CEQA DRAINAGE STUDY

RECORD ID: PDS2012-3500-12-020; ENVIRONMENTAL LOG NO.: PDS2012-3910-1209003

Dated 9/10/12, Revised 2/8/13, 5/1/13, 11/21/13, 1/27/14, 5/7/14

For: Kahoots, Retail Feed & Pet Supplies

LOCATION: HWY 67 & Letton Street, Ramona CA
APN: 282-221-05 & 06

OWNERS:

Kahoots, Inc.
c/o Mike Bittinger
PO Box 2123, Ramona, CA 92065
Phone: 760 505-2123
Email: mike@kahootspet.com

BY: SPEAR & ASSOCIATES, INC.
CIVIL ENGINEERING AND LAND SURVEYING
475 Production Street
San Marcos, CA 9207
PHONE: (760) 736-2040

Date: 5/7/14

Danny Abada, PE

REGISTERED PROFESSIONAL ENGINEER
DANNY ABADA
No. 45381
CIVIL
STATE OF CALIFORNIA

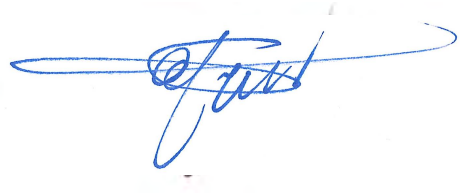
S&A, INC: J. N. 12-173

SDC PDS RCVD 01-23-15
STP12-020

DECLARATION OF RESPONSIBLE CHARGE

I, HEREBY DECLARE THAT I AM THE CIVIL ENGINEER OF WORK FOR THIS PROJECT, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE DESIGN OF THIS PROJECT AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONAL CODE AND THAT THE DESIGN IS CONSISTENT WITH CURRENT DESIGN STANDARDS.

I UNDERSTAND THAT THE CHECK OF PROJECT DRAWINGS AND SPECIFICATIONS BY THE COUNTY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES FOR PROJECT DESIGN.



5/7/14

Danny Abada
REGISTERED CIVIL ENGINEER

DATE

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I. INTRODUCTION

This hydrology report is prepared for Kahoots, Retail Feed & Pet Supplies located at HWY 67 & Letton Street, Ramona CA. The site encompasses approximately 1.48 acres and is zoned Commercial. APN: 282-221-05 & 06.

The project will disturb approximately 1.48 acres and consists of developing a Retail Feed & Pet Supplies facility. Construction will include a new building, driveway, parking lot, utilities, landscaping and onsite bioretention facilities for stormwater treatment.

The development utilizes low impact development strategies that mimic the site's pre-development hydrology by using design techniques that infiltrate, store, evaporate and detain runoff close to its source. Pervious surfaces were minimized with extensive use of pervious pavement, landscaping and bioretention facilities.

The onsite topography slopes gently in a southeasterly direction with elevations approximately ranging from 1409' to 1404.5'. The undeveloped portion of the site was previously graded and is covered with native grasses, trees and patches of barren soils.

The drainage areas include northeastern offsite tributaries and the onsite flow drains into an existing channel running westerly, parallel to Kelly Avenue then to Santa Maria Creek, Santa Ysabel Creek, Lake Hodges, San Dieguito River and the Pacific Ocean approximately 24.2 miles west.

We have used the County of San Diego Hydrology Manual for this report to calculate the 100-year flow generated from the site. Based on the soil hydrologic group map in Appendix A of the County Hydrology Manual, offsite areas consist of type D soils. Also, according to a Soil Percolation test conducted by CTE Inc. dated 1/22/13, the project site area consists of soil Type A. (See Soil Map & Report in attachment A). A HEC-RAS study was conducted to compare existing and proposed conditions for the 100-year storm event, and it was concluded that there are no increased impacts to the adjacent streets and properties as a result of this development. Additionally, the project's post development outlet velocity for the channel adjacent to Kelly St. was lower than from pre-development at 2.41 ft/s versus 3.12 ft/s.

II. DISCUSSION/CONCLUSION

This project will maintain existing drainage patterns along the site and will not alter the course of a stream or river and therefore will not contribute to substantial erosion or siltation onsite or offsite.

Post development peak flows, flow volumes and velocities will be lower than or significantly maintained at pre-development rates by maximizing pervious surfaces, onsite times of concentration and with the use of low impact and Hydromodification strategies as shown on the project's Stormwater Management Plan. Therefore the project will not create or contribute runoff which will exceed the capacity of existing or planned storm water drainage systems. The project will not place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps. (See FIRM map in attachment A)

100-yr Hydrology Results Summary at Discharge Location							
	P_6	*C offsite/onsite*	I	*Area (acres) offsite/onsite*	*TC*	*Q (cfs) onsite/total*	*Outlet V (ft/s)*
Pre-Dev.	3.30	0.52,0.35, 0.79/ 0.2	1.80	93.0/1.48	57.4	1.0/115.0	3.12
Post-Dev.	3.30	0.52,0.35, 0.79/ 0.76	1.80	93.0/1.48	57.4	2.0/116.0	2.41

DMA Flow Rates (not including offsite confluence & TC)						
	P_6	*C*	I	*Area (acres)*	*TC*	*Q (cfs)*
DMA 1	3.30	0.76	6.22	0.31	8.4	1.5
DMA 2	3.30	0.76	8.18	0.26	5.5	1.6
DMA 3	3.30	0.76	7.49	0.46	6.3	2.6
DMA 4	3.30	0.9	6.04	0.22	8.8	1.2
DMA 5	3.30	0.9	7.27	0.11	6.6	0.8

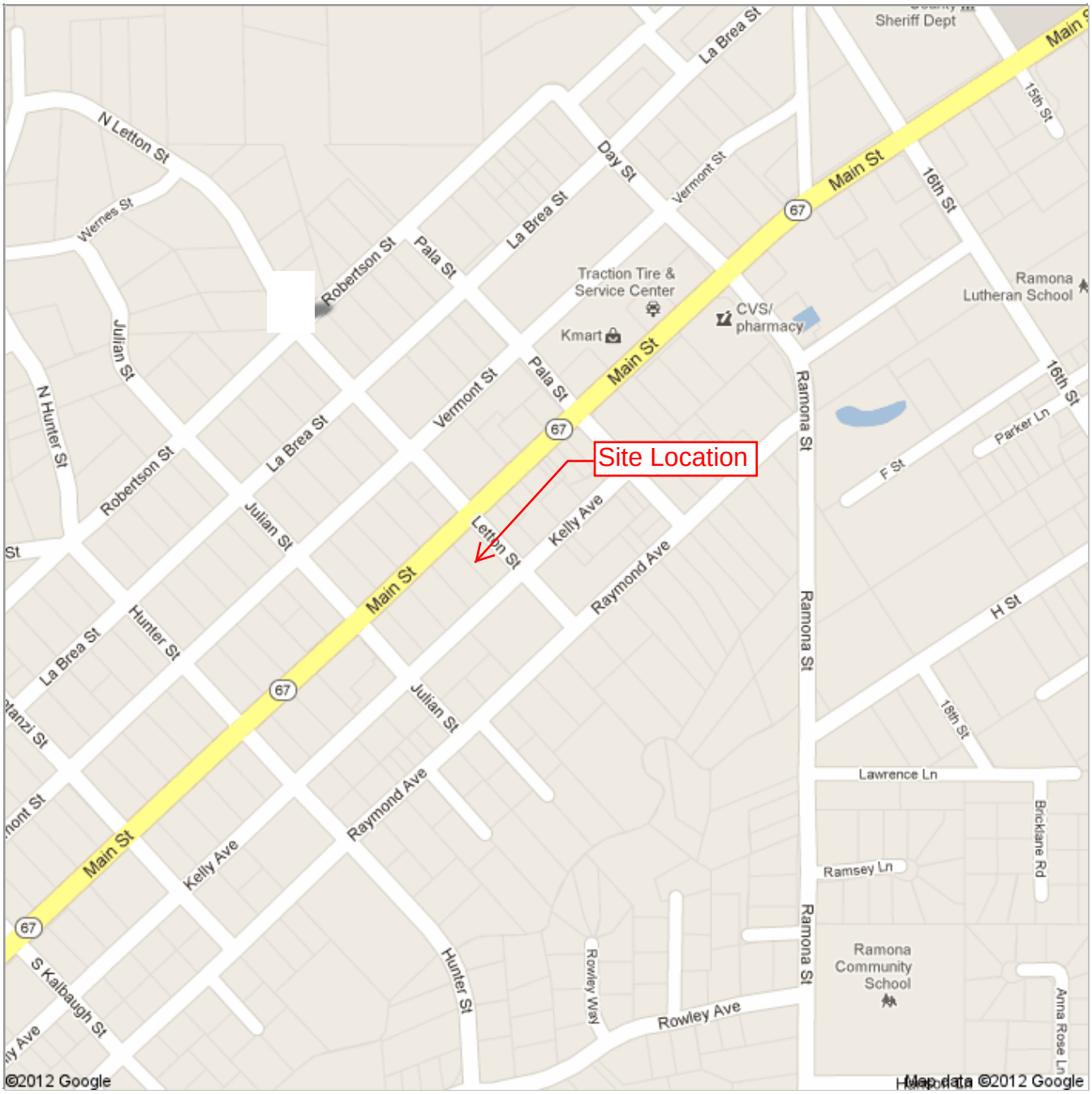
Pre and Post Development HEC-RAS 100-YR Water Surface Elevations Summary Table

Station	***Pre-Dev W.S.EL. (ft)***	***Post-Dev W.S.EL. (ft)***	***Difference (ft)***
260	1407.10	1406.86	-0.24
210	1406.96	1406.60	-0.36
160	1406.64	1406.47	-0.17
110	1406.53	1406.41	-0.12
84	n/a	1406.40	n/a
60	1406.22	1406.14	-0.08
36	1405.94	1406.01	0.07
30	n/a	1405.74	n/a
1	n/a	1405.56	n/a
0	1405.62	1405.54	-0.08

Note: At station 36 for which the W.S.EL. increased slightly, the entire flow is contained within the project's property boundary and outside the Public Right of Way.

ATTACHMENT A

Address Letton St
Ramona, CA 92065



CONSTRUCTION TESTING & ENGINEERING, INC.
1441 MONTIEL ROAD, SUITE 115 | ESCONDIDO, CA 92026 | 760.746.4955 | FAX 760.746.9806

November 19, 2013 CTE Job No. 10-11391G

Kahoots
Attention: Mr. Ed Hoban
P.O. Box 2123
Ramona, California 92065
Telephone: (760) 789-3003

Subject: Percolation Test Results for Storm Water Infiltration Design & Evaluation
Proposed Retail Feed and Pet Supplies Improvements
Highway 67 and Letton Street
Ramona, California

Mr. Hoban:

As requested, please find the provided results of previous percolation testing conducted at subject site. The testing was performed on January 15, 2013. Tests were conducted at the approximate locations as shown on the attached Figure 1.

Percolation testing was conducted in general accordance with the San Diego County Department of Environmental Health guidelines. The percolation testing consisted of excavating four test holes to the anticipated depth of the proposed infiltration improvements. Following excavation, the holes were presoaked by adding and maintaining 12 to 14 inches of clear water for a duration of four hours, then the water level was left to percolate overnight. CTE returned approximately 16 hours after the water levels were allowed to percolate overnight and found that the water had completely drained from the test holes, which results in a Case III percolation test to determine the rate. The holes were cleaned out, establishing a clean soil surface throughout the test holes and approximately two inches of pea gravel was added to all the holes. Following preparation of the holes, lath was placed across the top of each hole to establish a fixed point to measure from, and 6.0 inches of water was added to each hole. The water levels were measured every 30 minutes for the duration of four hours. The following table presents all readings for the percolation testing.

Time (min)	P-1 (drop in inches)	P-2 (drop in inches)	P-3 (drop in inches)	P-4 (drop in inches
30	1.00	0.13	0.13	1.13
60	1.00	0.13	0.13	1.13
90	0.56	0.88	1.00	0.50
120	0.75	0.50	0.25	0.50
150	0.75	0.50	0.38	0.50
180	0.50	0.50	0.38	0.50
210	0.38	0.50	0.25	0.50
240	0.38	0.50	0.25	0.50

The following rates were determined by multiplying the last drop by two to get the final or stabilized percolation rate in inches per hour.

- PT-1 3/4" per hour
- PT-2 1" per hour
- PT-3 1/2" per hour
- PT-4 1" per hour

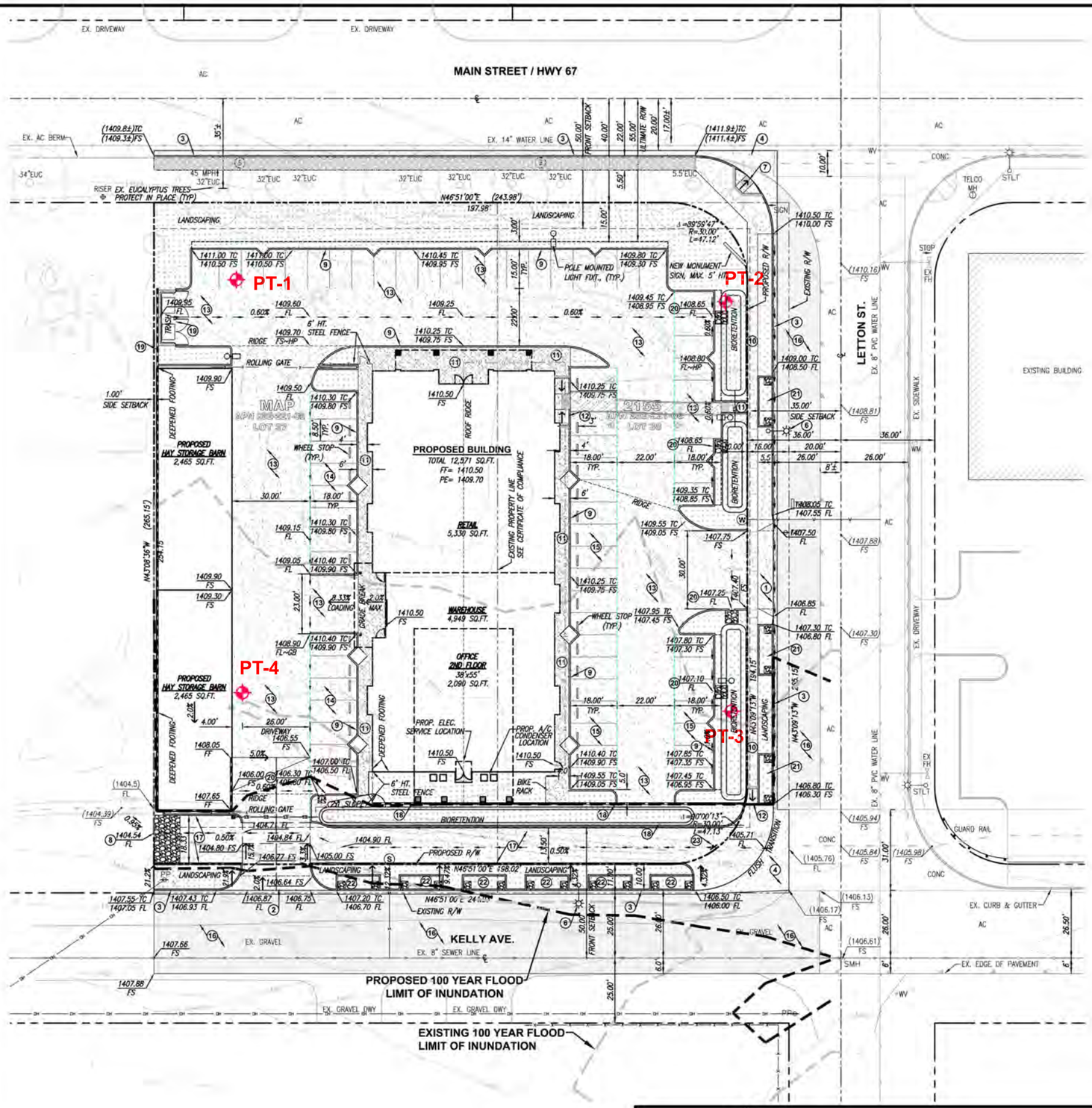
We appreciate the opportunity to be of service on this project. Should you have any questions or need further information please do not hesitate to contact this office.

Respectfully submitted,

CONSTRUCTION TESTING & ENGINEERING, INC.

Dan T. Math, GE #2665
Principal Engineer

CC: josh@spearinc.net; ehoban@commercialwest.com; mike@kahootspet.com; dannyabada@gmail.com



LEGEND

PT-4 ◆ APPROXIMATE PERCOLATION TEST LOCATION

Percolation Test Location	Percolation Rate (in/hr)
PT-1	3/4"
PT-2	1"
PT-3	1/2"
PT-4	1"

CONSTRUCTION TESTING & ENGINEERING, INC.
PLANNING - CIVIL ENGINEERING - LAND SURVEYING - GEOTECHNICAL
1441 MONTIEL ROAD, SUITE 115 ESCONDIDO CA. 92026, PH:(760) 746-4955

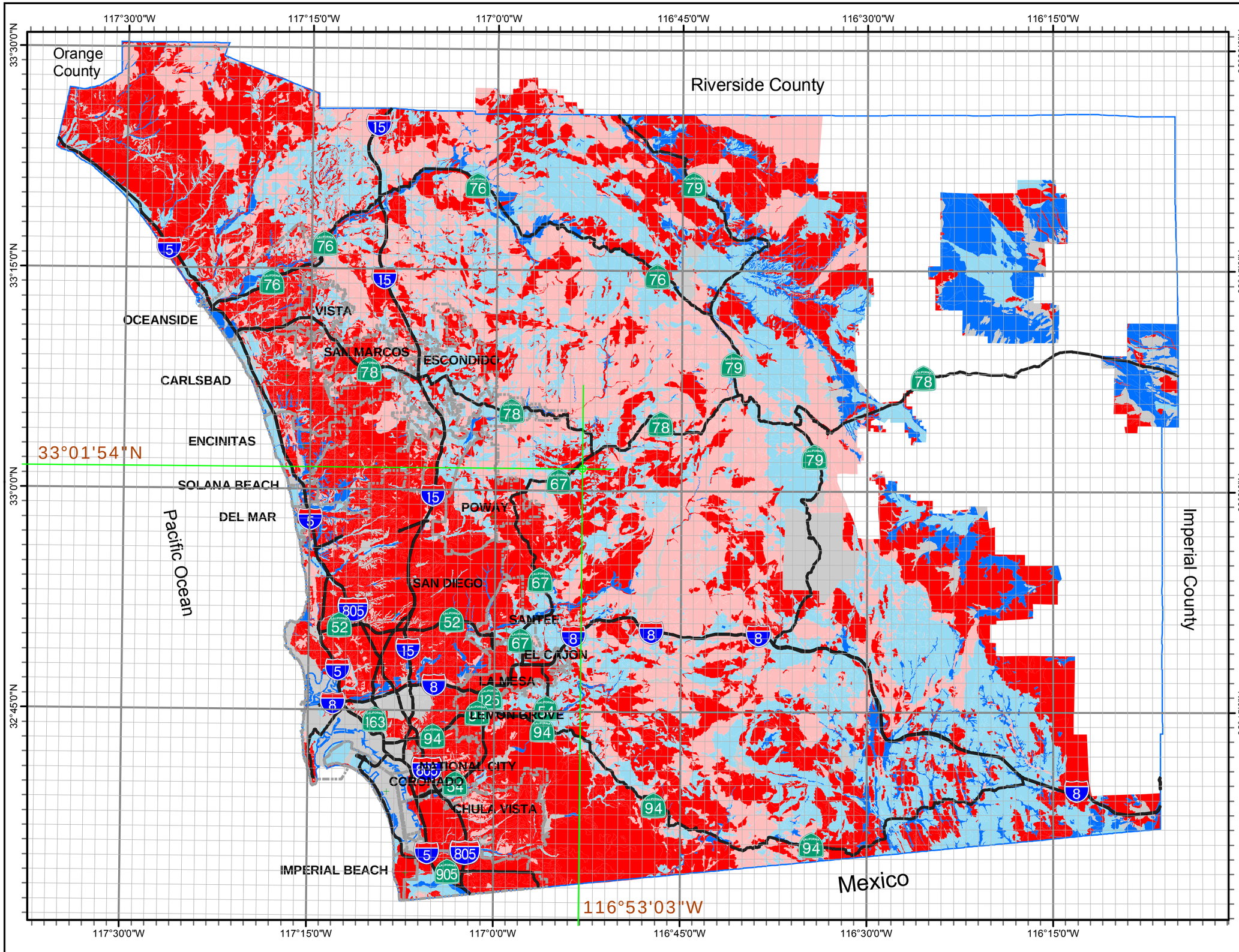
PERCOLATION TEST LOCATION MAP
PROPOSED RETAIL FEED AND PET SUPPLIES IMPROVEMENTS
HIGHWAY 67 AND LETTON STREET
RAMONA, CALIFORNIA

CTE JOB NO: 10-11391G
SCALE: 1" = 40'
DATE: 1/13
FIGURE: 1

\\Esc_server\projects\10-11391G\Figure 1.dwg 1/22/2013 11:30:44 AM PST

Soil Types & Infiltration Rates			
SCS Hydrologic Soil Group	INFILT Estimate		Runoff Potential
	(in/hr)	(mm/hr)	
A	0.4 - 1.0	10.0 - 25.0	Low
B	0.1 - 0.4	2.5 - 10.0	Moderate
C	0.05 - 0.1	1.25 - 2.5	Moderate to High
D	0.01 - 0.05	0.25 - 1.25	High

County of San Diego Hydrology Manual Soil Hydrologic Group



Legend

- Major Roads
- Incorporated City Bdy

HYDROLOGIC SOIL GROUP

- Hydrologic Group Undefined
- Hydrologic Group A
- Hydrologic Group B
- Hydrologic Group C
- Hydrologic Group D
- No Soil Data

Note: Soil Data Source
USDA/NRCS
SSURGO Soils 2007

N

31.50 3 Miles

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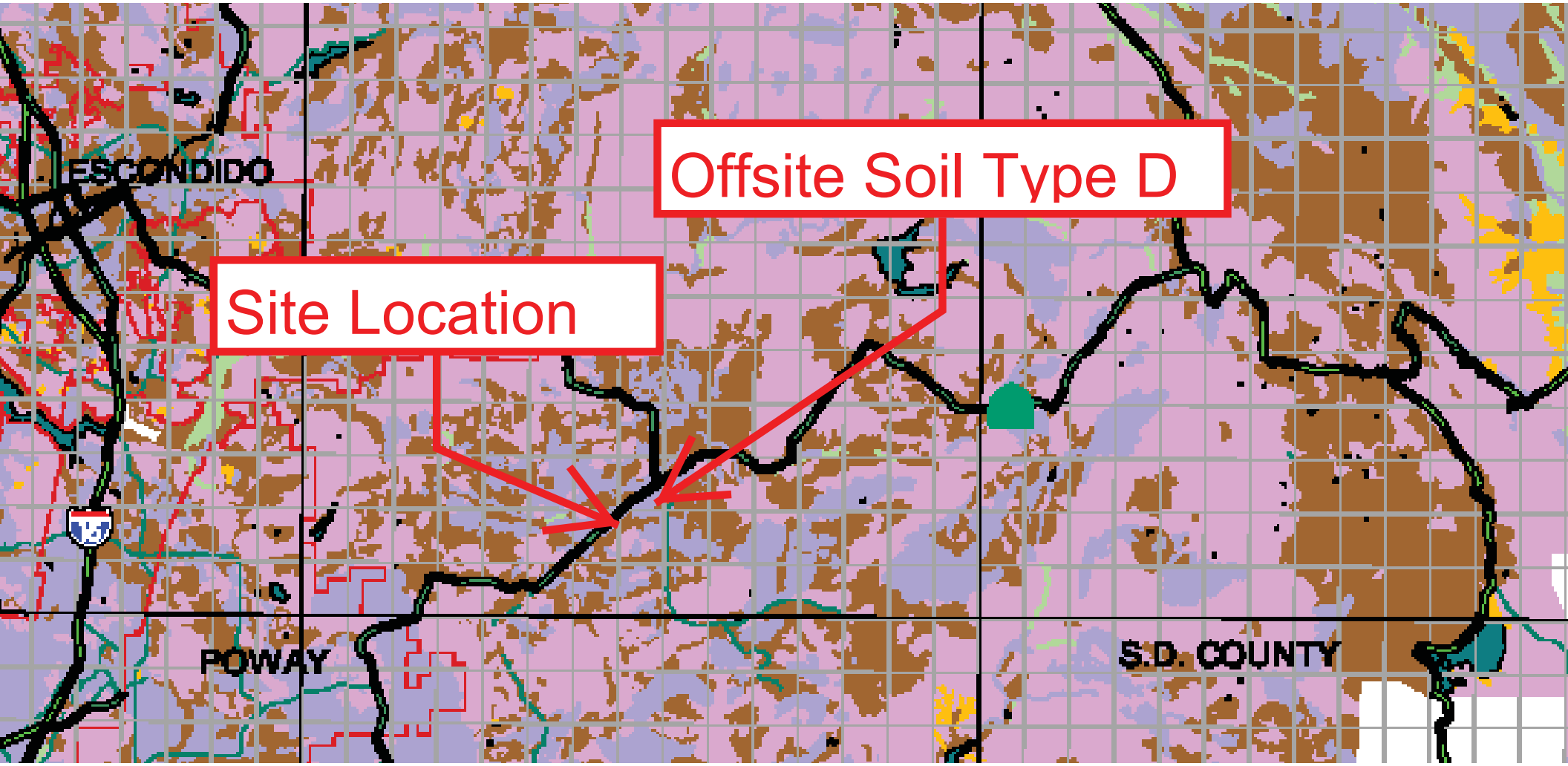
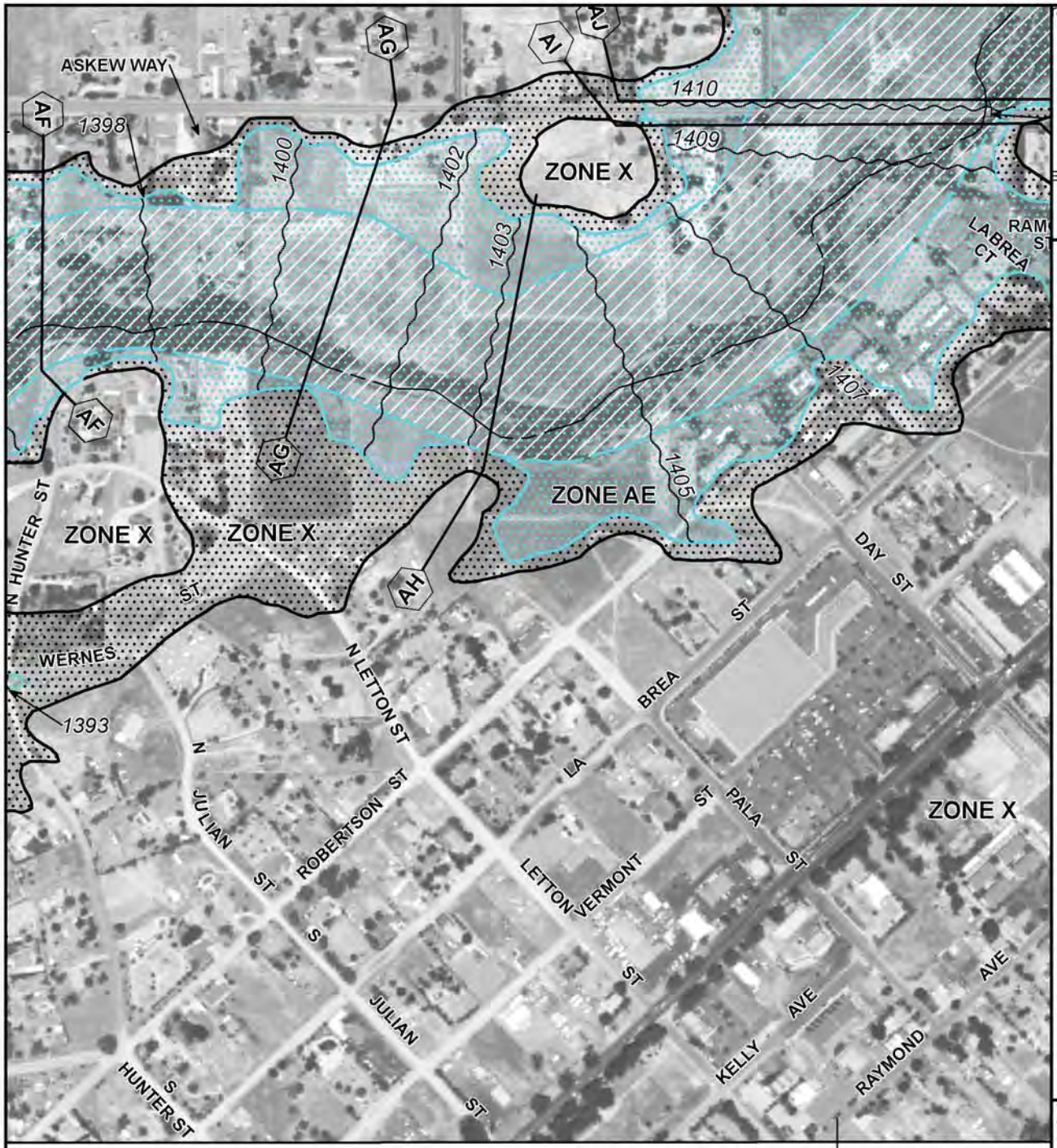

