slope (%) =	0.22
	n-value =	0.050
Calcs	Compute by =	Known Depth
	Depth (ft) =	1.50

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
1.50	10.15	9.000	1.13	12.37	0.84	12.00	1.52

E7 – Hydraflow Calculations – Subwatershed J



Section	Item	Input
Channel	Section Type =	User-defined
	Btm Width (ft) =	-0-
	Side Slope, z:1 =	-0-
	Sta-Elev =	Data
	Inv Elev (ft) =	166.00
	Slope (%) =	0.24
	n-value =	0.050
Calcs	Compute by =	Known Depth
	Depth (ft) =	4.00

Depth	Q	Area	Veloc	Wp	Yc	TopWidth	Energy
(ft)	(cfs)	(sqft)	(ft/s)	(ft)	(ft)	(ft)	(ft)
4.00	271.1	103.0	2.63	42.50	2.15	41.50	4.11

APPENDIX F

Onsite Drainage Calculations

- F1 – Onsite Drainage Calculations (Existing Conditions)
- F2 – Onsite Drainage Calculations (Proposed Conditions)

F1 – Onsite Drainage Calculations (Existing Conditions)

Onsite Drainage Calculations (Existing Conditions)

State Route 65 Widening

Subwatershed A
"A5" STA 156+84.78 - 176+73.93 NB
"A5" STA 156+84.78 - 177+08.56 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
A1	"A5" 168+26.80 NB	202779.24	4.66	0.95	1.1	1	434775.94	9.98	0.38	0.14	0.08	0.08	0.08	1.1	0.418	14.64	0.60	34.69	1.40	12.40
A2	"A5" 168+26.80 SB	101389.62	2.33	0.95	1.1	1	140431.62	3.22	0.38	0.14	0.08	0.08	0.08	1.1	0.418	5.55	0.66	22.57	1.77	6.51
A3	"A5" 169+06.08 NB	101389.62	2.33	0.95	1.1	1	60881.34	1.40	0.38	0.14	0.08	0.08	0.08	1.1	0.418	3.73	0.78	24.93	1.68	4.89

State Route 65 Widening

Subwatershed B
"A5" STA 176+73.93 - 202+79.01 NB
"A5" STA 177+08.56 - 207+18.98 SB
"P5" STA 207+12.54 - 219+01.34 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
B1	"A5" 199+23.15 NB	135606.07	3.11	0.95	1.1	1	258814.76	5.94	0.38	0.14	0.08	0.08	0.08	1.1	0.418	9.05	0.62	14.30	2.25	12.61
B2	"A5" 199+23.15 SB	306802.94	7.04	0.95	1.1	1	790560.57	18.15	0.38	0.14	0.08	0.08	0.08	1.1	0.418	25.19	0.58	20.46	1.87	27.31

Onsite Drainage Calculations (Existing Conditions)

State Route 65 Widening

Subwatershed C
"A5" STA 202+79.01 - 250+80.53 NB
"A5" STA 207+18.98 - 248+18.68 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
C1	"A5" 248+06.43 SB	284031.83	6.52	0.95	1.1	1	766696.29	17.60	0.38	0.14	0.08	0.08	0.08	1.1	0.42	24.12	0.58	14.60	2.23	30.94
C2	"A5" 248+06.43 NB	848676.84	19.48	0.95	1.1	1	1620494.03	37.20	0.38	0.14	0.08	0.08	0.08	1.1	0.42	56.68	0.62	24.11	1.71	59.90

Onsite Drainage Calculations (Existing Conditions)

State Route 65 Widening

Subwatershed D
"A5" STA 250+80.53 to 300+43.52 NB
"A5" STA248+18.68 to 297+66.56 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
D1	"A5" 256+62.59 SB	0	0.00	0.95	1.1	1	41463.81	0.95	0.38	0.14	0.08	0.08	0.08	1.1	0.42	0.95	0.42	5.00	3.78	1.50
D2	"B4" 264+93.42 SB	46002.16	1.06	0.95	1.1	1	155607.73	3.57	0.38	0.14	0.08	0.08	0.08	1.1	0.42	4.63	0.55	11.31	2.54	6.49
D3	"A5" 279+36.83 NB	39316.37	0.90	0.95	1.1	1	67000.83	1.54	0.38	0.14	0.08	0.08	0.08	1.1	0.42	2.44	0.63	10.00	2.71	4.18

Onsite Drainage Calculations (Existing Conditions)

State Route 65 Widening

Subwatershed E
"A5" STA 297+66.56 to 303+98.90 SB/NB
"A51" STA 97+58.11 to 103+88.29 SB/NB
"A3" STA 441+73.39 to 493+46.43 SB
"A3" STA 441+73.39 - 497+43.52 NB

Equation:

$$I_{25} = \frac{7.8662}{(T_c + 1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c + 1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area										Weighted				
Node	Location	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
E1	Pleasant Grove Creek NB	201949.25	4.64	0.95	1.1	1	257373.39	5.91	0.38	0.14	0.08	0.08	0.08	1.1	0.42	10.54	0.67	16.22	2.11	15.00
E2	Pleasant Grove Creek SB	413517.37	9.49	0.95	1.1	1	718243.93	16.49	0.38	0.14	0.08	0.08	0.08	1.1	0.42	25.98	0.63	75.60	0.92	14.99
E3	"A3" 476+86.34 SB	229382.32	5.27	0.95	1.1	1	237411.2	5.45	0.38	0.14	0.08	0.08	0.08	1.1	0.42	10.72	0.70	14.44	2.24	16.92
E4	"A3" 477+49.38 NB	524590.96	12.04	0.95	1.1	1	755388.55	17.34	0.38	0.14	0.08	0.08	0.08	1.1	0.42	29.38	0.66	29.05	1.55	29.84

Onsite Drainage Calculations (Existing Conditions)

State Route 65 Widening

Subwatershed H
"A3" STA 563+00.00 to 584+64.00

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
H1	"A3" 584+54.91 NB	105725.39	2.43	0.95	1.1	1	191679.66	4.40	0.38	0.14	0.08	0.08	0.08	1.1	0.42	6.83	0.62	22.09	1.79	7.65
H2	"A3" 584+54.91 SB	201243.27	4.62	0.95	1.1	1	469702.95	10.78	0.38	0.14	0.08	0.08	0.08	1.1	0.42	15.40	0.59	51.52	1.13	10.32

Onsite Drainage Calculations (Existing Conditions)

State Route 65 Widening

Subwatershed J
"A3" STA 629+84.01 - 635+70.46
"D13" STA 654+06.47 - 677+89.18

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

			Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	System	LOCATION	Area (SQ. FT)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
J1	Earth Ditch	"A3" 630+65.00 to 678+03.00 NB	311214.11	7.14	0.95	1.1	1	893342.01	20.51	0.38	0.14	0.08	0.08	0.08	1.1	0.418	27.65	0.57	117.06	0.72	11.28
J2	Earth Ditch	"A3" 630+00.00 to 672+40.68 SB	517852.57	11.89	0.95	1.1	1	1415968.80	32.51	0.38	0.14	0.08	0.08	0.08	1.1	0.418	44.39	0.57	96.77	0.80	20.32

F2 – Onsite Drainage Calculations (Proposed Conditions)

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed A
"A5" STA 156+84.78 - 176+73.93 NB
"A5" STA 156+84.78 - 177+08.56 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
Earth Ditch	"A5" 156+84.78 - 177+08.56 SB	319706.19	7.34	0.95	1.10	1.00	175812.12	4.04	0.38	0.14	0.08	0.08	0.08	1.10	0.42	11.38	0.79	34.69	1.05	9.51	3.72	Improvement Needed

*Rebuild existing 3:1, 3:1 Earth Ditch

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
AC Ditch	"A5" 156+84.78 to 176+73.93 NB	279181.82	6.41	0.95	1.10	1.00	266940.13	6.13	0.38	0.14	0.08	0.08	0.08	1.10	0.42	12.54	0.72	22.57	1.33	11.92	16.89	Good

*Rebuild existing 3:1, 3:1 AC Ditch

Proposed Improvements

AREA OF CONCERN: "A5" 156+84.78 to177+08.56 SB

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
AC Ditch	"A5" 156+84.78 - 177+08.56 SB	319706.19	7.34	0.95	1.10	1.00	175812.12	4.04	0.38	0.14	0.08	0.08	0.08	1.10	0.42	11.38	0.79	34.69	1.05	9.51	16.89	Good

*Proposed AC Ditch (3:1,3:1 V Ditch)

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
A1	"A5" 162+08.00	299447.23	6.87	0.95	1.10	1.00	313371.84	7.19	0.38	0.14	0.08	0.08	0.08	1.10	0.42	14.07	0.70	34.69	1.40	13.88
A2	"A5" 162+08.00	149723.61	3.44	0.95	1.10	1.00	91203.53	2.09	0.38	0.14	0.08	0.08	0.08	1.10	0.42	5.53	0.78	22.57	1.77	7.64
A3	"A5" 169+06.08	149723.61	3.44	0.95	1.10	1.00	38178.47	0.88	0.38	0.14	0.08	0.08	0.08	1.10	0.42	4.31	0.88	24.93	1.68	6.39

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed B
"A5" STA 176+73.93 - 202+79.01 NB
"A5" STA 177+08.56 - 207+18.98 SB
"P5" STA 207+12.54 - 219+01.34 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
AC Dike	"A5" 177+08.56 to 190+75.57 SB	110727.61	2.54	0.95	1.10	1.00	108738.06	2.50	0.38	0.14	0.08	0.08	0.08	1.10	0.42	5.04	0.71	14.26	1.69	6.07	11.37	Good
AC Ditch	"A5" 190+75.57 to 199+50.00 SB	182523.63	4.19	0.95	1.10	1.00	190873.58	4.38	0.38	0.14	0.08	0.08	0.08	1.10	0.42	8.57	0.70	14.26	1.69	10.20	55.10	Good
Earth Ditch	"A5"199+50.00 to 207+18.98 SB "P5" 207+12.54 to 219+01.34 SB	129565.09	2.97	0.95	1.10	1.00	172057.69	3.95	0.00	0.14	0.08	0.08	0.08	1.10	0.00	6.92	0.43	20.46	1.40	4.17	69.80	Good

*Potential Bioswale Option

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
AC Dike	"A5" 176+73.93 to190+43.99 NB	110974.34	2.55	0.95	1.10	1.00	114672.60	2.63	0.38	0.14	0.08	0.08	0.08	1.10	0.42	5.18	0.70	14.30	1.69	6.17	11.37	Good
AC Ditch	"A5" 190+43.99 to 199+00.00 NB	180311.32	4.14	0.95	1.10	1.00	192126.27	4.41	0.38	0.14	0.08	0.08	0.08	1.10	0.42	8.55	0.70	14.30	1.69	10.12	49.29	Good
AC Ditch	"A5" 199+00.000 to 202+79.01 NB	30699.78	0.70	0.95	1.10	1.00	34545.64	0.79	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.50	0.69	5.00	2.85	2.95	53.99	Good

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
B1	"A5" 199+23.15 NB	211011.10	4.84	0.95	1.10	1.00	226616.51	5.20	0.38	0.14	0.08	0.08	0.08	1.10	0.42	10.05	0.70	14.30	2.25	15.82
B2	"A5" 199+23.15 SB	528912.44	12.14	0.95	1.10	1.00	583661.71	13.40	0.38	0.14	0.08	0.08	0.08	1.10	0.42	25.54	0.69	20.46	1.87	33.12

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed C
"A5" STA 202+79.01 - 250+80.53 NB
"A5" STA 207+18.98 - 248+18.68 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area										Weighted							
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG	
AC Dike	"A5" 207+18.98 to 220+81.59 SB	156904.31	3.60	0.95	1.10	1.00	178118.92	4.09	0.38	0.14	0.08	0.08	0.08	1.10	0.42	7.69	0.69	11.41	1.90	10.10	13.34	Good	
AC Ditch Type 2	"A5" 220+81.59 to 235+00.00 SB	488505.88	11.21	0.95	1.10	1.00	484191.52	11.12	0.38	0.14	0.08	0.08	0.08	1.10	0.42	22.33	0.71	11.41	1.90	30.16	94.93	Good	AC Ditch Type 2 (6:1 (8ft), Dike)
Trapezoid AC Ditch	"A5" 235+00.00 to 247+00.00 SB	504505.88	11.58	0.95	1.10	1.00	558802.09	12.83	0.38	0.14	0.08	0.08	0.08	1.10	0.42	24.41	0.69	14.60	1.67	28.36	74.65	Good	
AC Ditch	"A5" 247+00.00 to 250+76.06 SB	0.00	0.00	0.95	1.10	1.00	28922.50	0.66	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.66	0.42	5.00	2.85	0.79	38.18	Good	
DI	"A5" 237+00.00 to 248+18.68 SB	89862.78	2.06	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	2.06	1.00	9.32	2.11	4.35	2.96	Improvement Needed	

		Pavement (Developed Area)					Undeveloped Area										Weighted							
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG	
AC Ditch Type 2	"A5" 202+79.01 to 224+74.90 NB	362283.23	8.32	0.95	1.10	1.00	539873.17	12.39	0.38	0.14	0.08	0.08	0.08	1.10	0.42	20.71	0.65	18.31	1.49	20.05	94.93	Good	AC Ditch Type 2 (6:1 (8ft), Dike)
AC Ditch Type 2	"A5" 224+74.90 to 238+70.78 NB	461514.39	10.59	0.95	1.10	1.00	698819.63	16.04	0.38	0.14	0.08	0.08	0.08	1.10	0.42	26.64	0.65	18.31	1.49	25.70	94.93	Good	Replace Concrete Ditch with AC Ditch Type 2
Trapezoid AC Ditch	"A5" 238+70.78 to 250+80.53 NB	545919.04	12.53	0.95	1.10	1.00	787346.96	18.07	0.38	0.14	0.08	0.08	0.08	1.10	0.42	30.61	0.66	24.11	1.28	25.76	73.08	Good	

Proposed Improvements

AREA OF CONCERN: "A5" 235+00.00 to 248+18.68

		Pavement (Developed Area)					Undeveloped Area										Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
DI	"A5" 237+00.00 to 242+58.00 SB	44867.85	1.03	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.03	1.00	5.00	2.85	2.93	2.96	Good
DI	"A5" 242+58.00 to Existing DI SB	44994.93	1.03	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.03	1.00	5.00	2.85	2.94	2.96	Good

		Pavement (Developed Area)					Undeveloped Area										Weighted				
Node	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
C1	"A5" 248+06.43 SB	433868.48	9.96	0.95	1.10	1.00	587724.59	13.49	0.38	0.14	0.08	0.08	0.08	1.10	0.42	23.45	0.67	14.60	2.23	34.78
C2	"A5" 248+06.43 NB	1059920.37	24.33	0.95	1.10	1.00	1375071.55	31.57	0.38	0.14	0.08	0.08	0.08	1.10	0.42	55.90	0.67	24.11	1.71	64.17

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed D
"A5" STA 250+80.53 to 300+43.52 NB
"A5" STA248+18.68 to 297+66.56 SB

Equation:

$$I_{25} = \frac{7.8662}{(T_c + 1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c + 1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
DI	"A5" 248+18.68 to 268+00.00 SB	148179.61	3.40	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	3.40	1.00	16.63	1.56	5.32	2.96	Improvement Needed
DI	"A5" 268+00.00 to 297+66.56 SB	92219.37	2.12	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	2.12	1.00	15.62	1.62	3.42	1.55	Improvement Needed

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
AC Dike	"A5" 270+11.48 to 274+33.77 NB	25125.14	0.58	0.95	1.10	1.00	19902.63	0.46	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.03	0.74	5.00	2.85	2.19	3.85	Good
AC Dike	"A5" 274+33.77 to 279+27.30 NB	59488.31	1.37	0.95	1.10	1.00	61972.93	1.42	0.38	0.14	0.08	0.08	0.08	1.10	0.42	2.79	0.70	10.00	2.03	3.98	6.98	Good

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
AC Ditch	"A5" 250+75.75 to 256+62.59 SB	0.00	0.00	0.95	1.10	1.00	37333.04	0.86	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.86	0.42	5.00	2.85	1.02	38.18	Good
AC Ditch	"A5" 256+62.59 to "B4" 247+25.72 SB	61979.10	1.42	0.95	1.10	1.00	126341.90	2.90	0.38	0.14	0.08	0.08	0.08	1.10	0.42	4.32	0.61	11.31	1.91	5.03	26.43	Good

Proposed Improvements

AREA OF CONCERN: "A5" 248+18.68 to 268+00.00

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
DI	"A5" 248+18.68 to253+68.76 SB	43833.83	1.01	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.01	1.00	5.00	2.85	2.87	2.96	Good
DI	"A5" 253+68.76 to 259+13.83 SB	44834.18	1.03	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.03	1.00	5.00	2.85	2.93	2.96	Good
DI	"A5" 259+13.83 to 264+13.88 SB	37225.90	0.85	0.95	1.10	1.00	1.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.85	1.00	5.00	2.85	2.43	2.96	Good
Existing DI	"A5" 264+13.88 to 268+00.00 SB	22285.76	0.51	0.95	1.10	1.00	2.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.51	1.00	7.00	2.43	1.24	2.96	Good

AREA OF CONCERN: "A5" 268+00.00 to 297+66.56 SB

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
DI	"A5" 268+00.00 to 271+49.99 SB	21979.59	0.50	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.50	1.00	5.00	2.85	1.44	1.55	Good
DI	"A5" 271+49.99 to 274+74.97 SB	22535.80	0.52	0.95	1.10	1.00	0.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.52	1.00	5.00	2.85	1.47	1.55	Good
DI	"A5"274+74.97 to 276+74.95 SB	16703.93	0.38	0.95	1.10	1.00	1.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.38	1.00	5.00	2.85	1.09	1.55	Good
DI	"A5" 276+74.95 to 278+00.00 SB	13935.70	0.32	0.95	1.10	1.00	2.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.32	1.00	5.00	2.85	0.91	2.55	Good
Existing DI	"A5" 278+00.00 to 297+66.56 SB	17064.36	0.39	0.95	1.10	1.00	2.00	0.00	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.39	1.00	5.00	2.85	1.12	1.55	Good

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
D1	"A5" 256+62.59 SB	0.00	0.00	0.95	1.10	1.00	37333.04	0.86	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.86	0.42	5.00	3.78	1.35
D2	"B4" 264+93.42 SB	61979.10	1.42	0.95	1.10	1.00	126341.90	2.90	0.38	0.14	0.08	0.08	0.08	1.10	0.42	4.32	0.61	11.31	2.54	6.70
D3	"A5" 279+36.83 NB	59488.31	1.37	0.95	1.10	1.00	61972.93	1.42	0.38	0.14	0.08	0.08	0.08	1.10	0.42	2.79	0.70	10.00	2.71	5.31

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed E
"A5" STA 297+66.56 to 303+98.90 SB/NB
"A51" STA 97+58.11 to 103+88.29 SB/NB
"A3" STA 441+73.39 to 493+46.43 SB
"A3" STA 441+73.39 - 497+43.52 NB

Equation:

$$I_{25} = \frac{7.8662}{(T_c+1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c+1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area										Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
Earth Swale	"A5" 297+66.56 to 303+98.90 "A51"	62602.26	1.44	0.95	1.10	1.00	9824.01	0.23	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.66	0.92	23.50	1.30	1.99	56.64	Good
Earth Swale	"A3" 445+25.03 to 477+00.00	215900.53	4.96	0.95	1.10	1.00	31750.08	0.73	0.38	0.14	0.08	0.08	0.08	1.10	0.42	5.69	0.93	75.60	0.69	3.61	66.21	Good
Earth Swale	"A3" 477+00.00 to 481+26.31	28986.63	0.67	0.95	1.10	1.00	4262.74	0.10	0.38	0.14	0.08	0.08	0.08	1.10	0.42	0.76	0.93	10.14	2.02	1.43	70.89	Good
Earth Swale	"A3" 481+26.32 to 493+46.43	75258.28	1.73	0.95	1.10	1.00	11067.39	0.25	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.98	0.93	29.05	1.16	2.13	65.40	Good

		Pavement (Developed Area)					Undeveloped Area										Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG	
AC Gutter	"A3" 476+20.29 to 490+05.74 SB	222172.11	5.10	0.95	1.10	1.00	237264.80	5.45	0.38	0.14	0.08	0.08	0.08	1.10	0.42	10.55	0.70	14.44	1.68	12.42	31.92	Good	
AC Gutter	"A3" 462+24.69 to 476+20.29 SB	87582.06	2.01	0.95	1.10	1.00	47618.82	1.09	0.38	0.14	0.08	0.08	0.08	1.10	0.42	3.10	0.80	14.55	1.68	4.14	33.48	Good	
Earth Ditch	"A3" 445+25.53 to 462+24.69 SB	170343.55	3.91	0.95	1.10	1.00	124057.58	2.85	0.38	0.14	0.08	0.08	0.08	1.10	0.42	6.76	0.75	14.55	1.68	8.55	14.64	Good	*Proposed 2' Deep Earth Ditch (2:1,2:1)
Earth Ditch	"A5" 297+66.56 to 303+98.90 "A51"	40632.91	0.93	0.95	1.10	1.00	45000.16	1.03	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.97	0.69	21.09	1.38	1.88	5.62	Good	*Proposed 1.5' Deep Earth Ditch (2:1,2:1)

