BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

TECHNICAL MEMORANDUM

Date: April 12, 2019 **BKF Job Number: 181006**

To: Kenner Guerrero
Associate Engineer
City of Pico Rivera

From: **Daniel Villines**
Sr. Project Manager
BKF

Subject: **Preliminary Hydraulic Impact Analyses**
Pico Rivera Regional Bikeway Project (CIP No. 21280)

Introduction

The City of Pico Rivera (City) is proceeding with the planning and design of the Pico Rivera Regional Bikeway Project, CIP 21280 (Project). The Project will consist of approximately 1.5 miles of bicycle lanes along Mines Avenue from the Rio Hondo Channel to the San Gabriel (River). The Project will also include a dedicated bicycle bridge crossing of the San Gabriel River (River).

The proposed bridge crossing of the River will be locate approximately 2,600 feet north of the Mines Avenue alignment. The layout for the bridge presently proposes a bridge structure that will consist of a steel trust of three spans supported by two support piers founded in the riverbed. The bridge abutments will be located outside of the main conveyance area. As such, other than the presence of the pier supports, the hydraulics of the River conveyance will remain predominately unaffected.

The proposed bicycle lanes will consist of a Class I bike path along Mines Avenue from the Rio Hondo Channel to the River. As a part of the Project, several improvements to Mines Avenue will be made. The improvements will include pavement reconstruction, reconfigured travel ways and parking lanes, and the reconfiguration of the median to include the proposed bike trail. The Project proposes to include the construction of two bioswales along both sides of the median bikeway.

In the vicinity of River, the proposed path will turn north to align along the westerly edge of the San Gabriel Spreading Grounds and then turn east to align with the location of the proposed bridge crossing of the River. This portion of the bike path will coincide with existing access roads

located along the perimeter of the spreading grounds. Once the proposed bike path crosses the River, the path will turn north to Whittier Boulevard. This portion of the path will be aligned along the easterly side of the River and coincide with the existing Class I bikeway.

Figure 1 shows the Project location and the general alignment of its various components.

Purpose

1. The purpose of this technical memorandum is to evaluate the hydraulic impact of the proposed bicycle bridge structure on the hydraulic characteristics of the San Gabriel River.

2. This technical memorandum will also discuss the impacts to the existing storm drain facilities affected by the proposed improvements to Mines Avenue.

Hydraulic Impacts to the San Gabriel River

Methodology

The evaluation consisted of the creation of a base-line, pre-Project model of the River using the US Army Corps of Engineers River Analysis System (HEC-RAS). The pre-Project model was then revised to account for the presence of the proposed bridge crossing. The revised model constituted the post-project condition model. The differences in the hydraulic characteristics of the River, as noted in the changes between the pre- and post-Project condition models, were then assessed and reported.

At this stage in the Project's development, the survey of the channel is not yet complete. As such, the pre-Project model consists of an approximation of the channel geometry based on USGS mapping, scaled aerial photographs, and available GIS elevation data.

Given that the pre-Project model for the channel was used in both analyses, i.e. only the proposed bridge structure was added to the pre-Project model to create the post-Project model, any minor discrepancies in the pre-Project model will be carried forward into the post-Project model and the hydraulic effects of these discrepancies would be cancelled out. In other words, the post-Project model's hydraulics are equivalent to the pre-Project model's hydraulics without the inclusion of the proposed bridge crossing leaving the effects of the proposed bridge as the only impact to River hydraulics.

Hydrology

The analysis was performed for the 100-year peak discharge in the San Gabriel River. In 2003, the Los Angeles County Department of Public Works published 100-year flow rates

for the River in a report entitled "San Gabriel River and Montebello Forebay Water Conservation System" (LACDPW Report). The LACDPW Report stated the peak 100-year flow rate in the River at Washington Boulevard as 14,000 cfs.

Hydraulic Modeling

The hydraulic analysis of the River was performed using the HEC-RAS computer software program. HEC-RAS uses cross-sectional data, a given flow rate, and boundary conditions to compute flow depths and velocities along the analysis reach. For this study, the analysis spanned from the drop structure located downstream of Washington Boulevard upstream to the drop structure located to the south of Whittier Boulevard, a distance of approximately 7,500 feet (Project Reach).

In general, cross sections were located at 400-foot intervals. This spacing recognizes the predominately prismatic configuration of the trapezoidal channel section that forms the River. Intermediate cross sections were added at locations where access ramps interrupted the prismatic geometry of the channel. A HEC-RAS Work Map, Figure 2, was prepared that shows the location of the sections used in both models.

The hydraulic modeling process for the project involved the following steps:

- Pre-Project: Model the Project Reach of the San Gabriel River
- Post-Project: Modify the pre-Project Model to include the proposed bicycle bridge and its associated pier supports.

For both models, Manning's n-values were set to reflect the relative roughness of the channel surface. The n-values that were used are based on past modeling judgement. Table 1 below summarizes the n-values used in the analysis.

Table 1
Summary of Manning n-Values

Surface Description	Manning's n-Value
Riprap Surfaces	0.035
Mowed Vegetative or Earthen Surfaces	0.025
Concrete Surfaces	0.014

The River-channel slope is relatively flat and the vegetated channel bottom is relative rough. Both of these attributes indicate that subcritical flow exists in the channel. Therefore,

the depth of flow and its corresponding water surface elevation (WSEL) at the downstream drop structure will act as a hydraulic control point for the analysis.

The depth of flow over the drop structure was determined by a weir analysis of the drop structure's rectangular opening. The weir coefficient was assumed to be equal to 3.0 to account for its relatively narrow width and its sharp downstream drop.

As noted above, the channel is fairly prismatic. As such losses due to expansion and contractions are fairly minor. However, small changes in the channel base width were noted during the creation of the pre-Project model. Therefore, expansion and contraction coefficients of 0.3 and 0.1 were used, respectively.

The proposed bridge will be located approximately 7,000 feet upstream of the downstream model limit. For the post-Project analysis the proposed bicycle bridge crossing was modeled based on information for possible bridge configurations. At this time, the bridge is anticipated to consist of an above-deck steel trust of three spans supported by two support piers founded in the riverbed. A width of 4 feet was assumed for each bridge pier and debris effects were assumed to be negligible. Figure 3 shows a preliminary layout of the proposed bicycle bridge crossing of the River.

The bridge abutments will be located outside of the main conveyance area of the River and a narrowing of the channel to shorten the bridge span is not proposed.

Losses in flow energy related to bridge structures are caused by the frictional contact and the obstruction of flow caused by the introduction of the bridge components to a riverine system. Constrictions in conveyance area may also contribute to losses but are not proposed for this Project.

Under subcritical flow conditions, such as those that exist in the River, a loss in energy will result in a higher WSEL upstream of the bridge structure, and the number of pier supports is proportional the bridge's impact to the upstream WSEL. For this reason, the proposed bicycle bridge was modeled under the more conservative configuration of two piers and three spans.

Results

The results of the hydraulic analyses are reported in Table 2, below. Detailed summary sheets and analytical cross sections of both the pre- and post-Project analyses are included in the technical appendices.

Table 2
Results of Hydraulic Analyses
100-Year Flow (Q = 14,000 cfs)

Station U/S to D/S	Pre-Project WSEL (Ft)	Post-Project WSEL (Ft)	Difference (Ft)
82+65	155.96	155.98	**0.02**
82+65	155.75	155.77	**0.02**
81+15**	155.35	155.38	**0.03**
80+95**	155.33	155.33	0.00
79+00	155.06	155.06	0.00
75+35	154.79	154.79	0.00
71+70	154.49	154.49	0.00
68+05	154.21	154.21	0.00
64+40	153.89	153.89	0.00
60+75	153.57	153.57	0.00
57+10	153.28	153.28	0.00
53+50	153.11	153.11	0.00
49+80	152.76	152.76	0.00
46+15	152.51	152.51	0.00
42+50	152.32	152.32	0.00
38+90	152.15	152.15	0.00
35+00	151.95	151.95	0.00
31+40	151.81	151.81	0.00
27+80	151.55	151.55	0.00
24+20	151.12	151.12	0.00
20+60	150.60	150.60	0.00
17+00	150.28	150.28	0.00
13+50	149.93	149.93	0.00
11+60*	149.81	149.81	0.00
11+05*	149.79	149.79	0.00
10+50	149.42	149.42	0.00
10+15	149.26	149.26	0.00
10+00	149.17	149.17	0.00

* Washington Boulevard Bridge Location
** Proposed Bicycle Bridge Location

A review of Table 2 indicates the following points of interest that are described below:

- Downstream of the proposed bridge structure, the water surface elevation is constant across both the pre-Project and the post-Project condition models. This is to be expected given that the River is flowing at subcritical depths and velocities. Under subcritical flow, downstream losses are cumulative from the downstream point of hydraulic control, i.e. the existing drop structure located downstream of Washington Boulevard. The analysis progresses upstream from that point. Since the

Project affects no changes to the River downstream of the proposed bridge the losses downstream of the proposed bridge are constant in both the pre- and post-Project conditions.

- Upstream of the proposed bridge structure the changes in water surface are minimal. As a method of reference, the Federal Emergency Manage Agency requires that localized changes in water surface brought about by projects in the floodplain match the pre-project water surfaces upstream and downstream of the proposed project to within six inches. FEMA considers a change within six inches to be less than significant. As such, the effects of the proposed bicycle bridge crossing are well within this criteria and its impacts to the River can be characterized as being less than significant.