Offsite Soil Type D
Site Location
ESCONDIDO
POWAY
S.D. COUNTY



JOINS PANEL 1119

ance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

0 250 500 750 1,000 FEET

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1117G

FIRM

FLOOD INSURANCE RATE MAP

SAN DIEGO COUNTY, CALIFORNIA

AND INCORPORATED AREAS

PANEL 1117 OF 2375

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN DIEGO COUNTY	060284	1117	G

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

MAP NUMBER
06073C1117G

MAP REVISED
MAY 16, 2012

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

Montecito Rd
Askew Way
1397
1398
1400
1402
1405
1407
1409
AF
AG
AH
AJ
08-09-0232A
09-09-2694A
12-09-1374A
06073C1117G
Main St, Ramona, CA 92065, USA
15th St
Wernes St
Pala St
Day St
Robertson St
N Hunter St
Carlin St
HUC 18070304
La Brea St
Letton St
Vermont St
Kahoots
Ramona St
F St
Parker Ln
Arlene Way
Hunter St
Rotanzi St
Main St
Kelly Ave
Julian St
Raymond Ave
Gam Ln
H St
18th St
Lawrence Ln
67
© 2013 Google
© 2013 INEGI
Google earth
Imagery Date: 8/23/2010 33°02'03.88" N 116°52'59.81" W elev 1422 ft eye alt 6132 ft

ATTACHMENT B

100-yr Event ***Rational Method** **Offsite Areas Soil Type D**

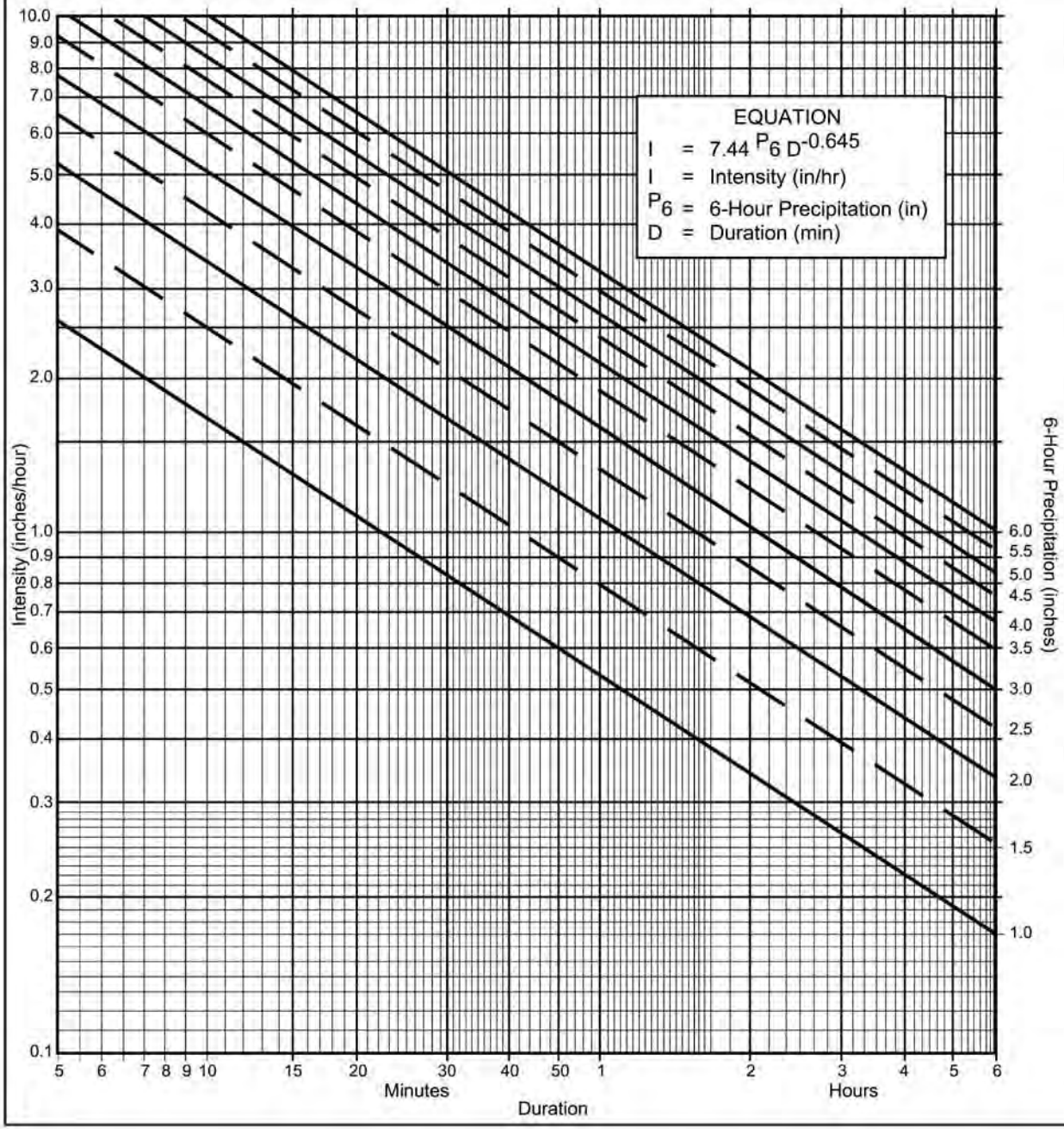
Site Area Soil Type A

REACH	Development Type	TC	C	A	CA	∑CA	P_6	I	**Q cfs**	Lower Section	Slope %	V ft/s	L ft	T	∑TC
O1	N Com/HDR	13.3	0.79	1.48	1.17	1.17	3.30	4.63	**5.4**						
	O1/lower O2 Travel Time									O2	0.5	1.2	575	8	21.3
O2	N Com/HDR	21.3	0.79	6.1	4.82	5.99	3.30	3.41	**20.4**						
	O2/Lower O3 Travel Time									O3	0.5	1.8	1015	9.4	30.7
O3	HDR	30.7	0.79	13.2	10.43	16.42	3.30	2.70	**44.3**						
	O3/Lower O4 Travel Time									O4	0.5	2.1	645	5.1	35.8
O4	N Com/HDR	35.8	0.79	13.71	10.83	27.25	3.30	2.44	**66.6**						
	O4/Lower O5 Travel Time									O5	0.7	2.5	625	4.2	40
O5	N Com		0.79	5.1	4.03										
	HDR		0.79	2.9	2.29										
	open space		0.35	6.04	2.11										
confluence O5		40.0				35.68	3.30	2.27	**81.1**						
	O5/Lower O6 Travel Time									O6	0.5	2.3	1014	7.3	47.3
O6	N Com/HDR		0.79	10.74	8.48										
	open space		0.35	11.38	3.98										
confluence O6		47.3				48.15	3.30	2.04	**98.3**						
	O6/Lower O7 Travel Time									O7	0.5	2.6	1003	6.4	53.7
O7	MDR		0.52	1.86	0.97										
	open space		0.35	2.3	0.81										
	N Com/HDR		0.79	8.95	7.07										
confluence O7		53.7				56.99	3.30	1.88	**107.2**						
	O7/Lower O8 Travel Time										0.5	2.9	645	3.7	57.4
O8	MDR		0.52	0.88	0.46										

100-yr Event ***Rational Method** **Offsite Areas Soil Type D**

Site Area Soil Type A

REACH	Development Type	TC	C	A	CA	∑CA	P_6	I	**Q cfs**	Lower Section	Slope %	V ft/s	L ft	T	∑TC
	open space		0.35	1	0.35										
	N Com/HDR		0.79	7.36	5.81										
confluence O8		57.4				63.61	3.30	1.80	**114.6**						
Pre-Dev Site Area		57.4	0.2	1.48	0.30		3.30	1.80	**1.0**						
Confluence total pre-dev		57.4				63.91	3.30	1.80	**115.0**						
Post-Dev Site Area		57.4	0.76	1.48	1.12		3.30	1.80	**2.0**						
Confluence total post-dev		57.4				64.74	3.30	1.80	**116.0**						
DMA Flow Rates (Not Including Offsite Confluence & TC)															
DMA 1		8.4	0.76	0.31	0.24	0.24	3.30	6.22	**1.5**						
DMA 2		5.5	0.76	0.26	0.20	0.20	3.30	8.18	**1.6**						
DMA 3		6.3	0.76	0.46	0.35	0.35	3.30	7.49	**2.6**						
DMA 4	Kelly	8.8	0.9	0.22	0.20	0.20	3.30	6.04	**1.2**						
DMA 5	Letton	6.6	0.9	0.12	0.11	0.11	3.30	7.27	**0.8**						



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 3.3 in., P_{24} = 5.8, $\frac{P_6}{P_{24}}$ = 57 %(2)

(c) Adjusted P_6(2) = 3.3 in.

(d) t_x = _____ min.

(e) I = _____ in./hr.

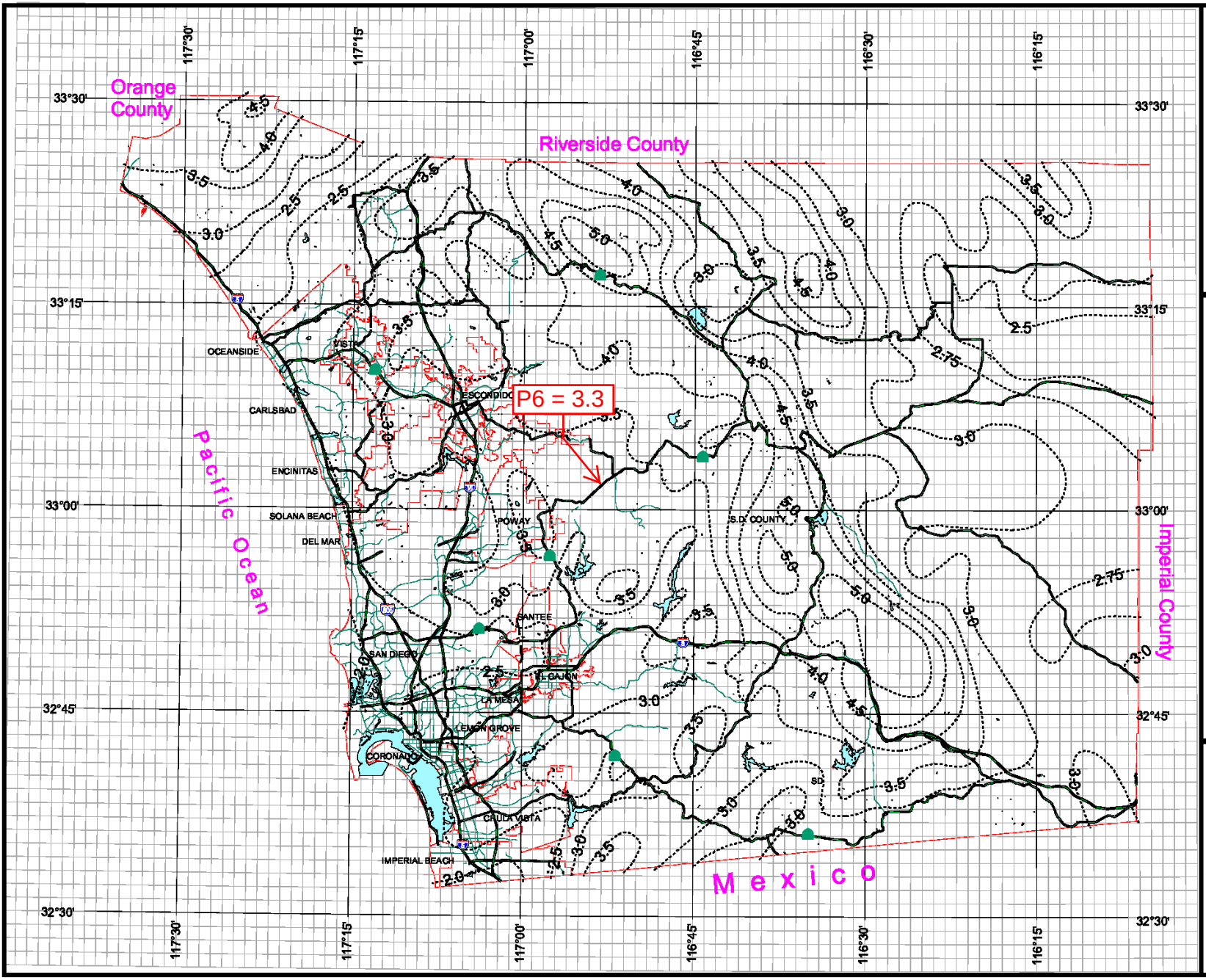
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

33 01′54″
116 53′03″

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

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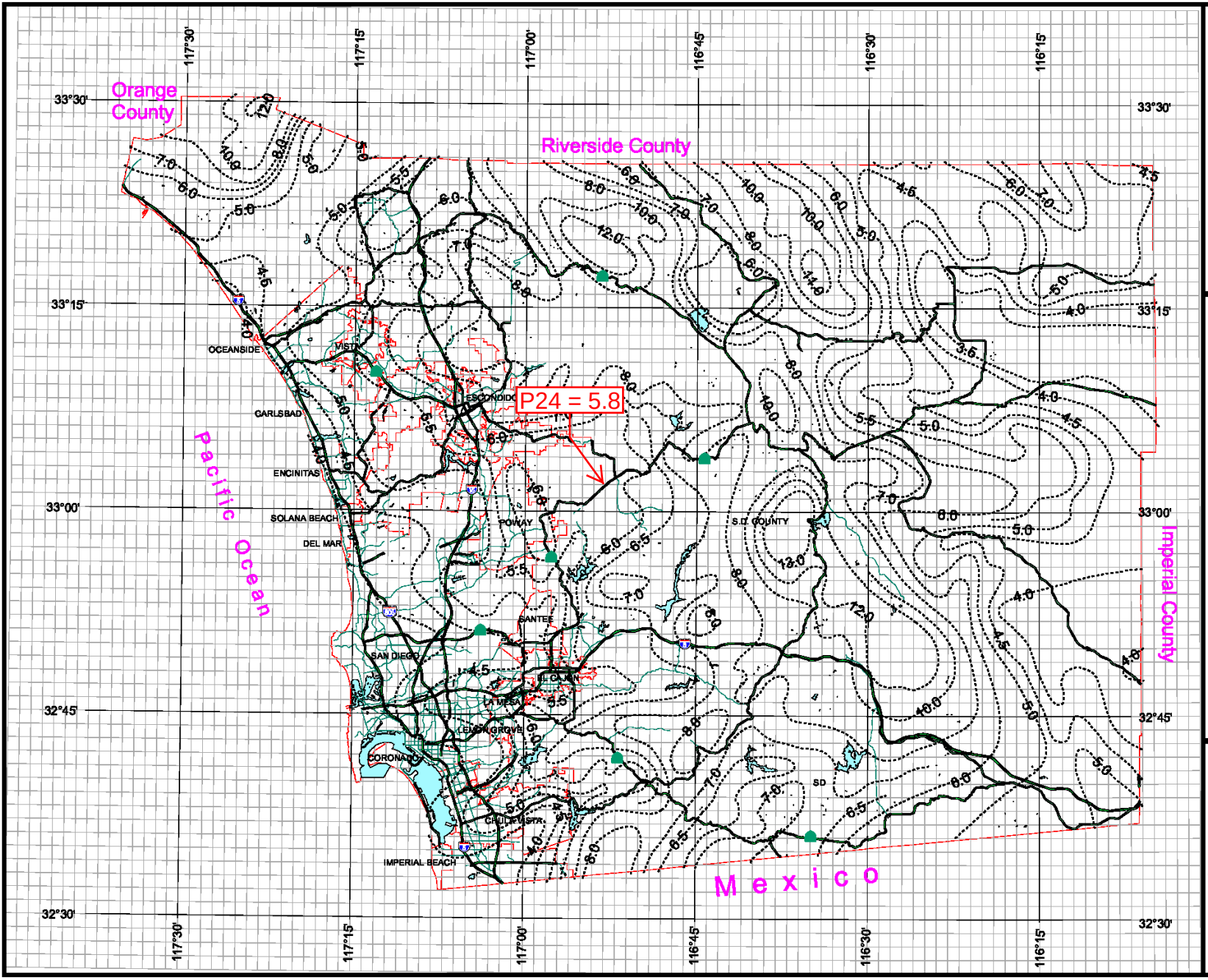

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N
W E
S

3 0 3 Miles

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Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).
DU/A = dwelling units per acre
NRCS = National Resources Conservation Service

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

Time of Concentration

Location	Initial Average slope %	Initial L (ft)	**Initial TC Initial T (min)**	Add'l L (ft)	Average slope %	area (ac)	Q (cfs)	Mannings V (ft/s)	**Additional TC (travel time) Inc. T (min)**	**total T (min)**
										(5 minutes min)
							* Est. Average Q			
O1	0.5	50	5.3	480	0.5	1.48	2.7	1	8.0	13.3
(N. Com/HDR)										
DMA 1	0.6	50	5.3	165	0.6	0.31	0.8	0.8	3.4	8.7
DMA 2	0.9	60	4.5	60	0.9	0.26	0.8	1	1.0	5.5
DMA 3	0.7	60	5	120	2	0.46	1.2	1.6	1.3	6.3
DMA 4	0.5	50	5.3	210	0.5	0.22	0.7	1	2.9	8.8
DMA 5	2.5	75	4	155	1	0.12	0.5	1	2.6	6.6

Channel Report

Offsite O1 Average Velocity - Initial TC Travel Time

Triangular

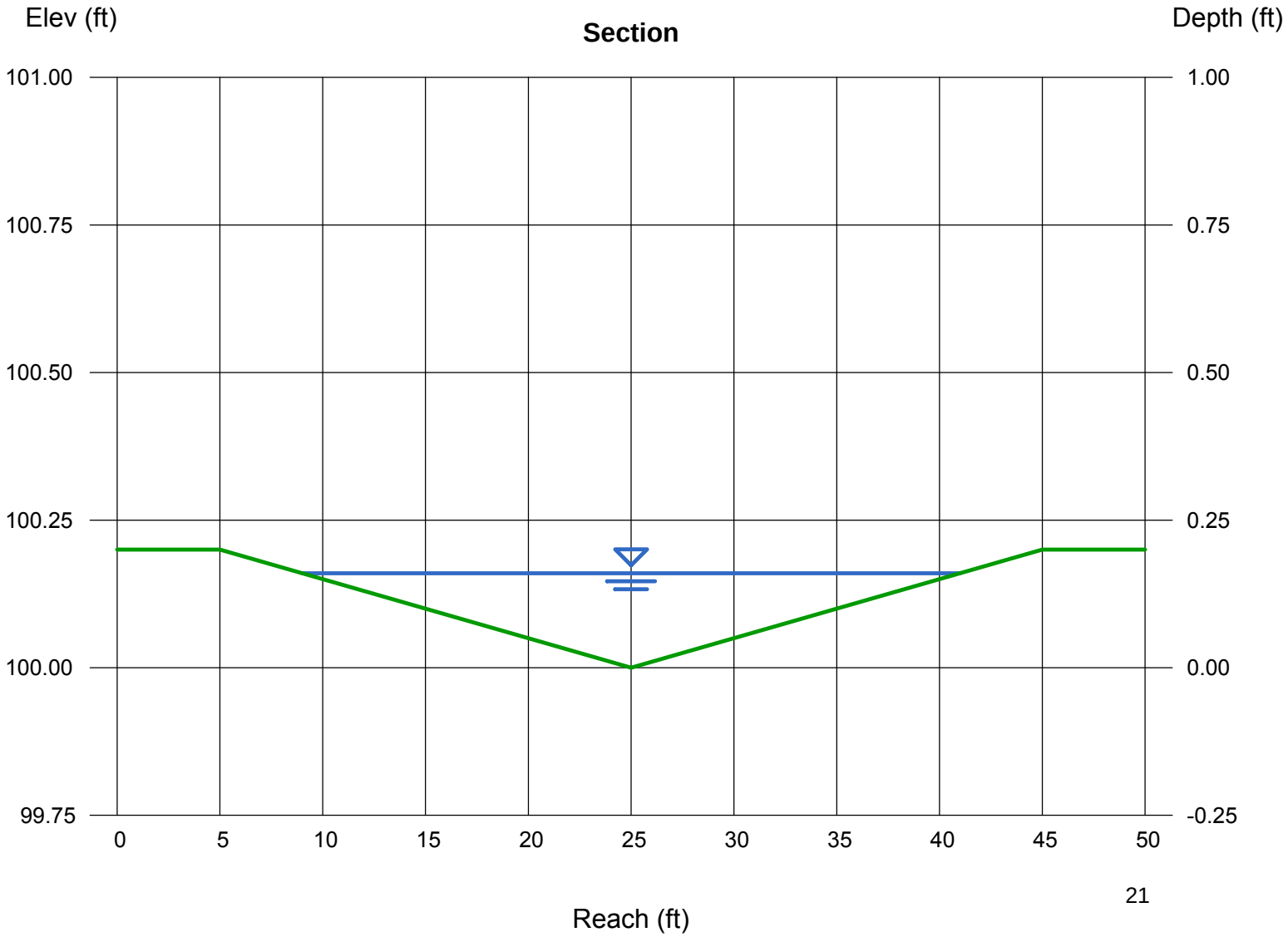
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.20
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.018

Calculations

Compute by:		Known Q
Known Q (cfs)	=	2.70

Highlighted

Depth (ft)	=	0.16
Q (cfs)	=	2.700
Area (sqft)	=	2.56
Velocity (ft/s)	=	1.05
Wetted Perim (ft)	=	32.00
Crit Depth, Yc (ft)	=	0.14
Top Width (ft)	=	32.00
EGL (ft)	=	0.18



Channel Report

O1-O2 Travel Time

Triangular

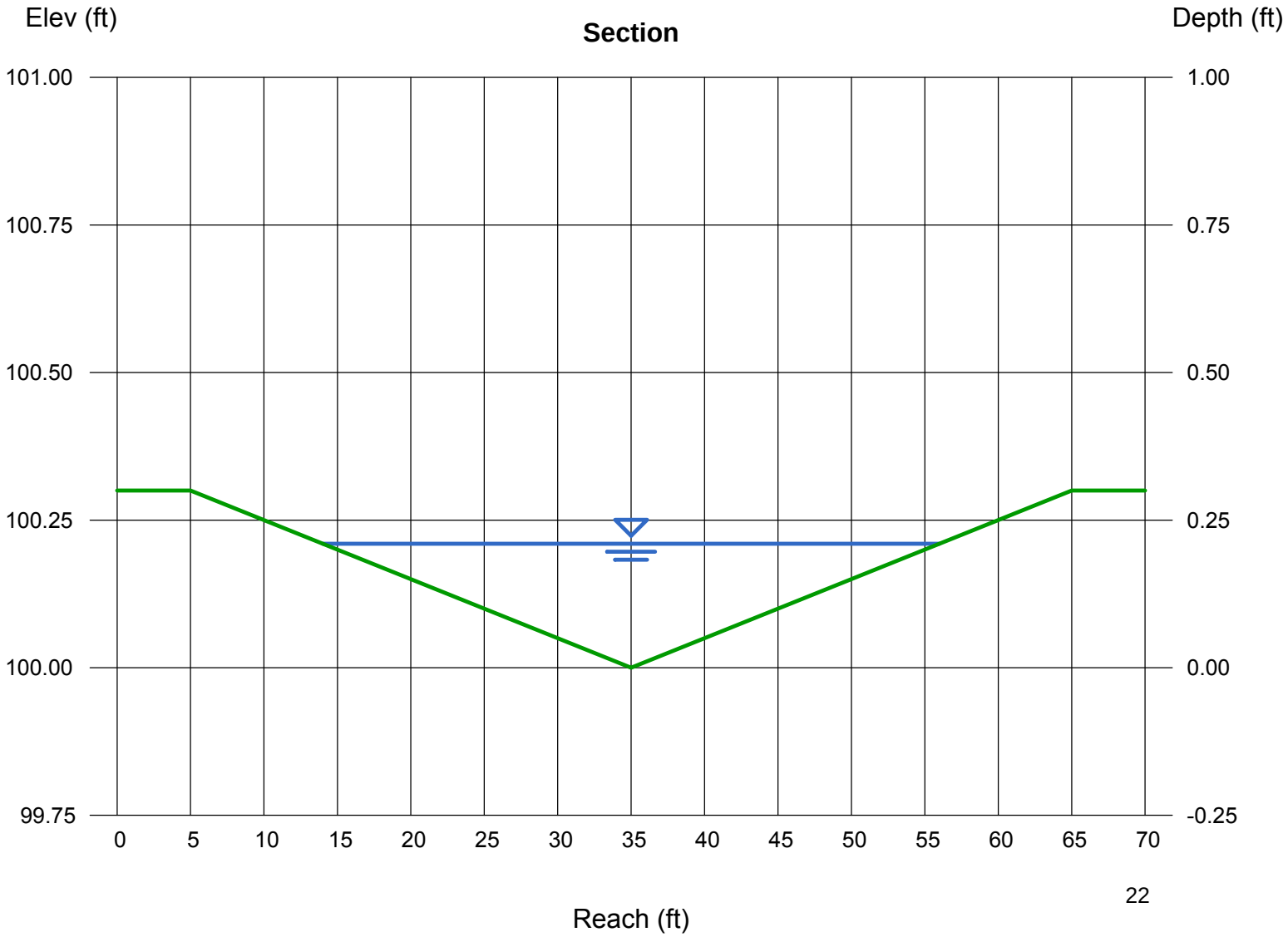
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.30
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.018

Calculations

Compute by:		Known Q
Known Q (cfs)	=	5.40

Highlighted

Depth (ft)	=	0.21
Q (cfs)	=	5.400
Area (sqft)	=	4.41
Velocity (ft/s)	=	1.22
Wetted Perim (ft)	=	42.00
Crit Depth, Yc (ft)	=	0.18
Top Width (ft)	=	42.00
EGL (ft)	=	0.23