		Pavement (Developed Area)					Undeveloped Area										Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG	
AC Gutter	"A3"477+36.29 to 496+44.00 NB	288905.37	6.63	0.95	1.10	1.00	413436.83	9.49	0.38	0.14	0.08	0.08	0.08	1.10	0.42	16.12	0.66	20.91	1.38	14.67	31.92	Good	
AC Gutter	"A3" 460+24.74 to 477+36.29 NB	100045.25	2.30	0.95	1.10	1.00	99498.91	2.28	0.38	0.14	0.08	0.08	0.08	1.10	0.42	4.58	0.71	14.54	1.68	5.45	33.48	Good	
Earth Ditch	"A3"445+00.63 to 460+24.74 NB	170154.32	3.91	0.95	1.10	1.00	182940.68	4.20	0.38	0.14	0.08	0.08	0.08	1.10	0.42	8.11	0.70	14.54	1.68	9.50	14.64	Good	*Proposed 2' Deep Earth Ditch (2:1,2:1)
Earth Ditch	"A5" 297+66.56 to 303+98.90 "A51"	31246.74	0.72	0.95	1.10	1.00	51005.00	1.17	0.38	0.14	0.08	0.08	0.08	1.10	0.42	1.89	0.64	16.22	1.58	1.91	5.62	Good	*Proposed 1.5' Deep Earth Ditch (2:1,2:1)

		Pavement (Developed Area)					Undeveloped Area										Weighted				
Node	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
E1	Pleasant Grove Creek NB	201401.05	4.62	0.95	1.10	1.00	234032.84	5.37	0.38	0.14	0.08	0.08	0.08	1.10	0.42	10.00	0.69	16.22	2.11	14.50
E2	Pleasant Grove Creek SB	458228.76	10.52	0.95	1.10	1.00	710580.64	16.31	0.38	0.14	0.08	0.08	0.08	1.10	0.42	26.83	0.65	75.60	0.92	15.87
E3	"A3" 476+86.34 SB	222172.11	5.10	0.95	1.10	1.00	206751.14	4.75	0.38	0.14	0.08	0.08	0.08	1.10	0.42	9.85	0.72	14.44	2.24	15.89
E4	"A3" 477+49.38 NB	826407.62	18.97	0.95	1.10	1.00	596019.65	13.68	0.38	0.14	0.08	0.08	0.08	1.10	0.42	32.65	0.76	29.05	1.55	38.18

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed H
"A3" STA 563+00.00 to 584+64.00

Equation:

$$I_{25} = \frac{7.8662}{(T_c + 1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c + 1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

		Pavement (Developed Area)					Undeveloped Area									Weighted						
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
Earth Swale	"A3" 563+00.00 to 584+64.00 CEN	23803.92	0.55	0.95	1.10	1.00	144987.50	3.33	0.38	0.14	0.08	0.08	0.08	1.10	0.42	3.87	0.50	51.52	0.85	1.64	43.95	Good

		Pavement (Developed Area)					Undeveloped Area									Weighted							
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG	
AC Ditch Type 2	"A3" 563+00.00 to 582+68.15 SB	90534.80	2.08	0.95	1.10	1.00	108286.04	2.49	0.38	0.14	0.08	0.08	0.08	1.10	0.42	4.56	0.68	20.51	1.40	4.36	14.68	Good	
Earth Ditch	"A3" 582+68.15 to 584+64.00 SB	99537.95	2.29	0.95	1.10	1.00	116696.50	2.68	0.38	0.14	0.08	0.08	0.08	1.10	0.42	4.96	0.69	20.51	1.40	4.76	10.15	Good	*Proposed Earth Ditch (1.5' depth)

		Pavement (Developed Area)					Undeveloped Area									Weighted							
System	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SF)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{25}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG	
AC Ditch Type 2	"A3" 563+00.00 to 581+67.06 NB	85884.74	1.97	0.95	1.10	1.00	168800.54	3.88	0.38	0.14	0.08	0.08	0.08	1.10	0.42	5.85	0.61	19.45	1.44	5.17	14.68	Good	
Earth Ditch	"A3" 581+67.06 to 584+64.00 NB	99538.11	2.29	0.95	1.10	1.00	186309.24	4.28	0.38	0.14	0.08	0.08	0.08	1.10	0.42	6.56	0.62	19.45	1.44	5.85	10.15	Good	*Proposed Earth Ditch (1.5' depth)

		Pavement (Developed Area)					Undeveloped Area									Weighted				
Node	Location	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)
H1	"A3" 584+54.91 NB	99538.11	2.29	0.95	1.10	1.00	186309.24	4.28	0.38	0.14	0.08	0.08	0.08	1.10	0.42	6.56	0.62	22.09	1.78	7.25
H2	"A3" 584+54.91 SB	222878.64	5.12	0.95	1.10	1.00	447985.04	10.28	0.38	0.14	0.08	0.08	0.08	1.10	0.42	15.40	0.61	51.52	1.12	10.58

ctpa

Onsite Drainage Calculations (Proposed Condition)

State Route 65 Widening

Subwatershed J
"A3" STA 629+84.01 - 635+70.46
"D13" STA 654+06.47 - 677+89.18

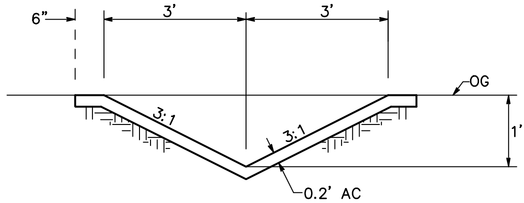
Equation:

$$I_{25} = \frac{7.8662}{(T_c + 1.1000)^{0.5620}} \qquad I_{100} = \frac{10.5549}{(T_c + 1.2000)^{0.5633}}$$

Reference: 25 year storm, NOAA 14

			Pavement (Developed Area)					Undeveloped Area									Weighted						
Node	System	LOCATION	Area (SF)	Area (Acres)	C	C(f)	C_t	Area (SQ. FT)	Area (Acres)	C	Relief	Soil Infiltration	Vegetal Cover	Surface Storage	C(f)	C_t	Area (Acres)	C	T_c (min)	I_{100}	$Q_{calculated}$ (cfs)	$Q_{capacity}$ (cfs)	Pass/NG
J1	Earth Ditch	"A3" 630+65.00 to 678+03.00 NB	311214.11	7.14	0.95	1.10	1.00	893342.01	20.51	0.38	0.14	0.08	0.08	0.08	1.10	0.42	27.65	0.57	117.06	0.72	11.28	271.10	Good
J2	Earth Ditch	"A3" 630+00.00 to 672+40.68 SB	530435.95	12.18	0.95	1.10	1.00	1304961.27	29.96	0.38	0.14	0.08	0.08	0.08	1.10	0.42	42.13	0.59	96.77	0.80	19.70	271.10	Good

SUBWATERSHED A



AC DITCH DETAIL
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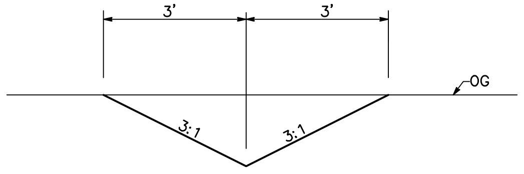
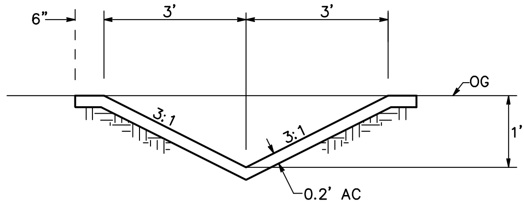


EARTH DITCH DETAIL
NO SCALE

SUBWATERSHED B



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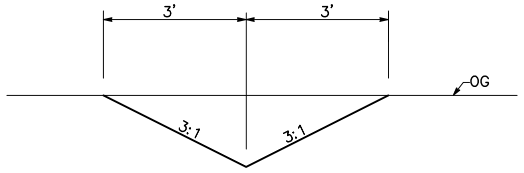

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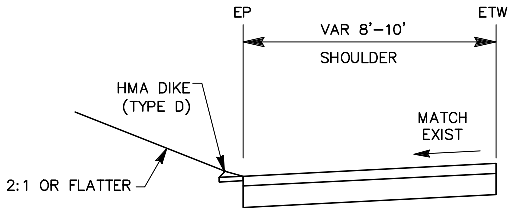
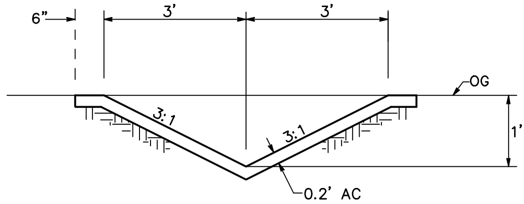


AC DIKE DETAIL
NO SCALE

SUBWATERSHED C



AC DITCH DETAIL
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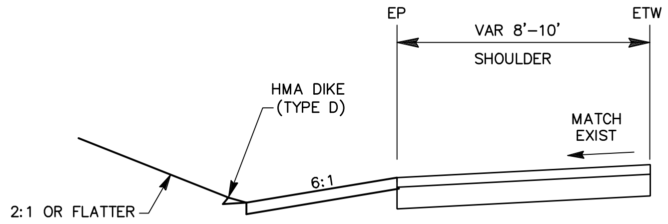

AC DITCH (TYPE 2) DETAIL
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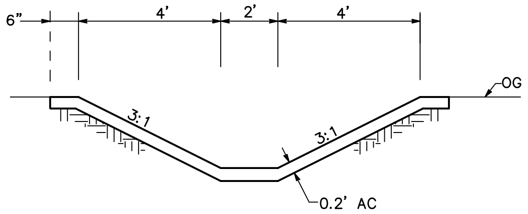

TRAPEZOIDAL AC DITCH DETAIL
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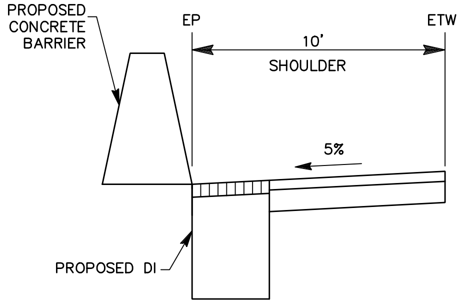
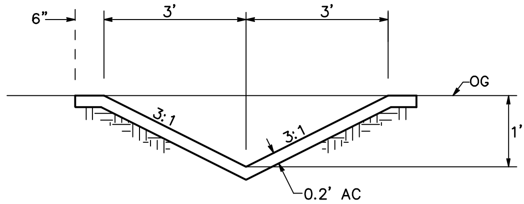


PROPOSED DI
NO SCALE

SUBWATERSHED D



AC DITCH DETAIL
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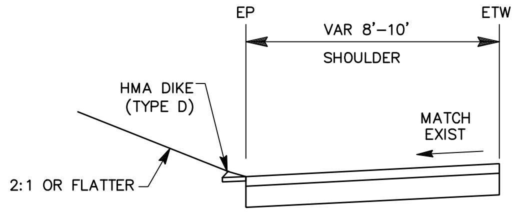

AC DIKE DETAIL
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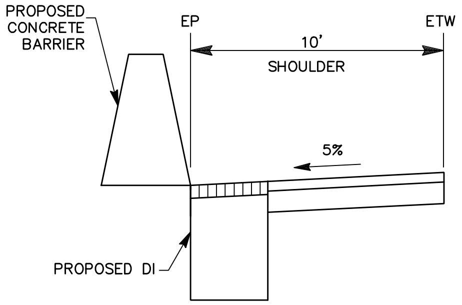

PROPOSED DI
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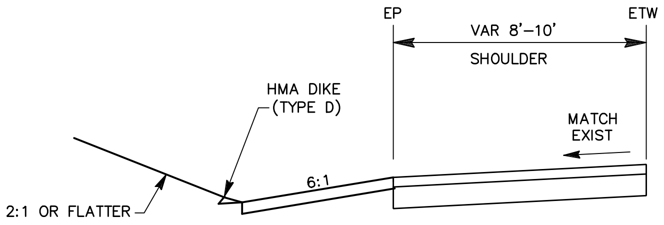
SUBWATERSHED E



AC DITCH (TYPE 2) DETAIL
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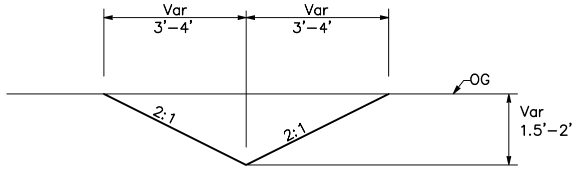

EARTH DITCH DETAIL
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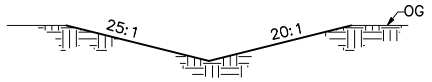
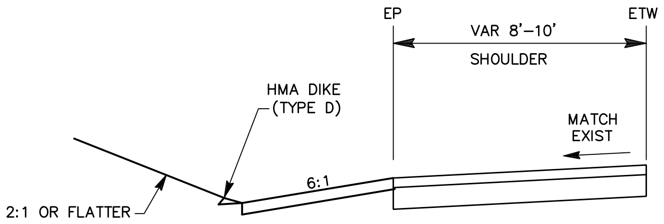


EARTH SWALE DETAIL
NO SCALE

SUBWATERSHED H



AC DITCH (TYPE 2) DETAIL
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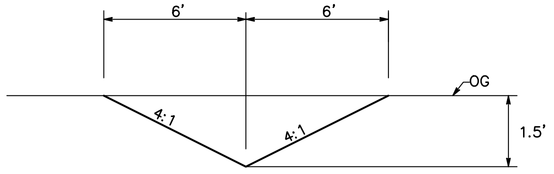
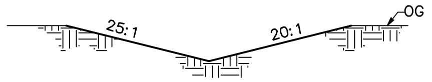
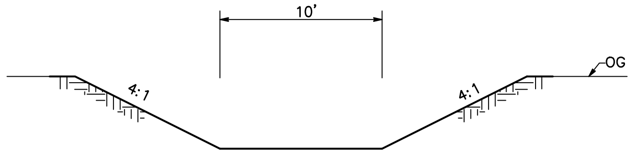


EARTH DITCH DETAIL
NO SCALE



EARTH SWALE DETAIL
NO SCALE

SUBWATERSHED J



EARTH DITCH DETAIL
NO SCALE

APPENDIX G

Biofilitration Swale Options

- G1 – Biofilitration Swale Options
- G2 – Reference: Caltrans Storm Water Quality Handbooks

G1 – Biofilitration Swale Options

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (235+00 -247+00)

Paved area contributing to bioswale: A_p = **0.3673** ac

Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **1.7128** ac

Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**

Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr

(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**

Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **1.06%**

Side slopes (***z* : 1** *, where z = 4 or flatter, R or L looking downstream:* z_L = **4**

z_R = **4**

Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **2.00 ft** must be equal (after goal-seek)

Resulting $\mathbf{Q_{25}}$ *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* $\mathbf{Q_{25}}$ = **4.12 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$

Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 4.12 cfs

Depth of flow for Q_{25}: D_{25} = **0.59 ft**

Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 1.59 ft/s **OK, <= 4 ft/s**

Water top width for Q_{25}: T_{25} = 6.74 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**

Q_{WQF} *("Water Quality Flow" in the swale)* $= I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ $\mathbf{Q_{WQF}}$ = **0.21 cfs** must be equal

Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.21 cfs

Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.29 ft** **OK, <= 0.5 ft**

Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.23 ft/s **OK, <= 1 ft/s**

Water top width for Q_{WQF}: T_{WQF} = 4.35 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): *$HRT = (L / V_{WQF}) / 60$* HRT = 18.45 min **OK, >= 5 min**

Must satisfy: HRT / $(D_{WQF} \cdot V_{WQF})$ >= 1300 sec^2/ft^2 : 16700 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (247+00-257+00)

Paved area contributing to bioswale: A_p = **0.0000** ac

Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **1.5829** ac

Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**

Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr

(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**

Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **1.06%**

Side slopes (***z* : 1** *, where z = 4 or flatter, R or L looking downstream:* z_L = **4**

z_R = **4**

Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **2.00 ft** must be equal (after goal-seek)

Resulting **Q_{25}** *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* **Q_{25} =** **2.79 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$

Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 2.79 cfs

Depth of flow for Q_{25}: D_{25} = **0.49 ft**

Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 1.44 ft/s **OK, <= 4 ft/s**

Water top width for Q_{25}: T_{25} = 5.92 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**

Q_{WQF} *("Water Quality Flow" in the swale)* $= I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ **Q_{WQF} =** **0.14 cfs** must be equal

Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.14 cfs

Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.24 ft** **OK, <= 0.5 ft**

Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.20 ft/s **OK, <= 1 ft/s**

Water top width for Q_{WQF}: T_{WQF} = 3.90 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): $HRT = (L / V_{WQF}) / 60$ HRT = 20.76 min **OK, >= 5 min**

Must satisfy: HRT / ($D_{WQF} \cdot V_{WQF}$) >= 1300 sec^2/ft^2 : 26205 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (257+00-263+00)

Paved area contributing to bioswale: A_p = **0.2331** ac
Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **0.7870** ac
Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**
Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr
(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**
Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **0.31%**
Side slopes (***z* : 1** *, where z = 4 or flatter, R or L looking downstream:* z_L = **4**
z_R = **4**
Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **2.00 ft** must be equal (after goal-seek)
Resulting $\mathbf{Q_{25}}$ *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* $\mathbf{Q_{25}}$ **=** **2.08 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$
Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 2.08 cfs
Depth of flow for Q_{25}: D_{25} = **0.57 ft**
Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 0.85 ft/s **OK, <= 4 ft/s**
Water top width for Q_{25}: T_{25} = 6.58 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**
Q_{WQF} *("Water Quality Flow" in the swale)* $= I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ $\mathbf{Q_{WQF}}$ **=** **0.11 cfs** must be equal
Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.11 cfs
Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.29 ft** **OK, <= 0.5 ft**
Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.12 ft/s **OK, <= 1 ft/s**
Water top width for Q_{WQF}: T_{WQF} = 4.31 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): *$HRT = (L / V_{WQF}) / 60$* HRT = 34.46 min **OK, >= 5 min**
Must satisfy: HRT / ($D_{WQF} \cdot V_{WQF}$) >= 1300 sec^2/ft^2 : 59323 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (263+00-273+92)

Paved area contributing to bioswale: A_p = **0.9361** ac

Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **2.1241** ac

Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**

Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr

(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**

Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **1.96%**

Side slopes (***z* : 1** *, where z = 4 or flatter, R or L looking downstream:* z_L = **4**

z_R = **4**

Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **2.00 ft** must be equal (after goal-seek)

Resulting $\mathbf{Q_{25}}$ *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* $\mathbf{Q_{25}}$ = **6.54 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$

Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 6.54 cfs

Depth of flow for Q_{25}: D_{25} = **0.64 ft**

Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 2.26 ft/s **OK, <= 4 ft/s**

Water top width for Q_{25}: T_{25} = 7.10 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**

Q_{WQF} *("Water Quality Flow" in the swale)* = $I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ $\mathbf{Q_{WQF}}$ = **0.33 cfs** must be equal

Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.33 cfs

Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.32 ft** **OK, <= 0.5 ft**

Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.32 ft/s **OK, <= 1 ft/s**

Water top width for Q_{WQF}: T_{WQF} = 4.53 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): *$HRT = (L / V_{WQF}) / 60$* HRT = 13.03 min **OK, >= 5 min**

Must satisfy: HRT / ($D_{WQF} \cdot V_{WQF}$) >= 1300 sec^2/ft^2 : 7738 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (219+51-227+22)

Paved area contributing to bioswale: A_p = **0.9118** ac

Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **1.8606** ac

Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**

Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr
(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**

Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **1.00%**

Side slopes (***z* : 1** *, where z = 4 or flatter, R or L looking downstream:* z_L = **4**

z_R = **4**

Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **2.00 ft** must be equal (after goal-seek)

Resulting $\mathbf{Q_{25}}$ *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* $\mathbf{Q_{25}}$ = **6.00 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$

Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 6.00 cfs

Depth of flow for Q_{25}: D_{25} = **0.72 ft**

Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 1.72 ft/s **OK, <= 4 ft/s**

Water top width for Q_{25}: T_{25} = 7.73 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**

Q_{WQF} *("Water Quality Flow" in the swale)* $= I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ $\mathbf{Q_{WQF}}$ = **0.31 cfs** must be equal

Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.31 cfs

Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.36 ft** **OK, <= 0.5 ft**

Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.25 ft/s **OK, <= 1 ft/s**

Water top width for Q_{WQF}: T_{WQF} = 4.91 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): *$HRT = (L / V_{WQF}) / 60$* HRT = 16.89 min **OK, >= 5 min**

Must satisfy: HRT / ($D_{WQF} \cdot V_{WQF}$) >= 1300 sec^2/ft^2 : 11297 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (220+81-233+50)

Paved area contributing to bioswale: A_p = **2.7757** ac

Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **2.4346** ac

Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**

Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr

(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**

Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **1.00%**

Side slopes (***z : 1***, *where z = 4 or flatter, R or L looking downstream:* z_L = **4**

z_R = **4**

Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **3.00 ft** must be equal (after goal-seek)

Resulting $\mathbf{Q_{25}}$ *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* $\mathbf{Q_{25}}$ **=** **12.58 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$

Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 12.58 cfs

Depth of flow for Q_{25}: D_{25} = **0.92 ft**

Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 2.06 ft/s **OK, <= 4 ft/s**

Water top width for Q_{25}: T_{25} = 10.32 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**

Q_{WQF} *("Water Quality Flow" in the swale)* $= I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ $\mathbf{Q_{WQF}}$ **=** **0.64 cfs** must be equal

Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.64 cfs

Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.45 ft** **OK, <= 0.5 ft**

Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.29 ft/s **OK, <= 1 ft/s**

Water top width for Q_{WQF}: T_{WQF} = 6.64 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): *$HRT = (L / V_{WQF}) / 60$* HRT = 14.25 min **OK, >= 5 min**

Must satisfy: HRT / ($D_{WQF} \cdot V_{WQF}$) >= 1300 sec^2/ft^2 : 6437 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

BIOSWALE (Bioswale Design Program)

Calculated by: Mark Thomas & Company
Date: 7/14/2015

BIOSWALE (199+50-223+15)

Paved area contributing to bioswale: A_p = **3.0916** ac

Unpaved area contributing to bioswale *(total area typically < 10 acres)* : A_u = **3.9746** ac

Runoff coefficient for pavement *(0.90 to 0.95):* C_p = **0.95**

Runoff coefficient *for unpaved areas (HDM Figure 819.2A):* C_u = **0.56**

Comments: Line "A3" from 533+61 to 536+43

Rainfall Intensity for Q_{25} (from IDF curves): I_{25} = **2.86** in/hr

Comments: I = 2.8 in/hr per NOAA Atlas 14

Rainfall Intensity for **Water Quality Flow (WQF)**: I_{WQF} = **0.16** in/hr

(Lake: 0.16 in/hr, Mendocino: 0.27 in/hr, Del Norte & Humboldt: 0.36 in/hr, PPDG Section 2.4.2)

Open channel calculation for Q_{25}:

Manning's n (0.05 by HDM table 864.3A): n = **0.050**

Swale longitudinal slope *(between 0.25% and 6%, but 1% - 2% is preferred):* S_L = **2.00%**

Side slopes (***z* : 1** *, where z = 4 or flatter, R or L looking downstream:* z_L = **4**

z_R = **4**

Width at invert *(0 ft for ditches, and between 2 and 10 ft for trapezoidal channels):* b = **2.00 ft** must be equal (after goal-seek)

Resulting $\mathbf{Q_{25}}$ *(HDM-819 requires a multiplier for Q_{25} equal to 1.1):* $\mathbf{Q_{25}}$ **=** **16.24 cfs** $= 1.1 \cdot I_{25} \cdot (A_p \cdot C_p + A_u \cdot C_u)$

Q for internal calcs *(use goal-seek to make it equal to Q_{25} by varying D_{25}):* Q = 16.24 cfs

Depth of flow for Q_{25}: D_{25} = **0.96 ft**

Velocity for Q_{25} *(maximum is 4 ft/s if not bypassed):* V_{25} = 2.88 ft/s **OK, <= 4 ft/s**

Water top width for Q_{25}: T_{25} = 9.71 ft

Open channel calculation for Q_{WQF} (flow that must be treated by the bioswale):

Manning's n *(0.20 for routinely mowed swales, 0.24 for infrequently mowed ones):* n = **0.24**

Q_{WQF} *("Water Quality Flow" in the swale)* $= I_{WQF} \cdot (Ap \cdot Cp + Au \cdot Cu)$ $\mathbf{Q_{WQF}}$ **=** **0.83 cfs** must be equal

Q for internal calcs *(use goal-seek to make it equal to Q_{WQF} by varying D_{WQF}):* Q = 0.83 cfs

Depth of flow for WQF *(maximum is 0.5 ft):* D_{WQF} = **0.50 ft** **OK, <= 0.5 ft**

Velocity for WQF *(maximum is 1 ft/s):* V_{WQF} = 0.42 ft/s **OK, <= 1 ft/s**

Water top width for Q_{WQF}: T_{WQF} = 6.00 ft

Hydraulic Residence Time Check (HRT):

Length of bioswale: L = **250.00 ft**

Comments:

Hydraulic Residence Time (minimum is 5 min): *$HRT = (L / V_{WQF}) / 60$* HRT = 10.03 min **OK, >= 5 min**

Must satisfy: HRT / $(D_{WQF} \cdot V_{WQF})$ >= 1300 sec^2/ft^2 : 2901 **OK, >= 1300**

DESIGN IS OK

Prepared by: Fernando Manzanera, Caltrans District 1 Hydraulics, January 2012
Sources: - Caltrans Biofiltration Swale Design Guidance, CTSW-TM-07-172-05, August 2009
- Storm Water Quality Handbooks Project Planning and Design Guide (PPDG), CTSW-RT-10-254.03

G2 – Reference: Caltrans Storm Water Quality Handbooks

These devices are well suited to be part of a "treatment-train" system of BMPs and should be considered whenever siting other BMPs that could benefit from pretreatment, especially Infiltration Basins, Infiltration Trenches, and Wet Basins.

B.2.3 Factors Affecting Design

Table B-1 summarizes preliminary design factors for Biofiltration Strips and Swales.

Table B-1. Summary of Biofiltration Strips and Swales Siting and Design Factors

Description	Applications/Siting	Preliminary Design Factors
Strips are vegetated land areas over which stormwater flows as sheet flow. Swales are vegetated channels that receive and convey stormwater as a concentrated flow. Biofiltration treats the WQF. Treatment Mechanisms: • Filtration through the vegetation • Sedimentation • Adsorption to soil particles • Infiltration Pollutants primarily removed: • Total Suspended Solids • Particulate metals • Nutrients • Dissolved Metals • Turbidity	• Site conditions and climate allow vegetation to be established – approximate 70% vegetation coverage will allow treatment, with better effects at higher coverage. • Consider locations for swales where flow velocities will not cause scour • If proposed location is above contaminated soils or groundwater plumes, coordinate with District/Regional NPDES Storm Water Coordinator and District Hazardous Waste Coordinator for clear direction	• Strips and Swales: vegetation mix appropriate for climates and location • Strips and Swales: Use the Rational Method to determine the Water Quality Flow (WQF) and peak flows for the peak drainage facility design event • Swales designed as a conveyance system for the peak drainage facility design event per HDM Chapters 800 to 890 • Swales: after designing to convey flows from the peak drainage facility design event, check swale against biofiltration criteria at WQF • Swales: design criteria under WQF: Hydraulic Residence Time of 5 minutes or more; maximum velocity of 1.0 ft/s; maximum depth of flow of 0.5 ft, and Eqn. 1 relationship among these variables. • Swales: slope in direction of flow: minimum 0.25%, maximum 6%, with 1 to 2% preferred; • Swales: A minimum width (in the direction of flow) at the invert of a trapezoidal biofiltration swale typically 2.0 ft; maximum bottom typically up to 10 ft; side slope ratio should be 4:1 (H:V) or flatter; discuss bottom width and side slope ratio with District Maintenance. • Swales: if flow velocity under the peak drainage facility design event exceeds 4.0 ft/s, consult with Hydraulics to determine if geosynthetic reinforcement of the biofiltration swale would be helpful to prevent erosion. • Swales: freeboard: Refer to HDM Topic 866 to determine if freeboard is required • Strips: sized as long (in direction of flow) and flat as the site will reasonably allow up to sheet flow boundaries (maximum length of Biofiltration Strip is approximately 100 ft); an HRT is not required. • Strips: should be free of gullies or rills

The listed values of rainfall intensity are used in the Rational Formula (Q=CiA) to estimate runoff from areas that would discharge flow to flow-based Treatment BMPs. The resulting runoff rate would be the design WQF to be used at any specific site.

1. Region 1 (North Coast) – 0.22 inches/hour ("/hr) for Siskiyou and Modoc Counties, 0.27 "/hr for Trinity and Mendocino Counties and 0.36 "/hr for Del Norte, Humboldt and Sonoma Counties.
2. Region 2 (San Francisco) –0.20 "/hr region wide.
3. Region 3 (Central Coast) –0.22 "/hr for Santa Cruz County and for that portion of San Mateo County within the region; 0.20 "/hr for Santa Clara County, 0.18 "/hr for San Benito, Monterey and San Luis Obispo Counties and 0.26 "/hr for Santa Barbara County and that portion of Ventura County within the Region.
4. Region 4 (Los Angeles) –0.20 "/hr region wide.
5. Region 5 (Central Valley) –0.16 "/hr for portions of Lassen and Modoc Counties within the Region, all areas of Region below 1,000' elevation north of and including Sacramento and Amador Counties and below 2,000' elevation south of Sacramento and Amador Counties, and all elevations on the west side of the Region (rain shadow side of the Coast Range), 0.20 "/hr for elevations in the Sierra Nevadas between 1,000' and 4,000' in the north and between 2,000' and 4,000' in the south, and 0.24 "/hr for all elevations above 4,000' in the Sierra Nevadas.
6. Region 6 (Lahontan) –
    a. Where there are location-specific requirements (Truckee River, East and West Forks Carson River, Mammoth Creek, and Lake Tahoe), the WQF will conform to the Basin Plan requirement for runoff from impervious areas. Where runoff from pervious areas contributes to the flow to the treatment device, the WQF value to be used will be as specified in the following two items:
    b. The WQF to be used for that portion of the Lahontan Region including Inyo County and areas southward will be 0.16 "/hr. The WQF to be used for pervious surface areas within the Mammoth Creek watershed above 7,000' elevation will be 0.16 "/hr.
    c. For all other areas of the Lahontan Region other than as indicated in item a) above, the WQF to be used will be 0.20 "/hr. This includes pervious surface areas of the Truckee River, Carson River East and West Forks and Lake Tahoe Hydrologic units.
7. Region 7 (Colorado River) –0.16 "/hr region wide.
8. Region 8 (Santa Ana River) –0.20 "/hr region wide.
9. Region 9 (San Diego) –0.20 "/hr region wide.

2.4.3 Construction Site Best Management Practices

Construction Site BMPs (also called temporary control practices) are deployed during construction activities to reduce pollutants in stormwater discharges during construction. Table C-1 in Appendix C is a matrix of approved Construction Site BMPs that are consistent

2. Basis of Biofiltration Swale Design

2.1. *Design Criteria*

To perform as an effective Treatment BMP, the Biofiltration Swale must meet certain design criteria; the primary factors to be incorporated into the design are found in below Table 2-1.

Table 2-1 Biofiltration Swale Design Criteria

Parameter	Min. Value	Max. Value
Flow Rate (See Note 1)	For water quality treatment: WQF	For roadway drainage ("Design Event") (*HDM* Topic 831)
Bottom Width (See Note 2)	0 ft, as v-ditch 2 ft, as trapezoid	Consult with District Hydraulics and District Maintenance (See Note 3)
Side Slope (sides of the Bioswale, in cross section)	4H:1V	3H:1V with District Maintenance approval
Longitudinal Slope	0.25%	1% to 2% preferred but no theoretical maximum, but the resulting depth, velocity and HRT must meet the Interrelationship formula
Hydraulic Residence Time (HRT) at WQF	5 minutes	No maximum
Length of flow path	Based on minimum HRT	No maximum
Flow Depth during WQF	No minimum	6 inches (See Note 4)
Velocity	No minimum	During WQF: 1.0 ft/sec (See Note 4) During HDM flow: 4.0 ft/sec (*HDM* Table 873.3E) (See Note 5)
Interrelationship Formula for HRT, depth, and velocity	1300 sec^2/ft^2	No maximum
Manning's *n* value	During WQF: 0.20 to 0.30 but 0.24 recommended During HDM flow: 0.05 (*HDM* Table 864.3A)	
Hydraulic conductivity of the soils in the Biofiltration Swale	There is no minimum set of this parameter at this time set for water treatment purposes.	

Superseded in July 2010 table

Notes:

1. Bioswale should be designed based on both the WQF and peak flow of the HDM design storm, unless bypass of the larger flows are made.
2. Consult with District Maintenance for whatever bottom width is proposed. If the smallest mower on hand in the District is 4-feet wide, that is the minimum bottom width.
3. From *HDM* Topic 863: "For large flows, consideration should be given to using a minimum bottom width of 12 feet for construction and maintenance purposes, but depths of flow less than one foot are not recommended." However, smaller bottom widths are preferred for water quality purposes, in order to limit the tendency at low flows to concentrate into smaller rivulets.
4. Maximum value may be limited if HRT less than 10 minutes, using the Interrelationship Formula. Higher if protected from erosion; see Section 4.2.3.

APPENDIX H

Floodplain Evaluation Report/ Location Hydraulic Studies

Culvert Inventory

District 3 Hydraulics

**** Culvert data is preliminary and requires field verification. Data should be used for general reference only. ****

CO	RTE	PM	Size	Type	Rust	Date	Inlet Condition	Outlet Condition	Remarks
PLA	65	5.92	48	CMP		3/27/2008			
PLA	65	6.03	48	CMP		3/27/2008			
PLA	65	6.13	36	CMP		3/27/2008			
PLA	65	6.28	30	CMP		3/27/2008			DI in median
PLA	65	6.71	72	RCP		3/27/2008			Double 72" RCP, DI in median
PLA	65	7.35	18	CMP		3/27/2008			Crosses SB lanes only, DI in median
PLA	65	7.65	7x6	RCB		3/27/2008			Double 7x6 RCB
PLA	65	7.83	42	CMP		3/27/2008			
PLA	65	8.03	48	CMP		3/27/2008			FES inlet on SB side of freeway
PLA	65	8.21	18	CMP		3/27/2008			Crosses SB lanes only, DI in median
PLA	65	8.3	30	CMP		3/27/2008			
PLA	65	8.42	18	CMP		3/27/2008			Crosses NB lanes only, DI in median
PLA	65	8.58	10x5	RCB		3/27/2008			Double 10x5 RCB (Little Pleasant Grove Creek Bridge No. 19-0137
PLA	65	8.77				3/27/2008			PLEASANT GROVE CREEK BRIDGE NO. 19-0136
PLA	65	9.37	24	PVC		3/27/2008			Crosses NB lanes only, DI in median, PVC

CO	RTE	PM	Size	Type	Rust	Date	Inlet Condition	Outlet Condition	Remarks
PLA	65	9.44	24	RCP		3/27/2008			Double 24" RCP
PLA	65	9.57	24	PVC		3/27/2008			
PLA	65	9.79	18	PVC		3/27/2008			Crosses NB lanes only, DI in median, PVC
PLA	65	9.88	7x5	RCB		3/27/2008			
PLA	65	10.71	6x5	RCB		3/27/2008			Double 6x5 RCB
PLA	65	11.4	7x5	RCB		3/27/2008			
PLA	65	11.66	10x5	RCB		3/27/2008			Triple 10x5 RCB (Orchard Creek Bridge No. 19-0138)
PLA	65	12.28	10x5	RCB		3/27/2008			Triple 10x5 RCB (North Branch Orchard Creek Bridge No. 19-0139)
PLA	65	12.54	6x5	RCB		6/17/1998			
PLA	65	12.55	72	CMP					
PLA	65	12.72	6x6	RCB					DOUBLE
PLA	65	12.96	36	CSP					
PLA	65	13.03	3x3	RCB					MEDIAN LEFT
PLA	65	13.33	18	CMP		6/17/1998			
PLA	65	13.38	18	CSP					

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing At North Branch Orchard Creek

June 2016

Prepared By:

CIVIL ENGINEERING SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

nature dated:

THOMAS S
PLUMMER
No. C49582
EXP. 9/30/16

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Highway 65 Crossing at North Branch Orchard Creek

1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the North Branch Orchard Creek crossing. This report will present historical flooding records, hydrologic analysis of Orchard Creek watershed and hydraulic analysis of the existing crossing.

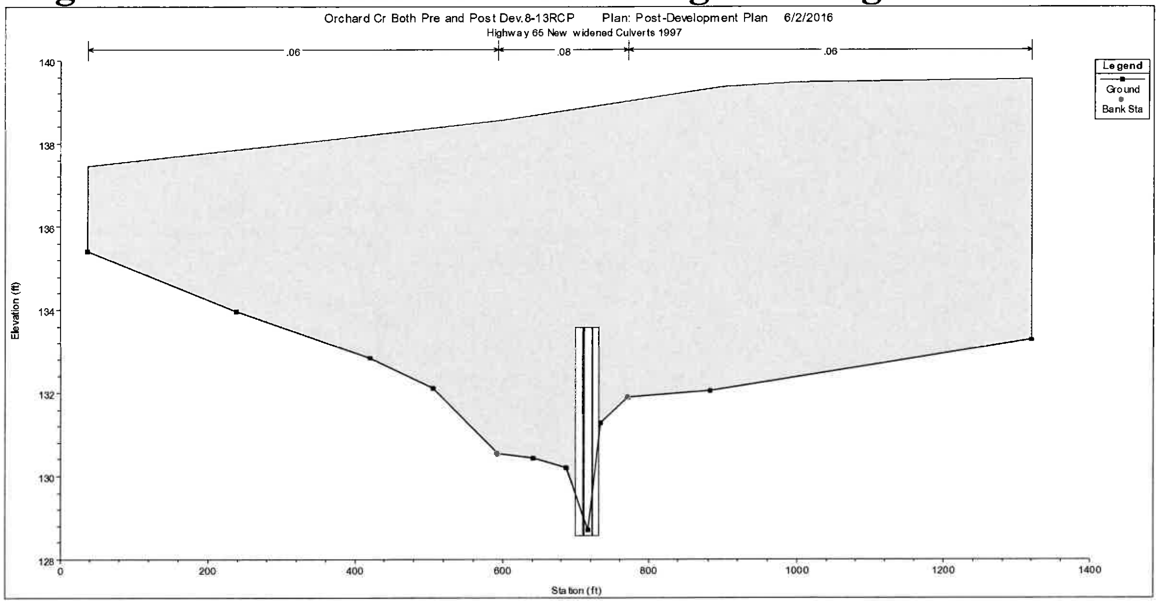
2.0 Project Location and Description

The crossing is located at Highway 65 at the North Branch Orchard Creek crossing (03-PLA-065-R12.27). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map

The culverts convey the North Branch Orchard Creek for a distance of 254 feet. There are three culverts approximately 10 ft wide by 5 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Orchard Creek watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Orchard Creek watershed. The Study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Orchard Creek Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the City of Lincoln NGVD 29 datum.

The FEMA analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Orchard Creek Floodway. As a result bridge improvements within the Orchard Creek Floodway would not require an encroachment permit.

7.0 Summary

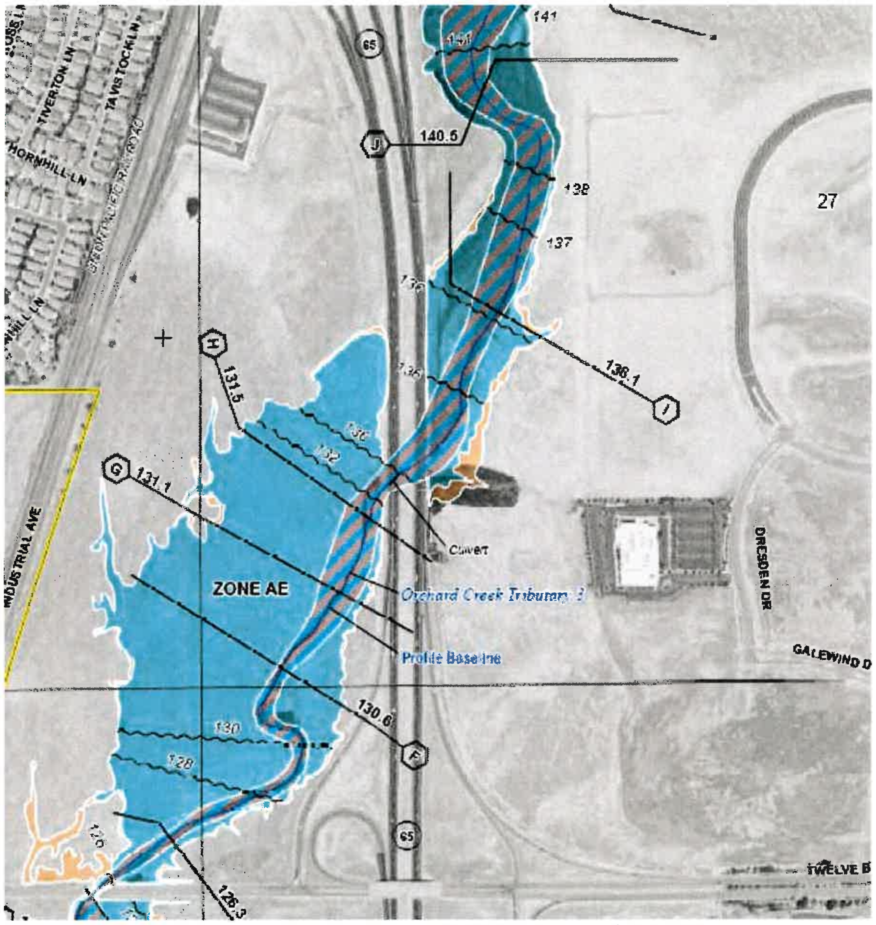
This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Orchard Creek, the existing crossing at

Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 culverts.