- As the design progresses, the effects of general and localized scour associated with the placement of the piers in the earthen riverbed will be determined. The design of the pier foundations will accommodate the computed scour depths.

Hydraulic Impacts to Mines Avenue

A field review of Mines Avenue indicates that an existing storm drain is located below the Mines Avenue alignment. Changes to the surface of Mines Avenue will need to accommodate or possibly relocate the existing catch basin inlets to the storm drain that are affected by the Project.

The proposed improvements to Mines Avenue will include Low Impact Development (LID) features in order to improve the quality of storm water runoff from the right-of-way. The following is a lists the LID features that are presently proposed for incorporation into the Project:

- Bike path to be constructed of permeable pavement
- Bioswales incorporated in the proposed median on either side of the bike path
- Parking lanes constructed with permeable asphalt
- Reduction of the number of travel lanes

The proposed LID features will also serve to increase the amount of pervious area within the Mines Avenue right-of-way. As a result on the increase, storm water will be more susceptible to infiltration and the magnitude of storm water runoff intercepted by the existing storm drain system will be reduced. Therefore, the Project will have a positive effect on the capacity and water quality of storm water conveyed in the affected storm drain lines and the Project's impacts on storm water will be less than significant.

• • •

Please feel free to call me at (949) 526-8488 should you have any questions.

Daniel D. Villines, PE
Sr. Project Manager

CITY OF PICO RIVERA
PICO RIVERA REGIONAL BIKEWAY
LOCATION MAP

Figure 1 April 2019

BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

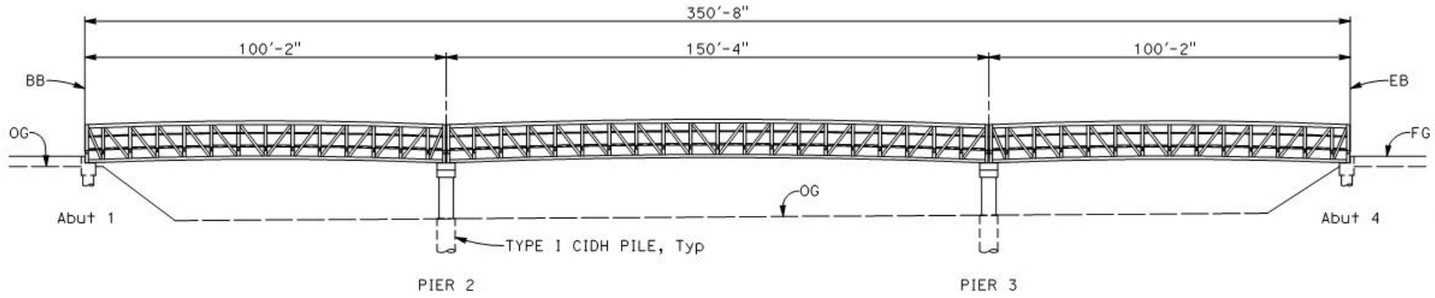
0 600 1200 FEET

CITY OF PICO RIVERA

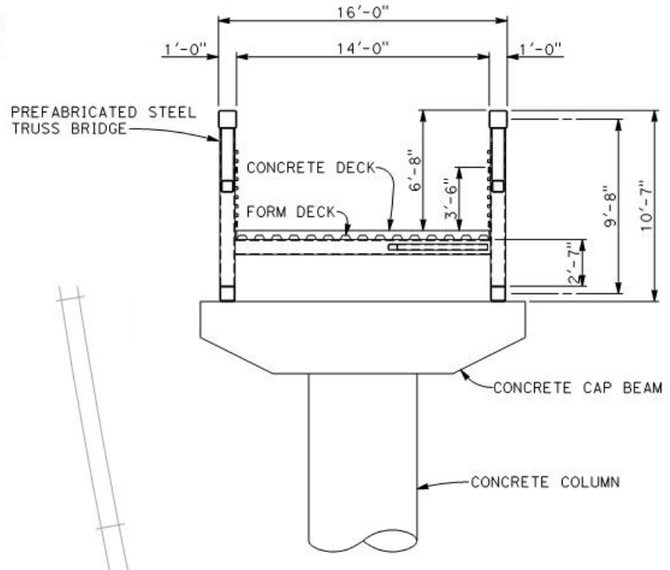
PICO RIVERA REGIONAL BIKEWAY
HEC-RAS WORKMAP

Figure 2 April 2019

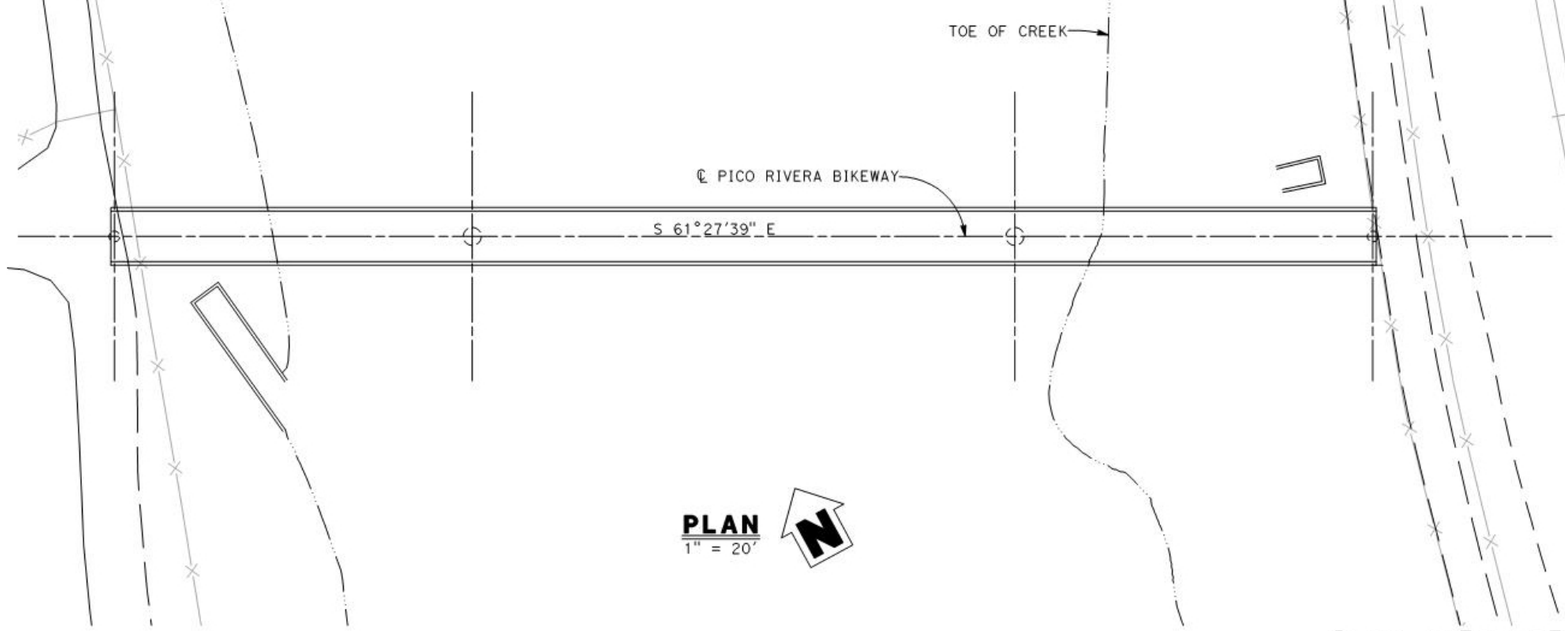
BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS



ELEVATION
1" = 20'



TYPICAL SECTION
1/4" = 1'-0"



PLAN
1" = 20'

PLAN CHECK SET/NOT FOR CONSTRUCTION (01/30/19)

DESIGNED BY: DPC
DRAWN BY: DM
CHECKED BY:
SCALE: AS SHOWN

REV	DATE	DESCRIPTION

BIGGS CARDOSA ASSOCIATES INC
STRUCTURAL ENGINEERS
865 The Alameda
San Jose, California 95126
408-296-5515

GENERAL PLAN - OPTION 1
PICO RIVERA BIKEWAY
PICO RIVERA CALIFORNIA
(2018347_S1_option_1)

SHEET NUMBER S-1 OF SHEETS
DRAWING NO. 2018347_S1
2018347

CITY OF PICO RIVERA
PICO RIVERA REGIONAL BIKEWAY
PRELIMINARY SAN GABRIEL RIVER BICYCLE BRIDGE LAYOUT

Figure 3 April 2019

BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

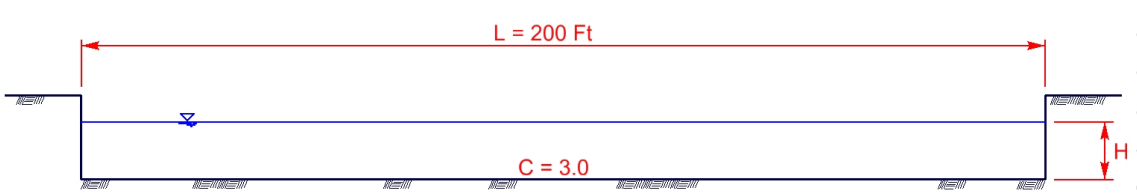
BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

San Gabriel River
Weir Structure Downstream of Washington Boulevard
Downstream Controlling Water Surface Elevation
Calculation

City of Pico Rivera Regional Bikeway Project (CIP No. 21280)
Bikeway Bridge Crossing of the San Gabriel River
Downstream Water Surface Elevation Determination

Given:

Weir section at Station 10+00 establishing downstream control of subcritical water surface.