Channel Report

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O2-O3 Travel Time

Triangular

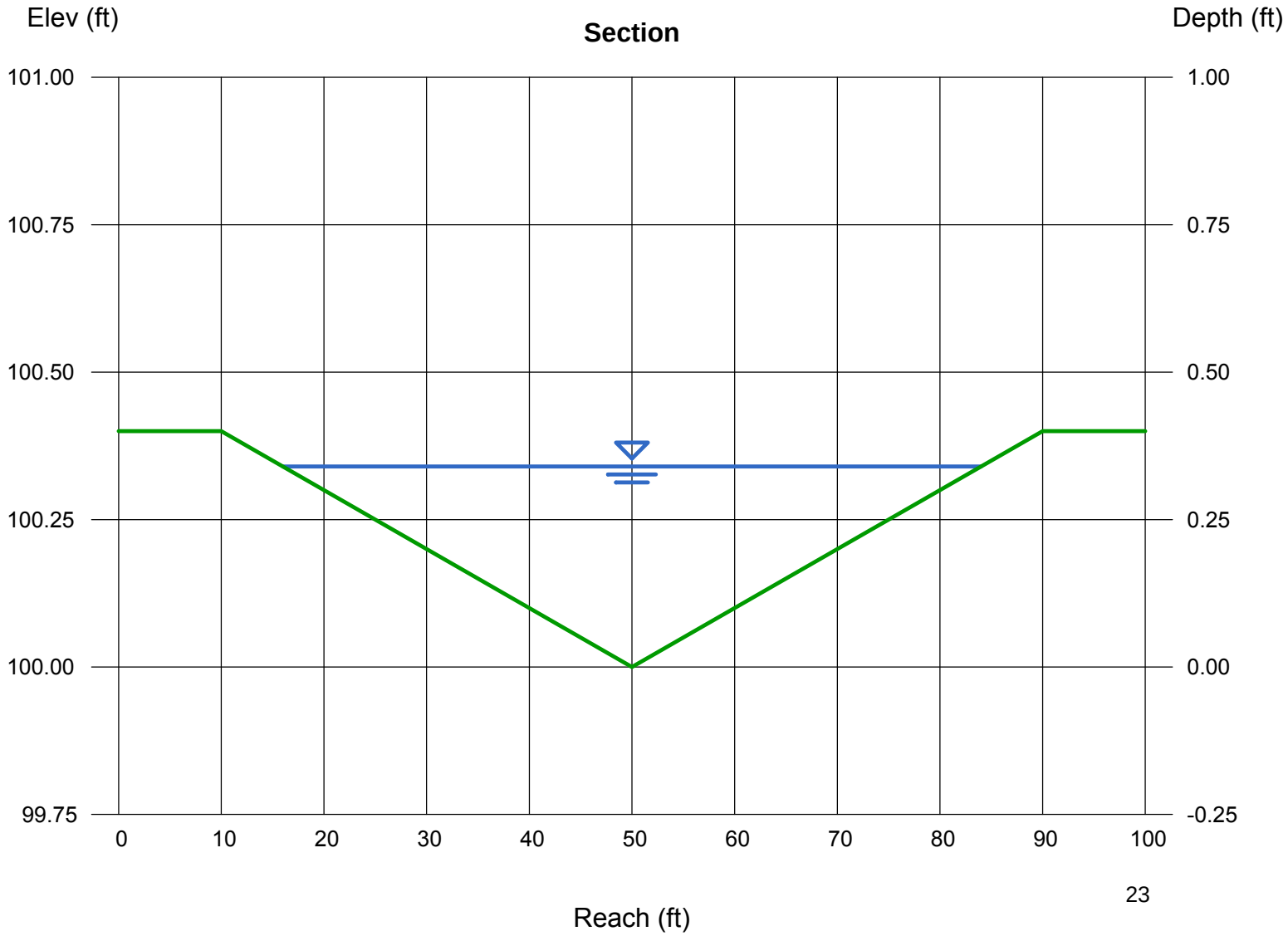
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.40
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.018

Calculations

Compute by:		Known Q
Known Q (cfs)	=	20.40

Highlighted

Depth (ft)	=	0.34
Q (cfs)	=	20.40
Area (sqft)	=	11.56
Velocity (ft/s)	=	1.76
Wetted Perim (ft)	=	68.00
Crit Depth, Yc (ft)	=	0.31
Top Width (ft)	=	68.00
EGL (ft)	=	0.39



Channel Report

O3-O4 Travel Time

Triangular

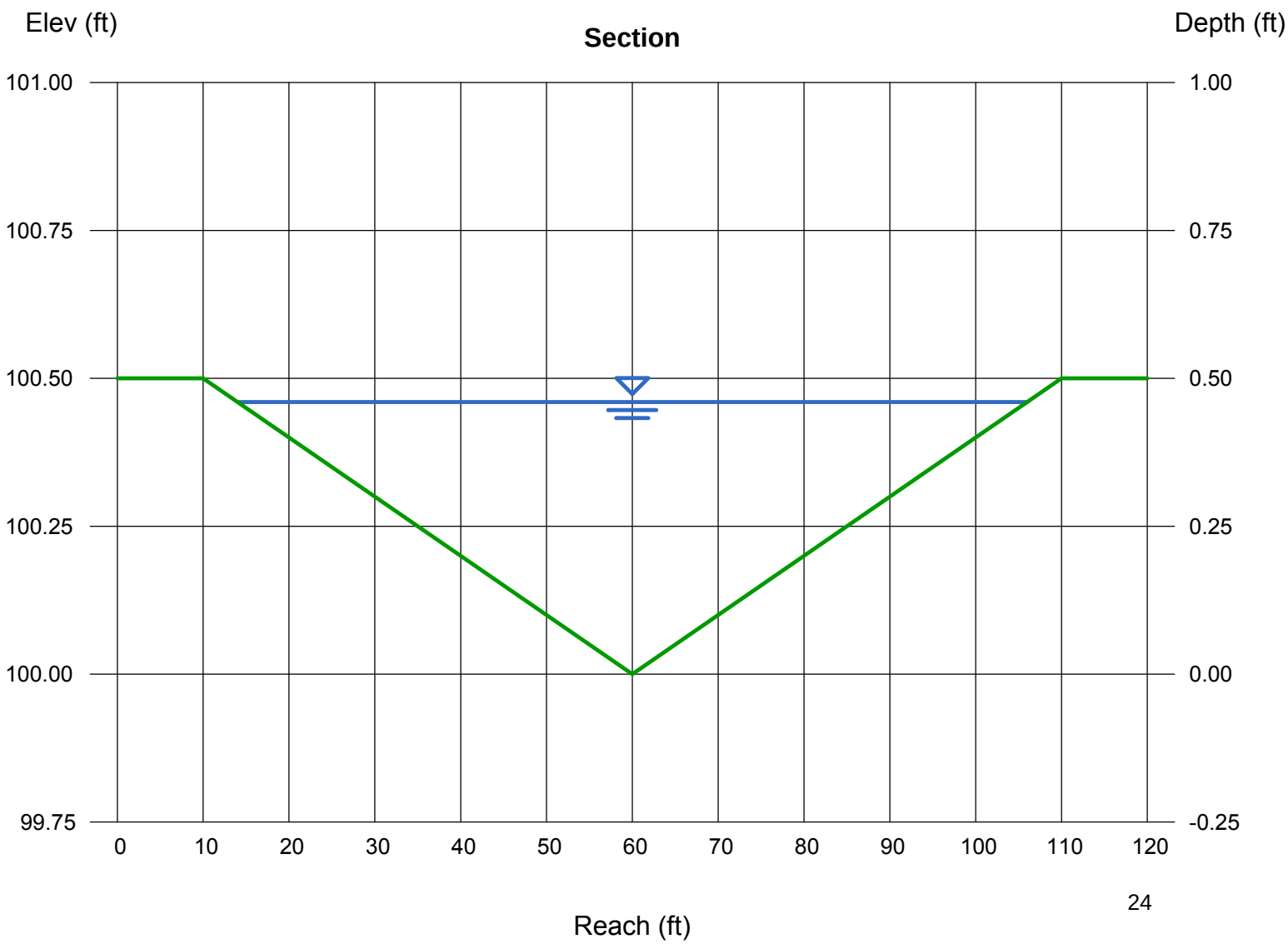
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.50
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.018

Calculations

Compute by:		Known Q
Known Q (cfs)	=	44.30

Highlighted

Depth (ft)	=	0.46
Q (cfs)	=	44.30
Area (sqft)	=	21.16
Velocity (ft/s)	=	2.09
Wetted Perim (ft)	=	92.00
Crit Depth, Yc (ft)	=	0.42
Top Width (ft)	=	92.00
EGL (ft)	=	0.53



Channel Report

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O4-O5 Travel Time

Triangular

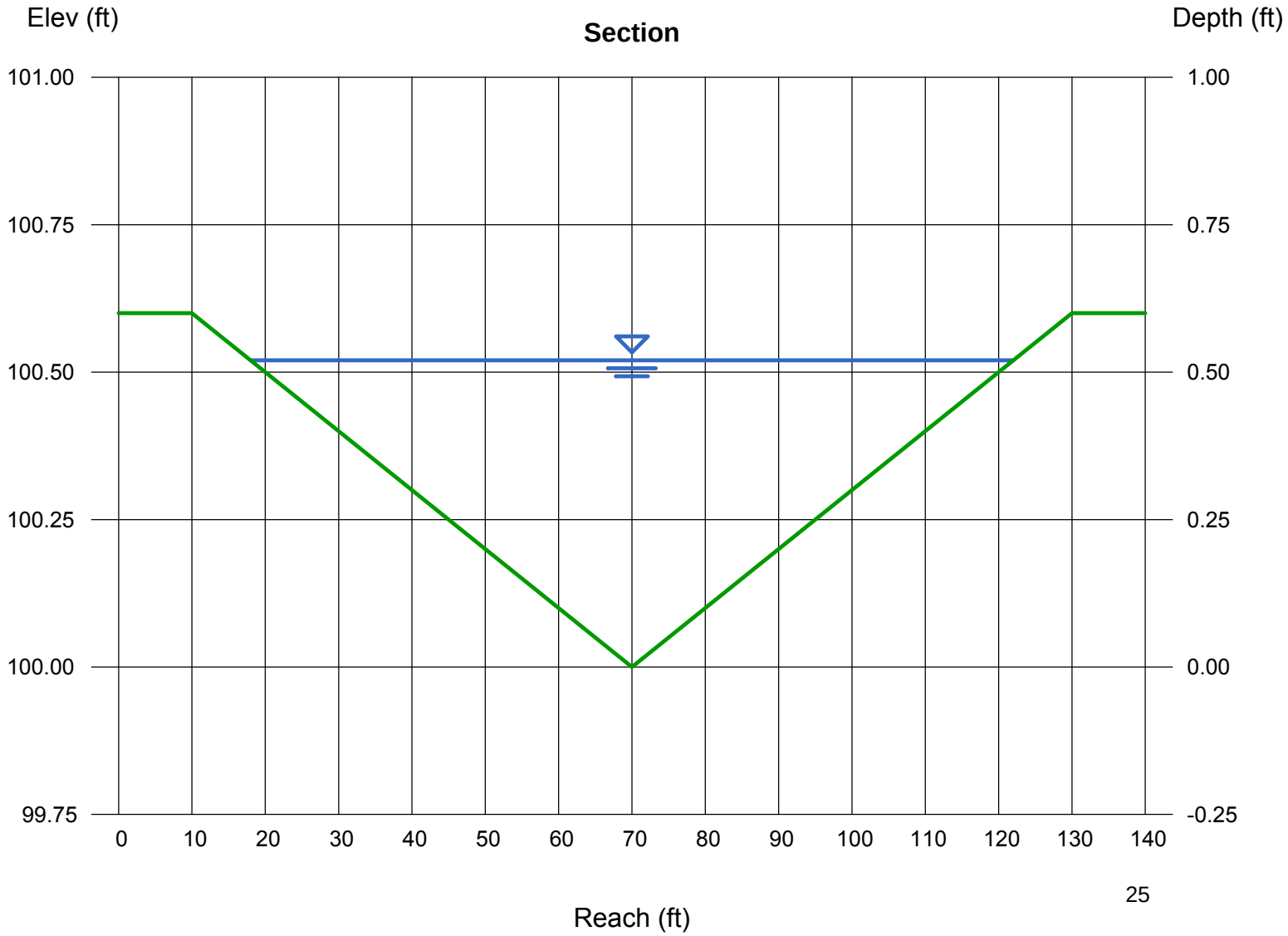
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.60
Invert Elev (ft)	=	100.00
Slope (%)	=	0.70
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	66.60

Highlighted

Depth (ft)	=	0.52
Q (cfs)	=	66.60
Area (sqft)	=	27.04
Velocity (ft/s)	=	2.46
Wetted Perim (ft)	=	104.01
Crit Depth, Yc (ft)	=	0.49
Top Width (ft)	=	104.00
EGL (ft)	=	0.61



Channel Report

O5-O6 Travel Time

Triangular

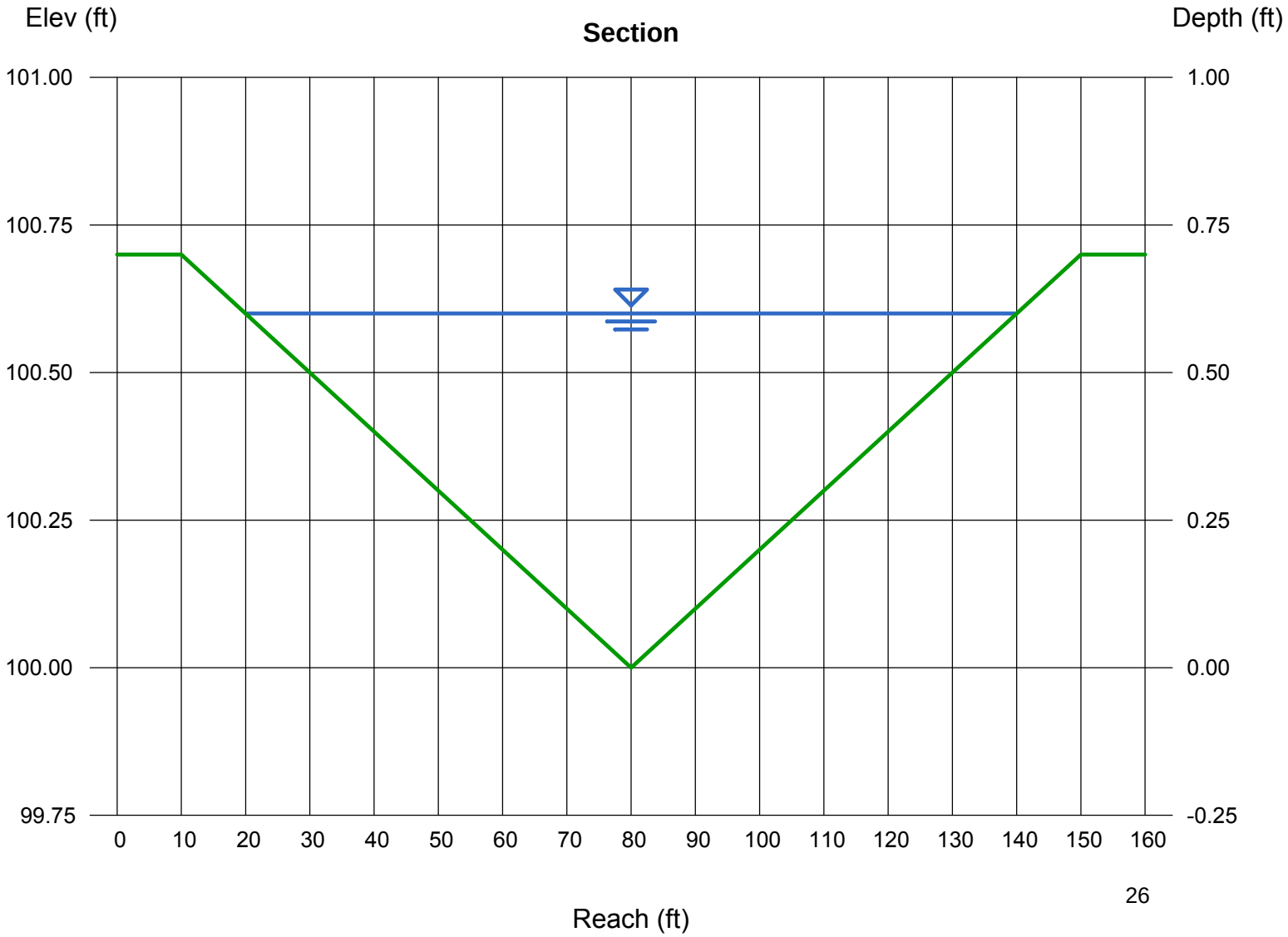
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.70
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.020

Calculations

Compute by:		Known Q
Known Q (cfs)	=	81.10

Highlighted

Depth (ft)	=	0.60
Q (cfs)	=	81.10
Area (sqft)	=	36.00
Velocity (ft/s)	=	2.25
Wetted Perim (ft)	=	120.01
Crit Depth, Yc (ft)	=	0.53
Top Width (ft)	=	120.00
EGL (ft)	=	0.68



Channel Report

O6-O7 Travel Time

Triangular

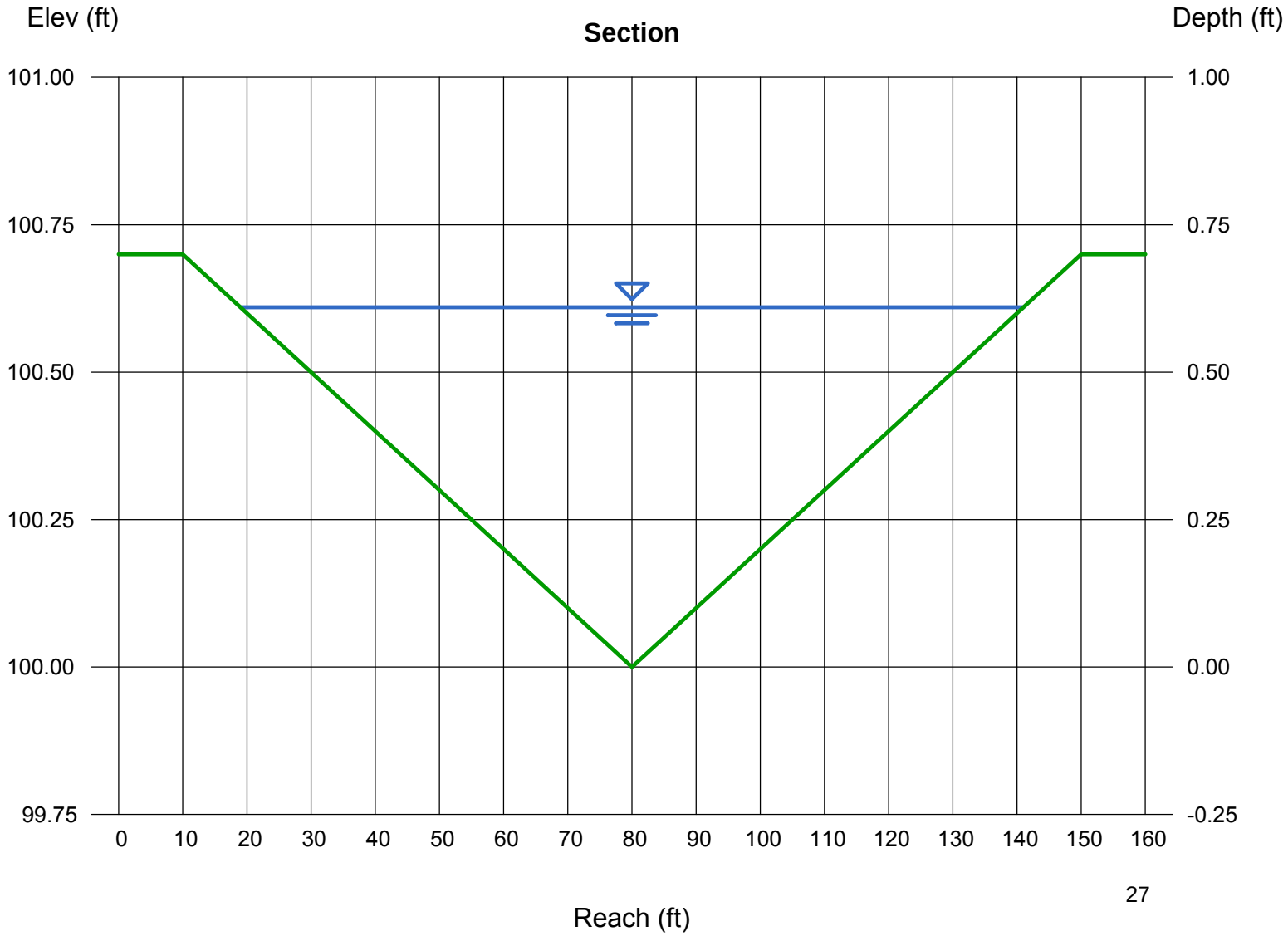
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.70
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.018

Calculations

Compute by:		Known Q
Known Q (cfs)	=	98.30

Highlighted

Depth (ft)	=	0.61
Q (cfs)	=	98.30
Area (sqft)	=	37.21
Velocity (ft/s)	=	2.64
Wetted Perim (ft)	=	122.01
Crit Depth, Yc (ft)	=	0.57
Top Width (ft)	=	122.00
EGL (ft)	=	0.72



Channel Report

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O7-O8 Travel Time

Triangular

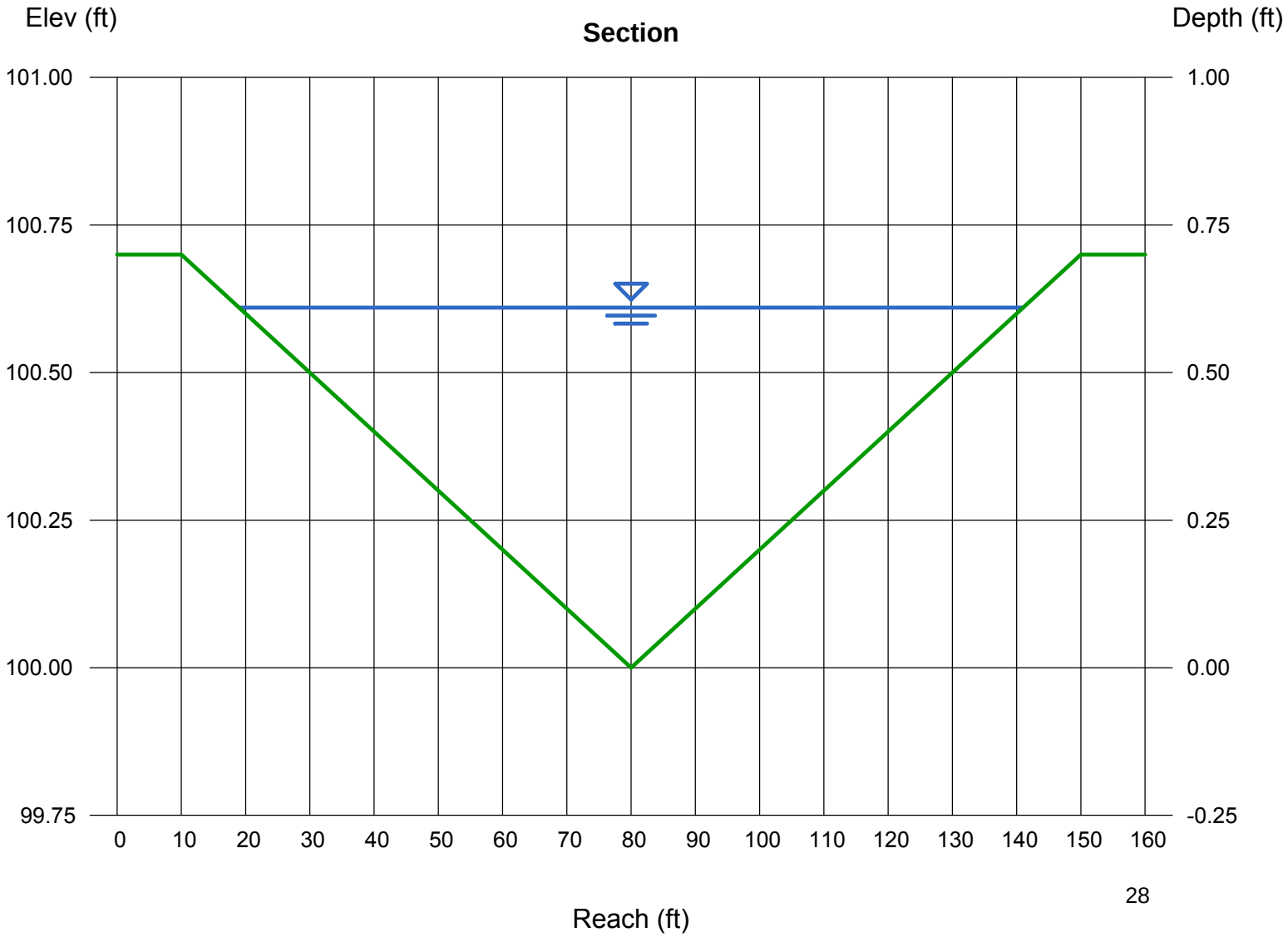
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.70
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.016

Calculations

Compute by:		Known Q
Known Q (cfs)	=	107.20

Highlighted

Depth (ft)	=	0.61
Q (cfs)	=	107.20
Area (sqft)	=	37.21
Velocity (ft/s)	=	2.88
Wetted Perim (ft)	=	122.01
Crit Depth, Yc (ft)	=	0.59
Top Width (ft)	=	122.00
EGL (ft)	=	0.74



Channel Report

DMA 1 TC Average Flow & Velocity

Triangular

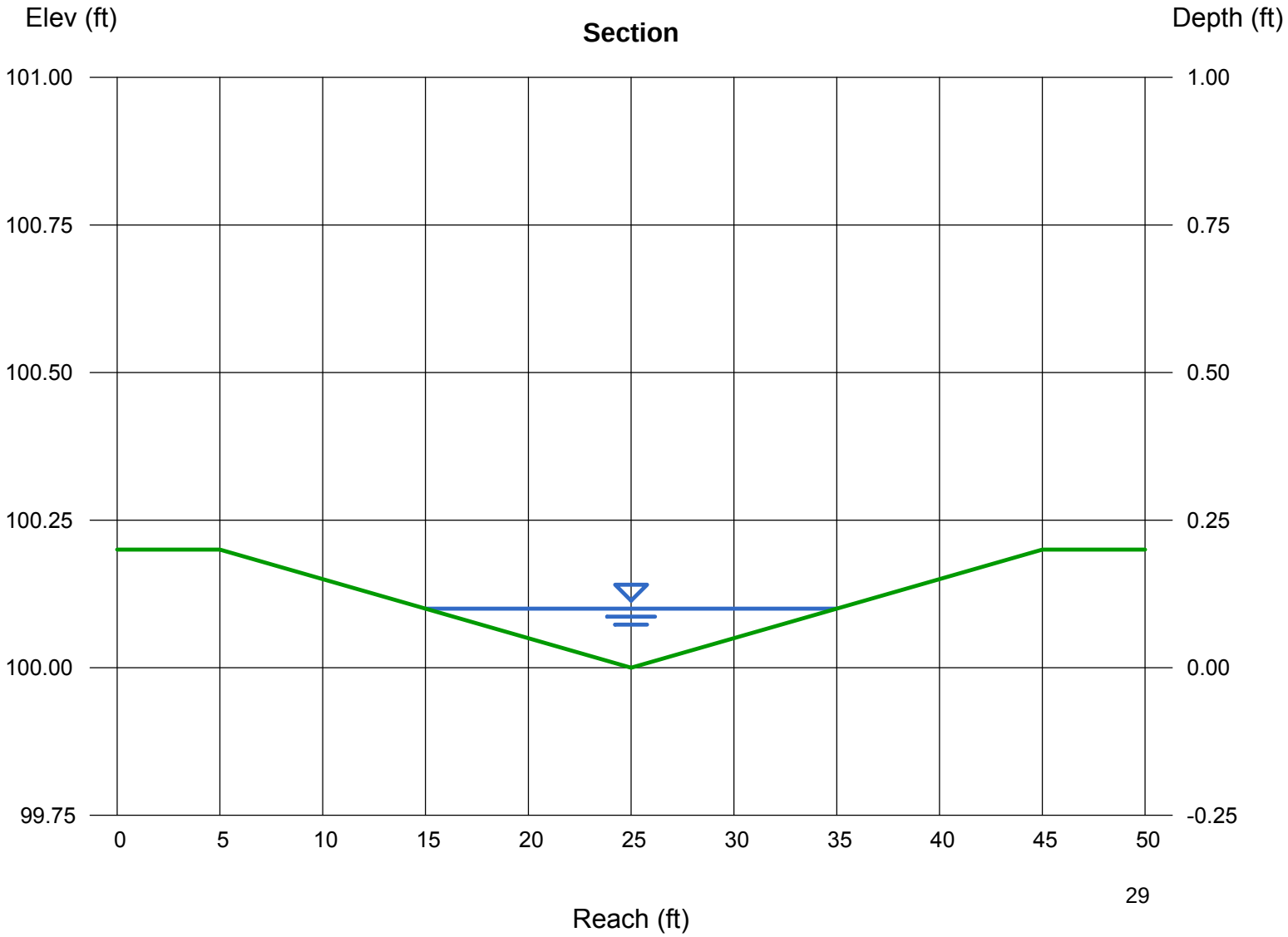
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.20
Invert Elev (ft)	=	100.00
Slope (%)	=	0.60
N-Value	=	0.016