Figure 3: Portion of the FEMA Floodplain and Floodway Map



(Source: Preliminary DFIRM panel 931H)

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ______ Project ID: ______

District: 03 County: Placer Route: 65 P.M.: 12.27

Br. No.: 19 0139 Br. Name: 03-PLA-065-R12.27

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: ______ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	1270	136	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available?	Yes	X	No	
Are NFIP studies available?	Yes	X	No	

4. Is the highway location alternative within a regulatory floodway? Yes ______ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:

A. Residences?	Yes		No	X
B. Other Bldgs.?	Yes		No	X
C. Crops?	Yes		No	X
D. Natural and beneficial floodplain values?	Yes	X	No	

6. Type of Traffic:
   A. Emergency supply or evacuation route? Yes X No ____
   B. Emergency vehicle access? Yes X No ____
   C. Practicable detour available? Yes X No ____
   D. School bus or mail route? Yes X No ____

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.
   A. Roadway $ 0
   B. Property $ 0
   Total $ 0

9. Assessment of Level of Risk
   Low X Moderate ____ High ____
   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ____

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
    Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date 6/13/16
Title
Company MTCo

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing
At Orchard Creek

June 2016

Prepared By:

CIVIL ENGINEERING
SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

THOMAS S.
PLUMMER
No. C49582
EXP. 9/30/16

nature dated:

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Location Hydraulic Study
Highway 65 Crossing at Orchard Creek

1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Orchard Creek crossing. This report will present historical flooding records, hydrologic analysis of Orchard Creek watershed and hydraulic analysis of the existing crossing.

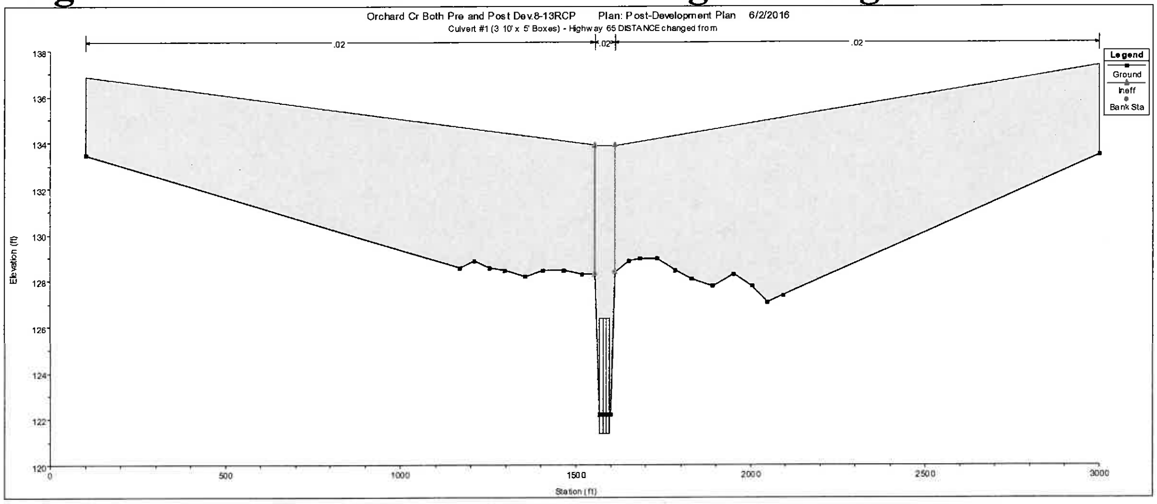
2.0 Project Location and Description

The crossing is located at Highway 65 at the Orchard Creek crossing (03-PLA-065-R11.66). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map

The culverts convey Orchard Creek for a distance of 220 feet. There are three culverts approximately 10 ft wide by 5 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Orchard Creek watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Orchard Creek watershed. The Study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Orchard Creek Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the City of Lincoln NGVD 29 datum.

The FEMA analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Orchard Creek Floodway. As a result bridge improvements within the Orchard Creek Floodway would not require an encroachment permit.

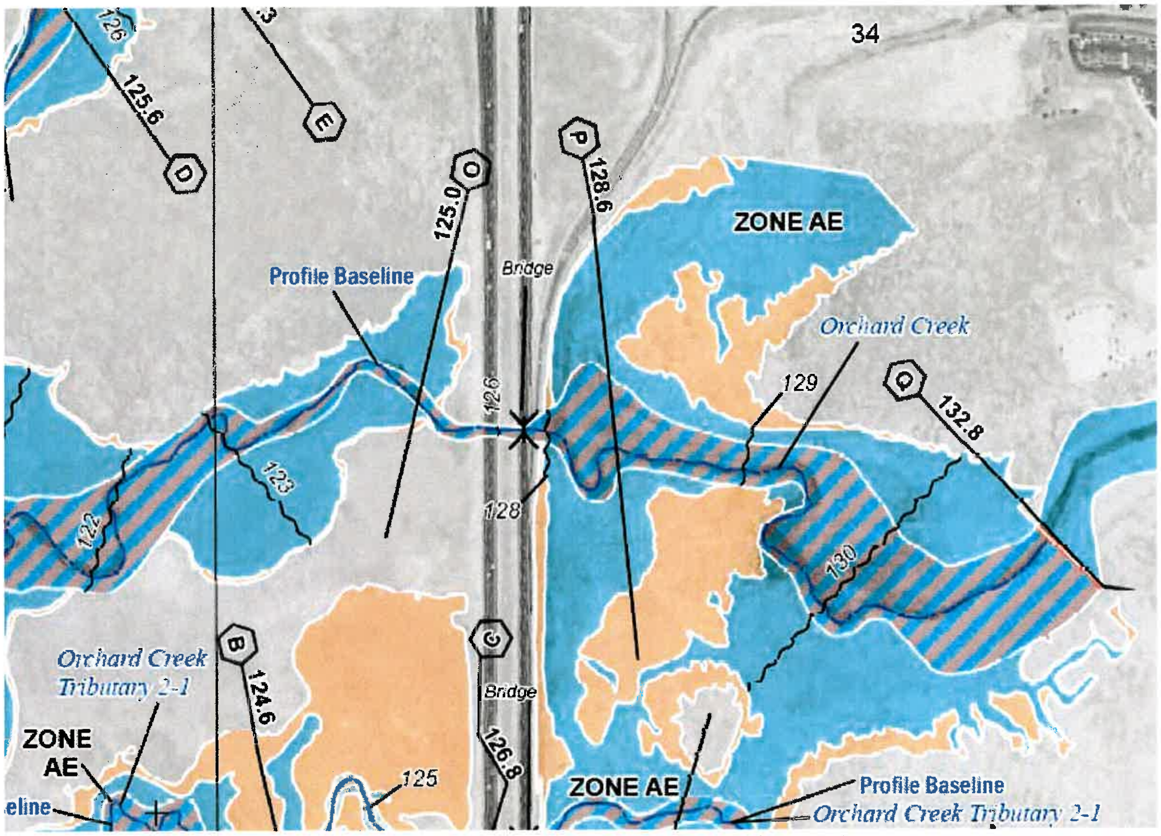
7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Orchard Creek, the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 culverts.

Figure 3: Portion of the FEMA Floodplain and Floodway Map



(Source: Preliminary DFIRM panel 931H)

Technical Information for Location Hydraulic Study – Oversight Projects

EA: __________ Project ID: __________

District: 03 County: Placer Route: 65 P.M.: 11.66

Br. No.: 19 0138 Br. Name: 03-PLA-065-R11.66

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: __________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	24100	128	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available?	Yes	X	No	
Are NFIP studies available?	Yes	X	No	

4. Is the highway location alternative within a regulatory floodway? Yes ______ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:

A.	Residences?	Yes		No	X
B.	Other Bldgs.?	Yes		No	X
C.	Crops?	Yes		No	X
D.	Natural and beneficial floodplain values?	Yes	X	No	

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ______
   - B. Emergency vehicle access? Yes X No ______
   - C. Practicable detour available? Yes X No ______
   - D. School bus or mail route? Yes X No ______

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.
   - A. Roadway $ 0
   - B. Property $ 0
   - Total $ 0

9. Assessment of Level of Risk
   Low X Moderate ______ High ______
   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ______

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
    Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date 6/13/16
Title
Company MTCo.

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing At Orchard Creek Tributary 2-1

June 2016

Prepared By:

CIVIL ENGINEERING SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

REGISTERED PROFESSIONAL ENGINEER
THOMAS S. PLUMMER
No. C49582
EXP. 9/30/16
STATE OF CALIFORNIA

ature dated:

____

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Highway 65 Crossing at Orchard Creek Tributary 2-1

1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Orchard Creek Tributary 2-1 crossing. This report will present historical flooding records, hydrologic analysis of Orchard Creek Tributary 2-1 watershed and hydraulic analysis of the existing crossing.

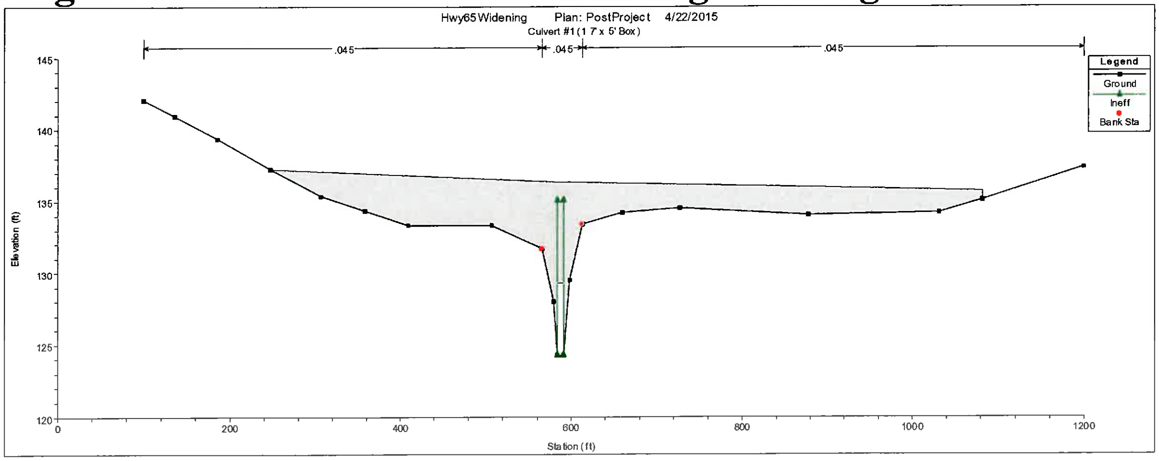
2.0 Project Location and Description

The crossing is located at Highway 65 at the Orchard Creek Tributary 2-1 crossing (03-PLA-065-R11.42). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map

The culverts convey Orchard Creek Tributary 2-1 for a distance of 190 feet. There is one culvert approximately 7 ft wide by 5 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Orchard Creek Tributary 2-1 watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Orchard Creek Tributary 2-1 watershed. The Study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Orchard Creek Tributary 2-1 Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the City of Lincoln NGVD 29 datum.

The FEMA analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Orchard Creek Tributary 2-1 Floodway. As a result bridge improvements within the Orchard Creek Tributary 2-1 Floodway would not require an encroachment permit.

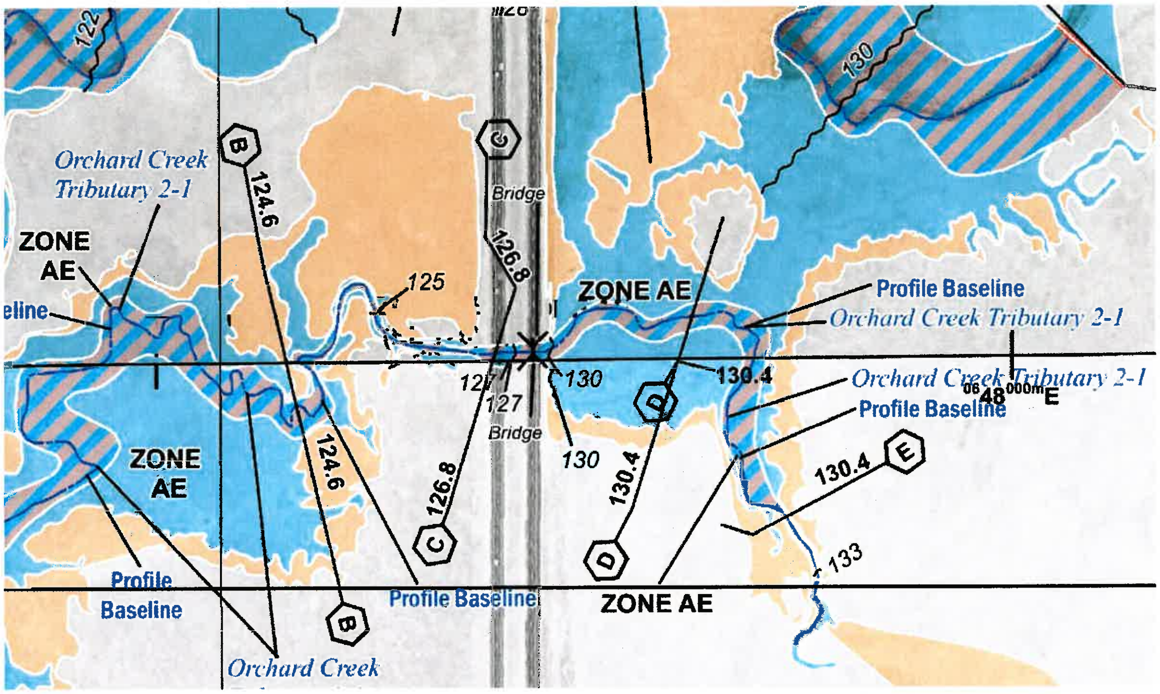
7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Orchard Creek Tributary 2-1, the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 culverts.

Figure 3: Portion of the FEMA Floodplain and Floodway Map



((Source: Preliminary DFIRM panels 931H and 933H))

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ____________ Project ID: ____________

District: 03 County: Placer Route: 65 P.M.: 11.42

Br. No.: 19 0138 Br. Name: 03-PLA-065-R11.42

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: ____________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	210	130	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available?	Yes	X	No	
Are NFIP studies available?	Yes	X	No	

4. Is the highway location alternative within a regulatory floodway? Yes ________ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:

A. Residences?	Yes		No	X
B. Other Bldgs.?	Yes		No	X
C. Crops?	Yes		No	X
D. Natural and beneficial floodplain values?	Yes	X	No	

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ____
   - B. Emergency vehicle access? Yes X No ____
   - C. Practicable detour available? Yes X No ____
   - D. School bus or mail route? Yes X No ____

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.
   - A. Roadway $ 0
   - B. Property $ 0
   - Total $ 0

9. Assessment of Level of Risk

   Low X Moderate ____ High ____

   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ____

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

    Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date 6/13/16
Title
Company MTCo.

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing At Orchard Creek Tributary 2

June 2016

Prepared By:

CIVIL ENGINEERING
SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

THOMAS S.
PLUMMER
No. C49582
EXP. 9/30/16

nature dated:

____

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Location Hydraulic Study
Highway 65 Crossing at Orchard Creek Tributary 2

1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Orchard Creek Tributary 2 crossing. This report will present historical flooding records, hydrologic analysis of Orchard Creek Tributary 2 watershed and hydraulic analysis of the existing crossing.

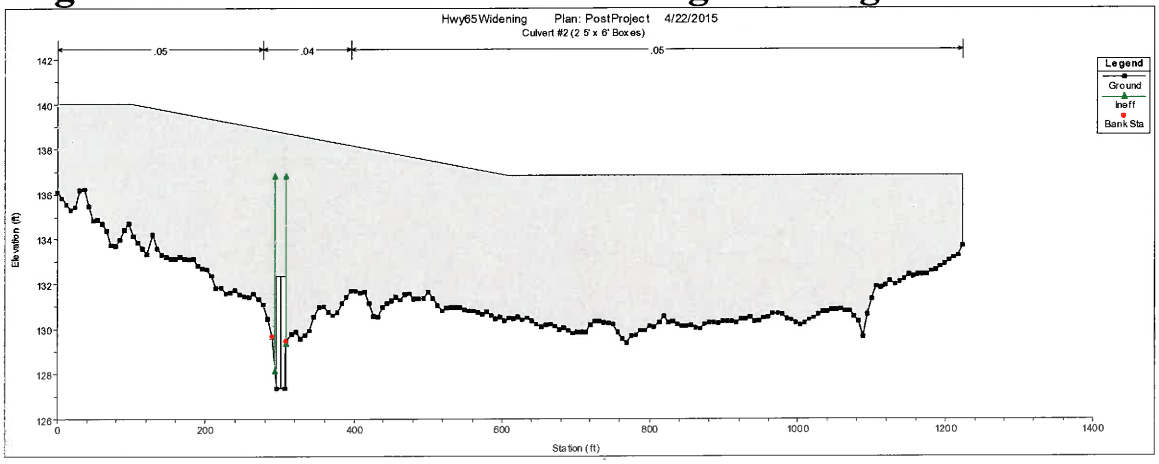
2.0 Project Location and Description

The crossing is located at Highway 65 at the Orchard Creek Tributary 2 crossing (03-PLA-065-R10.73). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map

The culverts convey Orchard Creek Tributary 2 for a distance of 195 feet. There are two culverts approximately 6 ft wide by 5 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Orchard Creek Tributary 2 watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Orchard Creek Tributary 2 watershed. The Study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Orchard Creek Tributary 2 Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the City of Lincoln NGVD 29 datum.

The FEMA analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Orchard Creek Tributary 2 Floodway. As a result bridge improvements within the Orchard Creek Tributary 2 Floodway would not require an encroachment permit.

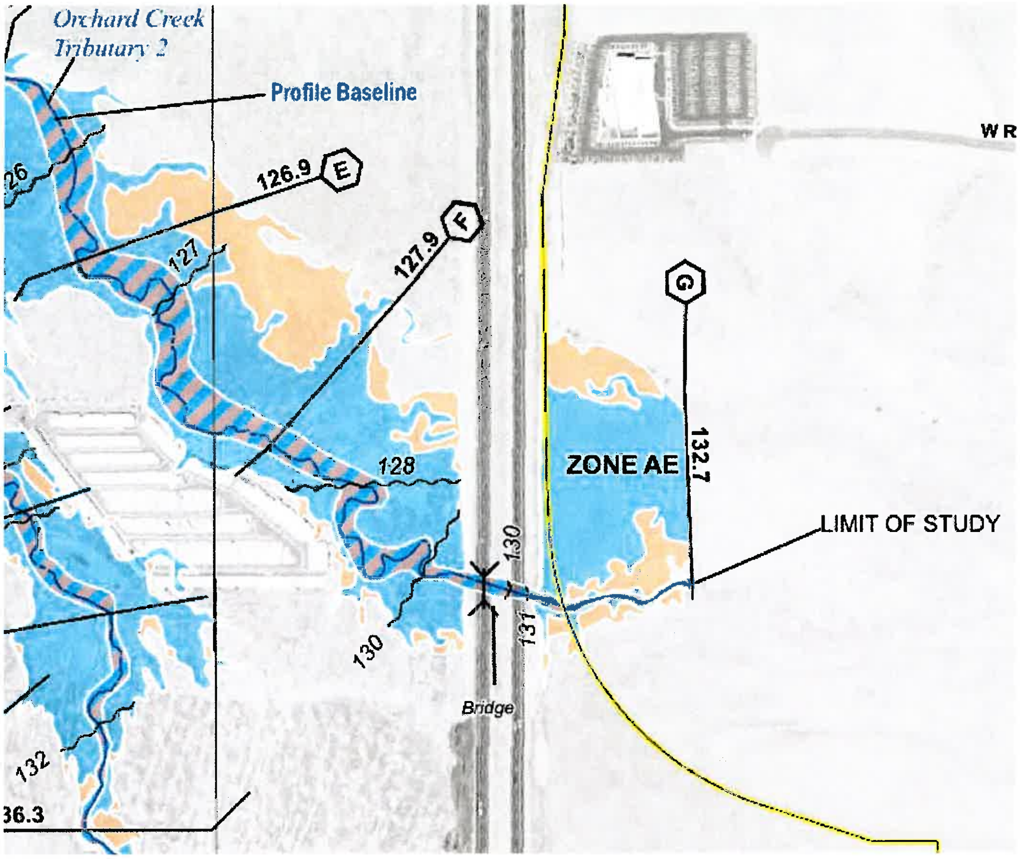
7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Orchard Creek Tributary 2, the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 culverts.