WEIR SECTION AT STATION 10+00

Q = 14,000 cfs
L = 200 Ft
C = 3.0

Find:

H = Depth of Flow Over Weir

Solve:

$Q = CLH^{1.5}$
$H = [Q/CL]^{2/3} = [14{,}000/(3 \bullet 200)]^{2/3}$
H = 8.17 Ft

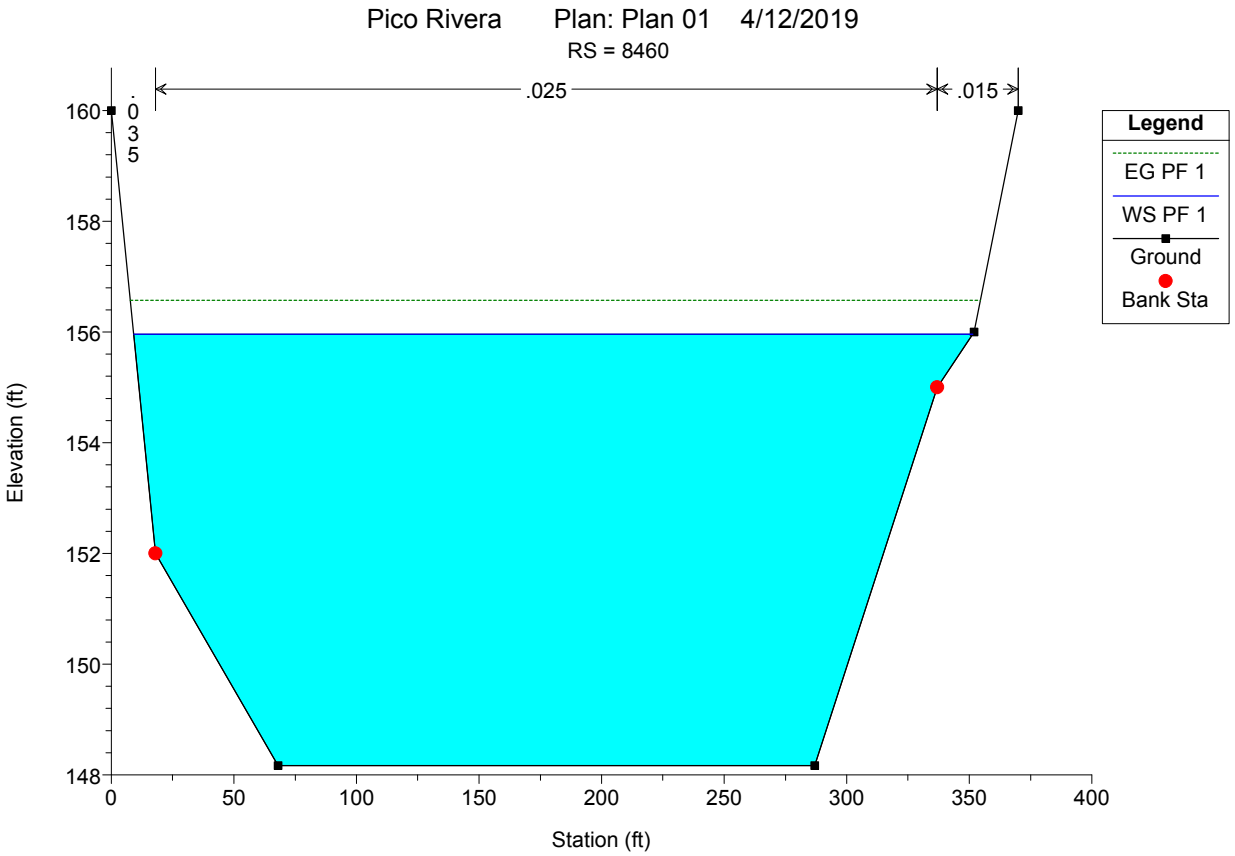
Weir Crest Elevation = 141.00 Ft
Down Stream Controlling Water Surface Elevation = 141.00 + 8.17
Down Stream Controlling Water Surface Elevation = **149.17 Ft**

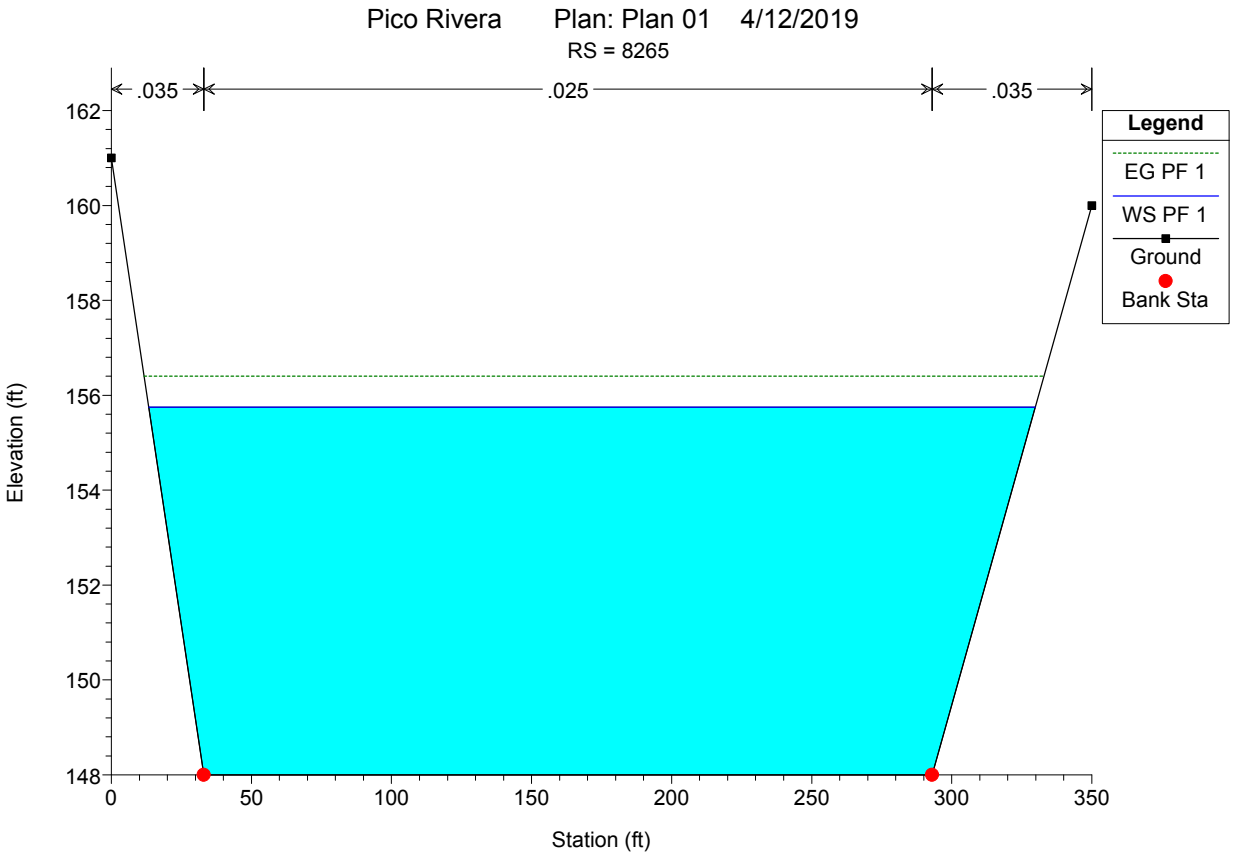
BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