Calculations

Compute by:		Known Q
Known Q (cfs)	=	0.80

Highlighted

Depth (ft)	=	0.10
Q (cfs)	=	0.800
Area (sqft)	=	1.00
Velocity (ft/s)	=	0.80
Wetted Perim (ft)	=	20.00
Crit Depth, Yc (ft)	=	0.09
Top Width (ft)	=	20.00
EGL (ft)	=	0.11



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Tuesday, Nov 19 2013

DMA 2 TC Average Flow & Velocity

Triangular

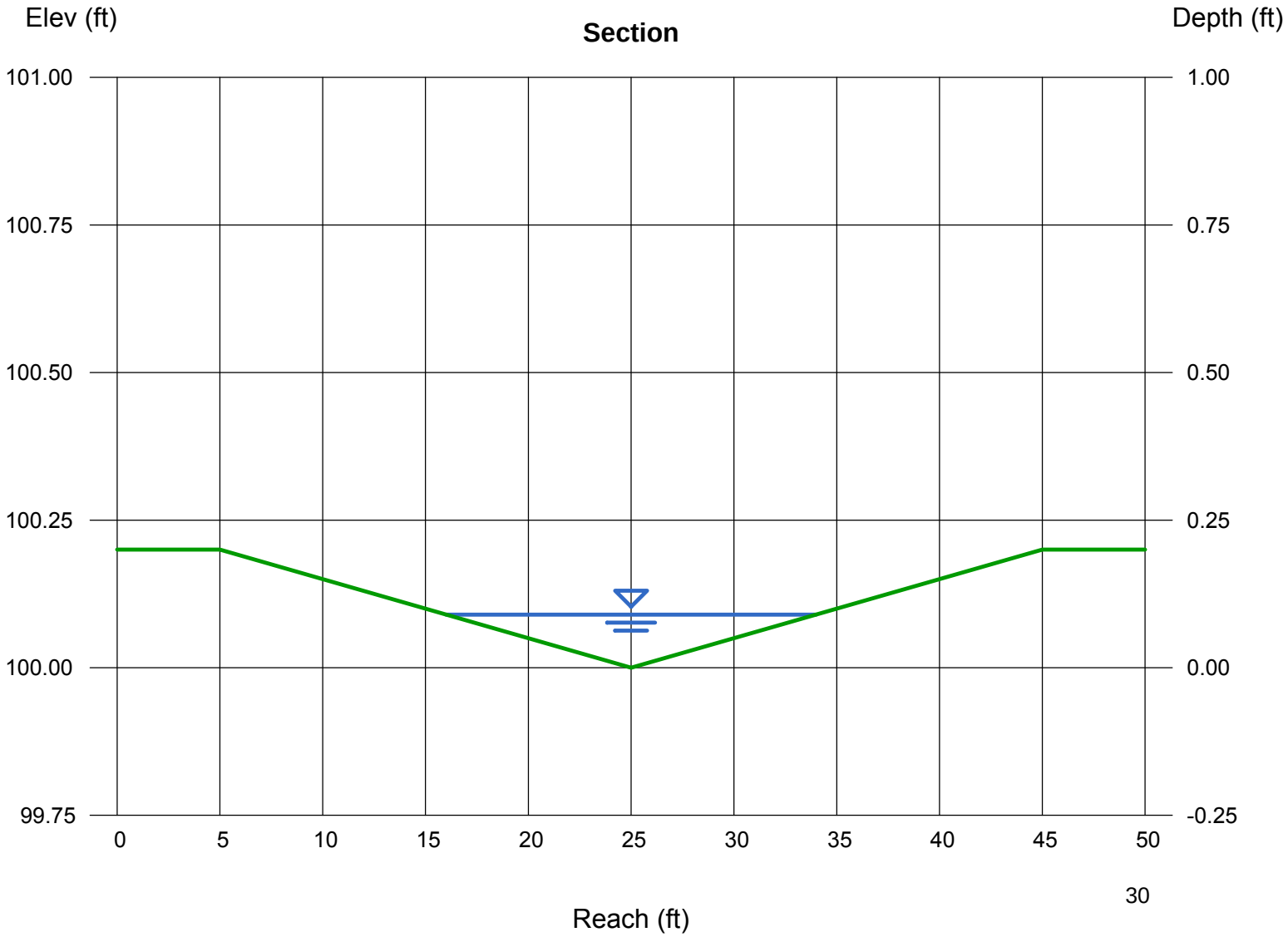
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.20
Invert Elev (ft)	=	100.00
Slope (%)	=	0.90
N-Value	=	0.016

Calculations

Compute by:		Known Q
Known Q (cfs)	=	0.80

Highlighted

Depth (ft)	=	0.09
Q (cfs)	=	0.800
Area (sqft)	=	0.81
Velocity (ft/s)	=	0.99
Wetted Perim (ft)	=	18.00
Crit Depth, Yc (ft)	=	0.09
Top Width (ft)	=	18.00
EGL (ft)	=	0.11



Channel Report

DMA 3 TC Average Flow & Velocity

Triangular

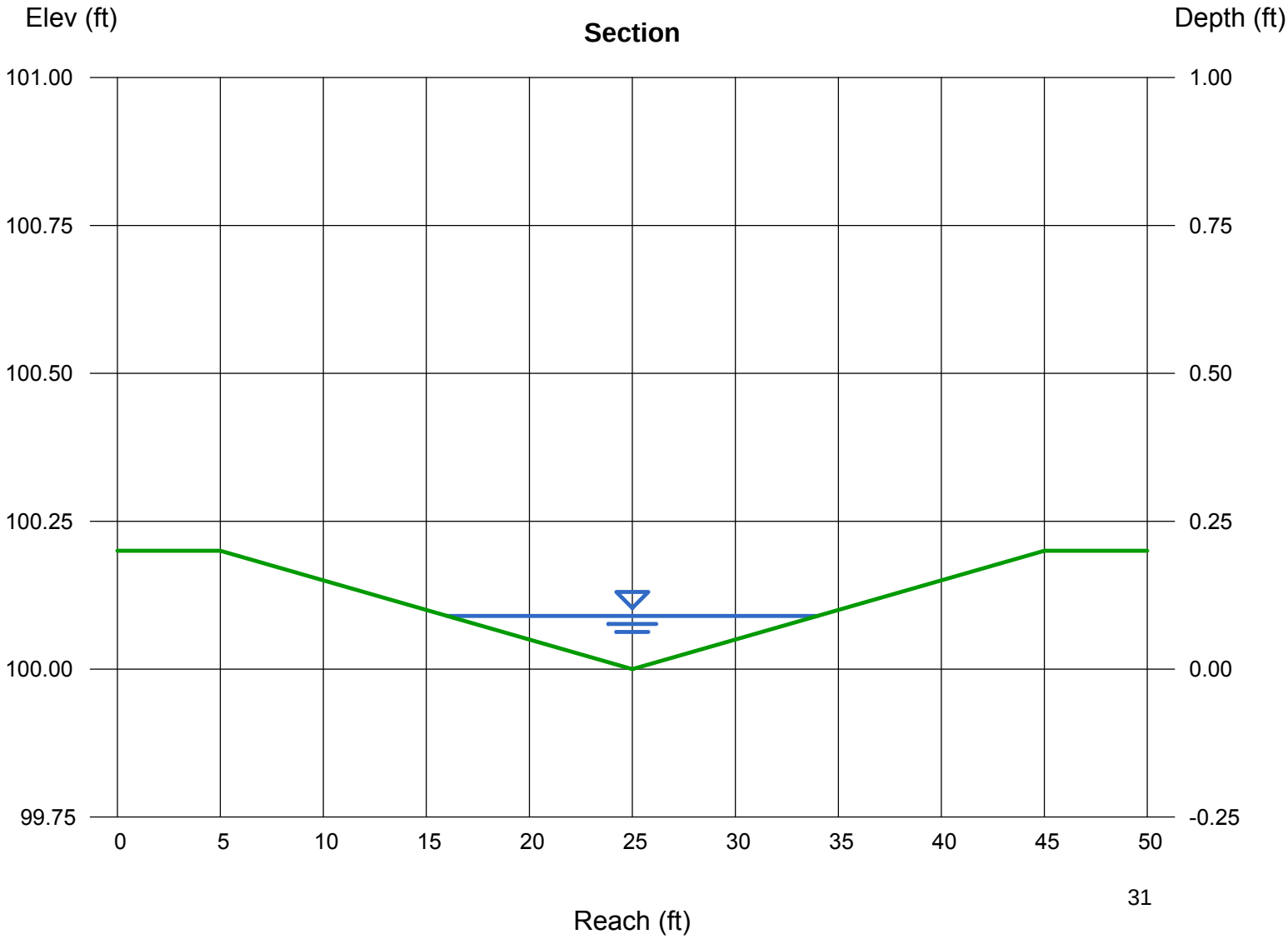
Side Slopes (z:1)	=	100.00, 100.00
Total Depth (ft)	=	0.20
Invert Elev (ft)	=	100.00
Slope (%)	=	2.00
N-Value	=	0.016

Calculations

Compute by:		Known Q
Known Q (cfs)	=	1.30

Highlighted

Depth (ft)	=	0.09
Q (cfs)	=	1.300
Area (sqft)	=	0.81
Velocity (ft/s)	=	1.60
Wetted Perim (ft)	=	18.00
Crit Depth, Yc (ft)	=	0.11
Top Width (ft)	=	18.00
EGL (ft)	=	0.13



Channel Report

DMA 4 TC Average Flow & Velocity

Gutter

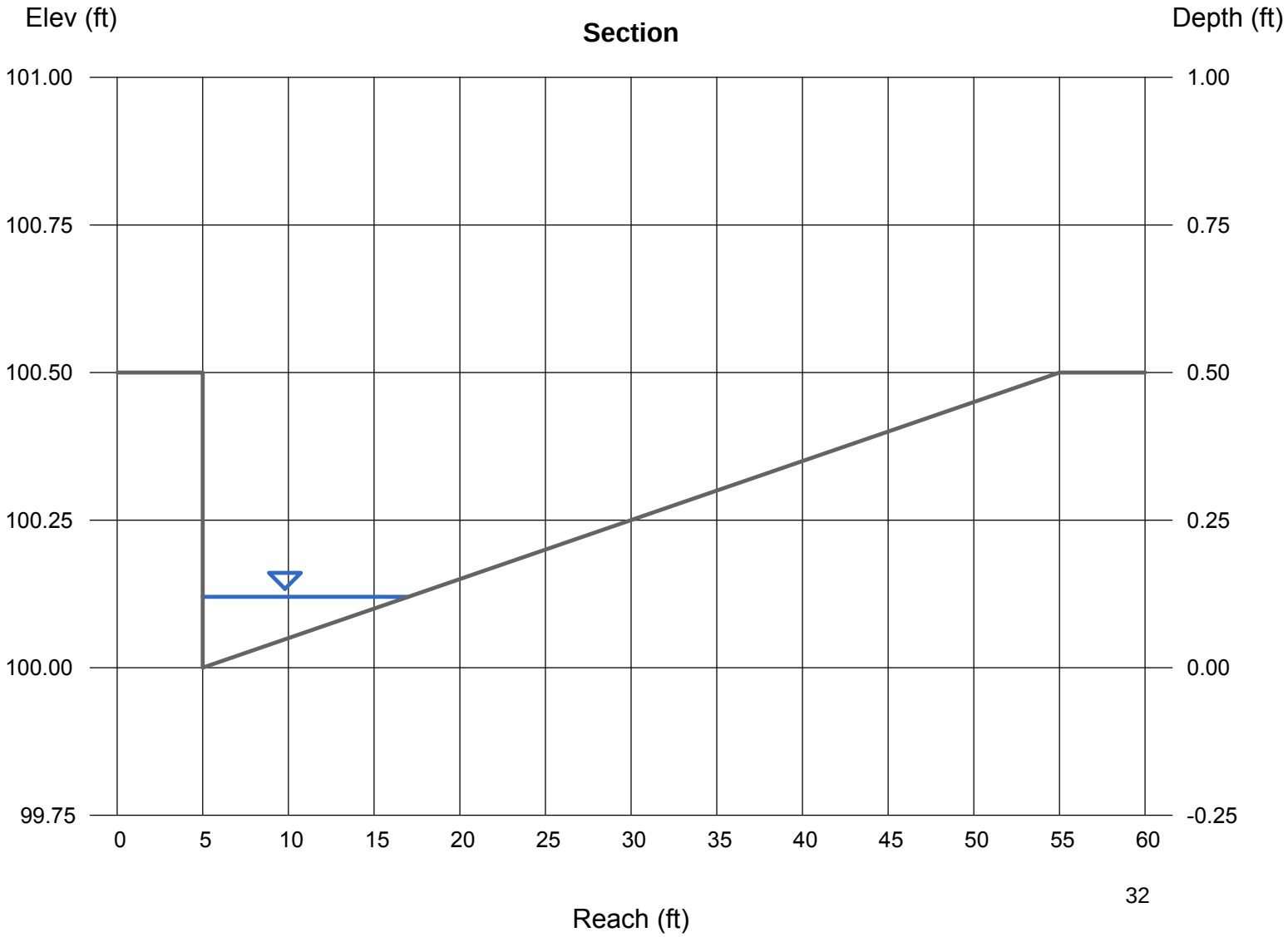
Cross Sl, Sx (ft/ft)	=	0.01
Cross Sl, Sw (ft/ft)	=	0.01
Gutter Width (ft)	=	0.50
Invert Elev (ft)	=	100.00
Slope (%)	=	0.50
N-Value	=	0.016

Calculations

Compute by:		Known Q
Known Q (cfs)	=	0.70

Highlighted

Depth (ft)	=	0.12
Q (cfs)	=	0.700
Area (sqft)	=	0.72
Velocity (ft/s)	=	0.97
Wetted Perim (ft)	=	12.12
Crit Depth, Yc (ft)	=	0.11
Spread Width (ft)	=	12.00
EGL (ft)	=	0.13



Channel Report

Hydraflow Express Extension for AutoCAD® Civil 3D® 2009 by Autodesk, Inc. Tuesday, Nov 19 2013

DMA 5 TC Average Flow & Velocity

Gutter

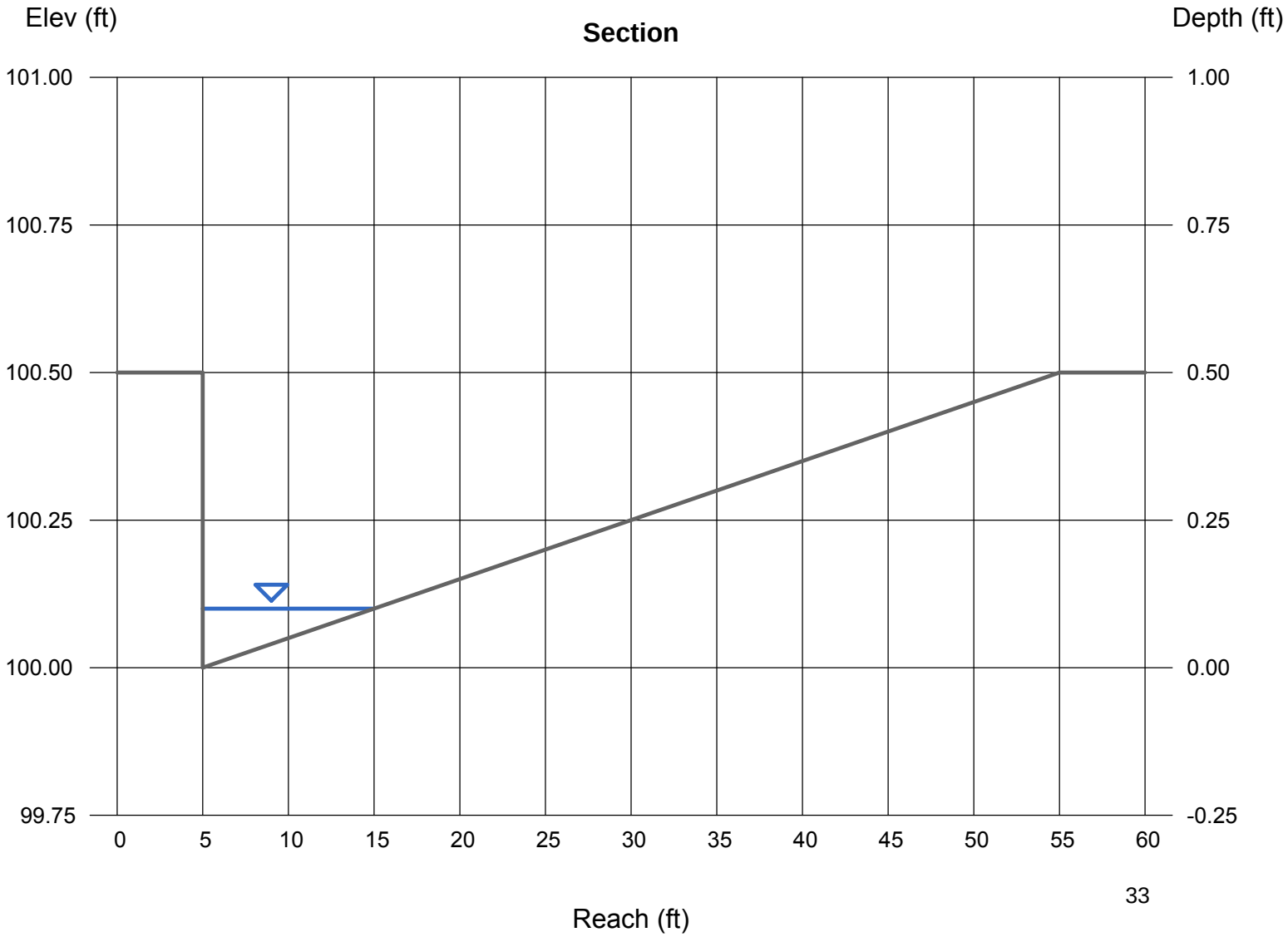
Cross Sl, Sx (ft/ft)	=	0.01
Cross Sl, Sw (ft/ft)	=	0.01
Gutter Width (ft)	=	0.50
Invert Elev (ft)	=	100.00
Slope (%)	=	1.00
N-Value	=	0.016

Calculations

Compute by:		Known Q
Known Q (cfs)	=	0.50

Highlighted

Depth (ft)	=	0.10
Q (cfs)	=	0.500
Area (sqft)	=	0.50
Velocity (ft/s)	=	1.00
Wetted Perim (ft)	=	10.10
Crit Depth, Yc (ft)	=	0.10
Spread Width (ft)	=	10.00
EGL (ft)	=	0.12



ATTACHMENT C1

PRE-DEVELOPMENT HEC-RAS

Kelly
100-yr
0.00
36
60
110
160
210
260

HEC-RAS Plan: Plan 04 River: Kelly Reach: 100-yr Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
100-yr	260	PF 1	115.00	1405.83	1407.10		1407.12	0.000388	1.19	96.65	154.30	0.26
100-yr	210	PF 1	115.00	1405.04	1406.96	1406.91	1407.06	0.006915	2.51	45.82	176.47	0.87
100-yr	160	PF 1	115.00	1404.86	1406.64		1406.76	0.005122	2.71	42.36	115.57	0.79
100-yr	110	PF 1	115.00	1404.94	1406.53		1406.59	0.002002	2.03	56.60	117.98	0.52
100-yr	60	PF 1	115.00	1404.73	1406.22	1406.22	1406.40	0.008520	3.40	33.81	96.39	1.01
100-yr	36	PF 1	115.00	1404.71	1405.94	1405.94	1406.10	0.008850	3.19	36.01	116.44	1.01
100-yr	0.00	PF 1	115.00	1404.46	1405.62	1405.61	1405.77	0.009003	3.12	36.92	125.39	1.01

Plan: Plan 04 Kelly 100-yr RS: 260 Profile: PF 1

E.G. Elev (ft)	1407.12	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.02	Wt. n-Val.		0.018	
W.S. Elev (ft)	1407.10	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		96.65	
E.G. Slope (ft/ft)	0.000388	Area (sq ft)		96.65	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	154.30	Top Width (ft)		154.30	
Vel Total (ft/s)	1.19	Avg. Vel. (ft/s)		1.19	
Max Chl Dpth (ft)	1.27	Hydr. Depth (ft)		0.63	
Conv. Total (cfs)	5839.4	Conv. (cfs)		5839.4	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		154.35	
Min Ch El (ft)	1405.83	Shear (lb/sq ft)		0.02	
Alpha	1.00	Stream Power (lb/ft s)	281.00	0.00	0.00
Frctn Loss (ft)	0.05	Cum Volume (acre-ft)		0.29	
C & E Loss (ft)	0.01	Cum SA (acres)		0.77	

Plan: Plan 04 Kelly 100-yr RS: 210 Profile: PF 1

E.G. Elev (ft)	1407.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.10	Wt. n-Val.		0.020	
W.S. Elev (ft)	1406.96	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)	1406.91	Flow Area (sq ft)		45.82	
E.G. Slope (ft/ft)	0.006915	Area (sq ft)		45.82	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	176.47	Top Width (ft)		176.47	
Vel Total (ft/s)	2.51	Avg. Vel. (ft/s)		2.51	
Max Chl Dpth (ft)	1.92	Hydr. Depth (ft)		0.26	
Conv. Total (cfs)	1383.0	Conv. (cfs)		1383.0	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		176.95	
Min Ch El (ft)	1405.04	Shear (lb/sq ft)		0.11	
Alpha	1.00	Stream Power (lb/ft s)	305.00	0.00	0.00
Frctn Loss (ft)	0.30	Cum Volume (acre-ft)		0.21	
C & E Loss (ft)	0.00	Cum SA (acres)		0.58	

Plan: Plan 04 Kelly 100-yr RS: 160 Profile: PF 1

E.G. Elev (ft)	1406.76	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.11	Wt. n-Val.		0.020	
W.S. Elev (ft)	1406.64	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		42.36	
E.G. Slope (ft/ft)	0.005122	Area (sq ft)		42.36	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	115.57	Top Width (ft)		115.57	
Vel Total (ft/s)	2.71	Avg. Vel. (ft/s)		2.71	

Plan: Plan 04 Kelly 100-yr RS: 160 Profile: PF 1 (Continued)

Max Chl Dpth (ft)	1.78	Hydr. Depth (ft)		0.37	
Conv. Total (cfs)	1606.8	Conv. (cfs)		1606.8	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		116.12	
Min Ch El (ft)	1404.86	Shear (lb/sq ft)		0.12	
Alpha	1.00	Stream Power (lb/ft s)	314.00	0.00	0.00
Frctn Loss (ft)	0.15	Cum Volume (acre-ft)		0.16	
C & E Loss (ft)	0.02	Cum SA (acres)		0.42	

Plan: Plan 04 Kelly 100-yr RS: 110 Profile: PF 1

E.G. Elev (ft)	1406.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.06	Wt. n-Val.		0.020	
W.S. Elev (ft)	1406.53	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		56.60	
E.G. Slope (ft/ft)	0.002002	Area (sq ft)		56.60	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	117.98	Top Width (ft)		117.98	
Vel Total (ft/s)	2.03	Avg. Vel. (ft/s)		2.03	
Max Chl Dpth (ft)	1.59	Hydr. Depth (ft)		0.48	
Conv. Total (cfs)	2570.2	Conv. (cfs)		2570.2	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		118.47	
Min Ch El (ft)	1404.94	Shear (lb/sq ft)		0.06	
Alpha	1.00	Stream Power (lb/ft s)	258.00	0.00	0.00
Frctn Loss (ft)	0.18	Cum Volume (acre-ft)		0.10	
C & E Loss (ft)	0.01	Cum SA (acres)		0.28	

Plan: Plan 04 Kelly 100-yr RS: 60 Profile: PF 1

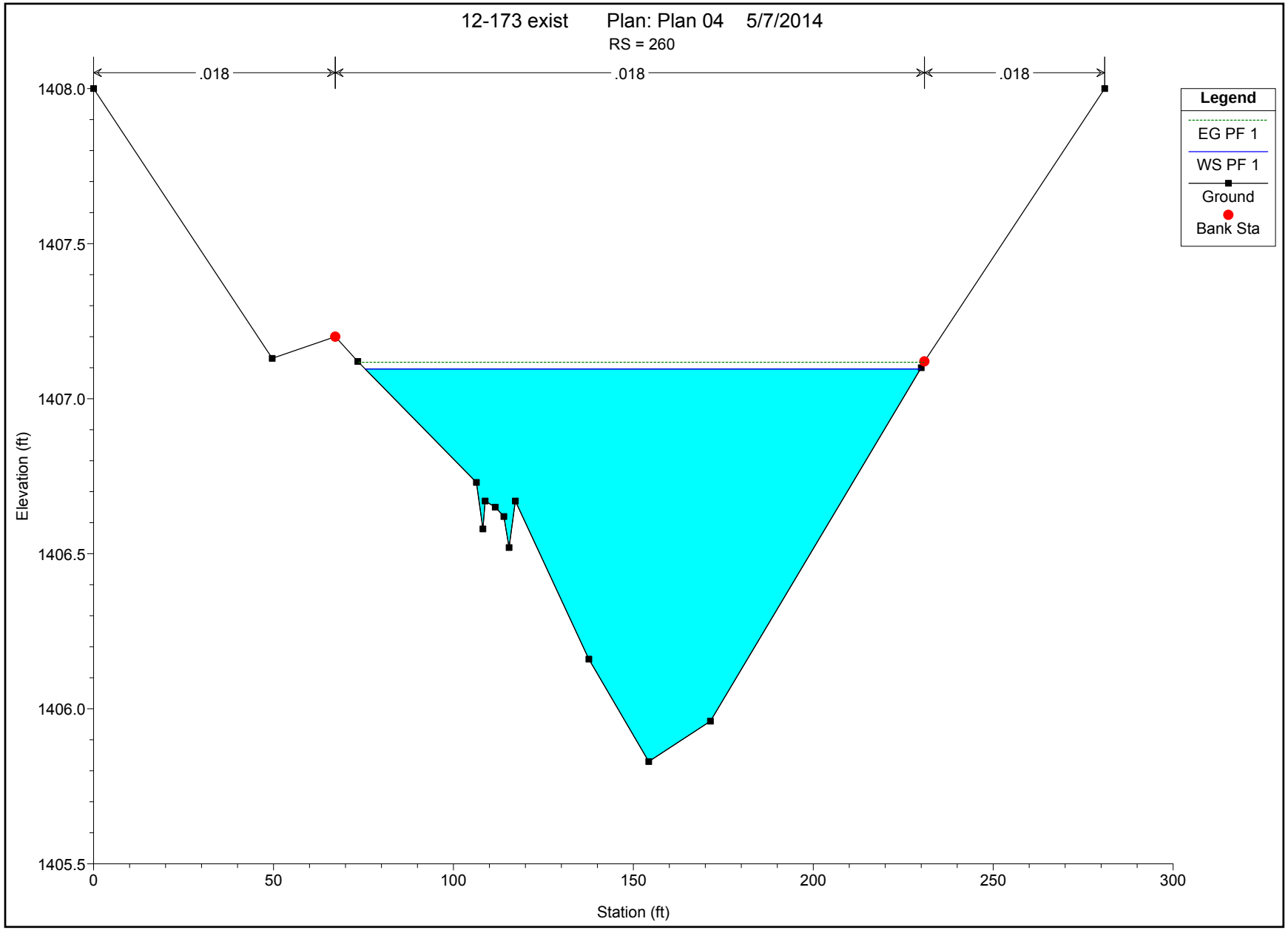
E.G. Elev (ft)	1406.40	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.18	Wt. n-Val.		0.020	
W.S. Elev (ft)	1406.22	Reach Len. (ft)	24.00	24.00	24.00
Crit W.S. (ft)	1406.22	Flow Area (sq ft)		33.81	
E.G. Slope (ft/ft)	0.008520	Area (sq ft)		33.81	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	96.39	Top Width (ft)		96.39	
Vel Total (ft/s)	3.40	Avg. Vel. (ft/s)		3.40	
Max Chl Dpth (ft)	1.49	Hydr. Depth (ft)		0.35	
Conv. Total (cfs)	1245.9	Conv. (cfs)		1245.9	
Length Wtd. (ft)	24.00	Wetted Per. (ft)		96.78	
Min Ch El (ft)	1404.73	Shear (lb/sq ft)		0.19	
Alpha	1.00	Stream Power (lb/ft s)	269.00	0.00	0.00
Frctn Loss (ft)	0.21	Cum Volume (acre-ft)		0.05	
C & E Loss (ft)	0.01	Cum SA (acres)		0.16	