Figure 3: Portion of the FEMA Floodplain and Floodway Map



(Source: Preliminary DFIRM panel 933H)

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ______ Project ID: ______

District: 03 County: ______ Route: 65 P.M.: 10.73

Br. No.: UNK Br. Name: 03-PLA-065-R10.73 (assumed)

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

    - Extend culvert as required for Hwy 65 widening.
    -
    -
    -
    -
    -
    -

2. ADT: Current: ______ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	330	131	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available?	Yes	X	No	
Are NFIP studies available?	Yes	X	No	

4. Is the highway location alternative within a regulatory floodway? Yes ______ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.

    Potential Q_{100} backwater damages:

A. Residences?	Yes		No	X
B. Other Bldgs.?	Yes		No	X
C. Crops?	Yes		No	X
D. Natural and beneficial floodplain values?	Yes	X	No	

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ____
   - B. Emergency vehicle access? Yes X No ____
   - C. Practicable detour available? Yes X No ____
   - D. School bus or mail route? Yes X No ____

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$ 0
B.	Property	$ 0
	Total	$ 0

9. Assessment of Level of Risk
Low X Moderate ____ High ____
For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ____

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date 6/13/16
Title
Company MTCo

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing At Pleasant Grove Creek North Branch

June 2016

Prepared By:

CIVIL ENGINEERING SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

THOMAS S. PLUMMER
No. C49582
EXP. 9/30/16

nature dated:

____

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Location Hydraulic Study
Highway 65 Crossing at Pleasant Grove Creek North Branch

1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Pleasant Grove Creek North Branch crossing. This report will present historical flooding records, hydrologic analysis of Pleasant Grove Creek North Branch watershed and hydraulic analysis of the existing crossing.

2.0 Project Location and Description

The crossing is located at Highway 65 at the Pleasant Grove Creek North Branch crossing (03-PLA-065-R9.89). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map

The culverts convey Pleasant Grove Creek North Branch for a distance of 200 feet. There are two culverts approximately 6 ft wide by 5 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing

Model Xsec Not
Currently Available

3.0 Flooding History

No significant flooding events are known to have been noted in the Pleasant Grove Creek North Branch watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Pleasant Grove Creek North Branch watershed. The Study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Pleasant Grove Creek North Branch Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the City of Lincoln NGVD 29 datum.

The FEMA analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Pleasant Grove Creek North Branch Floodway. As a result bridge improvements within the Pleasant Grove Creek North Branch Floodway would not require an encroachment permit.

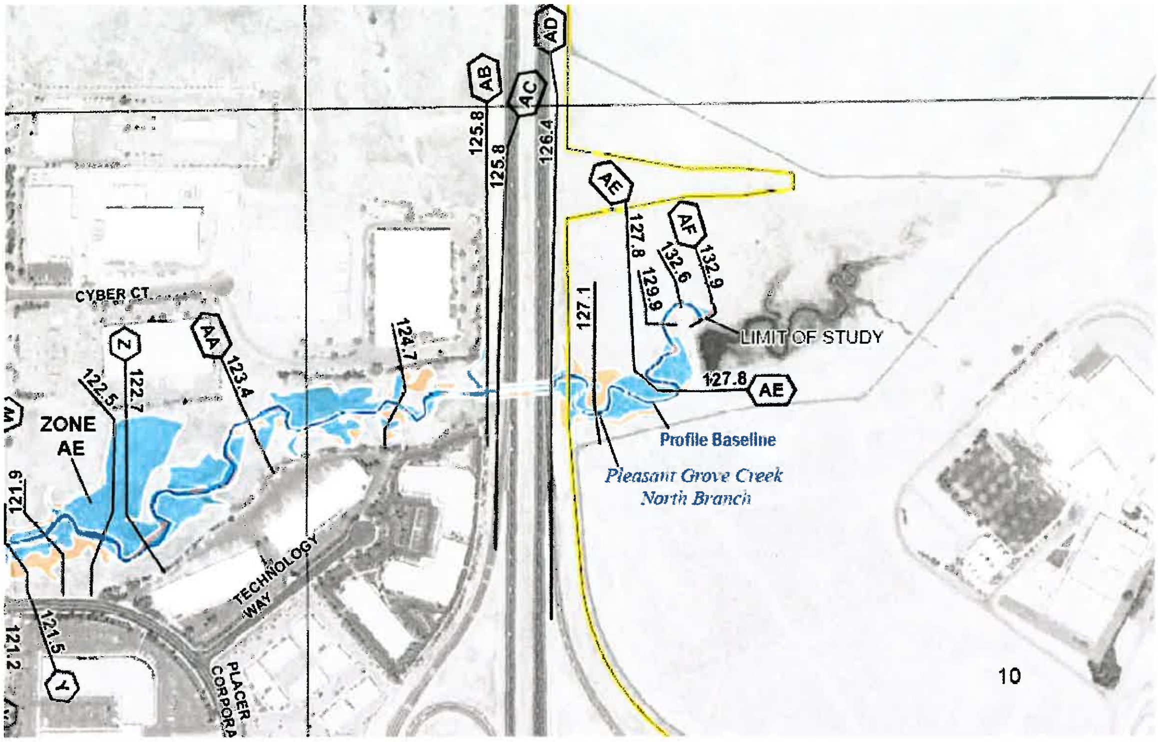
7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Pleasant Grove Creek North Branch, the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 culverts.

Figure 3: Portion of the FEMA Floodplain and Floodway Map



(Source: Preliminary DFIRM panel 933H)

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ________ Project ID: ________

District: 03 County: Placer Route: 65 P.M.: 9.89

Br. No.: UNK Br. Name: 03-PLA-065-R9.89 (assumed)

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: ________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	230	126.4	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available? Yes X No ________
Are NFIP studies available? Yes X No ________

4. Is the highway location alternative within a regulatory floodway? Yes ________ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:
   A. Residences? Yes ________ No **X**
   B. Other Bldgs.? Yes ________ No X
   C. Crops? Yes ________ No X
   D. Natural and beneficial floodplain values? Yes X No ________

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ______
   - B. Emergency vehicle access? Yes X No ______
   - C. Practicable detour available? Yes X No ______
   - D. School bus or mail route? Yes X No ______

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$	0
B.	Property	$	0
	Total	$	0

9. Assessment of Level of Risk
   Low X Moderate ______ High ______
   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ______

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
    Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

6/13/16

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date
Title
Company MT Co

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing At Pleasant Grove Creek

June 2016

Prepared By:

CIVIL ENGINEERING SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

REGISTERED PROFESSIONAL ENGINEER
THOMAS S. PLUMMER
No. C49582
EXP. 9/30/16
STATE OF CALIFORNIA

nature dated:

____

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Highway 65 Crossing at Pleasant Grove Creek

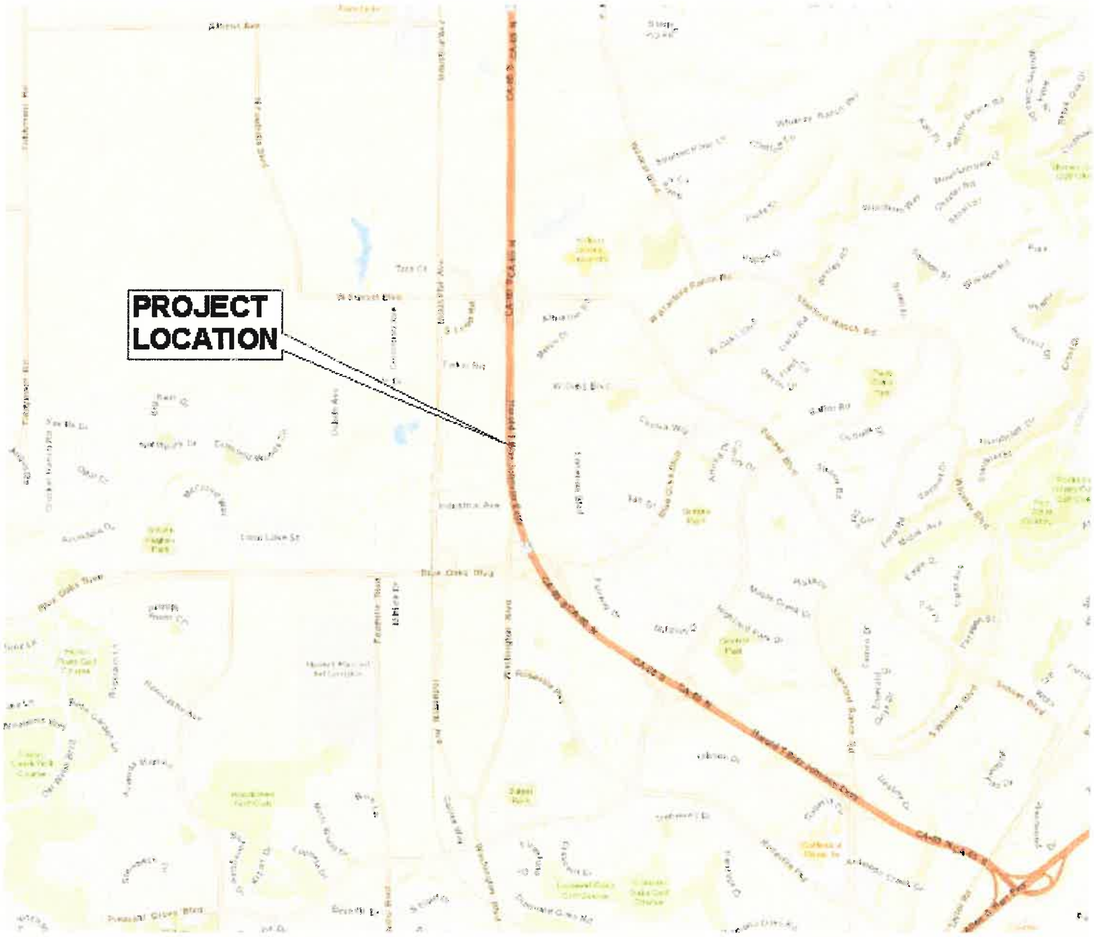
1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Pleasant Grove Creek crossing. This report will present historical flooding records, hydrologic analysis of Pleasant Grove Creek watershed and hydraulic analysis of the existing crossing.

2.0 Project Location and Description

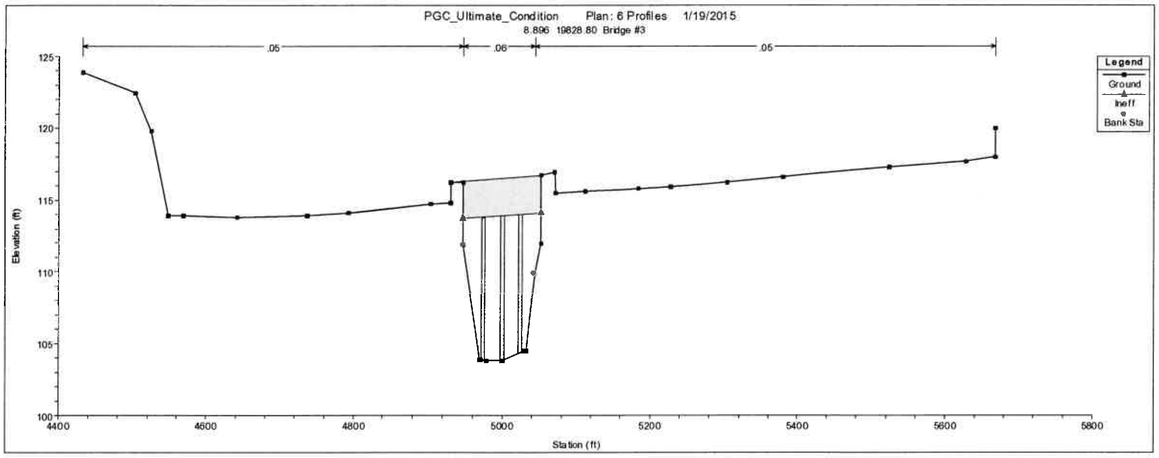
The crossing is located at Highway 65 at the Pleasant Grove Creek crossing (03-PLA-065-R8.77 & 8.76). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map



The bridge spans Pleasant Grove Creek for a distance of 104 feet. There are two bridge decks approximately 40 ft wide for each deck. A cross section of the existing bridge as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Pleasant Grove Creek watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Pleasant Grove Creek watershed. The Study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Pleasant Grove Creek Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. The guard rail was input in this model as part of the bridge deck.

The existing conditions bridge cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the NGVD 29 datum.

The FEMA analysis assumed all spans are clear and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Pleasant Grove Creek Floodway. As a result bridge improvements within the Pleasant Grove Creek Floodway would not require an encroachment permit.

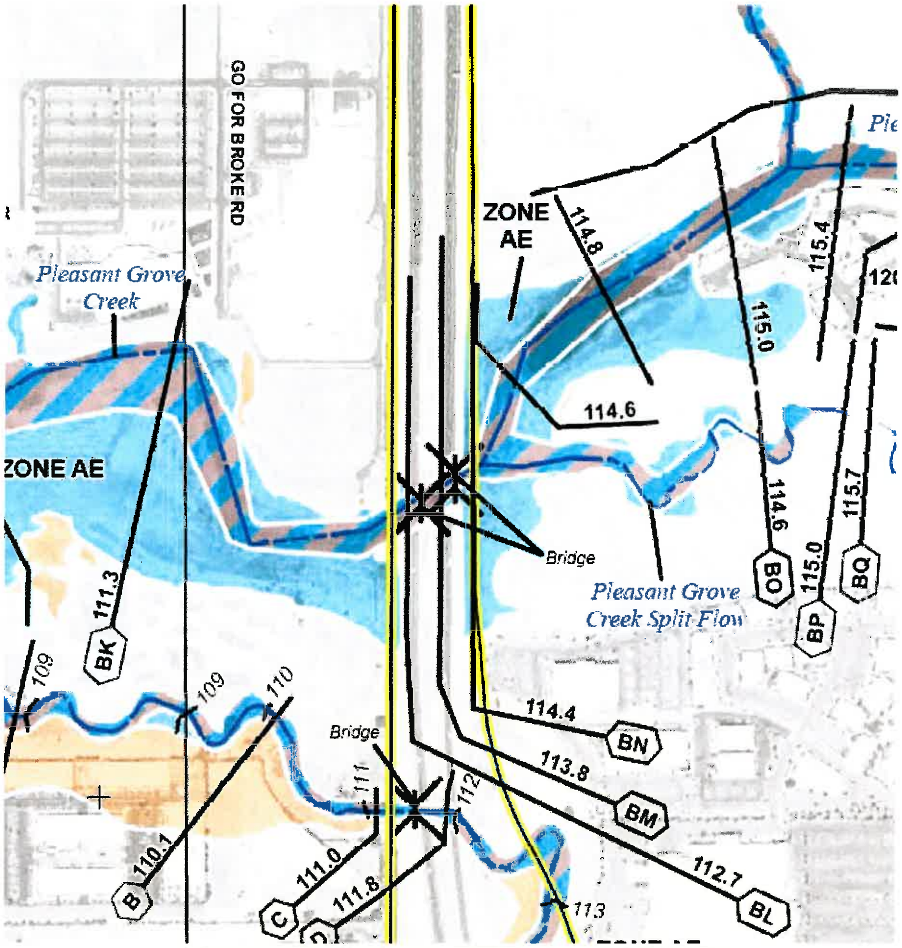
7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Pleasant Grove Creek, the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 bridge.

Figure 3: Portion of the FEMA Floodplain and Floodway Map



(Source: Preliminary DFIRM panel 941H)

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ____________ Project ID: ____________

District: 03 County: Placer Route: 65 NB&SB P.M.: 8.77 (NB) & 8.76 (SB)

Br. No.: 19 0136R & L Br. Name: 03-PLA-065-R8.77 & 8.76

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Widen bridge as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: ____________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	1590	114.4 NB 113.8 SB	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available?	Yes	X	No	
Are NFIP studies available?	Yes	X	No	

4. Is the highway location alternative within a regulatory floodway? Yes ______ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:

A. Residences?	Yes		No	X
B. Other Bldgs.?	Yes		No	X
C. Crops?	Yes		No	X
D. Natural and beneficial floodplain values?	Yes	X	No	

6. Type of Traffic:

A.	Emergency supply or evacuation route?	Yes	X	No	
B.	Emergency vehicle access?	Yes	X	No	
C.	Practicable detour available?	Yes	X	No	
D.	School bus or mail route?	Yes	X	No	

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$ 0
B.	Property	$ 0
	Total	$ 0

9. Assessment of Level of Risk

Low X Moderate ____ High ____

For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes ____ No X

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

6/13/16

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date
Title
Company MTCo

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing
At Highland Ravine

June 2016

Prepared By:

CIVIL ENGINEERING SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

REGISTERED PROFESSIONAL ENGINEER
THOMAS S. PLUMMER
No. C49582
EXP. 9/30/16
STATE OF CALIFORNIA

nature dated:

____

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Location Hydraulic Study
Highway 65 Crossing at Highland Ravine

1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Highland Ravine crossing. This report will present historical flooding records, hydrologic analysis of Highland Ravine watershed and hydraulic analysis of the existing crossing.

The FEMA FIS report identifies this reach of the Pleasant Grove Stream group as Pleasant Grove Creek Tributary 1 (based on the gis shapefile designation). The FIRM shows it as Highland Ravine. CalTrans identifies this reach as Little Pleasant Grove Creek.

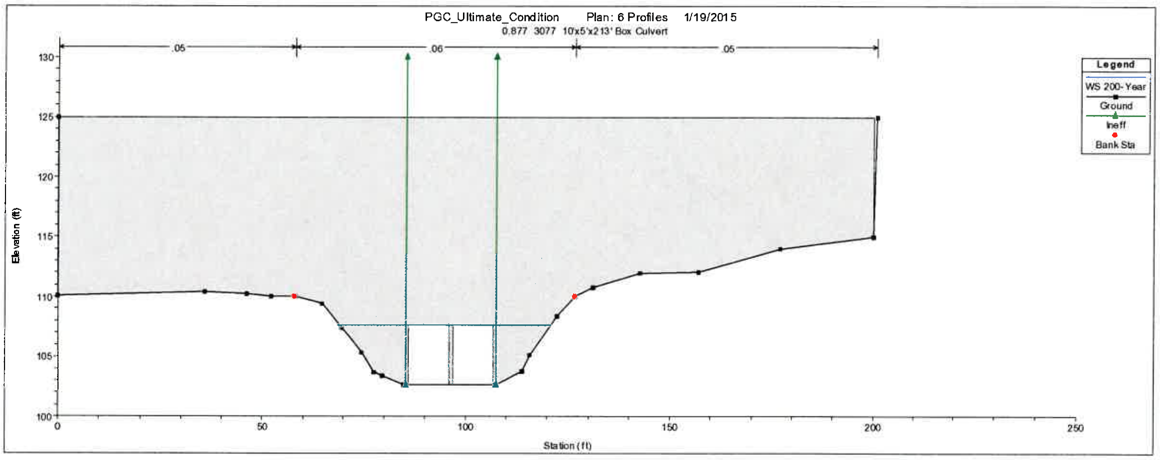
2.0 Project Location and Description

The crossing is located at Highway 65 at the Highland Ravine crossing (03-PLA-065-M8.59). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map

The culverts convey Highland Ravine for a distance of 264 feet. There are two culverts approximately 10 ft wide by 5 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Highland Ravine watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The FEMA FIS report identifies this reach of the Pleasant Grove Stream group as Pleasant Grove Creek Tributary 1 (based on the gis shapefile designation). The FIRM shows it as Highland Ravine.