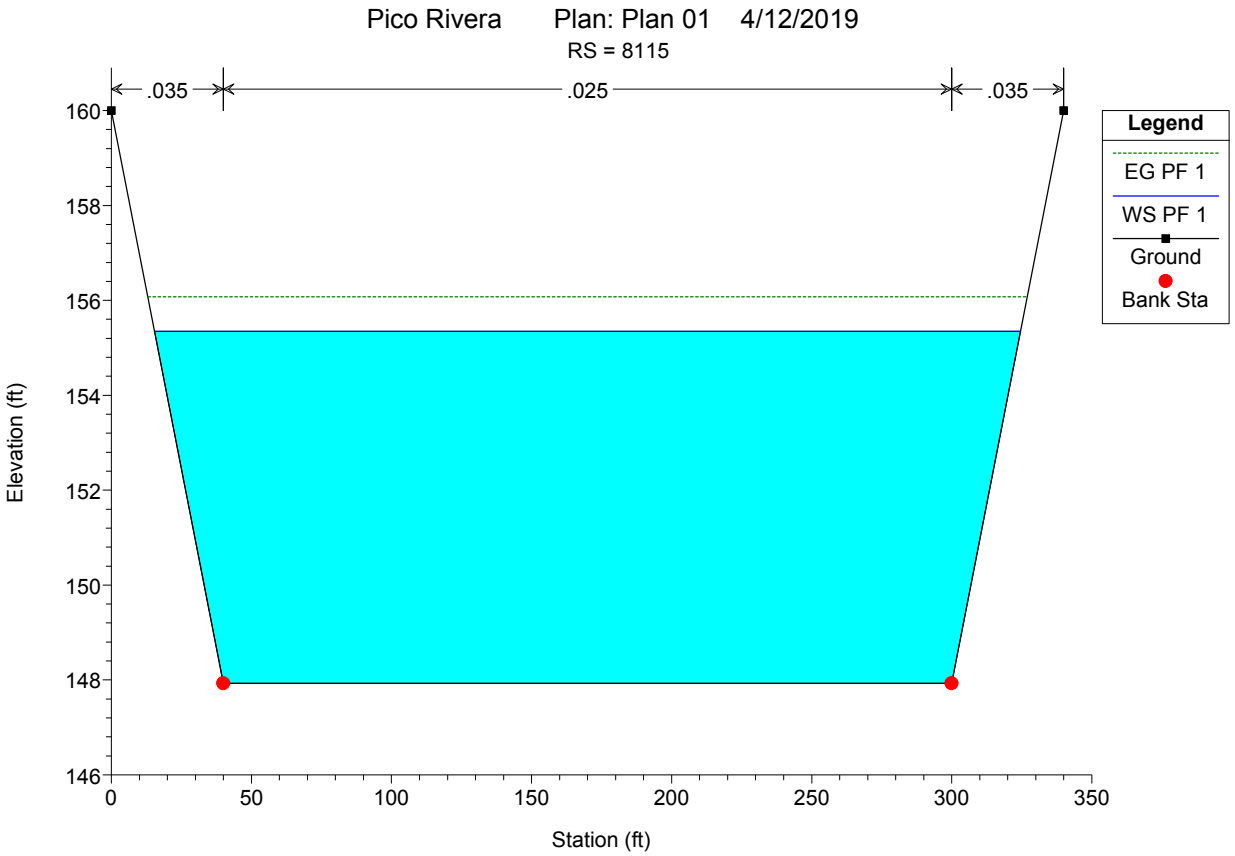
Pre-Project
HEC-RAS Analysis

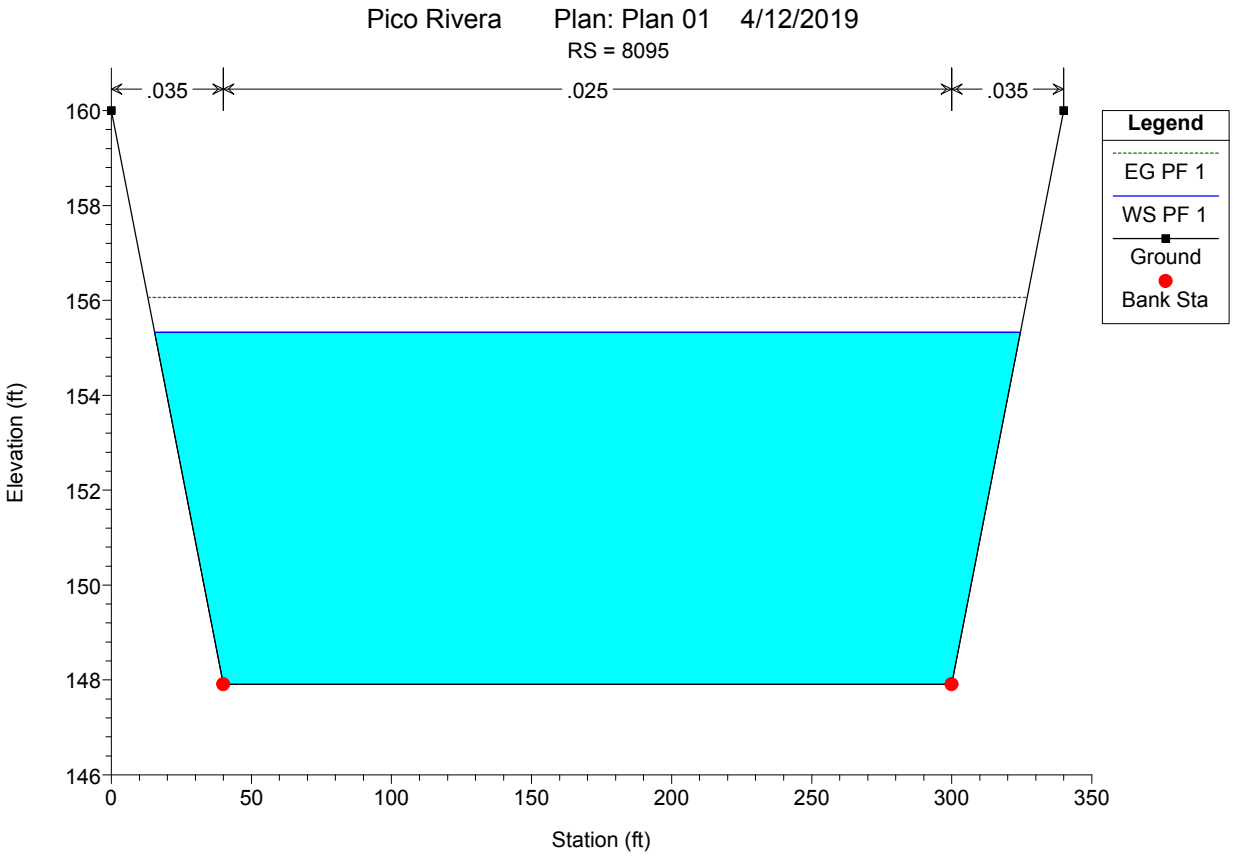
HEC-RAS Plan: Plan 01 River: SG Reach: 01 Profile: PF 1

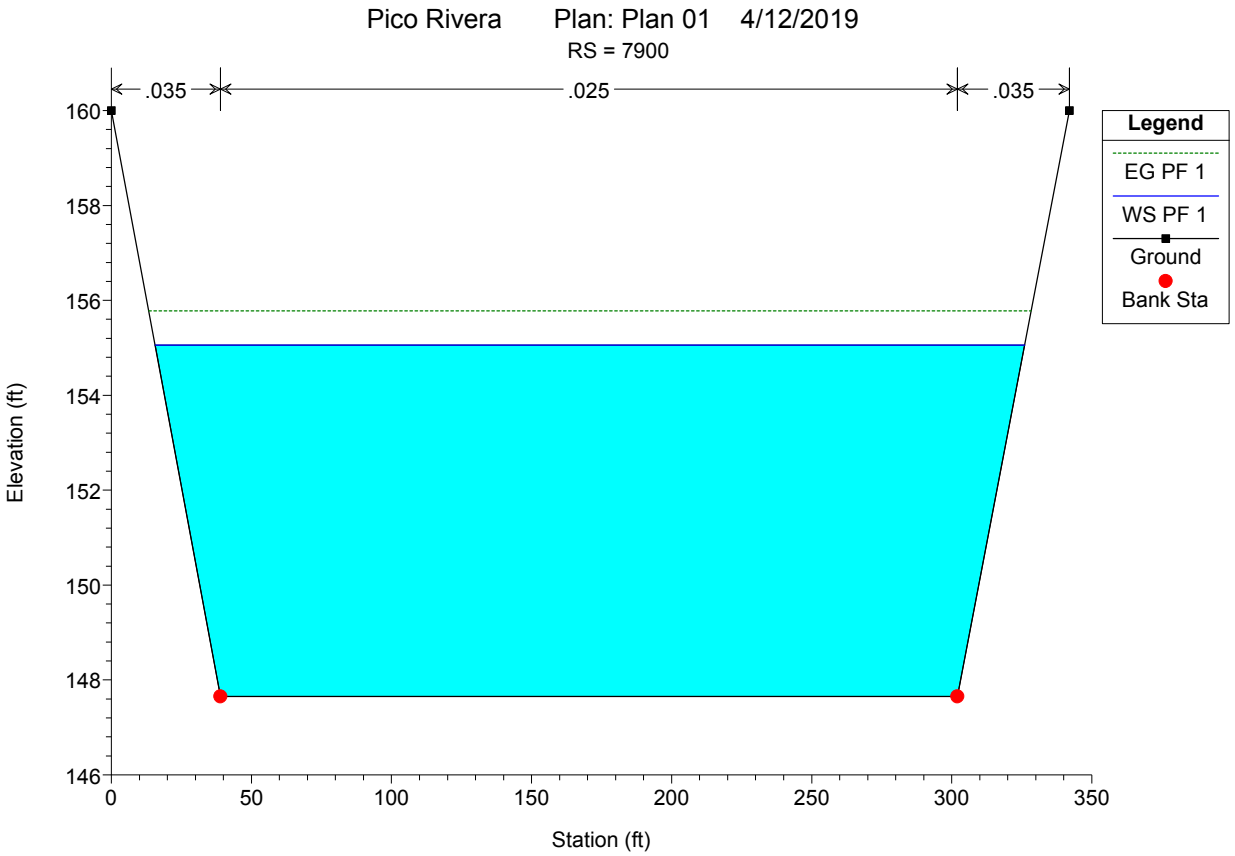
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
01	8460	PF 1	14000.00	148.17	155.96		156.57	0.000846	6.29	2242.67	342.29	0.42
01	8265	PF 1	14000.00	148.00	155.75		156.41	0.000813	6.63	2232.90	316.46	0.42
01	8115	PF 1	14000.00	147.93	155.35		156.08	0.000951	6.97	2110.79	309.16	0.45
01	8095	PF 1	14000.00	147.91	155.33		156.06	0.000951	6.97	2110.74	309.09	0.45
01	7900	PF 1	14000.00	147.65	155.06		155.78	0.000937	6.91	2123.62	310.38	0.45
01	7535	PF 1	14000.00	147.30	154.79		155.43	0.000821	6.52	2257.75	327.52	0.42
01	7170	PF 1	14000.00	146.95	154.49		155.13	0.000824	6.56	2259.30	329.36	0.42
01	6805	PF 1	14000.00	146.60	154.21		154.83	0.000794	6.48	2296.91	333.95	0.41
01	6440	PF 1	14000.00	146.25	153.89		154.54	0.000817	6.59	2252.95	324.99	0.42
01	6075	PF 1	14000.00	145.90	153.57		154.23	0.000833	6.67	2231.30	321.84	0.42
01	5710	PF 1	14000.00	145.55	153.28		153.93	0.000813	6.62	2246.28	321.51	0.42
01	5350	PF 1	14000.00	145.20	153.11		153.64	0.000627	5.91	2471.60	335.03	0.37
01	4980	PF 1	14000.00	144.85	152.76		153.38	0.000744	6.44	2324.35	327.73	0.40
01	4615	PF 1	14000.00	144.50	152.51		153.10	0.000713	6.35	2360.22	329.62	0.40
01	4250	PF 1	14000.00	144.15	152.32		152.84	0.000605	5.93	2507.62	338.99	0.37
01	3890	PF 1	14000.00	143.80	152.15		152.63	0.000532	5.64	2612.03	340.89	0.34
01	3500	PF 1	14000.00	143.45	151.95		152.42	0.000515	5.61	2639.66	341.30	0.34
01	3140	PF 1	14000.00	143.10	151.81		152.23	0.000443	5.30	2793.16	351.25	0.32
01	2780	PF 1	14000.00	142.85	151.55		152.05	0.000536	5.82	2586.74	334.79	0.35
01	2420	PF 1	14000.00	142.50	151.12		151.80	0.000752	6.85	2230.01	297.60	0.41
01	2060	PF 1	14000.00	142.15	150.60		151.48	0.000977	7.71	1973.49	266.84	0.47
01	1700	PF 1	14000.00	141.80	150.28		151.12	0.000951	7.62	2015.78	275.67	0.46
01	1350	PF 1	14000.00	141.55	149.93		150.78	0.000979	7.67	2011.58	280.18	0.47
01	1160	PF 1	14000.00	141.37	149.81	146.60	150.59	0.000828	6.91	1987.41	268.87	0.43
01	1159		Bridge									
01	1105	PF 1	14000.00	141.32	149.79		150.46	0.000706	6.56	2132.79	275.80	0.40
01	1050	PF 1	14000.00	141.28	149.42		150.38	0.001123	8.06	1875.30	260.75	0.50
01	1015	PF 1	14000.00	141.25	149.26		150.33	0.001220	8.31	1692.04	222.36	0.52
01	1000	PF 1	14000.00	141.00	149.17	146.32	150.31	0.000454	8.56	1640.07	201.49	0.53