Plan: Plan 04 Kelly 100-yr RS: 36 Profile: PF 1

E.G. Elev (ft)	1406.10	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.16	Wt. n-Val.		0.020	
W.S. Elev (ft)	1405.94	Reach Len. (ft)	36.00	36.00	36.00
Crit W.S. (ft)	1405.94	Flow Area (sq ft)		36.01	
E.G. Slope (ft/ft)	0.008850	Area (sq ft)		36.01	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	116.44	Top Width (ft)		116.44	
Vel Total (ft/s)	3.19	Avg. Vel. (ft/s)		3.19	
Max Chl Dpth (ft)	1.23	Hydr. Depth (ft)		0.31	
Conv. Total (cfs)	1222.4	Conv. (cfs)		1222.4	
Length Wtd. (ft)	36.00	Wetted Per. (ft)		116.63	
Min Ch El (ft)	1404.71	Shear (lb/sq ft)		0.17	
Alpha	1.00	Stream Power (lb/ft s)	345.00	0.00	0.00
Frctn Loss (ft)	0.32	Cum Volume (acre-ft)		0.03	
C & E Loss (ft)	0.00	Cum SA (acres)		0.10	

Plan: Plan 04 Kelly 100-yr RS: 0.00 Profile: PF 1

E.G. Elev (ft)	1405.77	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.15	Wt. n-Val.		0.020	
W.S. Elev (ft)	1405.62	Reach Len. (ft)			
Crit W.S. (ft)	1405.61	Flow Area (sq ft)		36.92	
E.G. Slope (ft/ft)	0.009003	Area (sq ft)		36.92	
Q Total (cfs)	115.00	Flow (cfs)		115.00	
Top Width (ft)	125.39	Top Width (ft)		125.39	
Vel Total (ft/s)	3.12	Avg. Vel. (ft/s)		3.12	
Max Chl Dpth (ft)	1.16	Hydr. Depth (ft)		0.29	
Conv. Total (cfs)	1212.0	Conv. (cfs)		1212.0	
Length Wtd. (ft)		Wetted Per. (ft)		125.67	
Min Ch El (ft)	1404.46	Shear (lb/sq ft)		0.17	
Alpha	1.00	Stream Power (lb/ft s)	375.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			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.018
.018
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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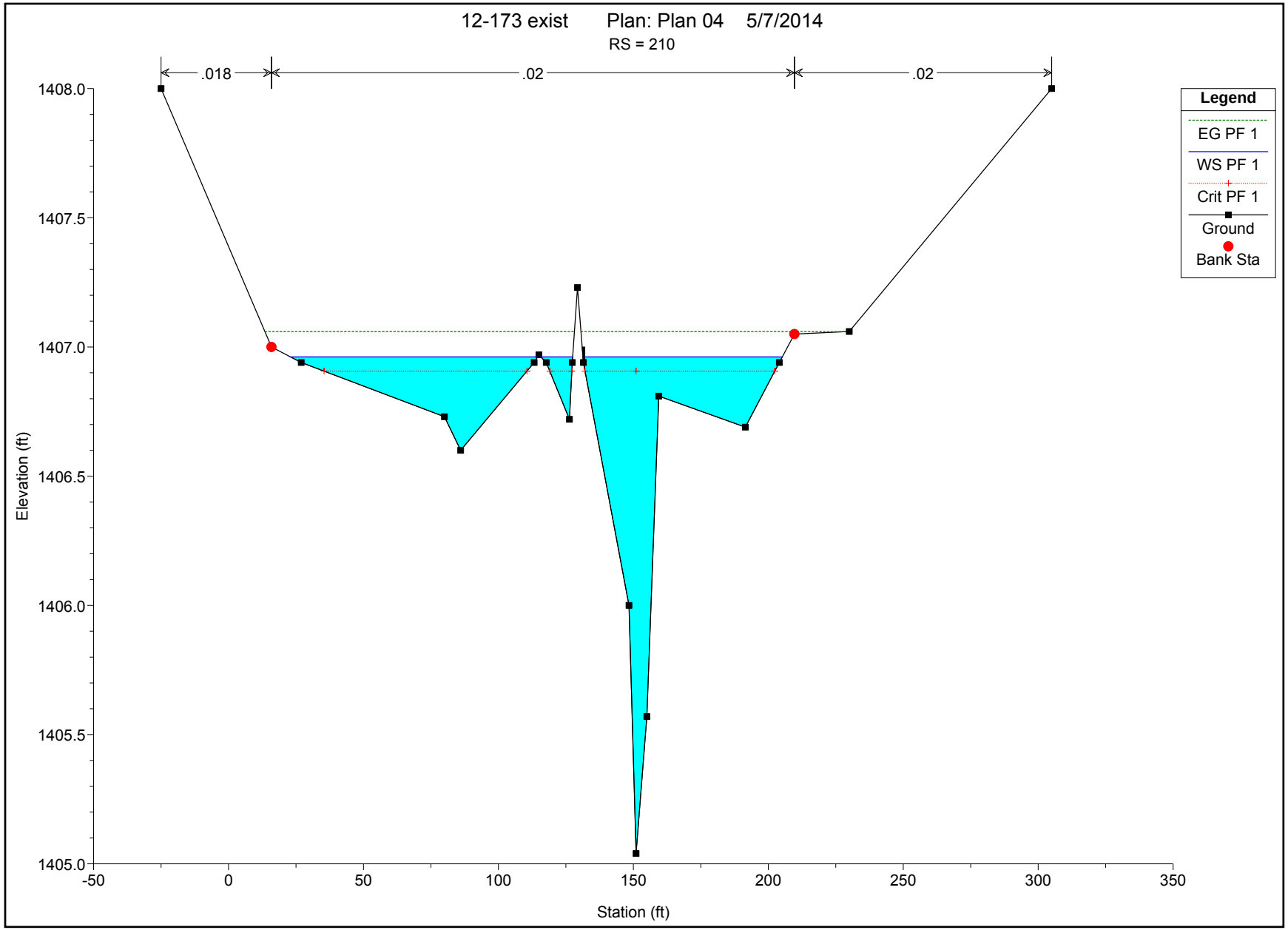
1407.0
1406.5
1406.0
1405.5
0
50
100
150
200
250
300
Station (ft)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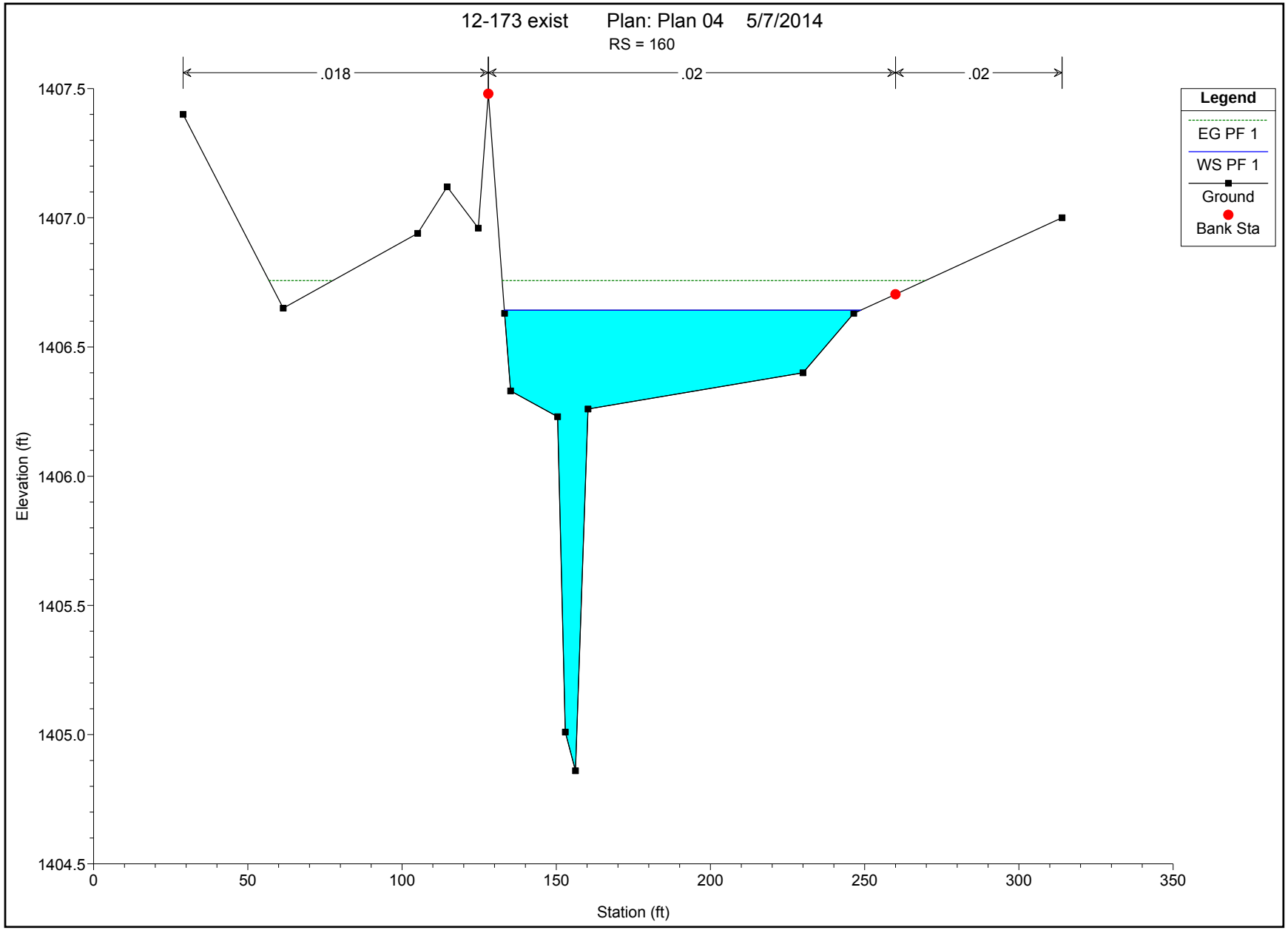
.02
.02
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1408.0
1407.5
1407.0
1406.5
1406.0
1405.5
1405.0
-50
0
50
100
150
200
250
300
350
Station (ft)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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
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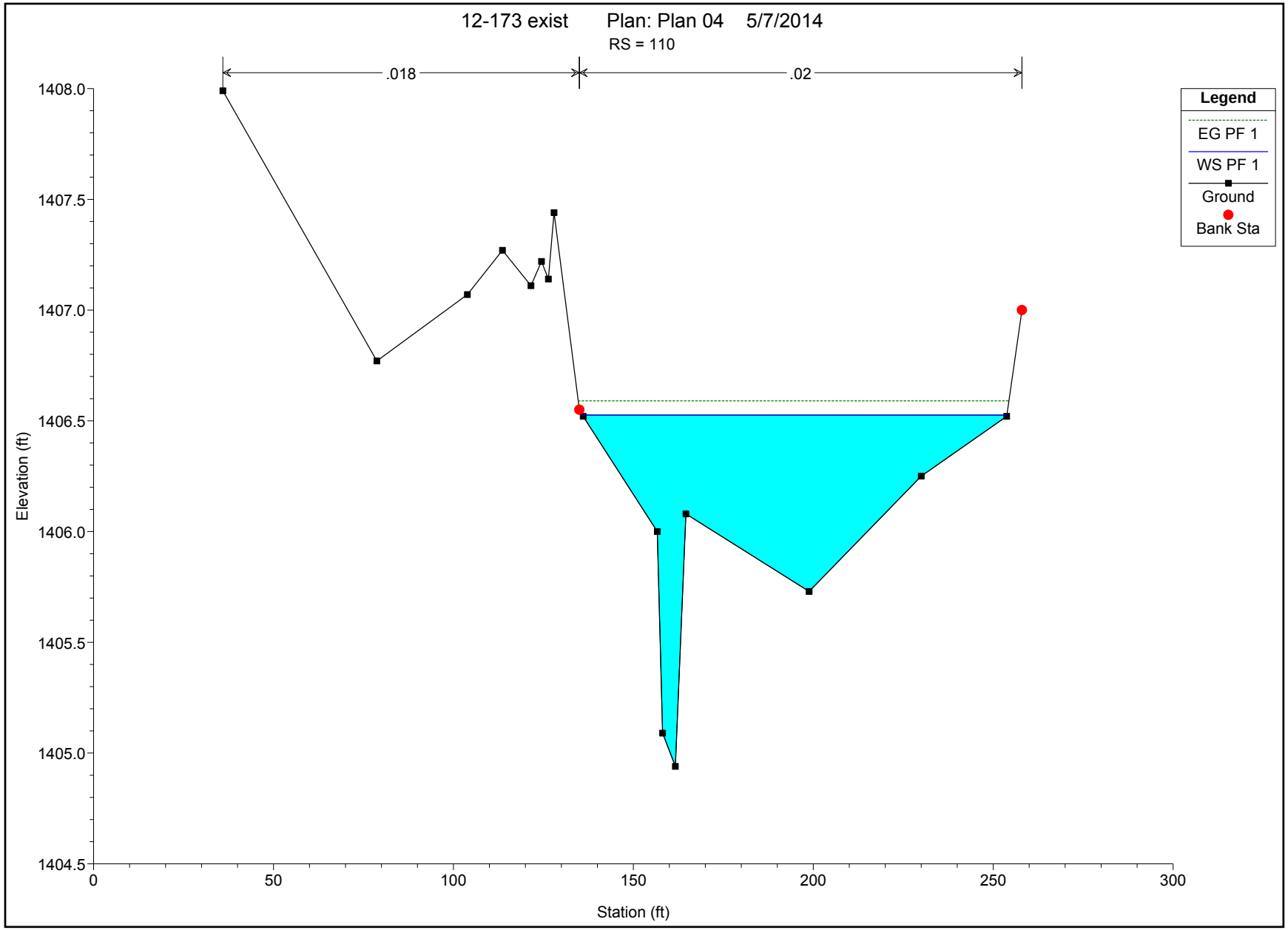
1407.0
1406.5
1406.0
1405.5
1405.0
1404.5
0
50
100
150
200
250
300
350
Station (ft)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EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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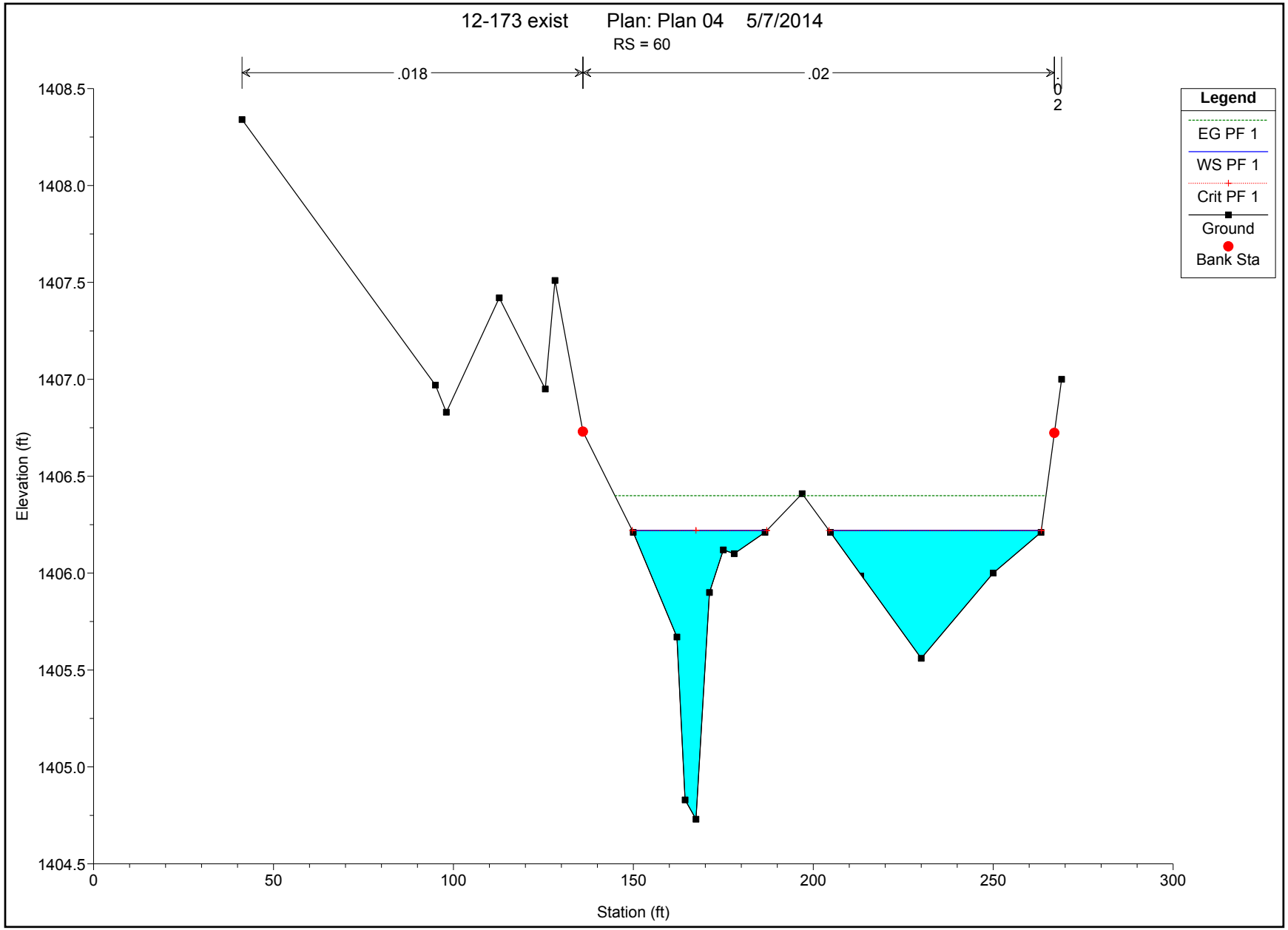
1407.5
1407.0
1406.5
1406.0
1405.5
1405.0
1404.5
0
50
100
150
200
250
300
Station (ft)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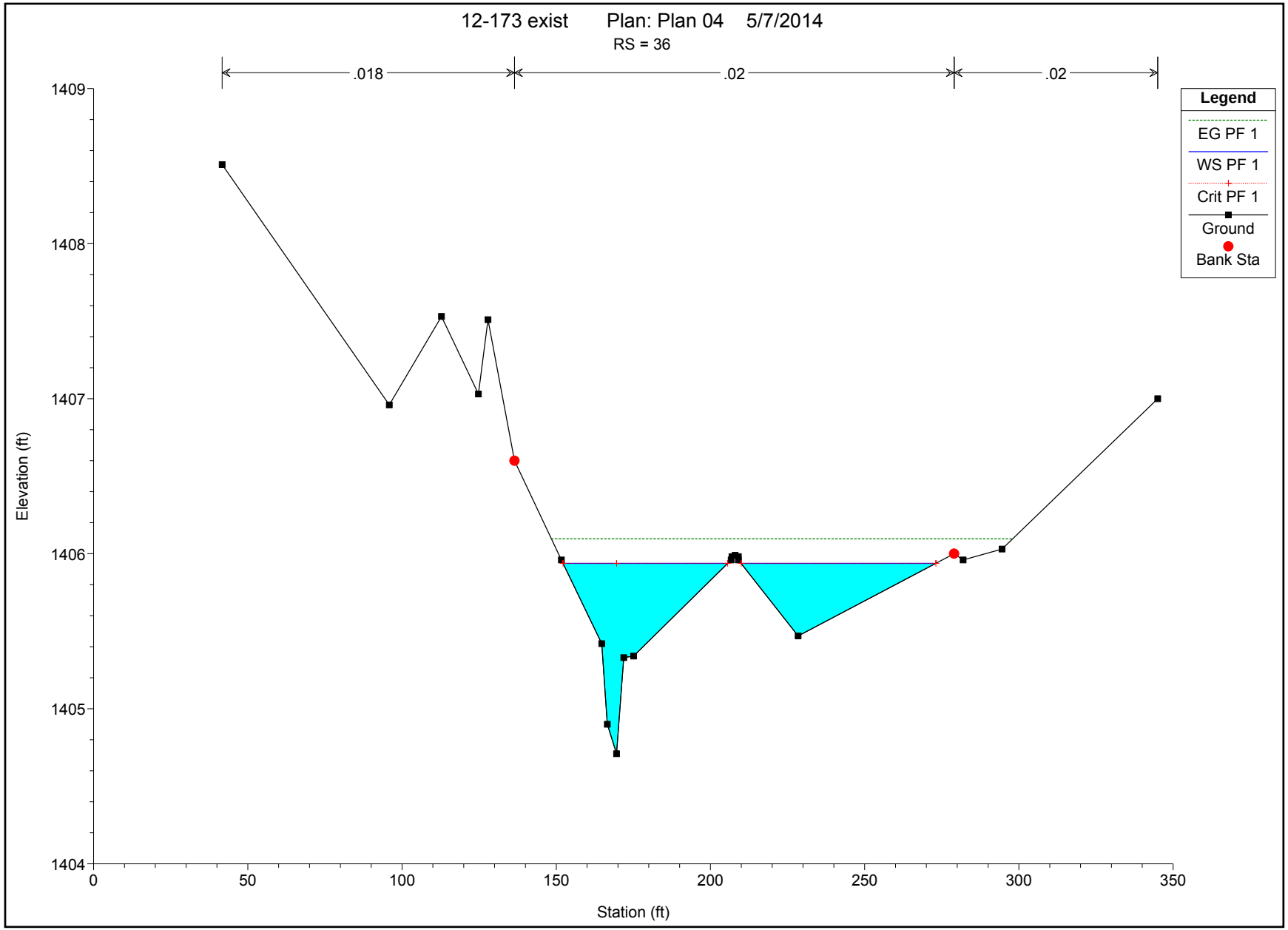
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1408.5
1408.0
1407.5
1407.0
1406.5
1406.0
1405.5
1405.0
1404.5
0
50
100
150
200
250
300
Station (ft)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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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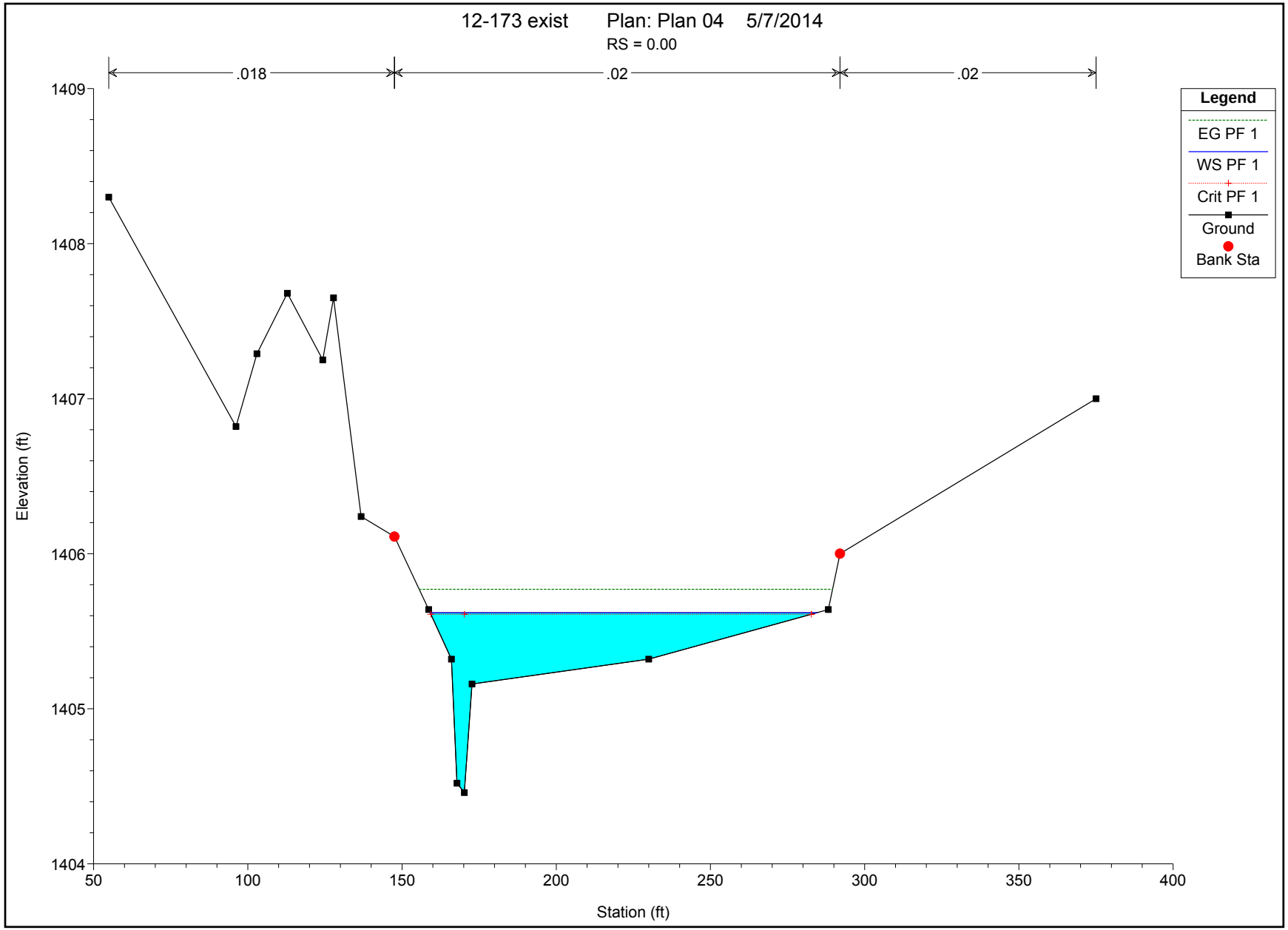
1408
1407
1406
1405
1404
0
50
100
150
200
250
300
350
Station (ft)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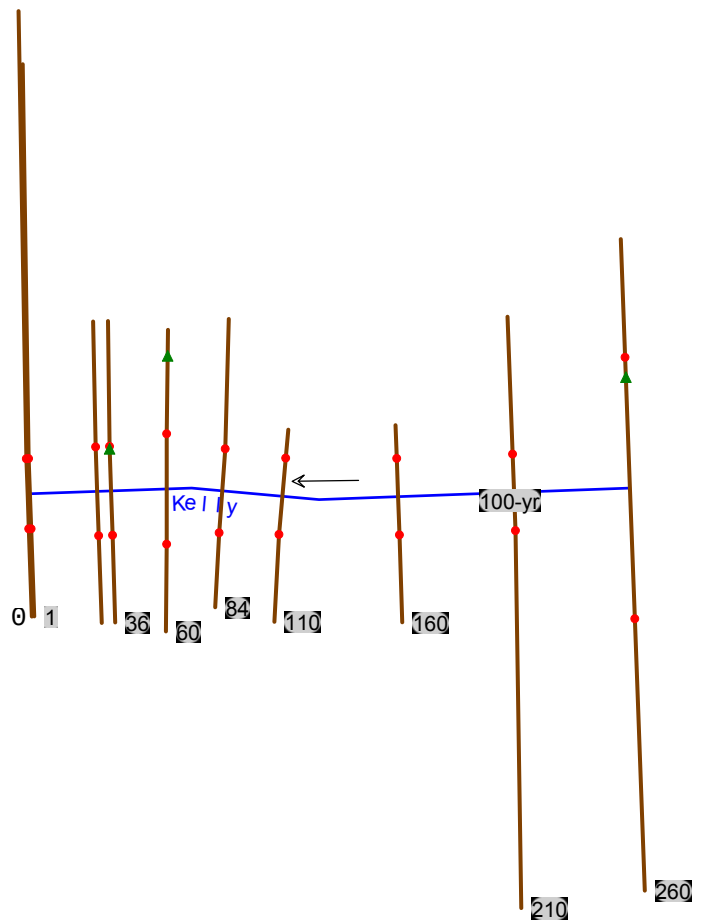
.02
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1409
1408
1407
1406
1405
1404
50
100
150
200
250
300
350
400
Station (ft)