The results presented by this study use the flow rates specified in the FEMA-CTP analysis for the FIS update which is currently being finalized by FEMA (Preliminary DFIRM release December 28, 2015). This is the most current and up-to-date hydrology study for the Highland Ravine watershed. The study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them. The updated FEMA hydrology analysis does not propose to use hydraulic routing for the estimation of Highland Ravine Peak flows and a steady state model is used for hydraulic analysis. The hydrology model was approved by FEMA in 2013.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The base model was obtained from the FEMA-CTP model. The centerline of the roadway elevations were used for roadway areas at the crossing. The elevations were determined based on the FEMA LiDAR. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the NGVD 29 datum.

The FEMA analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Highland Ravine Floodway. As a result bridge improvements within the Highland Ravine Floodway would not require an encroachment permit.

7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Highland Ravine, the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has issued a preliminary Flood Insurance Study (FIS) update for Placer County which is currently being finalized by FEMA. Figure 3 shows the preliminary DFIRM Revised mapping at the location of the Highway 65 culverts.

Figure 3: Portion of the FEMA Floodplain and Floodway Map

(Source: Preliminary DFIRM panel 941H)

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ____________ Project ID: ____________

District: 03 County: Placer Route: 65 P.M.: 8.59

Br. No.: 19 0137 Br. Name: 03-PLA-065-M8.59

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: ____________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	750	111.8	100
Overtopping Flood:			
Datum:	NAVD88		

	Yes	No
Are NFIP maps available?	X	
Are NFIP studies available?	X	

4. Is the highway location alternative within a regulatory floodway? Yes ____ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:

	Yes	No
A. Residences?		X
B. Other Bldgs.?		X
C. Crops?		X
D. Natural and beneficial floodplain values?	X	

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ______
   - B. Emergency vehicle access? Yes X No ______
   - C. Practicable detour available? Yes X No ______
   - D. School bus or mail route? Yes X No ______

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$	0
B.	Property	$	0
	Total	$	0

9. Assessment of Level of Risk

   Low X Moderate ______ High ______

   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ______

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

    Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016

Title - President

Company – Civil Engineering Solutions, Inc.

6/13/16

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date

Title

Company MTCo

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing #2
At Highland Ravine

June 2016

Prepared By:

CIVIL ENGINEERING
SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

REGISTERED PROFESSIONAL ENGINEER
THOMAS S. PLUMMER
No. C49582
EXP. 9/30/16
STATE OF CALIFORNIA

nature dated:

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Highway 65 Crossing #2 at Highland Ravine

1.0 Introduction

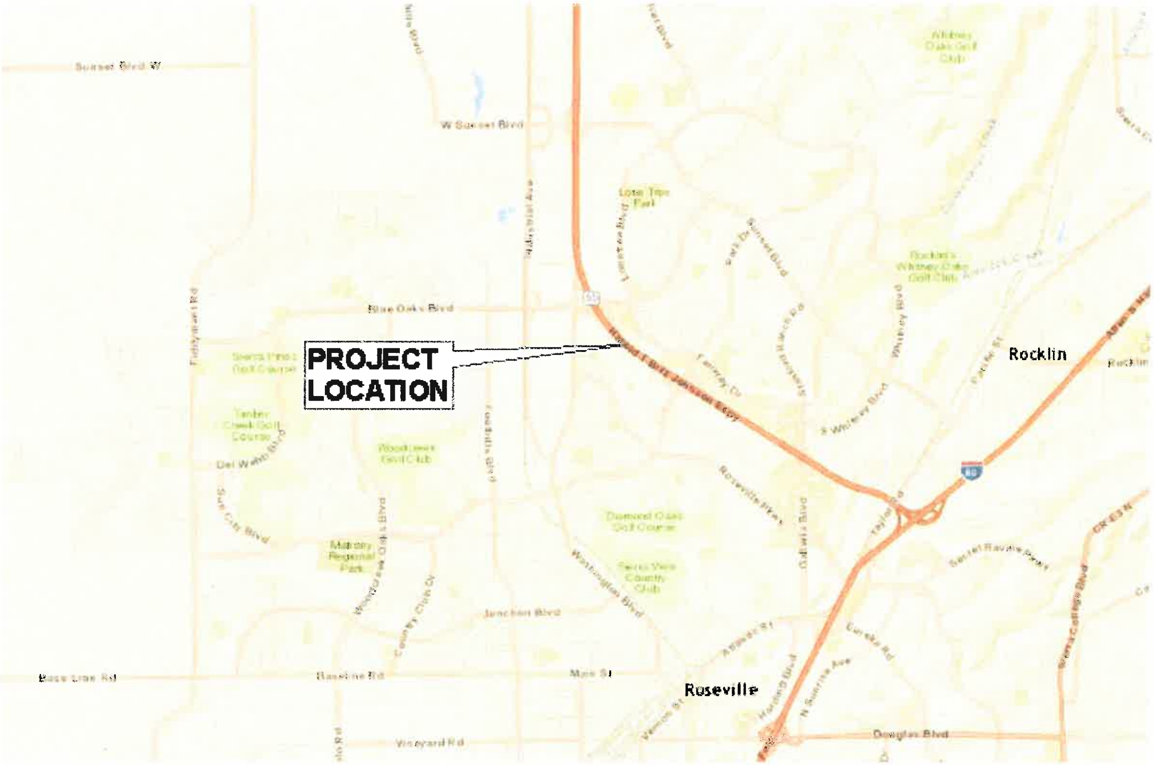
The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Highland Ravine crossing #2. This report will present historical flooding records, hydrologic analysis of Highland Ravine watershed and hydraulic analysis of the existing crossing.

The FEMA FIS report identifies this reach of the Pleasant Grove Stream group as Pleasant Grove Creek Tributary 1 (based on the gis shapefile designation). The FIRM shows it as Highland Ravine. CalTrans identifies this reach as Little Pleasant Grove Creek.

2.0 Project Location and Description

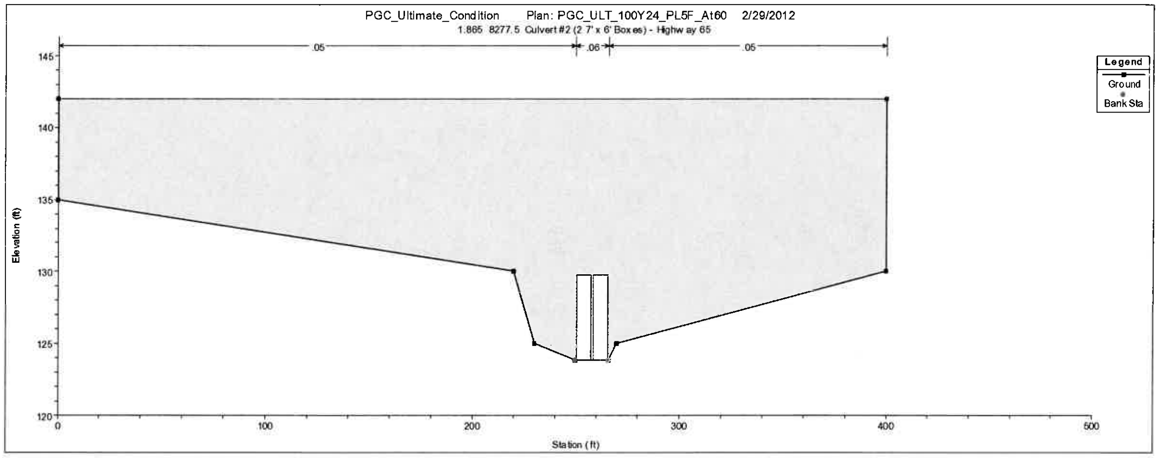
The crossing is located at Highway 65 at the Highland Ravine crossing #2 (03-PLA-065-M7.68). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map



The culverts convey Highland Ravine for a distance of 300 feet. There are two culverts approximately 7 ft wide by 6 feet high. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Highland Ravine watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the Pleasant Grove Creek Watershed Updated Hydrology and Hydraulic Analysis prepared for the City of Roseville by RBF Consulting in June 2010. This is the most current and up-to-date hydrology study for the Highland Ravine watershed. The study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The centerline of the roadway elevations were used for roadway areas at the crossing. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the NGVD 29 datum.

The analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Highland Ravine Floodway. As a result bridge improvements within the Highland Ravine Floodway would not require an encroachment permit.

7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Highland Ravine , the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has not issued any Flood Insurance Study (FIS) for this area of Placer County or the City of Roseville. Figure 3 shows floodplain mapping at the location of the Highway 65 culverts based on the most current available approved model.

Figure 3: Portion of the Highland Ravine Floodplain

Technical Information for Location Hydraulic Study – Oversight Projects

EA: Project ID:

District: 03 County: Placer Route: 65 P.M.: 7.68

Br. No.: UNK Br. Name: 03-PLA-065-M7.68

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.

2. ADT: Current: Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	636	130.8	100
Overtopping Flood:			
Datum:	NAVD88		

Are NFIP maps available? Yes ____ No X

Are NFIP studies available? Yes ____ No X

4. Is the highway location alternative within a regulatory floodway? Yes ____ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:
   A. Residences? Yes ____ No X
   B. Other Bldgs.? Yes ____ No X
   C. Crops? Yes ____ No X
   D. Natural and beneficial floodplain values? Yes X No ____

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ____
   - B. Emergency vehicle access? Yes X No ____
   - C. Practicable detour available? Yes X No ____
   - D. School bus or mail route? Yes X No ____

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.

A.	Roadway	$	0
B.	Property	$	0
	Total	$	0

9. Assessment of Level of Risk
   Low X Moderate ____ High ____
   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ____

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
   Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

6/13/16

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date
Title
Company MTCo

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing #3
At Highland Ravine

June 2016

Prepared By:

CIVIL ENGINEERING
SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

nature dated:

REGISTERED PROFESSIONAL ENGINEER
THOMAS S.
PLUMMER
No. C49582
EXP 9/30/16
STATE OF CALIFORNIA

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Location Hydraulic Study
Highway 65 Crossing #3 at Highland Ravine

1.0 Introduction

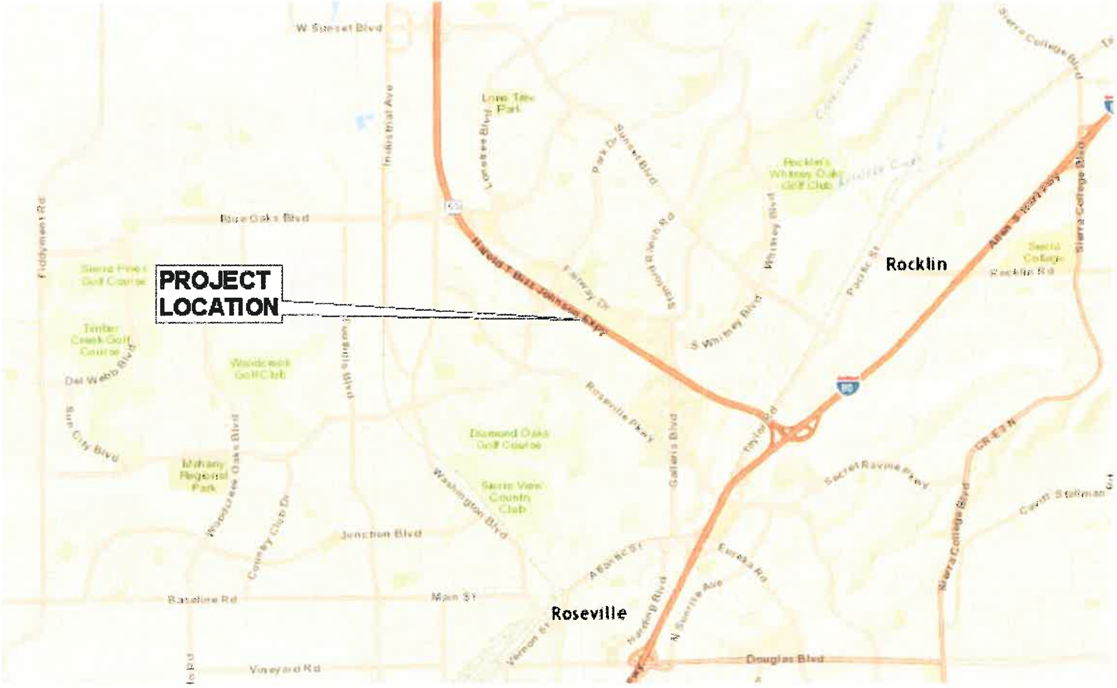
The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the Highland Ravine crossing #3. This report will present historical flooding records, hydrologic analysis of Highland Ravine watershed and hydraulic analysis of the existing crossing.

The FEMA FIS report identifies this reach of the Pleasant Grove Stream group as Pleasant Grove Creek Tributary 1 (based on the gis shapefile designation). The FIRM shows it as Highland Ravine. CalTrans identifies this reach as Little Pleasant Grove Creek.

2.0 Project Location and Description

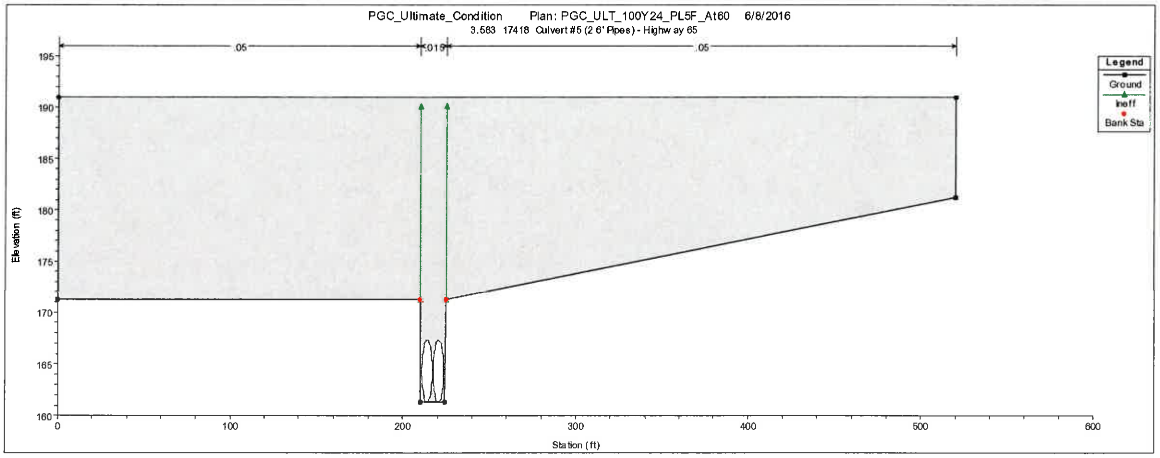
The crossing is located at Highway 65 at the Highland Ravine crossing #3 (03-PLA-065-M6.74). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map



The culverts convey Highland Ravine for a distance of 305 feet. There are two culverts 6 feet in diameter. A cross section of the existing crossing as depicted by the model is shown on Figure 2.

Figure 2: Cross section of the Existing Crossing



3.0 Flooding History

No significant flooding events are known to have been noted in the Highland Ravine watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates specified in the Pleasant Grove Creek Watershed Updated Hydrology and Hydraulic Analysis prepared for the City of Roseville by RBF Consulting in June 2010. This is the most current and up-to-date hydrology study for the Highland Ravine watershed. The study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

The hydraulic analysis of the crossing is performed using the Hydrologic Engineering Center's HEC-RAS software. The centerline of the roadway elevations were used for roadway areas at the crossing. No guard rail was input in this model as obstructed area.

The existing conditions culverts cross section is shown in Figure 1. The crossing itself is not overtopped during a 100-year storm event (1% chance). The cross sectional data is based on NAVD88 datum roughly 2.4 feet above the NGVD 29 datum.

The analysis assumed all barrels are clean and functional.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the Highland Ravine Floodway. As a result bridge improvements within the Highland Ravine Floodway would not require an encroachment permit.

7.0 Summary

This report and the included analysis demonstrates that based on current hydrologic and hydraulic analysis of Highland Ravine , the existing crossing at Highway 65 is capable of passing the 50-year or 100-year event without overtopping of the adjacent roadway.

8.0 FEMA Issues:

FEMA has not issued any Flood Insurance Study (FIS) for this area of Placer County or the City of Roseville. Figure 3 shows floodplain mapping at the location of the Highway 65 culverts based on the most current available approved model.

Figure 3: Portion of the Highland Ravine Floodplain

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ____________ Project ID: ____________

District: 03 County: Placer Route: 65 P.M.: 6.74

Br. No.: UNK Br. Name: 03-PLA-065-M6.74

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

    - Extend culvert as required for Hwy 65 widening.
    -
    -
    -
    -
    -
    -

2. ADT: Current: ____________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	531	168.6	100
Overtopping Flood:			
Datum:	NAVD88		

	Yes		No	
Are NFIP maps available?	Yes		No	X
Are NFIP studies available?	Yes		No	X

4. Is the highway location alternative within a regulatory floodway? Yes ______ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:

A. Residences?	Yes		No	X
B. Other Bldgs.?	Yes		No	X
C. Crops?	Yes		No	X
D. Natural and beneficial floodplain values?	Yes	X	No	

6. Type of Traffic:
   A. Emergency supply or evacuation route? Yes X No ____
   B. Emergency vehicle access? Yes X No ____
   C. Practicable detour available? Yes X No ____
   D. School bus or mail route? Yes X No ____

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.
   A. Roadway $ 0
   B. Property $ 0
   Total $ 0

9. Assessment of Level of Risk
   Low X Moderate ____ High ____
   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes X No ____

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113
    Extension of culverts would have a minor effect on the upstream and downstream conditions. Alternatives include no widening of the highway (no project alternative) or elevation (bridge) of the widened portion.

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9)
Title - President
Company – Civil Engineering Solutions, Inc.

Date 6/13/2016

6/13/16

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11)
Title
Company MTCo

Date

CITY OF LINCOLN

PLACER COUNTY, CALIFORNIA

LOCATION HYDRAULIC STUDY

FOR

Highway 65 Crossing
At South Branch
Pleasant Grove Creek

June 2016

Prepared By:

CIVIL ENGINEERING SOLUTIONS, INC.
590 E Street
Lincoln, CA 95648
(916) 645-5700

JOB # 2016.05

This document prepared under the supervision of:

REGISTERED PROFESSIONAL ENGINEER
THOMAS S. PLUMMER
No. C43582
EXP. 9/30/16
STATE OF CALIFORNIA

nature dated:

____

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Location Hydraulic Study
Highway 65 Crossing At South Branch Pleasant Grove Creek

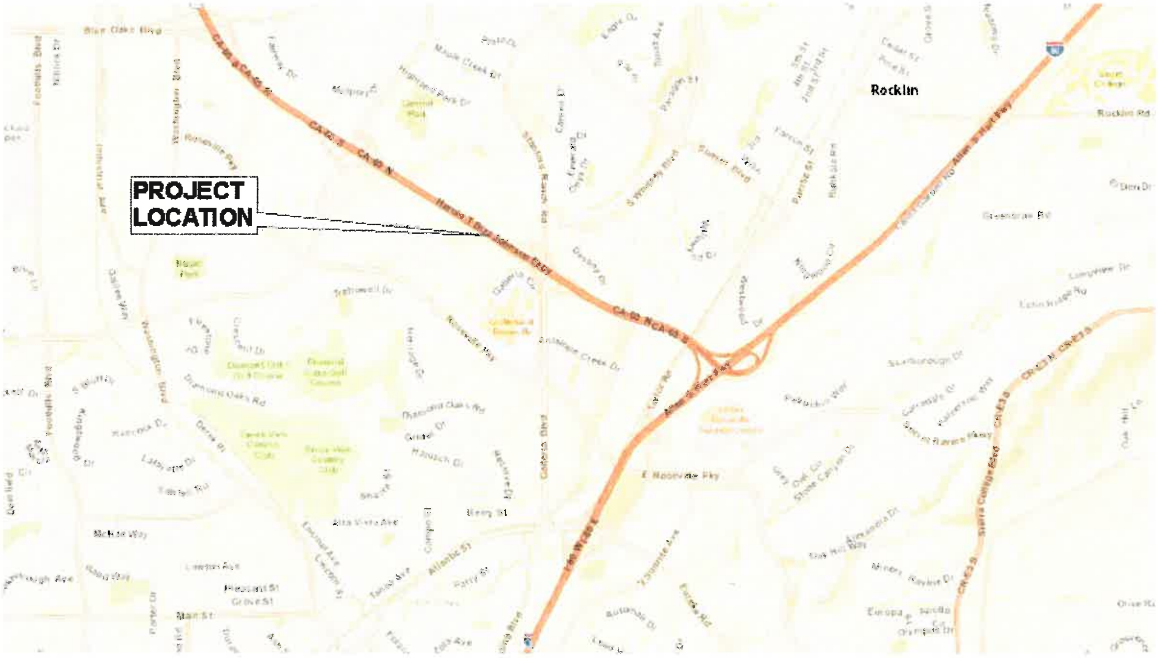
1.0 Introduction

The California Department of Transportation (Caltrans) proposes to widen Highway 65. The purpose of this report is to present a location hydraulic study of the existing crossing at Highway 65 at the South Branch Pleasant Grove Creek. This report will present historical flooding records, hydrologic analysis of this portion of South Branch Pleasant Grove Creek watershed and hydraulic analysis of the existing crossing.