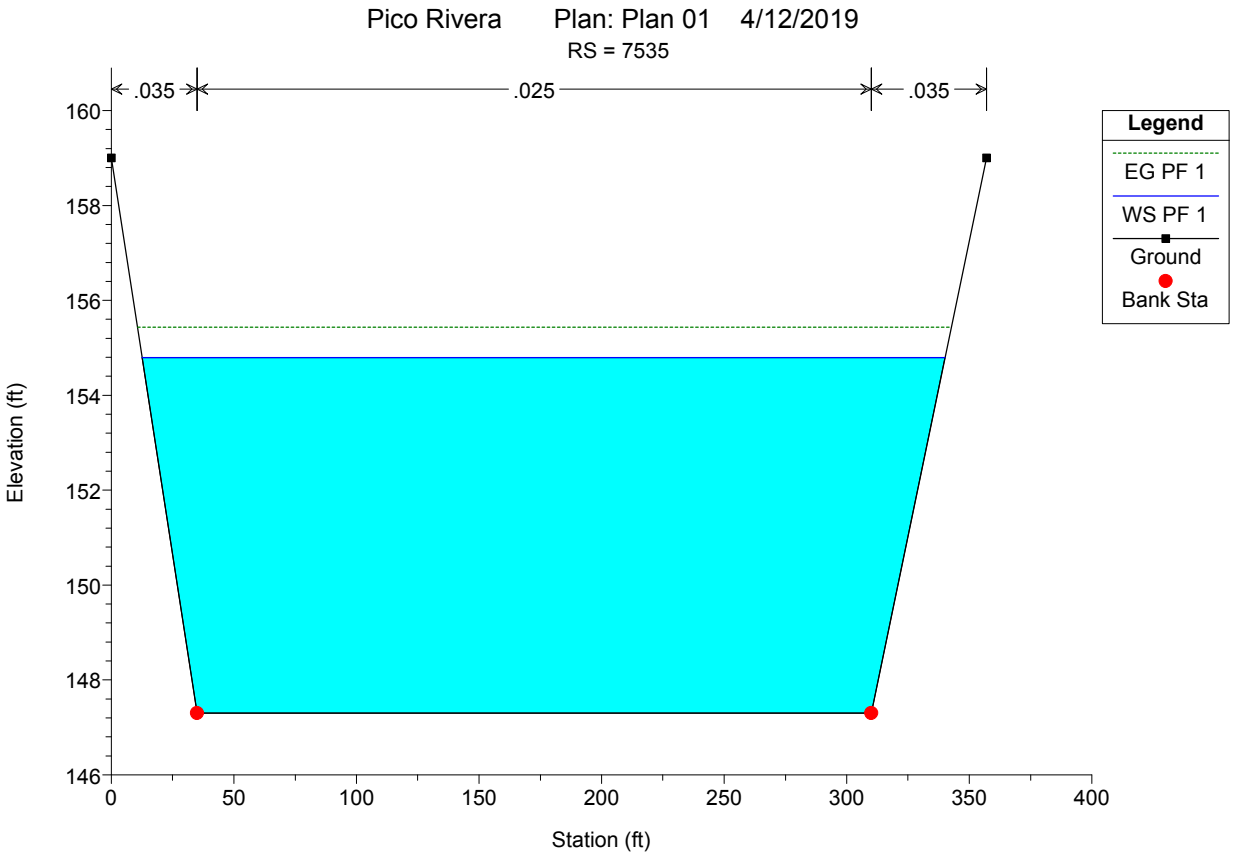

Pico Rivera Plan: Plan 01 4/12/2019
RS = 8460
.035
.025
.015
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
160
158
156
154
152
150
148
0
50
100
150
200
250
300
350
400

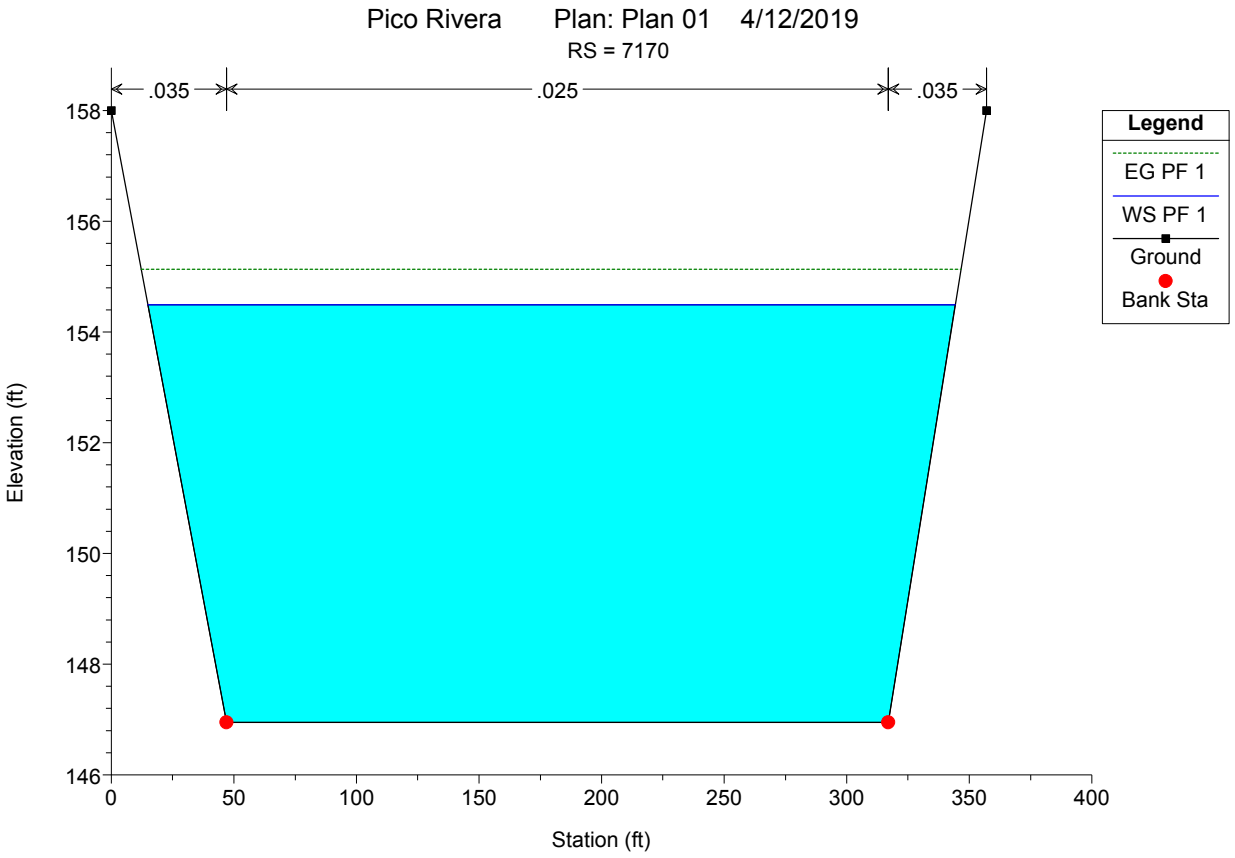

Pico Rivera Plan: Plan 01 4/12/2019
RS = 8265
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
0
50
100
150
200
250
300
350