ATTACHMENT C2

POST-DEVELOPMENT HEC-RAS



None of the XS's are Geo-Referenced (Geo-Ref user entered XS Geo-Ref interpolated XS Non Geo-Ref user entered XS Non Geo-Ref interpolated XS)

HEC-RAS Plan: Plan 04 River: Kelly Reach: 100-yr Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
100-yr	260	PF 1	116.00	1405.83	1406.86		1406.92	0.001141	1.82	63.85	121.33	0.44
100-yr	210	PF 1	116.00	1405.59	1406.60		1406.82	0.002612	3.76	30.82	47.17	0.82
100-yr	160	PF 1	116.00	1405.20	1406.47		1406.69	0.002324	3.76	30.88	41.83	0.77
100-yr	110	PF 1	116.00	1404.95	1406.41		1406.59	0.001255	3.48	33.31	31.40	0.60
100-yr	84	PF 1	116.00	1404.79	1406.40		1406.56	0.000955	3.27	35.52	29.79	0.53
100-yr	60	PF 1	116.00	1404.84	1406.14	1406.14	1406.50	0.002867	4.81	24.10	34.42	1.01
100-yr	36	PF 1	116.00	1404.71	1406.01	1406.01	1406.41	0.002733	5.07	22.88	29.13	1.01
100-yr	30	PF 1	116.00	1404.68	1405.74	1405.74	1406.22	0.003669	5.57	20.82	21.84	1.01
100-yr	1	PF 1	116.00	1404.54	1405.56	1405.56	1406.04	0.003689	5.55	20.90	22.14	1.01
100-yr	0.00	PF 1	116.00	1404.54	1405.54	1405.38	1405.63	0.009000	2.41	48.15	103.60	0.62

Plan: Plan 04 Kelly 100-yr RS: 260 Profile: PF 1

E.G. Elev (ft)	1406.92	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.05	Wt. n-Val.		0.018	
W.S. Elev (ft)	1406.86	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		63.85	
E.G. Slope (ft/ft)	0.001141	Area (sq ft)		63.85	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	121.33	Top Width (ft)		121.33	
Vel Total (ft/s)	1.82	Avg. Vel. (ft/s)		1.82	
Max Chl Dpth (ft)	1.03	Hydr. Depth (ft)		0.53	
Conv. Total (cfs)	3434.3	Conv. (cfs)		3434.3	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		121.40	
Min Ch El (ft)	1405.83	Shear (lb/sq ft)		0.04	
Alpha	1.00	Stream Power (lb/ft s)	381.00	0.00	0.00
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)		0.19	
C & E Loss (ft)	0.02	Cum SA (acres)		0.26	

Plan: Plan 04 Kelly 100-yr RS: 210 Profile: PF 1

E.G. Elev (ft)	1406.82	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.		0.015	
W.S. Elev (ft)	1406.60	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		30.82	
E.G. Slope (ft/ft)	0.002612	Area (sq ft)		30.82	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	47.17	Top Width (ft)		47.17	
Vel Total (ft/s)	3.76	Avg. Vel. (ft/s)		3.76	
Max Chl Dpth (ft)	1.01	Hydr. Depth (ft)		0.65	
Conv. Total (cfs)	2269.6	Conv. (cfs)		2269.6	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		48.07	
Min Ch El (ft)	1405.59	Shear (lb/sq ft)		0.10	
Alpha	1.00	Stream Power (lb/ft s)	230.00	0.00	0.00
Frctn Loss (ft)	0.12	Cum Volume (acre-ft)		0.14	
C & E Loss (ft)	0.00	Cum SA (acres)		0.17	

Plan: Plan 04 Kelly 100-yr RS: 160 Profile: PF 1

E.G. Elev (ft)	1406.69	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.22	Wt. n-Val.		0.015	
W.S. Elev (ft)	1406.47	Reach Len. (ft)	50.00	50.00	50.00
Crit W.S. (ft)		Flow Area (sq ft)		30.88	
E.G. Slope (ft/ft)	0.002324	Area (sq ft)		30.88	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	41.83	Top Width (ft)		41.83	
Vel Total (ft/s)	3.76	Avg. Vel. (ft/s)		3.76	

Plan: Plan 04 Kelly 100-yr RS: 160 Profile: PF 1 (Continued)

Max Chl Dpth (ft)	1.27	Hydr. Depth (ft)		0.74	
Conv. Total (cfs)	2406.3	Conv. (cfs)		2406.3	
Length Wtd. (ft)	50.00	Wetted Per. (ft)		44.28	
Min Ch El (ft)	1405.20	Shear (lb/sq ft)		0.10	
Alpha	1.00	Stream Power (lb/ft s)	185.00	0.00	0.00
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)		0.10	
C & E Loss (ft)	0.01	Cum SA (acres)		0.12	

Plan: Plan 04 Kelly 100-yr RS: 110 Profile: PF 1

E.G. Elev (ft)	1406.59	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.19	Wt. n-Val.		0.015	
W.S. Elev (ft)	1406.41	Reach Len. (ft)	26.00	26.00	26.00
Crit W.S. (ft)		Flow Area (sq ft)		33.31	
E.G. Slope (ft/ft)	0.001255	Area (sq ft)		33.31	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	31.40	Top Width (ft)		31.40	
Vel Total (ft/s)	3.48	Avg. Vel. (ft/s)		3.48	
Max Chl Dpth (ft)	1.46	Hydr. Depth (ft)		1.06	
Conv. Total (cfs)	3274.6	Conv. (cfs)		3274.6	
Length Wtd. (ft)	26.00	Wetted Per. (ft)		33.70	
Min Ch El (ft)	1404.95	Shear (lb/sq ft)		0.08	
Alpha	1.00	Stream Power (lb/ft s)	183.00	0.00	0.00
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)		0.07	
C & E Loss (ft)	0.01	Cum SA (acres)		0.07	

Plan: Plan 04 Kelly 100-yr RS: 84 Profile: PF 1

E.G. Elev (ft)	1406.56	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.17	Wt. n-Val.		0.015	
W.S. Elev (ft)	1406.40	Reach Len. (ft)	24.00	24.00	24.00
Crit W.S. (ft)		Flow Area (sq ft)		35.52	
E.G. Slope (ft/ft)	0.000955	Area (sq ft)		35.52	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	29.79	Top Width (ft)		29.79	
Vel Total (ft/s)	3.27	Avg. Vel. (ft/s)		3.27	
Max Chl Dpth (ft)	1.60	Hydr. Depth (ft)		1.19	
Conv. Total (cfs)	3753.5	Conv. (cfs)		3753.5	
Length Wtd. (ft)	24.00	Wetted Per. (ft)		32.23	
Min Ch El (ft)	1404.79	Shear (lb/sq ft)		0.07	
Alpha	1.00	Stream Power (lb/ft s)	230.00	0.00	0.00
Frctn Loss (ft)	0.04	Cum Volume (acre-ft)		0.05	
C & E Loss (ft)	0.02	Cum SA (acres)		0.05	

Plan: Plan 04 Kelly 100-yr RS: 60 Profile: PF 1

E.G. Elev (ft)	1406.50	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.36	Wt. n-Val.		0.013	
W.S. Elev (ft)	1406.14	Reach Len. (ft)	24.00	24.00	24.00
Crit W.S. (ft)	1406.14	Flow Area (sq ft)		24.10	
E.G. Slope (ft/ft)	0.002867	Area (sq ft)		24.10	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	34.42	Top Width (ft)		34.42	
Vel Total (ft/s)	4.81	Avg. Vel. (ft/s)		4.81	
Max Chl Dpth (ft)	1.30	Hydr. Depth (ft)		0.70	
Conv. Total (cfs)	2166.6	Conv. (cfs)		2166.6	
Length Wtd. (ft)	24.00	Wetted Per. (ft)		34.55	
Min Ch El (ft)	1404.84	Shear (lb/sq ft)		0.12	
Alpha	1.00	Stream Power (lb/ft s)	230.00	0.00	0.00
Frctn Loss (ft)	0.07	Cum Volume (acre-ft)		0.03	
C & E Loss (ft)	0.00	Cum SA (acres)		0.04	

Plan: Plan 04 Kelly 100-yr RS: 36 Profile: PF 1

E.G. Elev (ft)	1406.41	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.40	Wt. n-Val.		0.013	
W.S. Elev (ft)	1406.01	Reach Len. (ft)	6.00	6.00	6.00
Crit W.S. (ft)	1406.01	Flow Area (sq ft)		22.88	
E.G. Slope (ft/ft)	0.002733	Area (sq ft)		22.88	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	29.13	Top Width (ft)		29.13	
Vel Total (ft/s)	5.07	Avg. Vel. (ft/s)		5.07	
Max Chl Dpth (ft)	1.30	Hydr. Depth (ft)		0.79	
Conv. Total (cfs)	2218.9	Conv. (cfs)		2218.9	
Length Wtd. (ft)	6.00	Wetted Per. (ft)		29.27	
Min Ch El (ft)	1404.71	Shear (lb/sq ft)		0.13	
Alpha	1.00	Stream Power (lb/ft s)	230.00	0.00	0.00
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)		0.02	
C & E Loss (ft)	0.01	Cum SA (acres)		0.02	

Plan: Plan 04 Kelly 100-yr RS: 30 Profile: PF 1

E.G. Elev (ft)	1406.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.		0.015	
W.S. Elev (ft)	1405.74	Reach Len. (ft)	29.00	29.00	29.00
Crit W.S. (ft)	1405.74	Flow Area (sq ft)		20.82	
E.G. Slope (ft/ft)	0.003669	Area (sq ft)		20.82	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	21.84	Top Width (ft)		21.84	
Vel Total (ft/s)	5.57	Avg. Vel. (ft/s)		5.57	

Plan: Plan 04 Kelly 100-yr RS: 30 Profile: PF 1 (Continued)

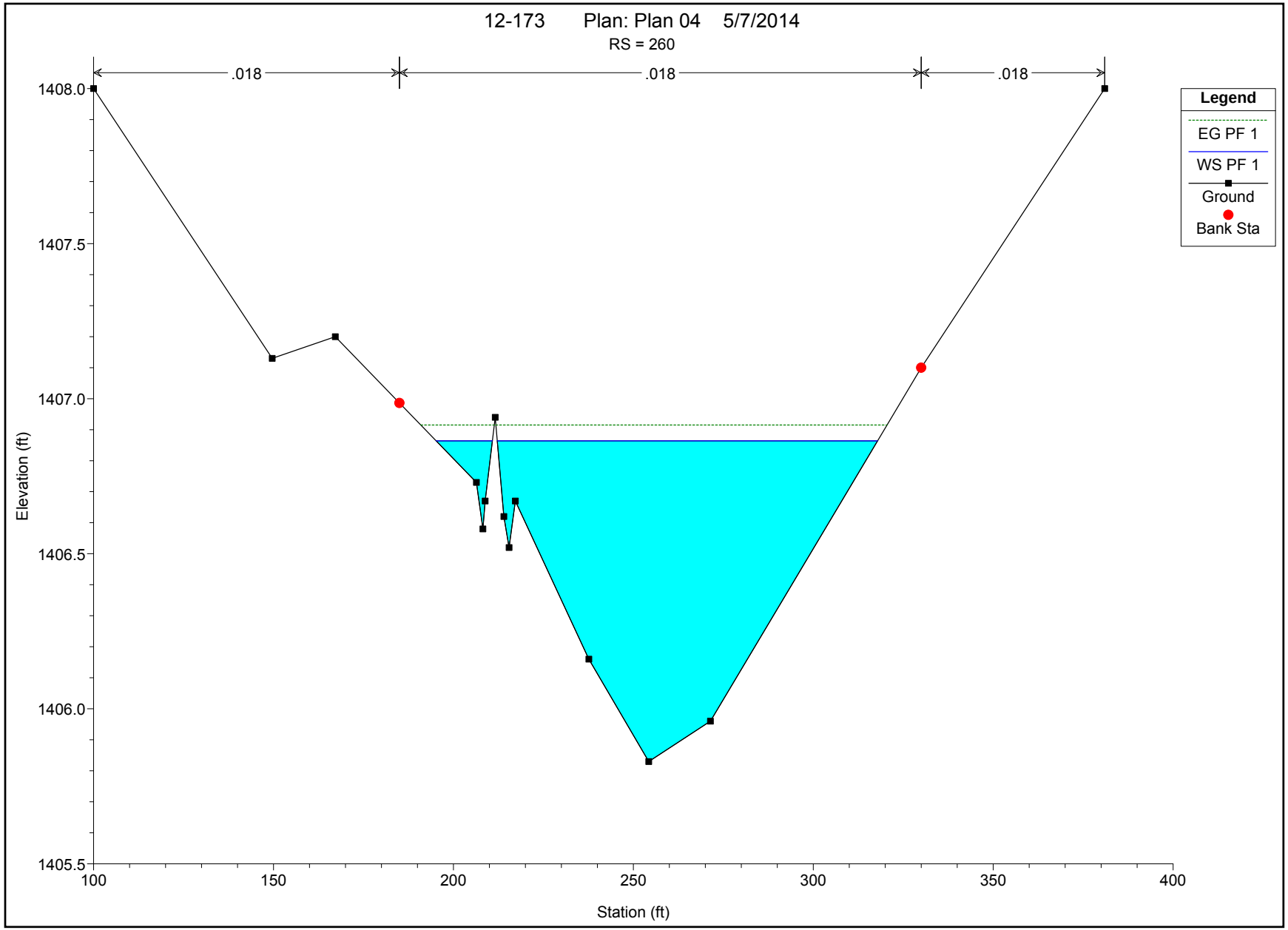
Max Chl Dpth (ft)	1.06	Hydr. Depth (ft)		0.95	
Conv. Total (cfs)	1915.1	Conv. (cfs)		1915.1	
Length Wtd. (ft)	29.00	Wetted Per. (ft)		23.27	
Min Ch El (ft)	1404.68	Shear (lb/sq ft)		0.20	
Alpha	1.00	Stream Power (lb/ft s)	230.00	0.00	0.00
Frctn Loss (ft)	0.11	Cum Volume (acre-ft)		0.01	
C & E Loss (ft)	0.00	Cum SA (acres)		0.02	

Plan: Plan 04 Kelly 100-yr RS: 1 Profile: PF 1

E.G. Elev (ft)	1406.04	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.48	Wt. n-Val.		0.015	
W.S. Elev (ft)	1405.56	Reach Len. (ft)	1.00	1.00	1.00
Crit W.S. (ft)	1405.56	Flow Area (sq ft)		20.90	
E.G. Slope (ft/ft)	0.003689	Area (sq ft)		20.90	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	22.14	Top Width (ft)		22.14	
Vel Total (ft/s)	5.55	Avg. Vel. (ft/s)		5.55	
Max Chl Dpth (ft)	1.02	Hydr. Depth (ft)		0.94	
Conv. Total (cfs)	1910.0	Conv. (cfs)		1910.0	
Length Wtd. (ft)	1.00	Wetted Per. (ft)		23.60	
Min Ch El (ft)	1404.54	Shear (lb/sq ft)		0.20	
Alpha	1.00	Stream Power (lb/ft s)	338.00	0.00	0.00
Frctn Loss (ft)	0.01	Cum Volume (acre-ft)		0.00	
C & E Loss (ft)	0.12	Cum SA (acres)		0.00	

Plan: Plan 04 Kelly 100-yr RS: 0.00 Profile: PF 1

E.G. Elev (ft)	1405.63	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.09	Wt. n-Val.		0.035	
W.S. Elev (ft)	1405.54	Reach Len. (ft)			
Crit W.S. (ft)	1405.38	Flow Area (sq ft)		48.15	
E.G. Slope (ft/ft)	0.009000	Area (sq ft)		48.15	
Q Total (cfs)	116.00	Flow (cfs)		116.00	
Top Width (ft)	103.60	Top Width (ft)		103.60	
Vel Total (ft/s)	2.41	Avg. Vel. (ft/s)		2.41	
Max Chl Dpth (ft)	0.99	Hydr. Depth (ft)		0.46	
Conv. Total (cfs)	1222.8	Conv. (cfs)		1222.8	
Length Wtd. (ft)		Wetted Per. (ft)		104.08	
Min Ch El (ft)	1404.54	Shear (lb/sq ft)		0.26	
Alpha	1.00	Stream Power (lb/ft s)	361.00	0.00	0.00
Frctn Loss (ft)		Cum Volume (acre-ft)			
C & E Loss (ft)		Cum SA (acres)			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.018
.018
.018
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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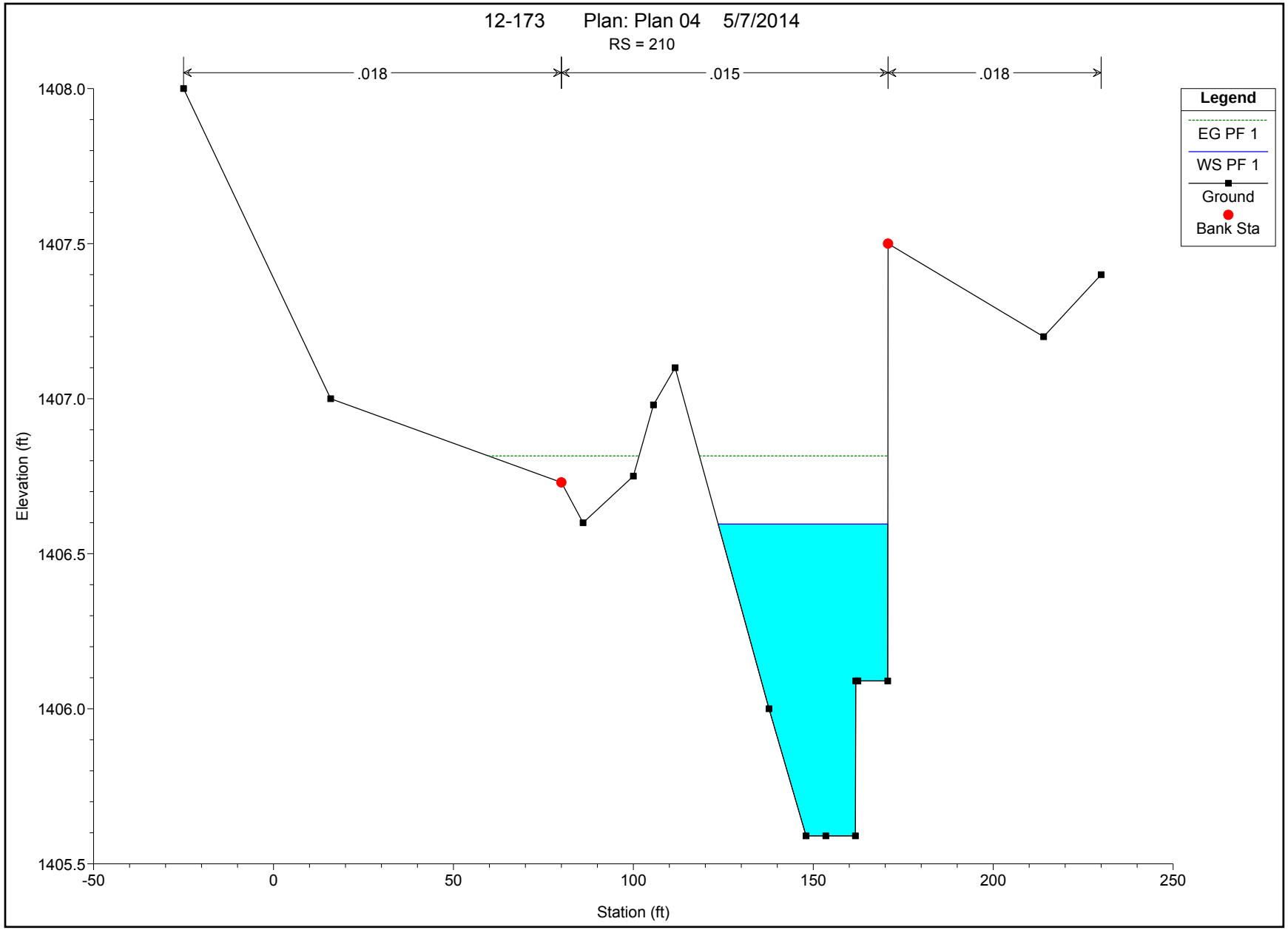
1407.5
1407.0
1406.5
1406.0
1405.5
100
150
200
250
300
350
400
Station (ft)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Legend
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WS PF 1
Ground
Bank Sta
Elevation (ft)
1408.0
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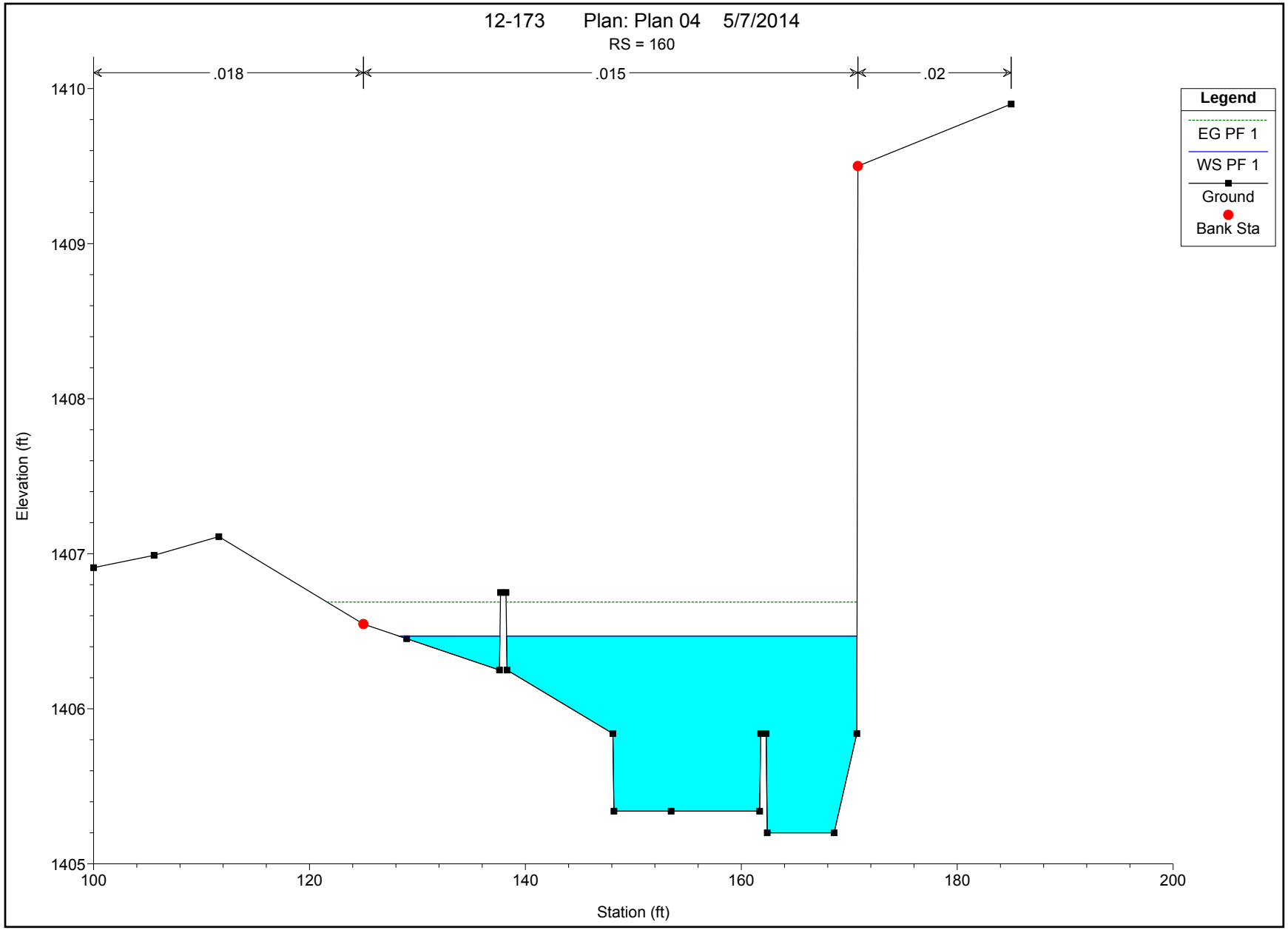
1406.0
1405.5
-50
0
50
100
150
200
250
Station (ft)