2.0 Project Location and Description

The crossing is located at Highway 65 at the South Branch Pleasant Grove Creek (03-PLA-065-M6.25). Figure 1 shows the location of the existing crossing.

Figure 1: Location Map



The culvert conveys a portion of South Branch Pleasant Grove Creek for a distance of about 200 feet.

3.0 Flooding History

No significant flooding events are known to have been noted in the South Branch Pleasant Grove Creek watershed.

4.0 Hydrology Analysis

4.1 Hydrologic Method

The results presented by this study use the flow rates computed with a modified version of the HEC-1 used in the Pleasant Grove Creek Watershed Updated Hydrology and Hydraulic Analysis prepared for the City of Roseville by RBF Consulting in June 2010. This is the most current and up-to-date hydrology study for the South Branch Pleasant Grove Creek watershed. The study is performed consistent with the requirements of the Placer County Stormwater Management Manual (SWMM), using published elevation varied precipitation rates from that same manual, and the kinematic wave hydrograph transformation process and factors described in that manual.

The Placer County SWMM methodologies use their internally developed PDP software for generation of precipitation factors for elevation and storm centered locations, and runoff event frequencies. During the Dry Creek Watershed Update project (2007 to 2011), it was found there were errors in the PDP program which were fixed and a new program was released called PDP2, which was used in this study.

Factors for the infiltration rates, % imperviousness were estimated using land use maps for the watershed. Hydrologic soil type factors are also used in the estimation of infiltration rates per table 5-3 of the SWMM.

The methodology utilizes the Hydraulic Engineering Center's HEC-1 and HEC-HMS software to develop flood hydrographs for watersheds and to combine and route them.

5.0 Hydraulics Analysis

5.1 Hydraulic Analysis Methodology

A hydraulic analysis has not been performed at this time due to insufficient data. Flows computed with the HEC-1 model indicate peak 100-year runoff of 24 cfs upstream of this culvert.

Once sufficient data has been obtained this culvert will be re-examined for adequacy.

6.0 Existing Crossing Structure Site

6.1 CVFPB Criteria

The Central Valley Flood Protection Board (CVFPB) does not claim Title 23 Section 8 listed stream jurisdiction over the South Branch Pleasant Grove Creek Floodway. As a result bridge improvements within the South Branch Pleasant Grove Creek Floodway would not require an encroachment permit.

7.0 Summary

To be completed at a later time.

8.0 FEMA Issues:

FEMA has not issued any Flood Insurance Study (FIS) for this area of Placer County or the City of Roseville.

Technical Information for Location Hydraulic Study – Oversight Projects

EA: ________ Project ID: ________

District: 03 County: Placer Route: 65 P.M.: 6.25

Br. No.: UNK Br. Name: 03-PLA-065-M6.25

Floodplain Description:

1. Description of Proposal (include any physical barriers i.e. concrete barriers, soundwalls, etc. and design elements to minimize floodplain impacts):

   - Extend culvert as required for Hwy 65 widening.
   -
   -
   -
   -
   -
   -

2. ADT: Current: ________ Projected: X

3. Hydraulic Data:

	Q (cfs)	WSE (ft)	Return Period (yrs)
Flood of Record (If > Q_{100}):			
Base Flood:	24	UNK	100
Overtopping Flood:			
Datum:	NAVD88		

   Are NFIP maps available? Yes ____ No X

   Are NFIP studies available? Yes ____ No X

4. Is the highway location alternative within a regulatory floodway? Yes ____ No X

5. Attach map with flood limits outlined showing all buildings or other improvements within the base floodplain.
   Potential Q_{100} backwater damages:
   A. Residences? Yes ____ No X
   B. Other Bldgs.? Yes ____ No X
   C. Crops? Yes ____ No X
   D. Natural and beneficial floodplain values? Yes ____ No X

6. Type of Traffic:
   - A. Emergency supply or evacuation route? Yes X No ____
   - B. Emergency vehicle access? Yes X No ____
   - C. Practicable detour available? Yes X No ____
   - D. School bus or mail route? Yes X No ____

7. Estimated duration of traffic interruption for 100-year event 0 hours.

8. Estimated value of Q_{100} flood damages (if any) – moderate risk level.
   - A. Roadway $ 0
   - B. Property $ 0
   - Total $ 0

9. Assessment of Level of Risk
   Low X Moderate ____ High ____
   For High Risk projects, during design phase, additional Design Study Risk Analysis may be necessary to determine design alternative.

10. Is there any longitudinal encroachment, significant encroachment, or any support of incompatible Floodplain development? Yes ____ No X

11. If yes, provide evaluation and discussion of practicability of alternatives in accordance with 23 CFR 650.113

Information developed to comply with the Federal requirement for the Location Hydraulic Study shall be retained in the project files.

PREPARED BY:

Signature – Hydraulics Engineer (Items 3-5, 7, & 9) Date 6/13/2016
Title - President
Company – Civil Engineering Solutions, Inc.

6/13/16

Signature – Project Engineer (Item numbers 1-2, 6, 8, & 10-11) Date
Title
Company MTCo

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 12.27

Project ID:

Bridge No. 19 0139 Bridge Name 03-PLA-065-R12.27

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 12.26 to 12.28.

Floodplain Description: North Branch Orchard Creek floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No ____
2. Are the risks associated with the implementation of the proposed action significant? Yes ____ No X
3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes ____ No X
4. Are Location Hydraulics Studies that document the above answers on file? Yes ____ No X
   If not, explain
   LHS completed but not yet on file.
5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes ____ No X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No X

If yes, explain. ______

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No X

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

Signature – Project Engineer
Title
Company MTCo

6/13/16
Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 11.66

Project ID:

Bridge No. 19 0138 Bridge Name 03-PLA-065-R11.66

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 11.65 to 11.67.

Floodplain Description: Orchard Creek floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No

2. Are the risks associated with the implementation of the proposed action significant? Yes No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes No X
   If not, explain
   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes No X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No __X__

If yes, explain.

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No __X__

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

6/13/16

Signature – Project Engineer
Title
Company MTCo

Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 11.42

Project ID:

Bridge No. 19 0138 Bridge Name 03-PLA-065-R11.42

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 11.41 to 11.43.

`

Floodplain Description: Orchard Creek Tributary 2-1 floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No

2. Are the risks associated with the implementation of the proposed action significant? Yes No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes No X
   If not, explain
   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes No X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No X

If yes, explain. ______

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No X

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

Signature – Project Engineer
Title
Company MTCo

6/13/16
Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 10.73

Project ID:

Bridge No. UNK Bridge Name 03-PLA-065-R10.73 (assumed)

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 10.72 to 10.74.

Floodplain Description: Orchard Creek Tributary 2 floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No

2. Are the risks associated with the implementation of the proposed action significant? Yes No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes No X

   If not, explain

   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes No X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

   Yes ______ No __X__

   If yes, explain. ______________________________

7. Will the proposed action support probable incompatible floodplain development?

   Yes ______ No __X__

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

6/13/16

Signature – Project Engineer
Title
Company MTCo

Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 9.89

Project ID:

Bridge No. UNK Bridge Name 03-PLA-065-R10.73 (assumed)

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 9.88 to 9.90.

Floodplain Description: Pleasant Grove Creek North Branch floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No ___

2. Are the risks associated with the implementation of the proposed action significant? Yes ___ No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes ___ No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes ___ No X
   If not, explain
   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes ___ No X

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No __X__

If yes, explain. ____

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No __X__

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

Signature – Project Engineer
Title
Company MTCo

6/13/16
Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 9.89

Project ID:

Bridge No. 19 0136R & L Bridge Name 03-PLA-065-R8.77 (NB) & 8.76 (SB)

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 8.74 to 8.79.

Floodplain Description: Pleasant Grove Creek floodplain under and adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105?	Yes	X	No	
2. Are the risks associated with the implementation of the proposed action significant?	Yes		No	X
3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105?	Yes		No	X
4. Are Location Hydraulics Studies that document the above answers on file?	Yes		No	X

If not, explain
LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105?	Yes		No	X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No __X__

If yes, explain. ____________________

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No __X__

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

6/13/16

Signature – Project Engineer
Title
Company MTCo

Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 9.89

Project ID:

Bridge No. 19 0137 Bridge Name 03-PLA-065-R8.59

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 8.56 to 8.58.

Floodplain Description: Highland Ravine floodplain under and adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No ___

2. Are the risks associated with the implementation of the proposed action significant? Yes ___ No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes ___ No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes ___ No X
   If not, explain
   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes ___ No X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No __X__

If yes, explain. ____

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No __X__

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

6/13/16

Signature – Project Engineer
Title
Company MTCo.

Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 7.68

Project ID:

Bridge No. UNK Bridge Name 03-PLA-065-R7.68

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 7.67 to 7.69.

Floodplain Description: Highland Ravine floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No ____

2. Are the risks associated with the implementation of the proposed action significant? Yes ____ No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes ____ No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes ____ No X
   If not, explain
   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes ____ No X

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes _______ No __X__

If yes, explain. ____

7. Will the proposed action support probable incompatible floodplain development?

Yes _______ No __X__

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

6/13/16

Signature – Project Engineer
Title
Company MTCo

Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Placer Route 65 P.M. 6.74

Project ID:

Bridge No. UNK Bridge Name 03-PLA-065-R6.74

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 6.73 to 6.75.

Floodplain Description: Highland Ravine floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No

2. Are the risks associated with the implementation of the proposed action significant? Yes No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes No X

   If not, explain

   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes No X

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

Yes ______ No X

If yes, explain. ______

7. Will the proposed action support probable incompatible floodplain development?

Yes ______ No X

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

Signature – Project Engineer
Title
Company MTCo

6/13/16
Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

Floodplain Evaluation Report Summary – Oversight Projects

District 03 EA County Plac er Route 65 P.M. 6.25

Project ID:

Bridge No. UNK Bridge Name 03-PLA-065-R6.25

Project Limits: Highway 65 between Lincoln and Roseville/Rocklin from approximately PM 6.24 to 6.26.

Floodplain Description: South Branch Pleasant Grove Creek floodplain adjacent to Hwy 65.

1. Is the proposed action a longitudinal encroachment of the base floodplain as defined in 23 CFR, Section 650.105? Yes X No

2. Are the risks associated with the implementation of the proposed action significant? Yes No X

3. Does the proposed action constitute a significant floodplain encroachment as defined in 23 CFR, Section 650.105? Yes No X

4. Are Location Hydraulics Studies that document the above answers on file? Yes No X
   If not, explain
   LHS completed but not yet on file.

5. Are there any significant impacts on natural and beneficial floodplain values as defined in 23 CFR, Section 650.105? Yes No X

Floodplain Evaluation Report Summary – Oversight Projects

6. Routine construction procedures are required to minimize impacts on the floodplain. Are there any special mitigation measures necessary to minimize impacts or restore and preserve natural and beneficial floodplain values?

   Yes ______ No X

   If yes, explain.

7. Will the proposed action support probable incompatible floodplain development?

   Yes ______ No X

PREPARED BY:

Signature – Hydraulics Engineer (Items 1-4)
Title - President
Company – Civil Engineering Solutions, Inc.

Date
06/13/2016

Signature – Environmental Specialist (Items 5-7)
Title
Company

Date

CONCUR:

Signature – Project Engineer
Title
Company MTCo.

6/13/16
Date

REVIEWED BY:

Signature – Environmental Branch Chief
CA DOT, District 03

Date

APPENDIX I

Caltrans Hydraulics Branch Unit Comment/Response Matrix

Local Funded Project

Comment Resolution Table

Project:	**SR65 C&O Improvements 1F170**	**EA:**	**03-1F170**
			0300001103
Review Phase:	**Preliminary Drainage Report**	**Co-Rte (KP/PM)**	**Pla-65-PM 6.2-12.8**
		CRT Distributed	**December 08, 2015**

Comment Disposition:

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
1	Clark Townsend	Hydraulics	Preliminary Drainage Report (PDR), Signature Page	The Drainage Report should contain a signature page noting the report was prepared by a licensed Civil Engineer in CA. See Attached signature page.	Signature page has been provided.	
2	Clark Townsend	Hydraulics	PDR, TOC	Include Appendices, Figures, and Tables in the Table of Contents. A copy of the Preliminary Drainage Layout sheets, Roadway Typical Sections and profiles should be included in an appendix. A complete set of Final Drainage Plans, Profiles, Details, and Quantities should be included with the Final Drainage Report (FDR).	Appendices, Figures, and Tables have been included in the Table of Contents. Drainage layout is been shown in the water sheds and roadway typical sections and profiles are in the GADs.	
3	Clark Townsend	Hydraulics	PDR, 2.D.	Master Watershed Maps may be provided, however, where the scale is too small to clearly identify all pertinent hydrologic characteristics including ditch flowline/flow direction, and longest travel path, larger scale maps should be included. Existing Watershed Maps should show	Legible maps with pertinent information including flowline, flow direction, and longest paths are being shown in the shed maps. Drainage structures,	

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
				and label all existing: drainage structures; contours; and longest travel paths. Proposed Watershed Maps should show and label all proposed: drainage structures with Drainage System and Drainage Unit numbers; contours; and longest travel paths.	contours, and longest paths have been shown in the Watershed Map.	
				Separate sub-watersheds should be developed as necessary for each drainage structure/inlet in the FDR. **Watersheds should not drain to multiple outlets.** (WS 3 drains to at least 3 separate outlets based on information shown on the watershed map). Each subshed should have a single outlet.	Separate sub-watershed have been developed to different outlets for sub-watershed area no. 3 in the Shed Map.	
				Node and sub-watershed symbols should not match Caltrans Drainage System and Drainage Unit symbols.	Symbols have been revised.	
				A copy of the Draft District 03 Culvert Inventory is included for your reference.		
				State Route 65 and all major roads should be overlain on all FEMA FIRMs. Bridges should be labeled with bridge name and number.	FEMA FIRMs have been overlain in the Water Sheds. Bridges are labeled with names and numbers.	
				Proposed improvements should be evaluated for encroachments on existing	Each encroachment	

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
				FEMA Floodplains and Technical Information for Location Hydraulic Studies completed for each encroachment and a Floodplain Evaluation Report Summary completed for the entire project. There are several multiple RCB culverts that have a combined span of over 20' and are therefore considered bridges and should be referenced as such, see attached Draft District 03 Culvert Inventory.	has been evaluated and Location Hydraulic Studies have been completed and attached in the Appendix H. Correct name of bridge has been added to the multiple RCB culverts that have a combined span of over 20'.	
4	Clark Townsend	Hydraulics	PDR, 3.A. Rainfall Data	What was the source of the annual precipitation noted? Separate hydrology should be analyzed based on the centroid of each tributary, or you can use the centroid location that produces the highest intensities.	The NOAA Atlas 14, Volume 6, version 2 has been used for rainfall data. The centroid of each tributary has been evaluated and the one that produces the highest intensities has been used in the analysis.	
5	Clark Townsend	Hydraulics	PDR, 3.A. Intensity	NOAA Altas 14, Volume 6, v2.3 precipitation intensities should be based on partial duration series data. NOAA ATLAS 14 does not provide IDF equations. IDF equations should be based on the FHA Method in Hydraflow Storm Sewers by Autodesk. A copy of the IDF Table input data, FHA IDF curve coefficients, and IDF output curves should be included in the Appendix.	IDF equations has been developed based on the FHA Method in Hydraflow Storm Sewers by Autodesk. IDF Table input data, FHA IDF curve coefficients, and IDF output curves have been added in the	

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
					Appendix D.	
6	Clark Townsend	Hydraulics	PDR, 3.B. Table 1	Include a column for PM. Field verify all culverts. Several culverts show up in the District 3 Culvert inventory that do not show up in Table 1. See Culvert inventory attached. A 10' double 10'x5 RCB would be considered a bridge unless the 2 culverts are separated by more than ½ the length of the largest span.	Table 1 for section 3B has been revised. Culverts will be field verified during the final design phase. Multiple RCB culverts that have a combined span of over 20' have been called out as bridges.	
7	Clark Townsend	Hydraulics	PDR, 3.B. Table 2	For the PDR, watersheds summaries for each cross drain are adequate, however, for the FDR, cross drain watersheds should be further sub-dived as necessary for each drainage structure/inlet within a cross drain watershed.	Cross drain watersheds will be further sub-dived as necessary for each drainage structure/inlet within a cross drain watershed at final design phase.	
8	Clark Townsend	Hydraulics	PDR, 4.A.	Supporting hydrology information should be included in an Appendix and referenced this section of the report, including watershed characteristics and documentation of all hydrologic assumptions.	Supporting information including calculation have been included in the Appendix.	
9	Clark Townsend	Hydraulics	PDR, 4.B.	The 25-year event should be used to design onsite Dis and OSDs if used, and for evaluation of spread where appropriate. Design Criteria for cross culverts and bridges are noted in HDM 821.3.	The 25-year event has been used to design onsite drainage and for evaluation of spread. Cross culverts are analyzed in 100-year.	

Local Funded Project

Comment Resolution Table

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
10	Clark Townsend	Hydraulics	PDR, 4.C.	Using a runoff coefficient for pavement of 0.95 is widely accepted and an appropriate per HDM Table 819.2B. Arbitrarily choosing a runoff coefficient of 0.56 for “unpaved areas” is not widely accepted or referenced in the HDM. Development of runoff coefficients for undeveloped areas should be based on the method contained in Figure 819.2A or another widely accepted source runoff coefficients for undeveloped areas with approval by District 03 Hydraulics. Watershed area characteristic should be adequately documented to support the values selected. All documentation should be included in an Appendix.	Runoff coefficients for undeveloped areas have been revised per HDM Figure 819.2A. The calculation spreadsheets in the appendix now show the appropriate watershed area characteristics for the undeveloped areas.	
11	Clark Townsend	Hydraulics	PDR, 4.E.	Points of concentration may also occur at gore paving. A field review after consulting with the District 03 area maintenance Engineer is recommended for verifying potential points of concentration.	Points of concentration at gore paving were not verified for this preliminary report. A field review after consulting with Caltrans maintenance Engineer will be performed during final design	
12	Clark Townsend	Hydraulics	Appendix B	FEMA FIRMs should be referenced to project plans so alignment will be visible on the FIRMs. Cross drainage structures should be labeled with Name, Br/ No./Drainage System and Unit Number, PM, and Creek or Tributary Name. Creation of larger scale FIRMettes may be	The changes have been made to the Shed Map attached in Appendix C.	

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
				necessary where text is not readily readable.		
13	Clark Townsend	Hydraulics	Appendix D	Provide Typical Sections of the Curb, Gutter, and Ditch Sections. HMA Lined ditches might have a depth of 1 feet with a width of 6 feet, but are not that deep nor do they have 3:1 side slopes (A5 190+44 – 199+00). An 8' wide 1' deep, HMA lined trapezoidal channel with a 2' bottom width is a ditch not a gutter. Without a profile, I cannot verify the gutter capacity and spread were analyzed at critical locations.	Typical Sections have been made and included adjacent to the calculation spreadsheets. Correct callouts have been added to the ditches/gutters.	
14	Clark Townsend	Hydraulics	Appendix E	"Pervious" is not a sufficient description of a watershed coverage. Tc calculations should be provided in detail. You need to show travel path lengths to use in determining Tc per HDM 816.6. A table of watershed characteristics for each sub watershed should be provided along with sufficient details to verify or adequately support the c value used. Runoff calculations should show each contributing sub-shed with weighted C, weighted C, C(f), and Ct values so that all calculations can be readily verified.	The revision has been made in the design calculation spreadsheets to document the characteristics of undeveloped areas.	
15	Clark Townsend	Hydraulics	Drainage Submittal General	Provide both a hard copy and electronic copy of the DR with all Appendices, spreadsheets, input and output files, etc. with each submittal.	Completed.	
16	Clark Townsend	Hydraulics	Project Limits	The project limits begin work and end work locations should include room for	The project limits have been	

Local Funded Project

Comment Resolution Table

Item No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If Needed)
				area construction signs.	established and this will not include rooms for construction area signs which will be determined at the final design.	