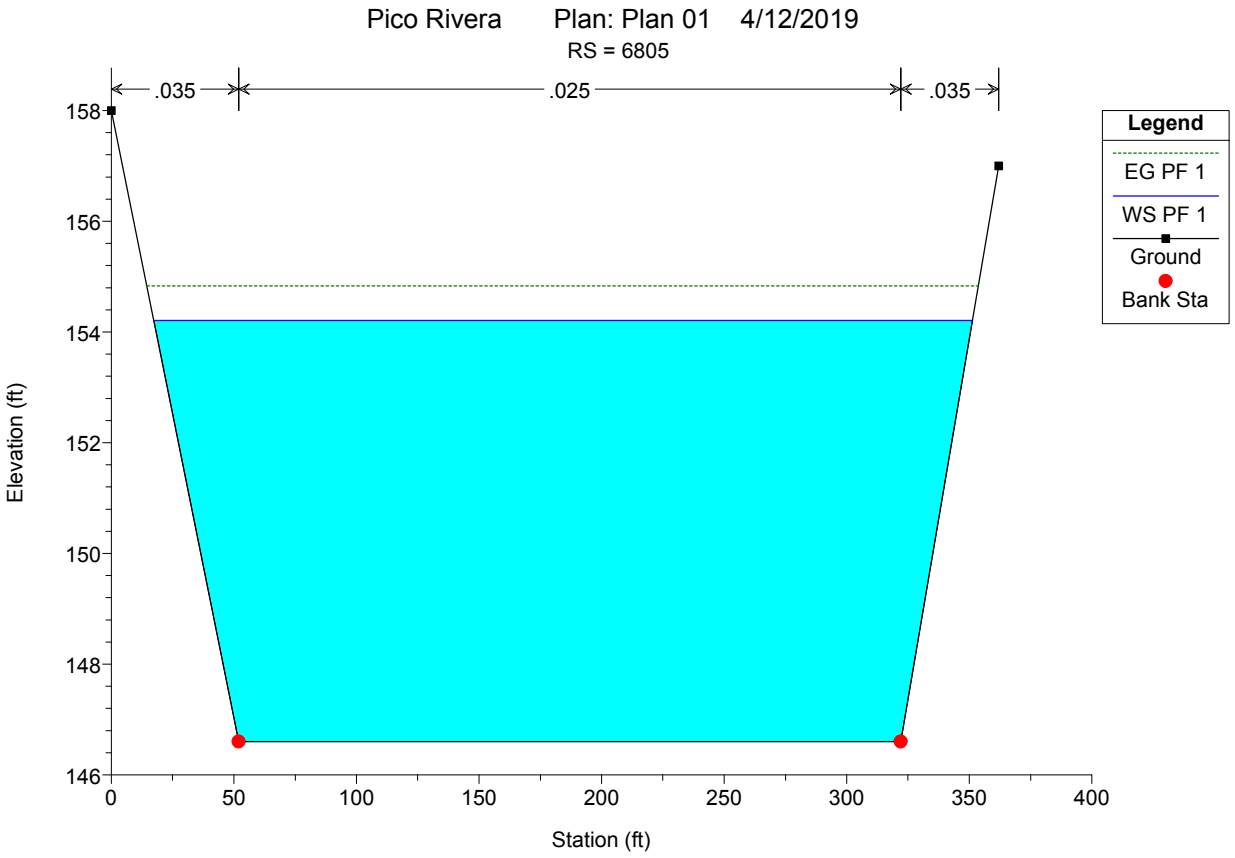

Pico Rivera Plan: Plan 01 4/12/2019
RS = 8115
.035
.025
.035
160
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

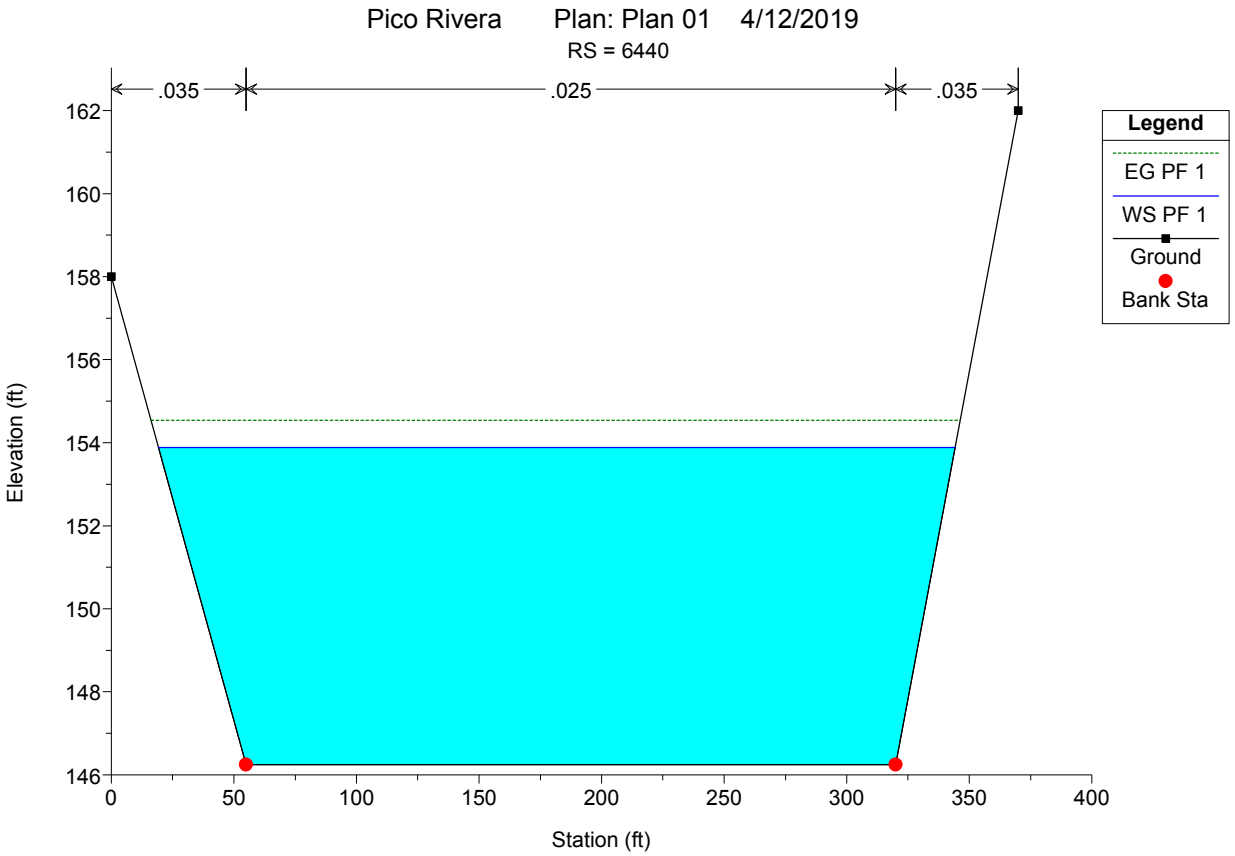

Pico Rivera Plan: Plan 01 4/12/2019
RS = 8095
.035
.025
.035
160
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

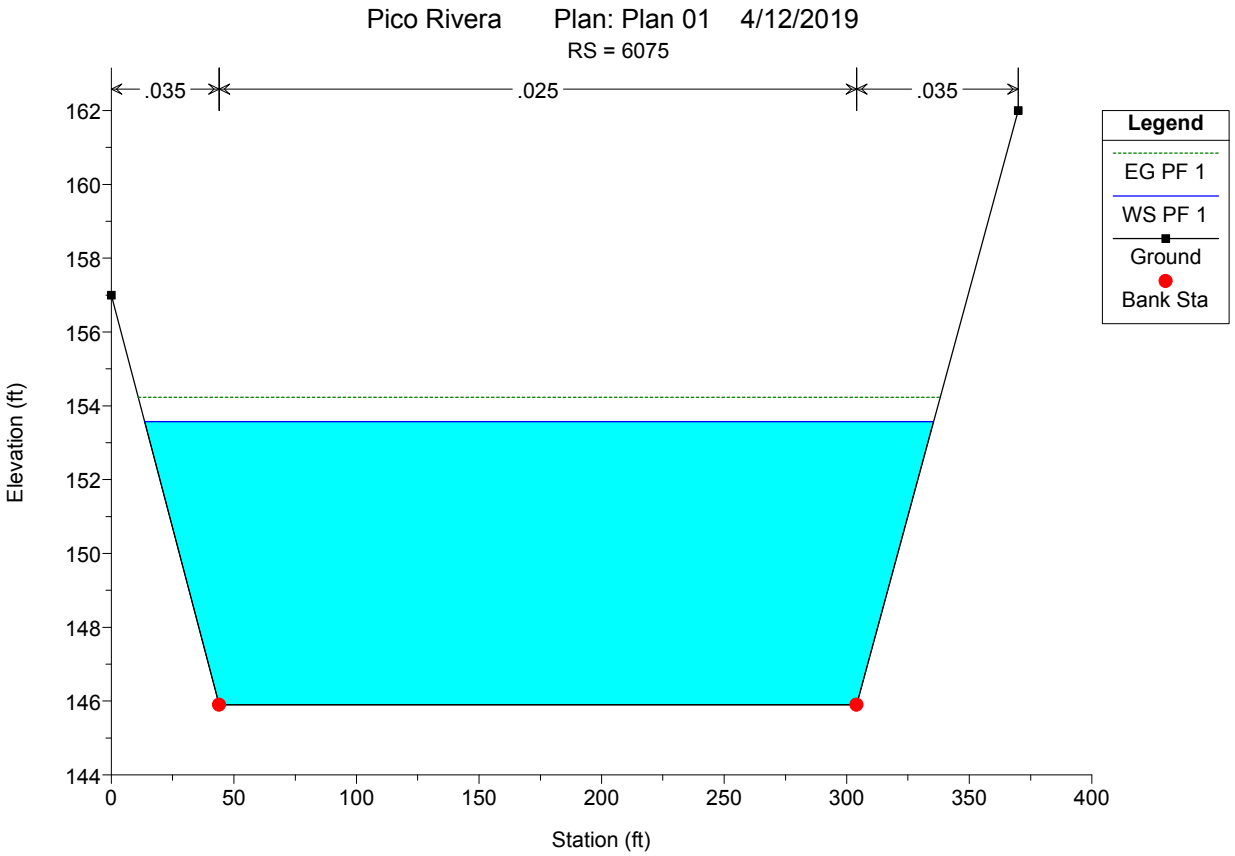

Pico Rivera Plan: Plan 01 4/12/2019
RS = 7900
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350
Station (ft)