12-173 Plan: Plan 04 5/7/2014
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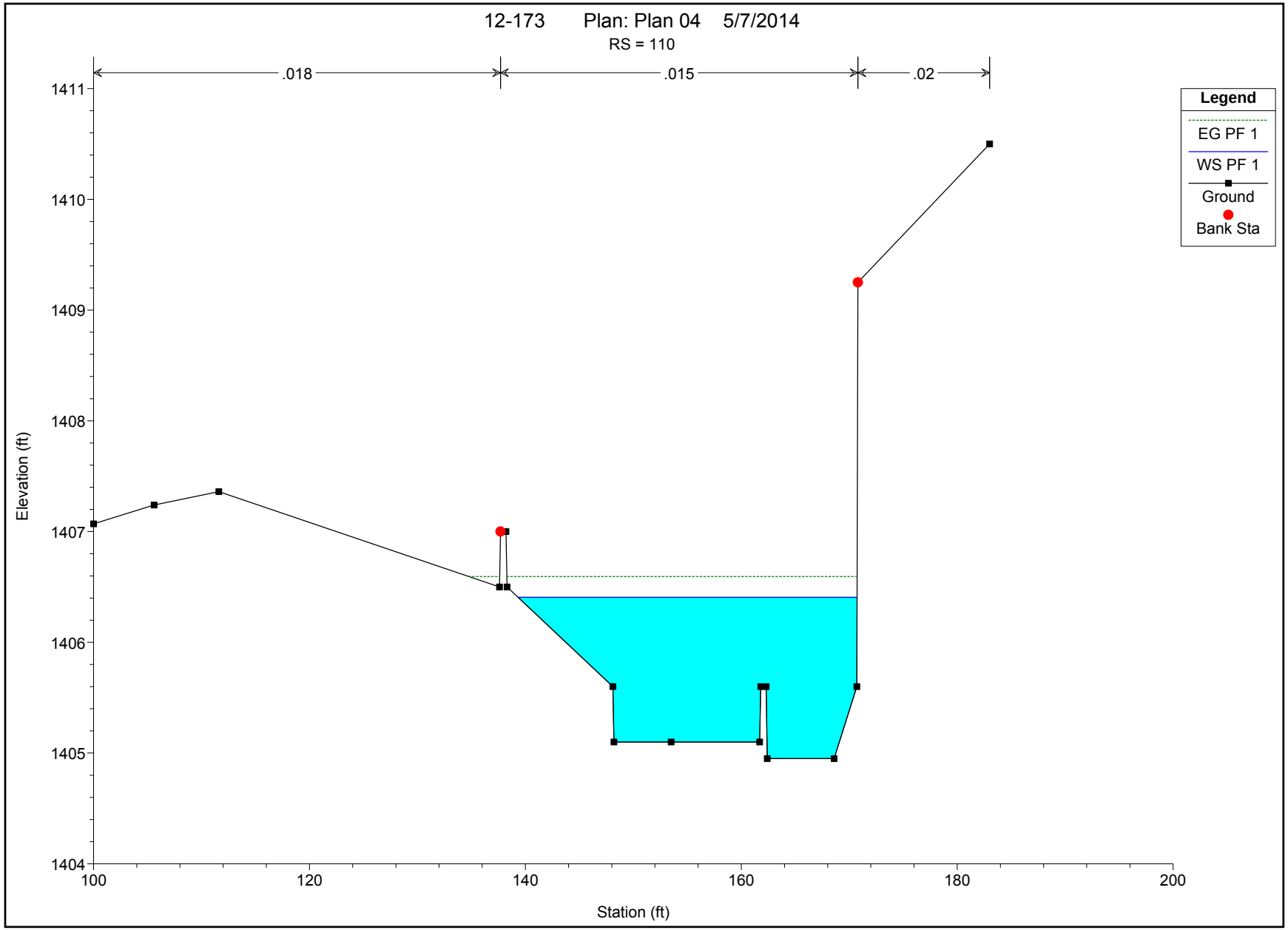
.015
.02
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
1410
1409
1408
1407
1406
1405
100
120
140
160
180
200
Station (ft)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Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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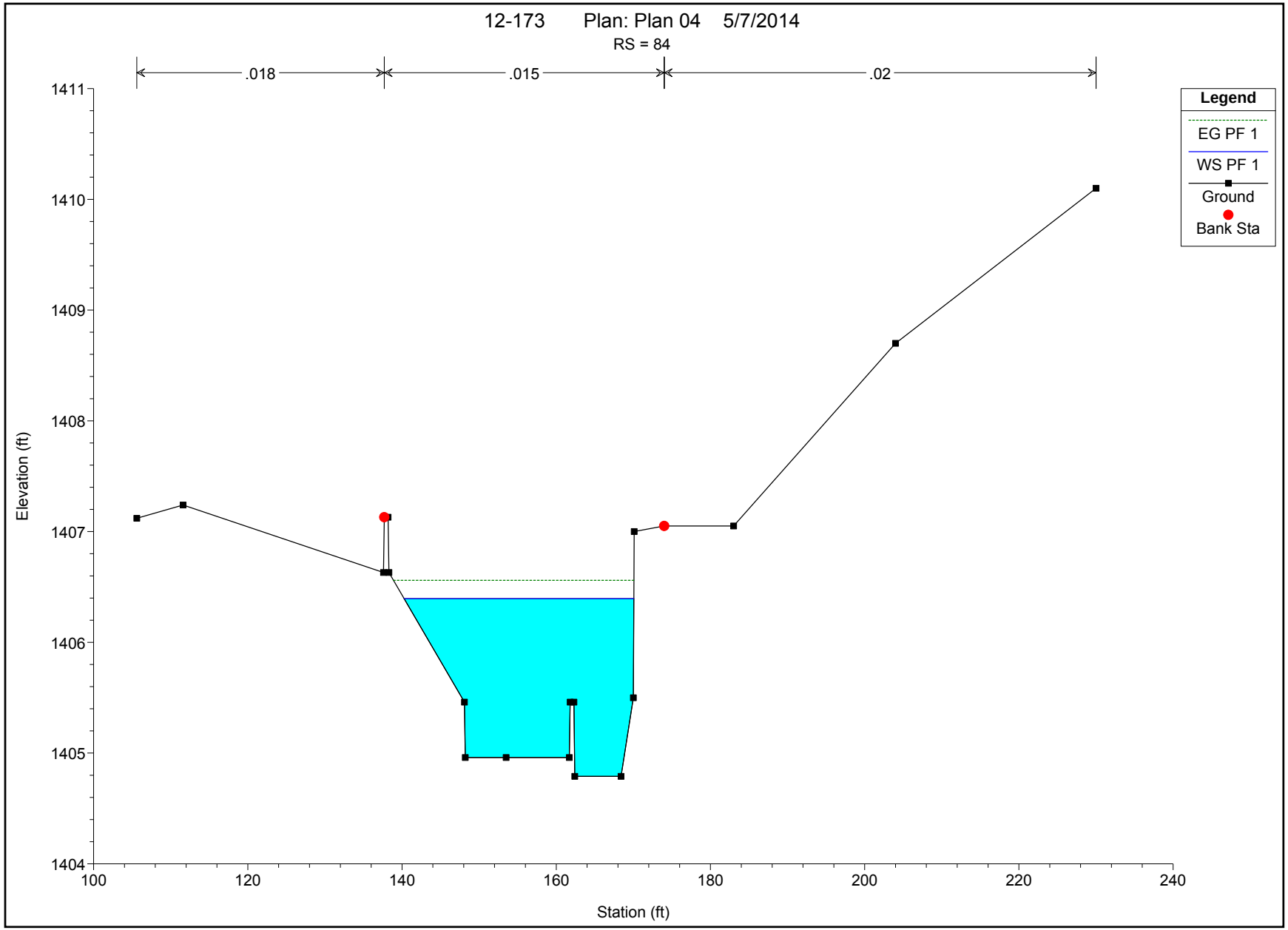
140
160
180
200
Station (ft)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EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
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1408
1407
1406
1405
1404
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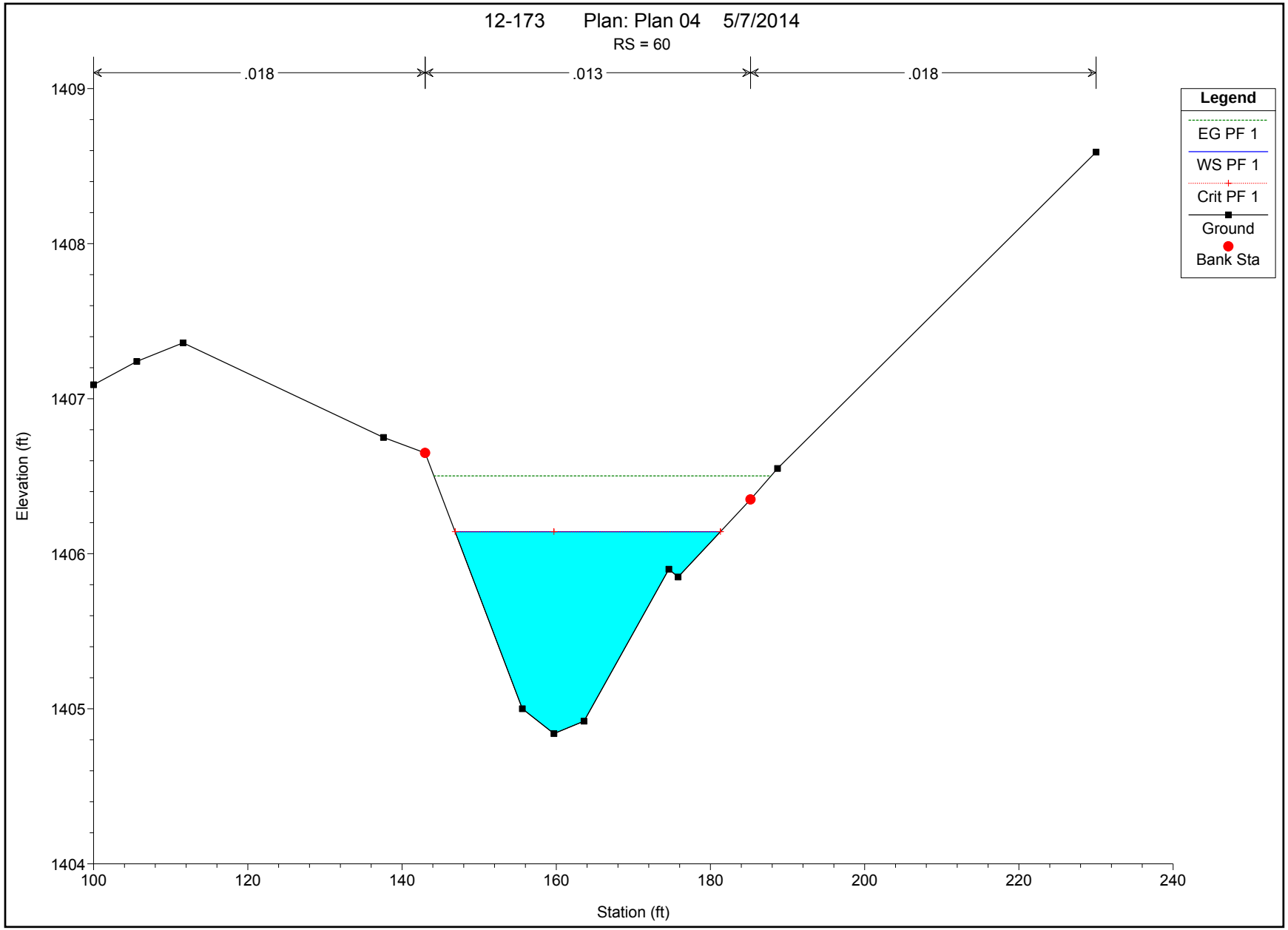
140
160
180
200
220
240
Station (ft)


12-173 Plan: Plan 04 5/7/2014
RS = 60
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.013
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Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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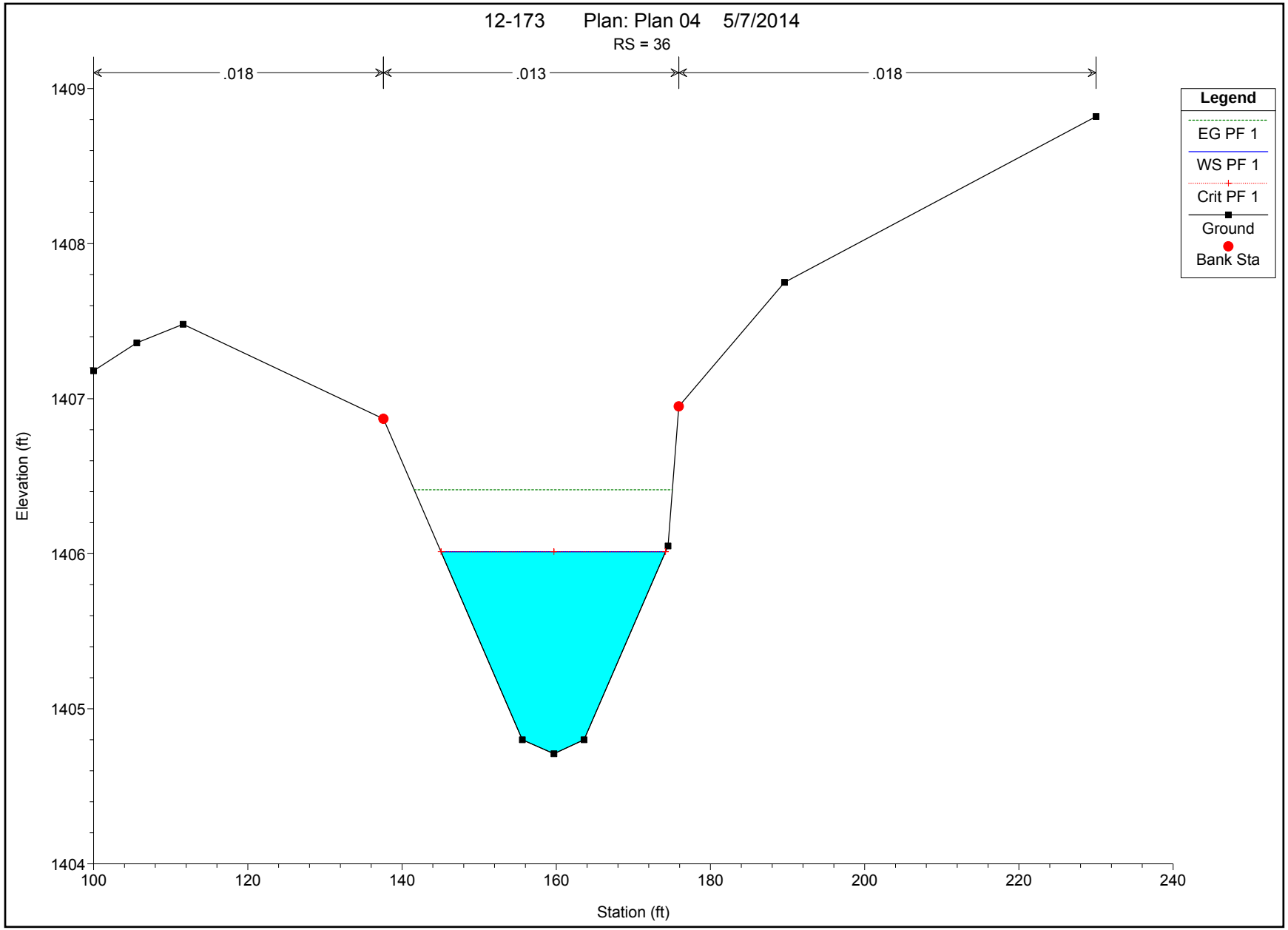
1408
1407
1406
1405
1404
100
120
140
160
180
200
220
240
Station (ft)


12-173 Plan: Plan 04 5/7/2014
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.013
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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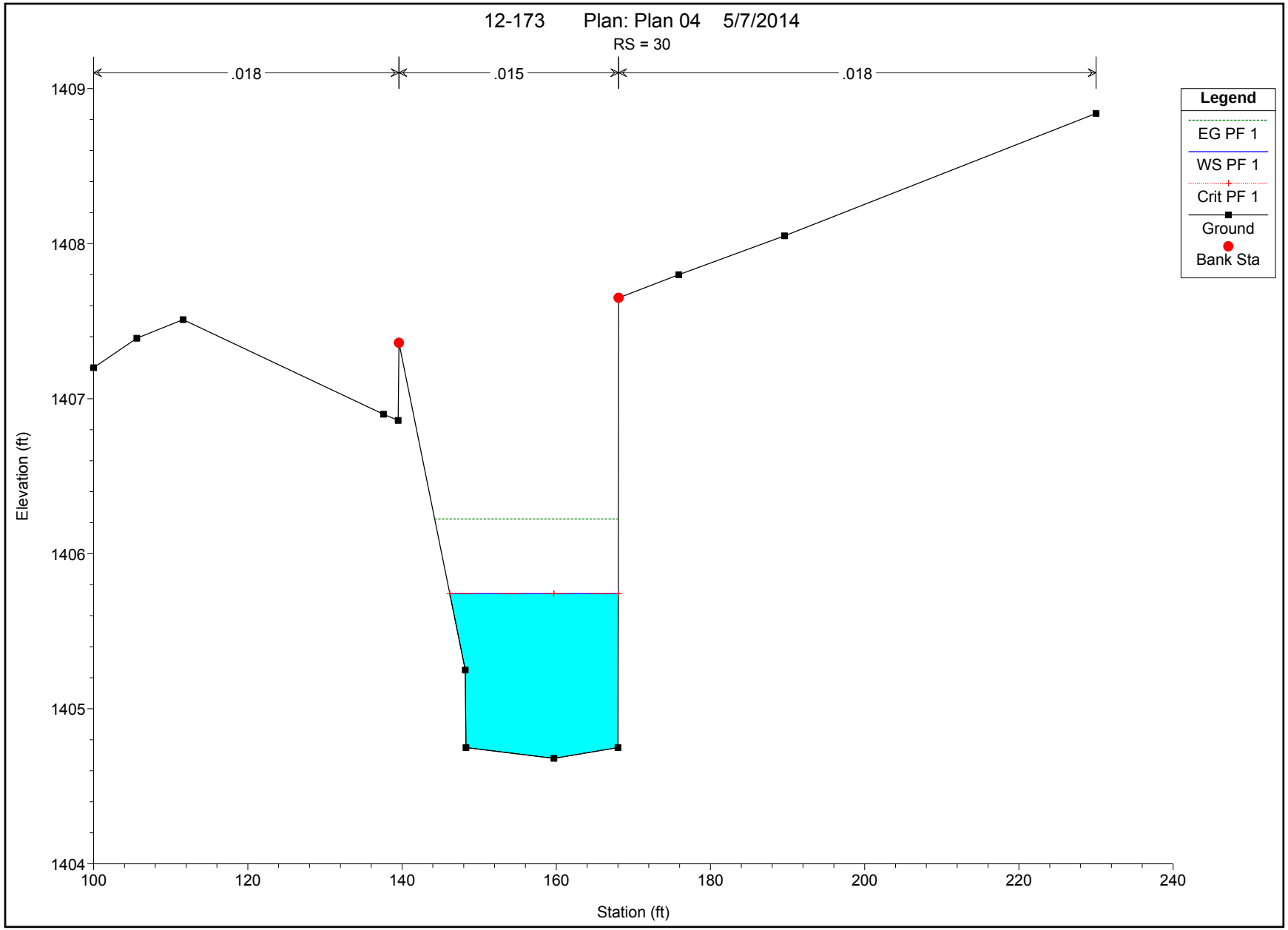
1407
1406
1405
1404
100
120
140
160
180
200
220
240
Station (ft)


12-173 Plan: Plan 04 5/7/2014
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.015
.018
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
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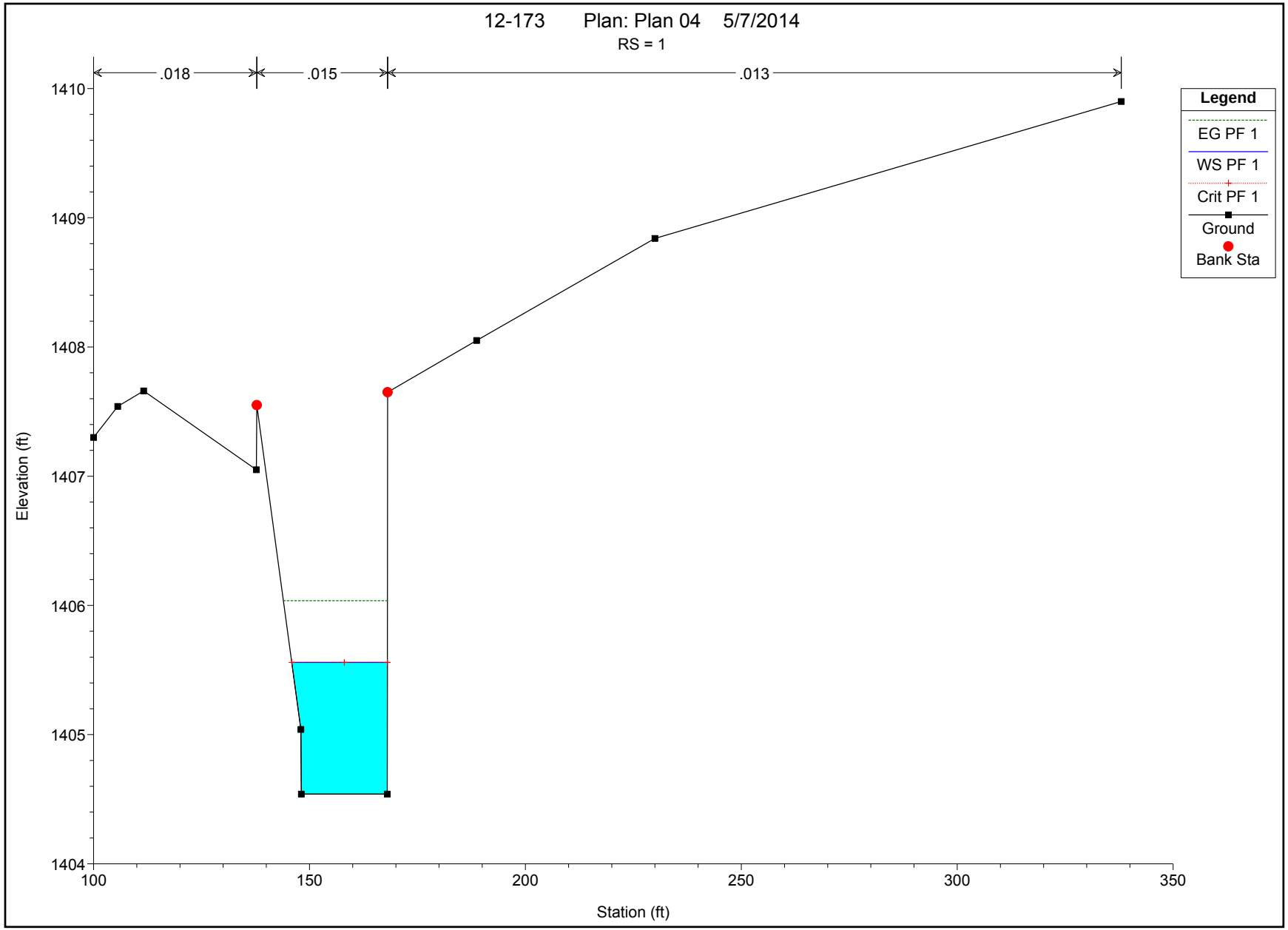
1407
1406
1405
1404
100
120
140
160
180
200
220
240
Station (ft)


12-173 Plan: Plan 04 5/7/2014
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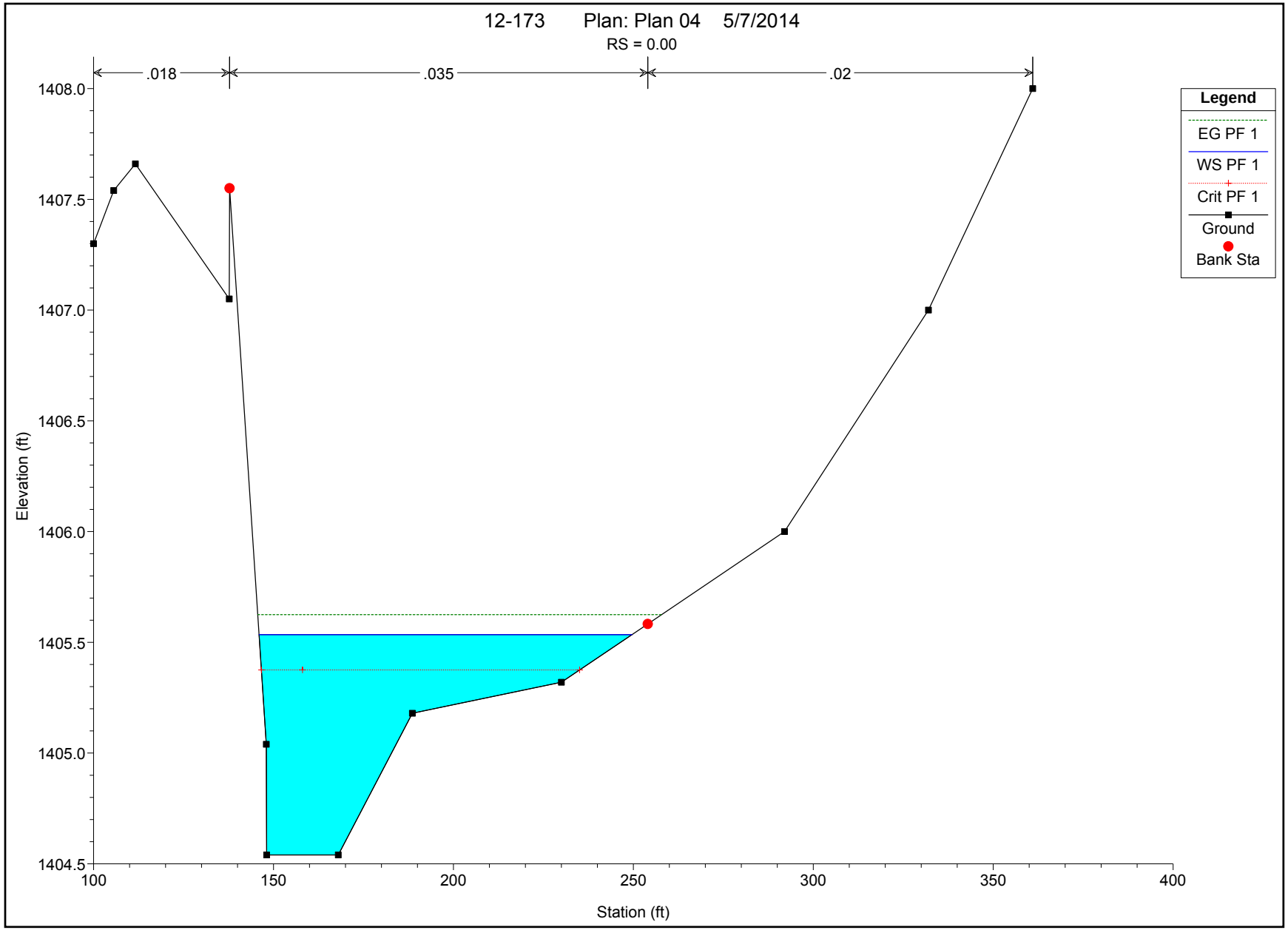
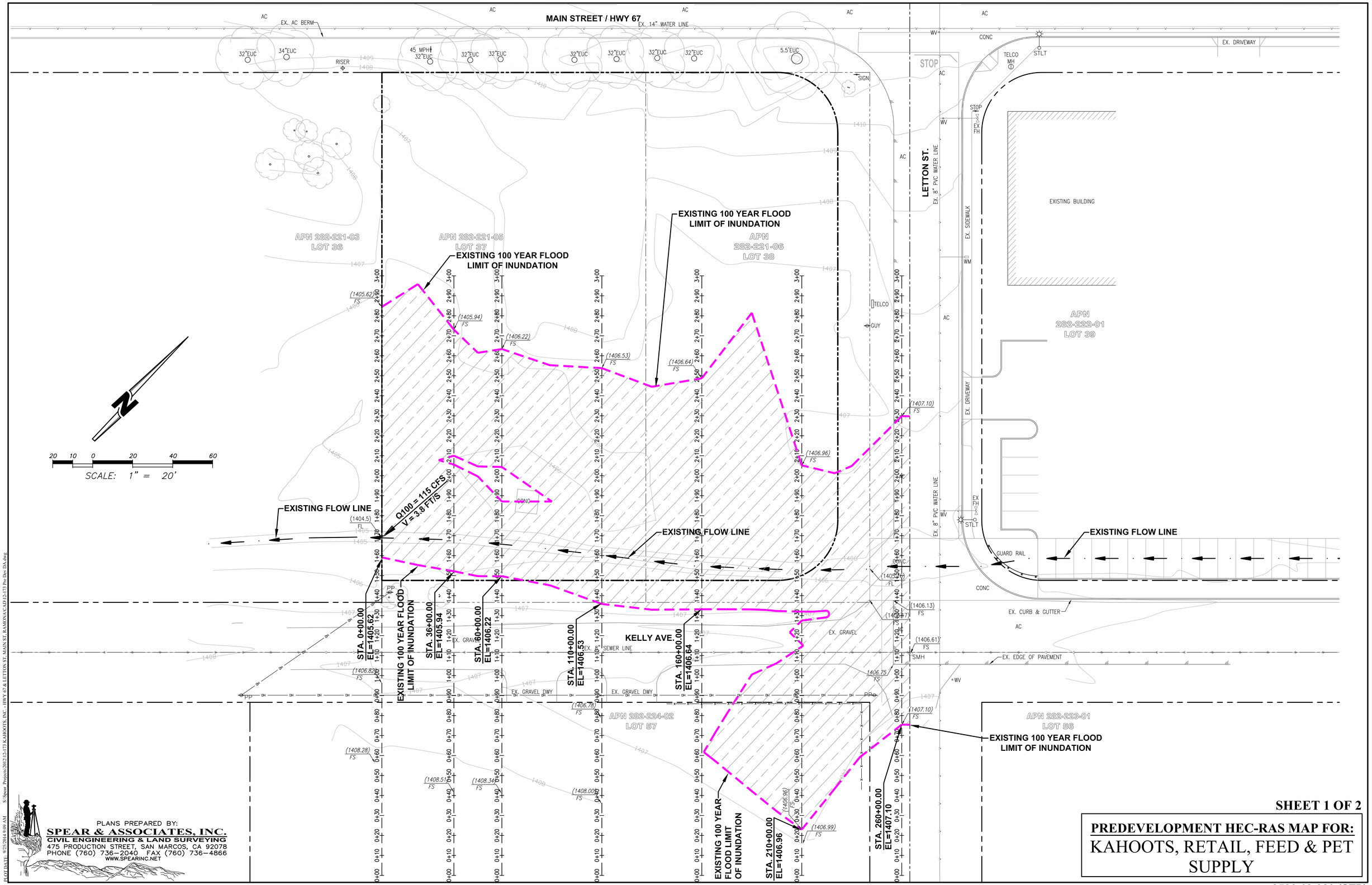
.018
.015
.013
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1410
1409
1408
1407
1406
1405
1404
100
150
200
250
300
350
Station (ft)