Local Funded Project
Comment Resolution Table

Review Phase/Stage:	**Preliminary Drainage Report 6-13-2016** **Hydrologic/Hydraulic Review Comments**	**CR Meeting/Comments Due:**	
		***CRT Distributed:**	June 13, 2016
		EA:	03-1F170 0300001103
Project Manager:	Rodney Murphy	**Co-Rte (KP/PM):**	Pla-65-PM R4.80-R12.80?
Description:	| **State Route 65 C&O Improvements**		

No.	Name	Unit	Ref/No	Comment/Issue/Solution	Response or Action Taken	Recommendation (If needed)
1.	Clark Townsend	Hydraulics	Preliminary Drainage Report (PDR)	Start and End Construction PM locations should be consistent between the Plans and the DR. and based on the Traffic Accident Surveillance and Analysis System (TASAS) Highway Sequence Listing (HSL), [PM Log]. A copy of the TASAS HSL covering the project area will be attached.	Will defer till Final Drainage Report (FDR).	
2.	Clark Townsend	Hydraulics	PDR	Provide both a hard copy and electronic copy of the DR with all Appendices, including an electronic copy of all CADD drawings (.dgn or .dwg with all reference files), spreadsheets (.xlsx), miscellaneous calculations, and software input/output files (Note software version) with each submittal. .	Will defer till Final Drainage Report (FDR).	
3.	Clark Townsend	Hydraulics	Table of Contents (TOC)	All tables included in the text of the PDR should have a Title and be listed in the TOC.	Will defer till Final Drainage Report (FDR).	

Local Funded Project
Comment Resolution Table

4.	Clark Townsend	Hydraulics	PDR, Pg 1, 1B, Paragraph (P) 1	Change to "Placer County Transportation Planning Agency (PCTPA) in cooperation with Caltrans,"	Will evaluate, in conflict with Project Description.	
5.	Clark Townsend	Hydraulics	PDR, Pg 2, 1B1, Whitney	Typo.	Typo has been fixed.	
6.	Clark Townsend	Hydraulics	PDR, Pg 4, 2A, ,P 1	For this project, there are a series of discrete watersheds that drain to Pleasant Grove Creek or Orchard Creek. There is not one watershed for each creek. Each watershed should be clearly delineated with a unique watershed ID.	Will defer till Final Drainage Report (FDR).	
7.	Clark Townsend	Hydraulics	PDR, Pg 4, 2A, P 2	The conditions of the existing culverts should be established in the PA&ED phase to ensure an accurate scope of work in order to determine the nature and extent of required permits and to secure adequate funding resources.	Will defer till Final Drainage Report (FDR).	
8.	Clark Townsend	Hydraulics	PDR, Pg 4, 2A, P 3	Grammar.	Grammar error has been fixed.	
9.	Clark Townsend	Hydraulics	PDR, Pg 4, 2A, P 5	Any increase in runoff which is not mitigated on site should be mitigated for volumetric impacts to prevent additional flooding in eastern Sutter County.	The paragraph no. 5 has been revised.	
10.	Clark Townsend	Hydraulics	PDR, Pg 4, 2B	Add "No increase in runoff is anticipated from future revisions to land use, since governing agencies are required to ensure no net increase in runoff to the State highway without receiving and Encroachment Permit from Caltrans that identifies all necessary mitigation required, along with a new/revised	The section 2B has been revised.	

				Cooperative Agreement.		
11.	Clark Townsend	Hydraulics	PDR, Pg 5, 2C, P 5	Section 2C covers Soil Type and Vegetation. Discussions of pavement surfaces do not belong in this section. Please correct typos (gassy?). Please define grades for grassy surfaces (shallow to medium grade?)	Will defer till Final Drainage Report (FDR).	
12.	Clark Townsend	Hydraulics	PDR, Pg 6, 3A, P 1	The Table should have a title and be listed in the TOC. The 4th column should note 25-Yr Return Period – 5 Min Duration. Precipitation data should be based on the centroid of each watershed, not each tributary. It would be conservative to use the intensity equation from the watershed that has the highest intensity values from NOAA AQTLAS 14, however, you should determine the intensity values for the northern, southern, eastern, and western most watersheds to ensure the IDF equation used will produce the largest intensities. NOAA ATLAS 14 intensities were not checked north of Blue Oaks Blvd. If you checked the NOAA ATLAS 14 web application and determined that the watershed intensities were lower north of Blue Oaks Blvd that should be stated in section 3A. The Hydraflow Express Extension IDF Equation output file should include a comment that it applies	Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	

				to all watersheds and be placed at the start or end of Appendix D. If you plan to analyze Bridges for the 50-year event, you will need to determine the IDF Equations for the 50-yr event. If you propose any new culverts, you will need IDF Equations for the 10-year event.	Will defer till Final Drainage Report (FDR).	
13.	Clark Townsend	Hydraulics	PDR, Pg 7, 3B, P 1	The first sentence is somewhat poorly worded. It implies that the project will not alter existing watershed boundaries. However, only 2 of the 18 watersheds listed in Table 2 have the same watershed areas. What we would be interested in would be the total acreage and runoff to the outlet of each watershed for the existing and proposed conditions. I do not believe that is what is represented in Table 2.	The first paragraph of Section 3B has been revised. Table 2 has been revised, the total acreage of the watershed is the same between the existing and proposed conditions.	
14.	Clark Townsend	Hydraulics	PDR, Pgs 7-8, 3B, P 2 & Table 1	The Caltrans District 3 Hydraulics Culvert Inventory is for reference only. A field investigation is required to locate all existing drainage facilities and establish the current condition of each facility in order to establish the appropriate scope of work and Environmental study limits. Table 1 should list the source of the information and the disclaimer that was included with the Caltrans District 3 Hydraulics Culvert Inventory.	Noted. Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	

				Since a field investigation has yet to be performed to verify all of the existing cross drainage facilities, it would be more appropriate to just include the Caltrans District 3 Hydraulics Culvert Inventory in an appendix.	Will defer till Final Drainage Report (FDR).	
				A Pick Test should be performed for each culvert as part of the culvert inspections. If a culvert is punctured or dented as a result of several forceful strikes with a sharp rock pick, the culvert would be considered to have a structure failure and need rehabilitation (lining or replacement), see HDM Topic 853.	Will defer till Final Drainage Report (FDR).	
				It would also be appropriate to have a Table of the cross drainage structures associated with FEMA Floodplains listing the existing and proposed and net change in runoff; inlet; and outlet water surface elevations (WSEs).	Will defer till Final Drainage Report (FDR).	
				The alignment and the station where the centerline of the cross culvert intersects the highway alignment should be listed for each cross drainage structure.	Will defer till Final Drainage Report (FDR).	
				The PMs for the drainage systems in Table 1 should be shown to 3 decimal places and be based on the TASAS Highway Sequence Listing (HSL) for District 3 attached. Note: The TASAS HSL	Will defer till Final Drainage Report (FDR).	

				is considered privileged information by Caltrans Headquarters Traffic Safety, and should be treated as such per the Cooperative Agreement between Caltrans and Placer County Planning Agency per Agreement 03-0535 dated 4-16-2013. The PMs listed are considered exact at the intersection of the State Route CL and each listed facility. The closest major structure (Bridge), readily identified in the field, should be used to establish the PMs (Ramp PMs should never be used to create new PMs and intersection PMs should only be used where there is no other reasonable option and the intersection can be readily surveyed in the field). The PM station starts at the bridge or accurately identifiable physical structure in the TASAS HSL and progresses up station along the CL alignment to the end of the project or the next bridge or accurately identifiable physical structure in the TASAS HSL at which point a Station Equation would be established. New PMs are only established within the project limits. TASAS PM reference points used to determine the PM for each drainage facility should be included in design layout sheets with all station equations listed.	Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	

Local Funded Project
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15.	Clark Townsend	Hydraulics	PDR, Pg 8, 3B, Table 2	In section 3B on page 7, the report states "the project is designed to direct runoff from watershed areas into the same, existing discharge points" If this is the case, why do only 2 of the 18 nodes (discharge points) listed in Table 2 have the same acreages for both the existing and proposed conditions? Is this due to gaps and overlaps, rough boundary determination, etc.?	There have been discrepancies in the area calculations and the Table 2 has been revised..	
16.	Clark Townsend	Hydraulics	PDR, Pg 9, 4A	Watersheds should be subdivided into sub watersheds with uniform coverages ('C" factors) that would include more than just pervious and impervious, See HDM Figure 819.2A, Table 819.2B, and District 03 Accepted Miscellaneous Rational Runoff Coefficient "C" Values in the attached file: Approved District 03 Hydrologic-Hydraulic Software, Guidance, Data Sources, and Misc. References v05 2016-04-06.xlsx. Watershed boundaries should be perpendicular to the contours and have a single outlet at the State R/W. Outlets should be clearly labeled with a Unique ID. Alignment stationing and aerial photos should be included on all watershed maps. The topo, contours should not extend across overcrossings, but end at the abutments. Contours should be labeled.	Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	

				Existing Watershed Maps should show and label all existing: drainage structures; contours; and longest travel paths Proposed Watershed Maps should show and label all proposed: drainage structures with Drainage System and Drainage Unit numbers; contours; and longest travel paths. All drainage facilities should be shown and uniquely identified on the watershed maps. Subwatersheds should have unique IDs that are sequenced (WS 1.01.01 or 1-A-01). For example, Watershed 1 drains to Outlet 1 and contains subwatersheds 1-01, 1-02-01, 1-02-02, etc. Watersheds should always be referenced by their Unique watershed ID. The watershed property table on each watershed map should have a title, list watershed and subwatershed unique sequenced IDs, coverage Type, Runoff coefficient, Area (in sf, acres), along with sufficient details to verify or adequately support the “C” values used. Runoff calculations should show each contributing sub-shed with weighted C, weighted C, C(f), and	Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	

				Ct values so that all calculations can be readily verified. Larger scale maps should be used where necessary to readily identify stationing, drainage features Type (Culvert, DI, ditches, curbs, dikes, etc.), size all pertinent hydrologic/hydraulic features. Where the scale is too small to clearly identify all pertinent hydrologic characteristics including ditch flowline/flow direction, and longest travel path, larger scale maps should be included. Ensure creek names are shown correctly, the watershed maps show Pleasant Grove Creek at station 199+00 and 445+00. At the first location, an unnamed tributary to Pleasant Grove Creek crosses State Route 65, not Pleasant Grove Creek.	Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	
17.	Clark Townsend	Hydraulics	PDR, Pg 9, 4B	Existing culverts need only be analyzed for the 100-year event, however, if new culverts are proposed, they will also need to be sized to ensure the headwater elevation does not exceed the crown elevation for the 10-year event (HDM 821.3(2)).	Section 4B has been revised.	
18.	Clark Townsend	Hydraulics	PDR, Pg 9, 4C	See District 03 Accepted Miscellaneous Rational Runoff Coefficient “C” Values in the attached file (Approved District 03 Hydrologic- Hydraulic Software, Guidance, Data Sources, and Misc.	Will defer till Final Drainage Report (FDR).	

				References v06 2016-08-02.xlsx). Watershed area characteristic should be adequately documented to support the values selected. All documentation should be included in an Appendix C(f) for a 50-yr frequency is 1.2.		
19.	Clark Townsend	Hydraulics	PDR, Pg 10, 4D	Note: for rural and undeveloped areas, a minimum Tc of 10 minutes should be used.	Will defer till Final Drainage Report (FDR).	
20.	Clark Townsend	Hydraulics	PDR, Pg 10, 4E	Grammar. Points of Concentration should be identified as a specific point on the watershed maps with a leader line to the point ID. Provide a table of the concentration points noting alignment, station, offset, and description. A plot of runoff arrows should be used to verify runoff will be collected in a DI or slotted drain prior to super-elevation reversals for final design. Maintenance issues should be a separate section “H. Known Maintenance Issues” (Concentrated flows, flooding, outstanding work, Maintenance Area Supervisor comments).	Will fix. Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	
21.	Clark Townsend	Hydraulics	PDR, Pg 11, 4G	Gutter Capacity (spread) should be analyzed where necessary to ensure neither gutter capacity or spread exceeds allowable values	Will defer till Final Drainage Report (FDR).	

22.	Clark Townsend	Hydraulics	PDR, Pg 11, 5	Grammar.	Section 5 has been revised.	
23.	Clark Townsend	Hydraulics	PDR, Pg 11, 6	Storm Water Quality should not be addressed in the drainage report.	Will defer till Final Drainage Report (FDR).	
24.	Clark Townsend	Hydraulics	Appendices	Update appendices should be in a logical order of work (Hydrology before Hydraulics),	Will defer till Final Drainage Report (FDR).	
25.	Clark Townsend	Hydraulics	Appendix B	Show all drainage facilities within a FEMA designated flood hazard area and label Br. #s; drainage facility size; type; and PM on all FIRMs in the FDR. Effective FIRMs should be referenced to the master layout CADD layout file and show the current alignment of State Route 65 in FDR. Provide copies of Preliminary FIRMs covering the project area and note any significant proposed revisions. Creation of larger scale FIRMettes may be necessary where text is not readily readable.	Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR). Will defer till Final Drainage Report (FDR).	
26.	Clark Townsend	Hydraulics	Appendix F	State Route 65 and all major roads should be overlain on all FEMA FIRMs. Bridges should be labeled with bridge name and number. PMs of structures should be labeled.	Will defer till Final Drainage Report (FDR).	

Local Funded Project
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27.	Clark Townsend	Hydraulics	Appendix H	The District 3 Culvert inventory should be in a separate Appendix. Typically we prepare a Floodplain Hydraulic Study for the entire project along with a Floodplain Evaluation Report Summary (Required) and supplement the study with the Technical Information for Location Hydraulic Study forms.	Will defer till Final Drainage Report (FDR).	
28.	Clark Townsend	Hydraulics	Appendix I.	Provide an Appendix containing the Complete Drainage Plans, Profiles, Details, and Quantities.	Will defer till Final Drainage Report (FDR).	
29.	Clark Townsend	Hydraulics	Project Limits	The project limits begin work and end work locations should include room for area construction signs.	Will defer till Final Drainage Report (FDR).	

Andy Lee

From:	Murphy, Rodney L@DOT <rodney.murphy@dot.ca.gov>
Sent:	Tuesday, August 23, 2016 7:15 PM
To:	Luke McNeel-Caird; Andy Lee; Zach Siviglia
Subject:	Fwd: Thursday Meeting, Comments and Responses to 2nd & 3rd Submittals, Additional Hrs Required.
Attachments:	03-Pla-65-PM 4.80-12.80 03-1F170 0300001103 Pla 65 C&O Improvements 3rd Submittal Hydraulics Comment Review Table 2016-08-02.pdf; ATT00001.htm

Hi Zach/Andy,

Please take a look at Clark's comments. Let me know if you would still like to meet. Please let me know by tomorrow afternoon so that I can confirm with Clark and others.

Thanks

Sent from my iPhone

Begin forwarded message:

> **From:** "Townsend, Clark W@DOT" <clark.townsend@dot.ca.gov>
> **Date:** August 23, 2016 at 10:41:27 AM PDT
> **To:** "Murphy, Rodney L@DOT" <rodney.murphy@dot.ca.gov>
> **Subject: RE: Thursday Meeting, Comments and Responses to 2nd & 3rd Submittals, Additional Hrs Required.**
>
> Rod:
>
> Preliminary DRs are primarily to provide a scope to Environmental and provide direction to the hydraulics Design team during the design phase. Since the hydraulic design team will be the same for the PDR and FDR, the primary function is to ensure the process is addressing or will address all of the relevant issues, permits, etc.
>
> Your comments referring to Items 1-16 I assume are regarding the 2nd submittal dated 12-8-2015 that were sent out on .
>
> I recall a lot of people attended the last PDT meeting and the consultant agreed with all of my comments.
>
> Item 16 deals with Construction Limits. The begin and End work limits to be shown on the title page should include room for construction area signs. This can be added during the design phase. Correcting the project limits should be done by PA&ED since the limits on the ED and PR should match the plans.
>
> I sent out the Hydraulic review comments for the 3rd submittal, dated 6/13/2016, on 8/2/2016. A copy of my comments are attached.

1. Construction Limits: Should be done by PA&ED since Ed limits should match project limits, but may be done during design phase. It may require additional work to update limits on all studies/reports.
2. Provide hard copy and electronic copies files: Should occur with each submittal. May wait until FDR.
3. List all tables in TOC: May wait until FDR.
4. Minor text revision: May wait until FDR.
5. Typo: Prefer corrected with PDR, but may be addressed in FDR.
6. Watershed map delineation: Great if done with PDR but may wait until FDR.
7. Define scope of work – Field inspection: Recommended by PDR, may complete with FDR.
8. Grammar: Recommended by PDR, may complete with FDR.
9. Mitigation for increased runoff: Should be addressed onsite or by City of Roseville or County former reason Farms detention/infiltration facilities, may be completed with FDR, should be discussed in PDR.
10. No Increase in flow to State Route 65 is anticipated: Recommend statement should be included in PDR, may wait until FDR.
11. Organizational/ content issues: Should be revised in PDR, may wait until FDR
12. General comments on Rainfall data and Intensity: Should be addressed in PDR but may wait until FDR.
13. Scope clarification, revised text should be included in PDR, required by FDR.
14. Preliminary Hydraulics culvert inventory: Include disclaimer with culvert inventory . Should be revised in PDR. Field investigation - recommended by PDR, may wait until FDR; PM locations should be based on TASAS Highway Sequence listing – May wait until FDR.
15. Misleading text /table should be revised in PDR.
16. Watershed delineation: may be addressed in FDR
17. Recurrence Intervals: Revision should be documented in PDR.
18. Updated Guidance Documentation: Should be used for FDR.
19. Time of Concentration: Should be revised in PDR text, analysis can be revised in FDR.
20. Points of Concentration: Should be addressed in FDR, Maintenance should be addressed in a separate Section – recommend in PDR, may wait until FDR.
21. Gutter Capacity: General comment to be addressed in FDR.
22. Grammar: Should be revised in PDR, Grammar issues should be resolved in FDR.
23. Storm Water Quality should be addressed in a separate report. May be resolved with FDR.
24. Appendices: general Comment: Should be for PDR no necessary until FDR.
25. FEMA FIRMs with project: General comments should be addressed in PDR, could wait until FDR.
26. FEMA FIRMs: General comments should be addressed in PDR, could wait until FDR.
27. Culvert Inventory: General comments typically addressed in PDR, could wait until FDR.
28. Appendix for Project Plans: Can wait until FDR.
29. Project begin/end work limits: Can wait until FDR.

Regarding the Draft Responses, I would expect most issues can be resolved via e-mail or a phone call.

1-15: Agreed

16:

District 3 rational Coefficients. The table was approved by Dennis Jagoda. Use of specific c values should be done on a case by case basis with the consultants Hydrologic Engineer during design.

All watersheds are not perpendicular to the contours; cross alignments are not shown; all alignments should not be dropped out; watershed coloring should be faded; Existing drainage should be readily identifiable without a magnifying glass; Aerial imagery is readily available via Google Earth and should be used to ensure watershed and sub-shed boundaries are appropriate; all Contours are not labeled, If I need a magnifying glass to identify the drainage structure, read the labels or verify the WS boundaries are perpendicular to the contours, the scale is too small; contours should be readily visible and labeled; the longest travel path should start at a watershed boundary; WS nomenclature should note all parent sheds; Appendices should be tabbed;

17. OK

18. Some areas outside the pavement may need higher C values per D3 accepted Misc. Rational runoff coefficient "C" values.

19. Agreed.

20. Typically we generate flow paths to ensure roadway drainage is captured prior to a reversal of the cross slope and to ensure there are no significant points of concentration. This would be addressed in design. Typically Maintenance issues are noted in the PDR, but may wait until the FDR.

21. Section 4G states the existing gutter capacity will be under sized. My comment is directed toward the analysis of final gutter capacity and spread during design. They are separate issues.

22. – 24. Agreed

25. Preliminary FIRMs show some overtopping of State Route 65 that are not accurate near Blue oaks Blvd and Whitney Ranch Parkway/ Placer Parkway. The corrections just north of Blue Oaks Blvd. should be made with the next effective FIRM. The City of Rocklin will need to request a LOMR-F to correct the floodplain at the NB onramp to SR 65. This project would likely require additional LOMR-Fs to be prepared and submitted to FEMA.

26. State Route 65 and all major roads /interchanges should be overlaid on FIRMs/ FIRMettes. Bridges should be labeled.

27. A single FERS could have been prepared, but separate FERS are fine.

28. Agreed.

29. The project limits shown on the plan sheets are construction limits and should cover all construction work. The begin/end work limits are shown on the Title sheet and should allow enough room for traffic control and construction area signs,(Begin Work, End Work, etc.)

Please share my responses with the consultant and PCTPA.

I do not see a need for a meeting but will show up if they still want to meet after reading my responses, assuming You allocate an additional 40 hrs. I ran out of hrs last week and I feel this project will require more consultation.

Let me know.

I

From: Murphy, Rodney L@DOT
Sent: Monday, August 22, 2016 2:33 PM
To: Townsend, Clark W@DOT <clark.townsend@dot.ca.gov>
Subject: Thursday Meeting

Hi Clark,

The consultant would still like to meet on Thursday. I sent you their draft comments. It appears that they will address everything up to #15. So, if you agree with their responses, we can begin with comment 16. Please let me know if you are available to meet so that I can update the consultant.

Thank you,
Rod