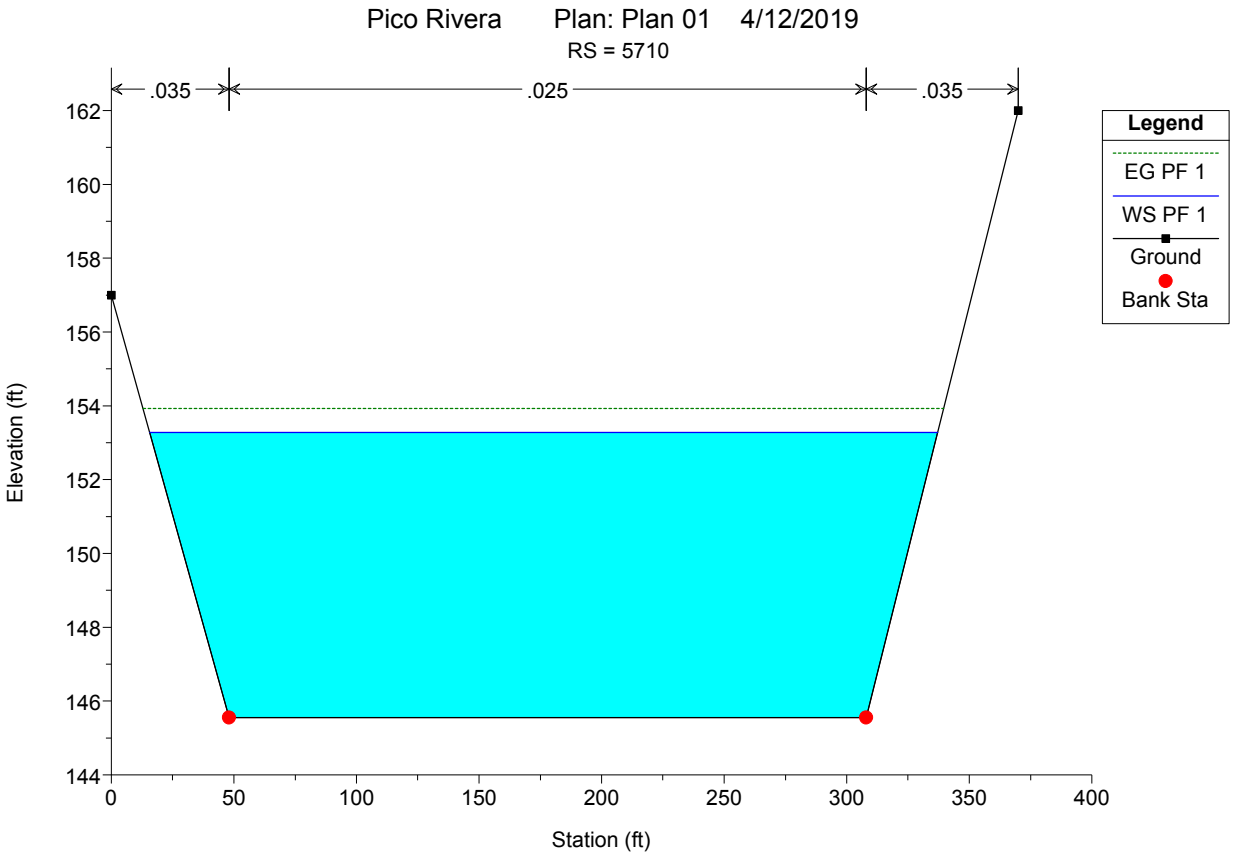

Pico Rivera Plan: Plan 01 4/12/2019
RS = 7535
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350
400
Station (ft)

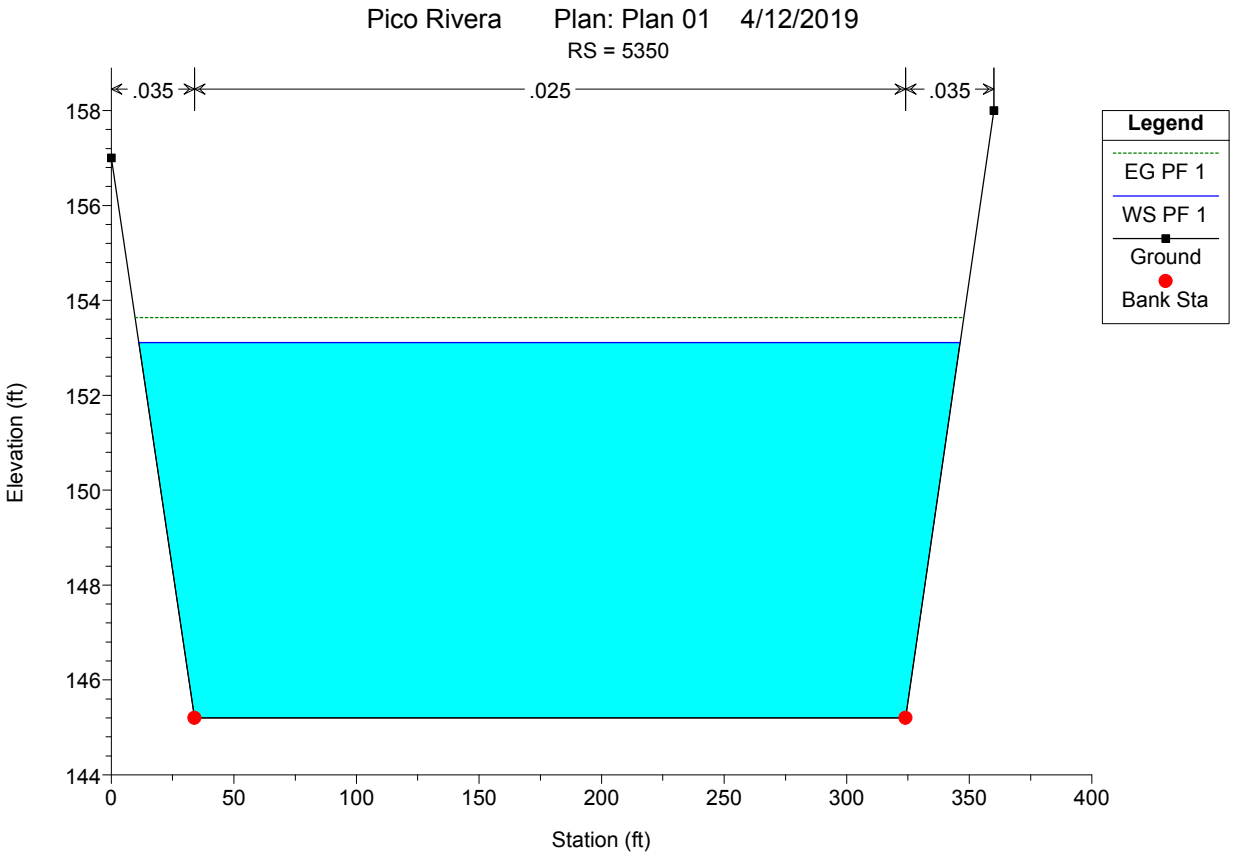

Pico Rivera Plan: Plan 01 4/12/2019
RS = 7170
.035
.025
.035
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