12-173 Plan: Plan 04 5/7/2014
RS = 0.00
.018
.035
.02
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
1408.0
1407.5
1407.0
1406.5
1406.0
1405.5
1405.0
1404.5
100
150
200
250
300
350
400
Station (ft)

ATTACHMENT D



SHEET 1 OF 2

PREDEVELOPMENT HEC-RAS MAP FOR:

KAHOOTS, RETAIL, FEED & PET SUPPLY

3500 12-020 (STP)

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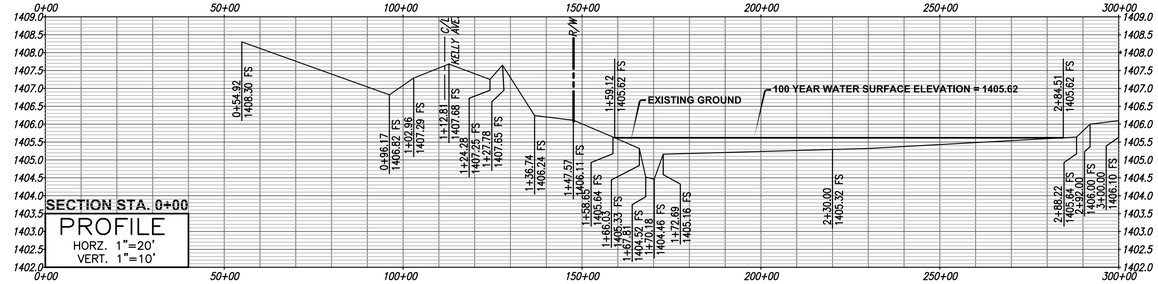

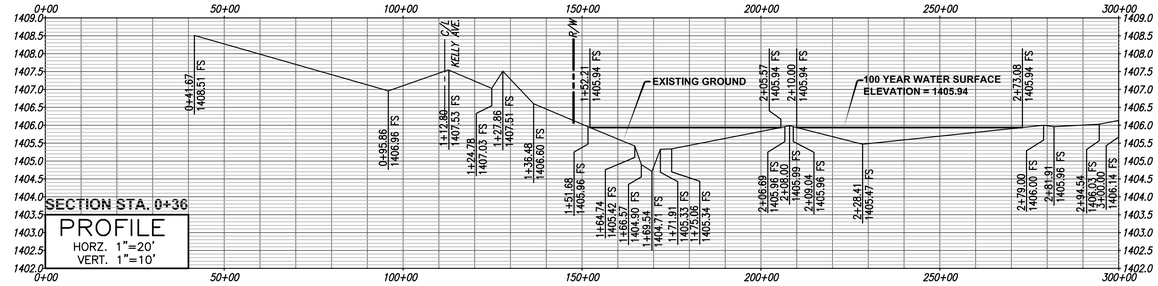

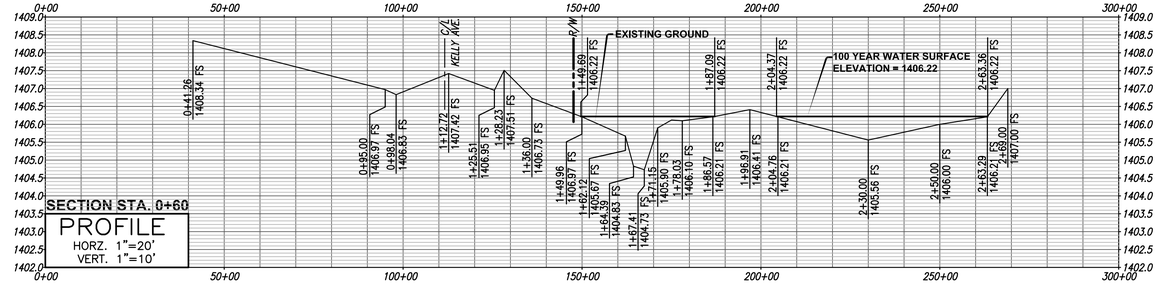

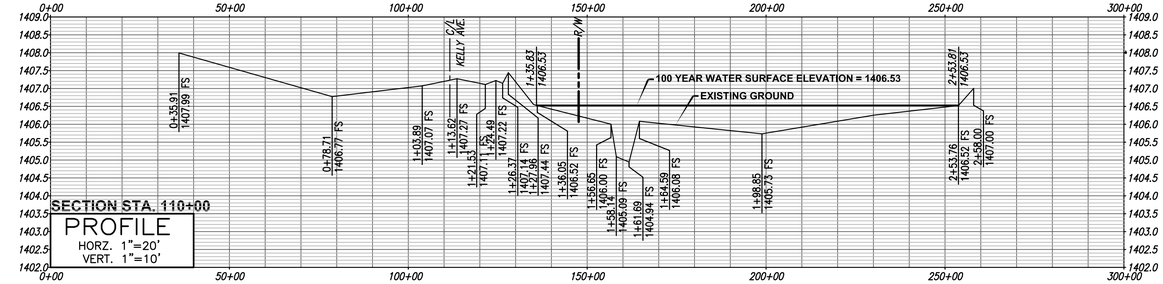

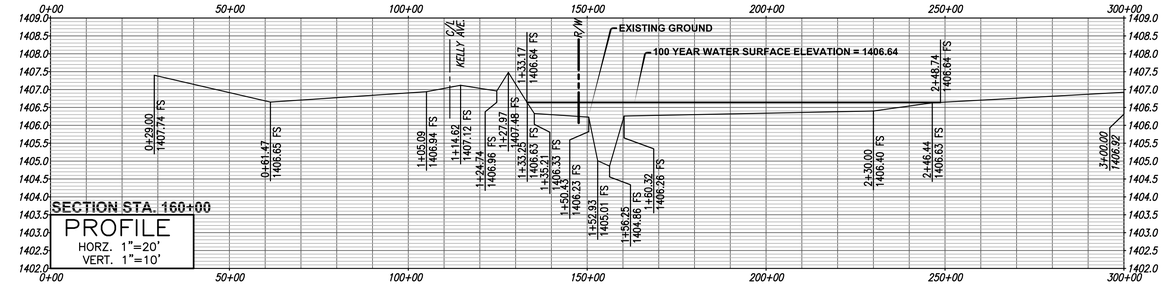

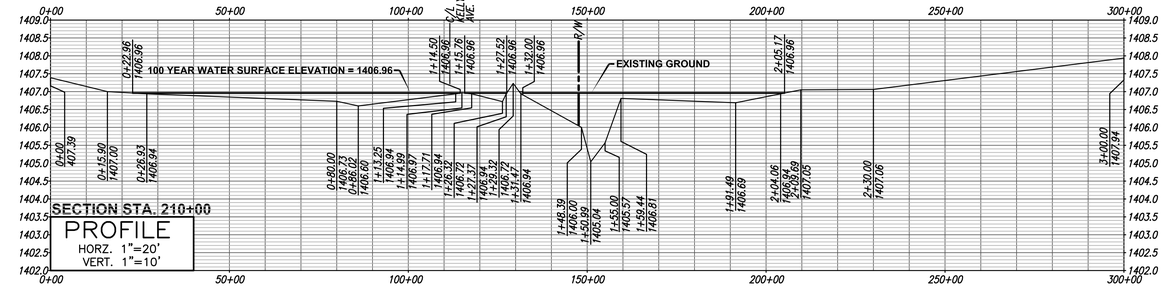

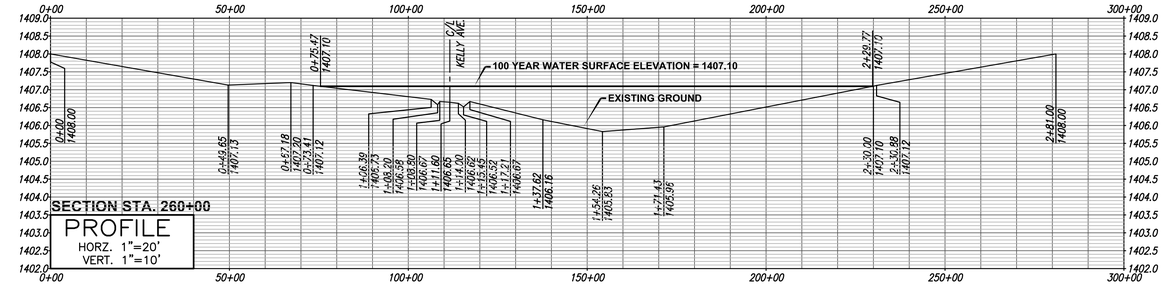

20 10 0 20 40 60

SCALE: 1" = 20'

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SHEET 2 OF 2

PREDEVELOPMENT HEC-RAS SECTIONS FOR:

KAHOOTS, RETAIL, FEED & PET SUPPLY

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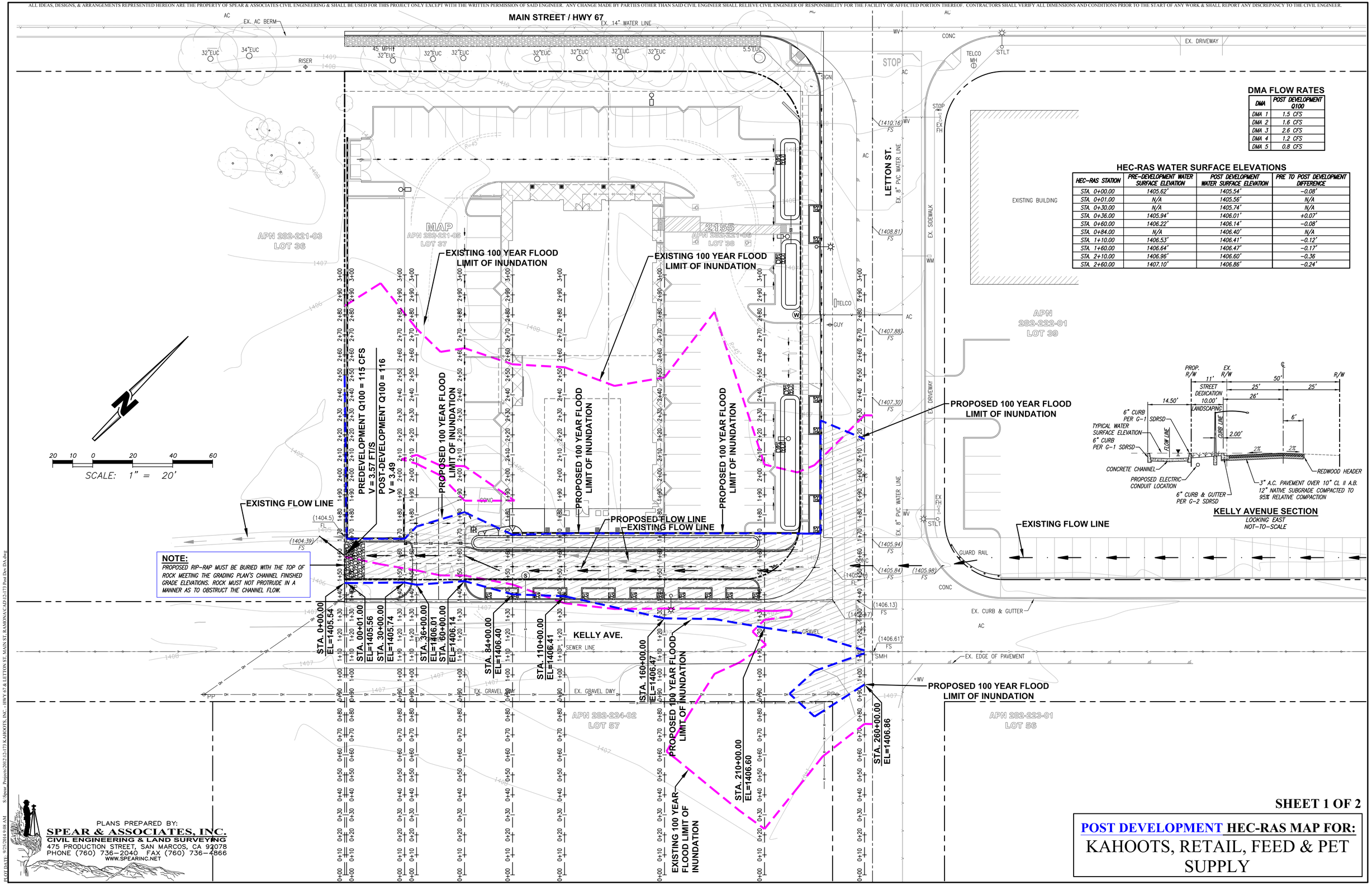

DMA FLOW RATES

DMA	POST DEVELOPMENT Q100
DMA 1	1.5 CFS
DMA 2	1.6 CFS
DMA 3	2.6 CFS
DMA 4	1.2 CFS
DMA 5	0.8 CFS

HEC-RAS WATER SURFACE ELEVATIONS

HEC-RAS STATION	PRE-DEVELOPMENT WATER SURFACE ELEVATION	POST DEVELOPMENT WATER SURFACE ELEVATION	PRE TO POST DEVELOPMENT DIFFERENCE
STA. 0+00.00	1405.62'	1405.54'	-0.08'
STA. 0+01.00	N/A	1405.56'	N/A
STA. 0+30.00	N/A	1405.74'	N/A
STA. 0+36.00	1405.94'	1406.01'	+0.07'
STA. 0+60.00	1406.22'	1406.14'	-0.08'
STA. 0+84.00	N/A	1406.40'	N/A
STA. 1+10.00	1406.53'	1406.41'	-0.12'
STA. 1+60.00	1406.64'	1406.47'	-0.17'
STA. 2+10.00	1406.96'	1406.60'	-0.36
STA. 2+60.00	1407.10'	1406.86'	-0.24'

NOTE:
PROPOSED RIP-RAP MUST BE BURIED WITH THE TOP OF ROCK MEETING THE GRADING PLAN'S CHANNEL FINISHED GRADE ELEVATIONS. ROCK MUST NOT PROTRUDE IN A MANNER AS TO OBSTRUCT THE CHANNEL FLOW.

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SHEET 1 OF 2

POST DEVELOPMENT HEC-RAS MAP FOR:
KAHOOTS, RETAIL, FEED & PET SUPPLY

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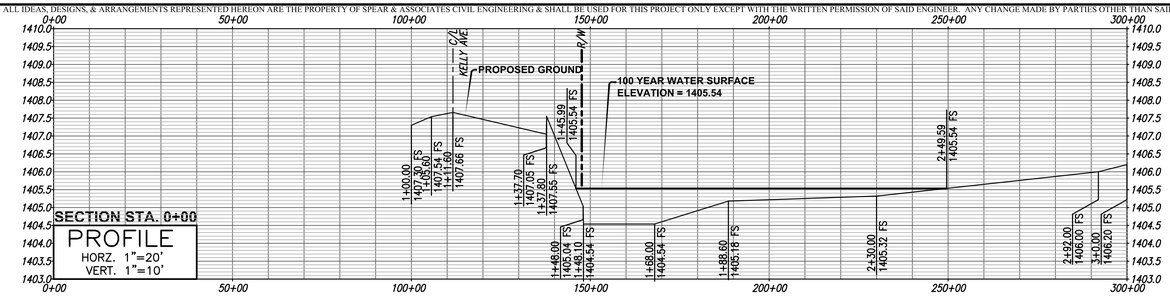

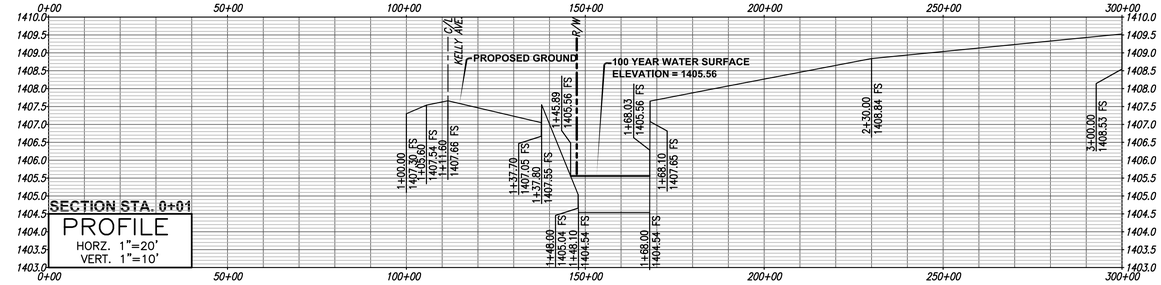

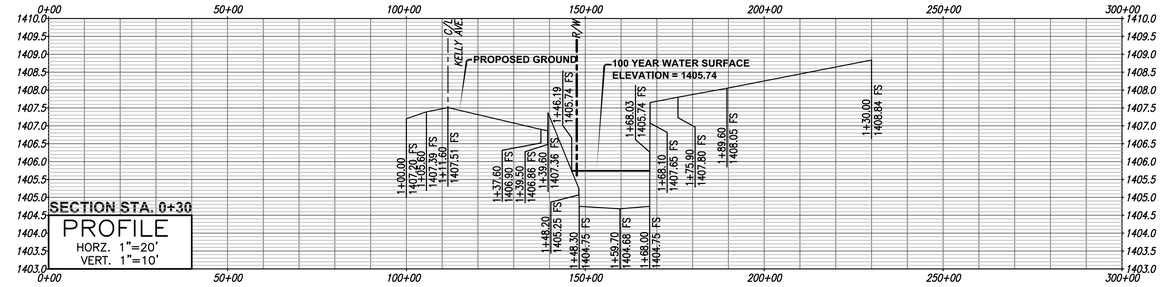

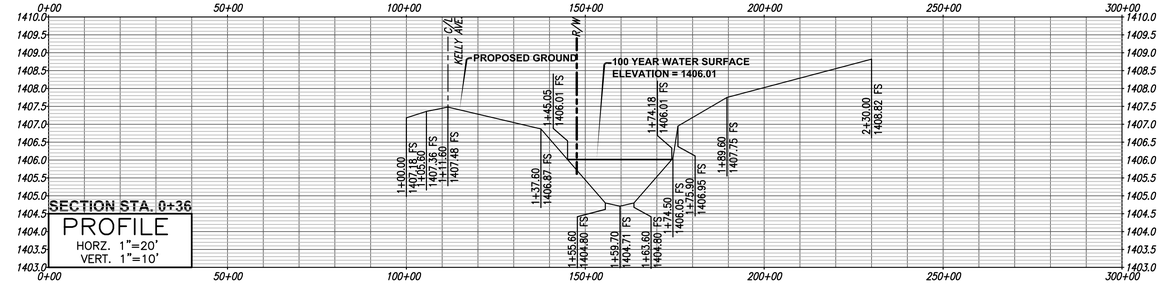

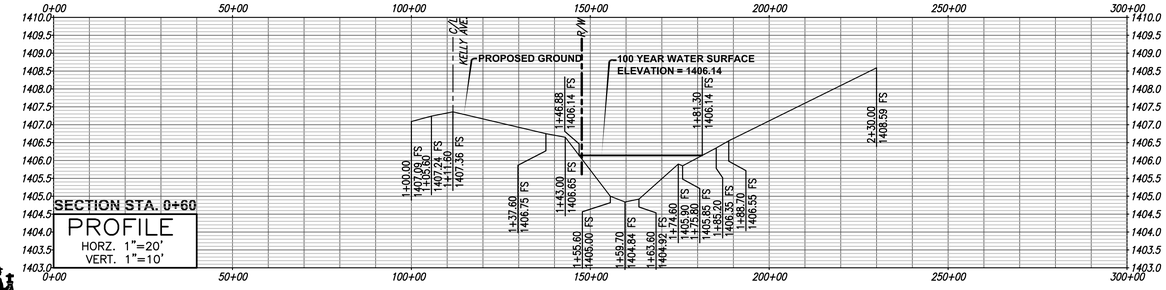

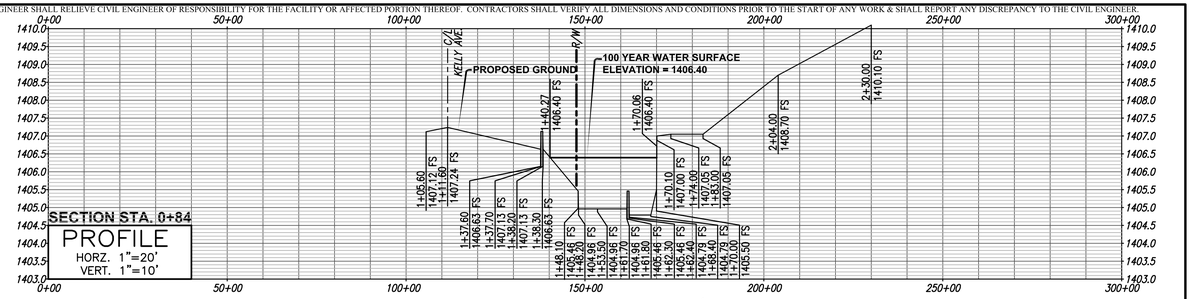

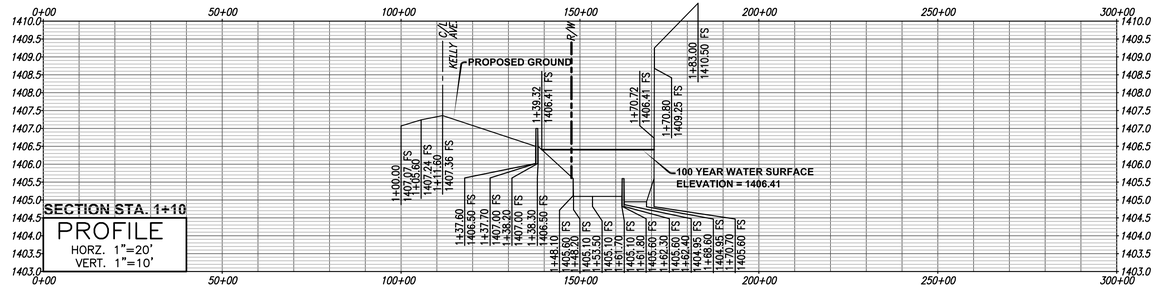

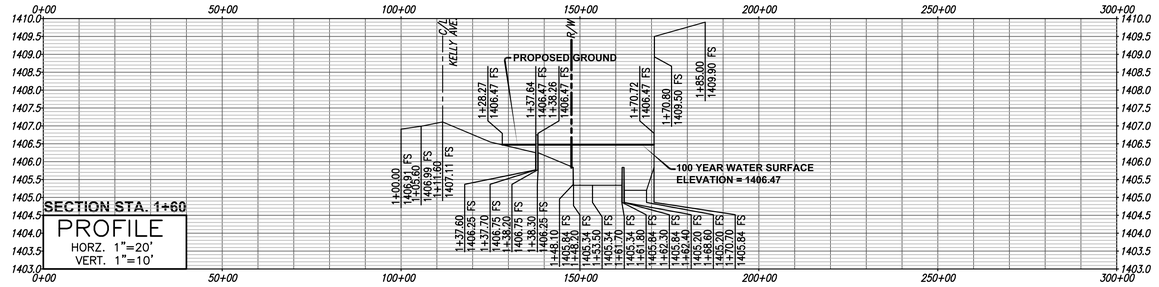

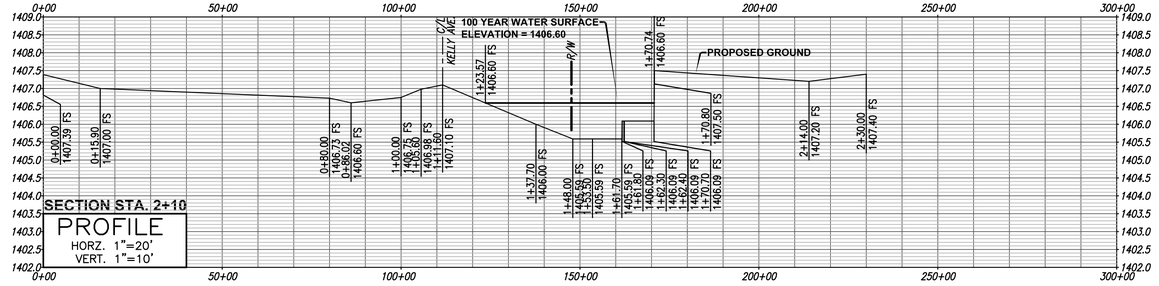

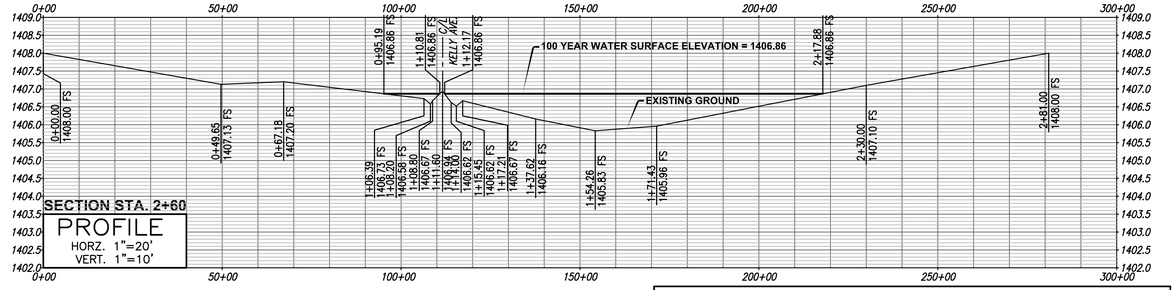

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SHEET 2 OF 2

POST DEVELOPMENT HEC-RAS SECTIONS FOR:
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SHEET	COUNTY OF SAN DIEGO DEPARTMENT OF PUBLIC WORKS	SHEETS
1		1

OFFSITE DRAINAGE AREA MAP FOR:

KAHOOTS, RETAIL FEED & PET SUPPLIES