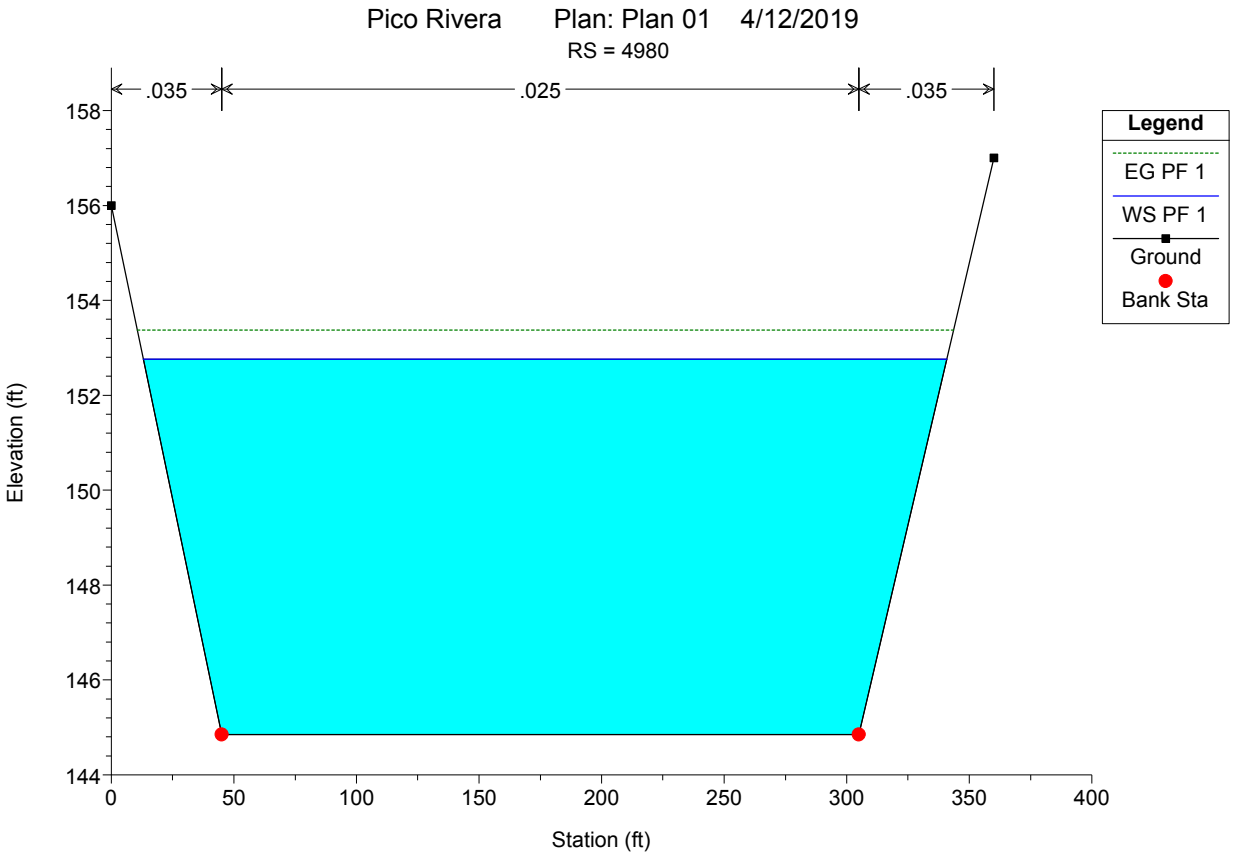

Pico Rivera Plan: Plan 01 4/12/2019
RS = 6805
.035
.025
.035
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

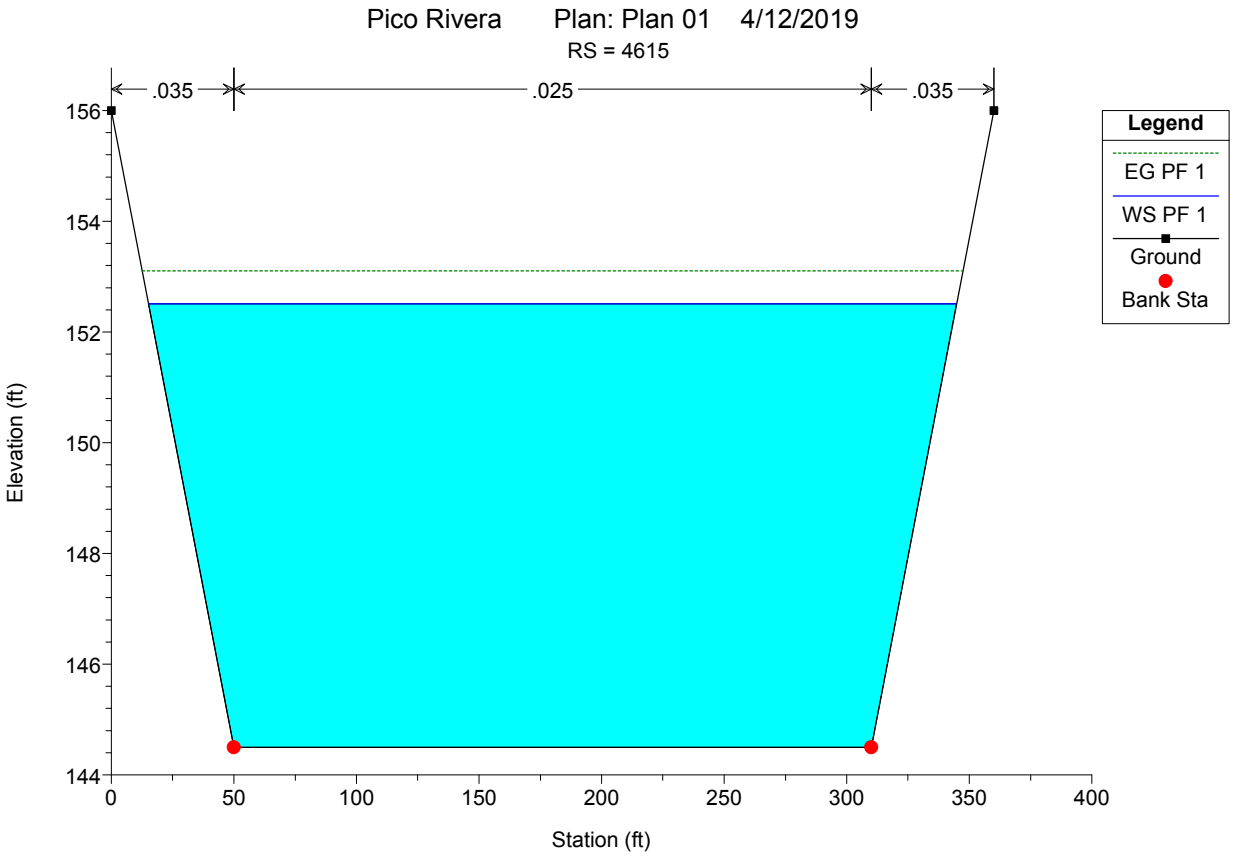

Pico Rivera Plan: Plan 01 4/12/2019
RS = 6440
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350
400

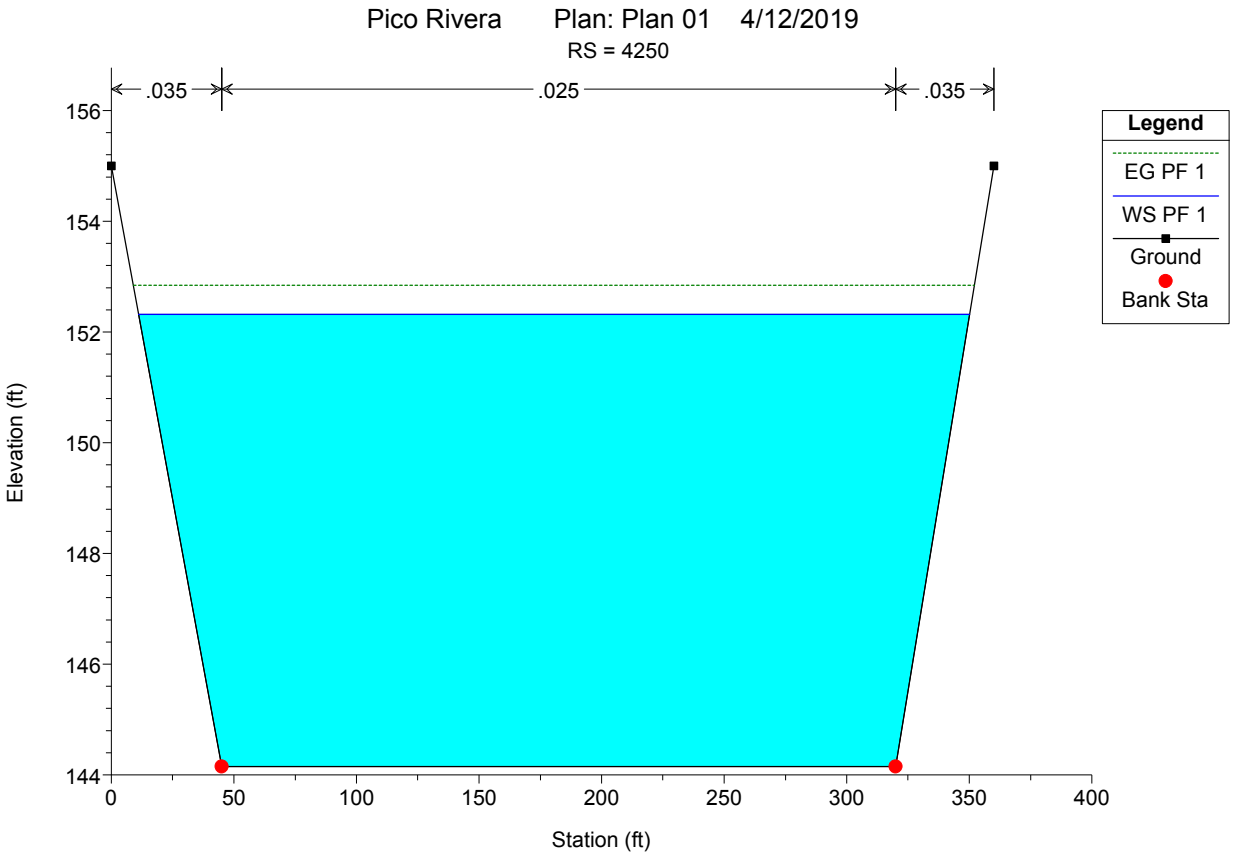

Pico Rivera Plan: Plan 01 4/12/2019
RS = 6075
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400

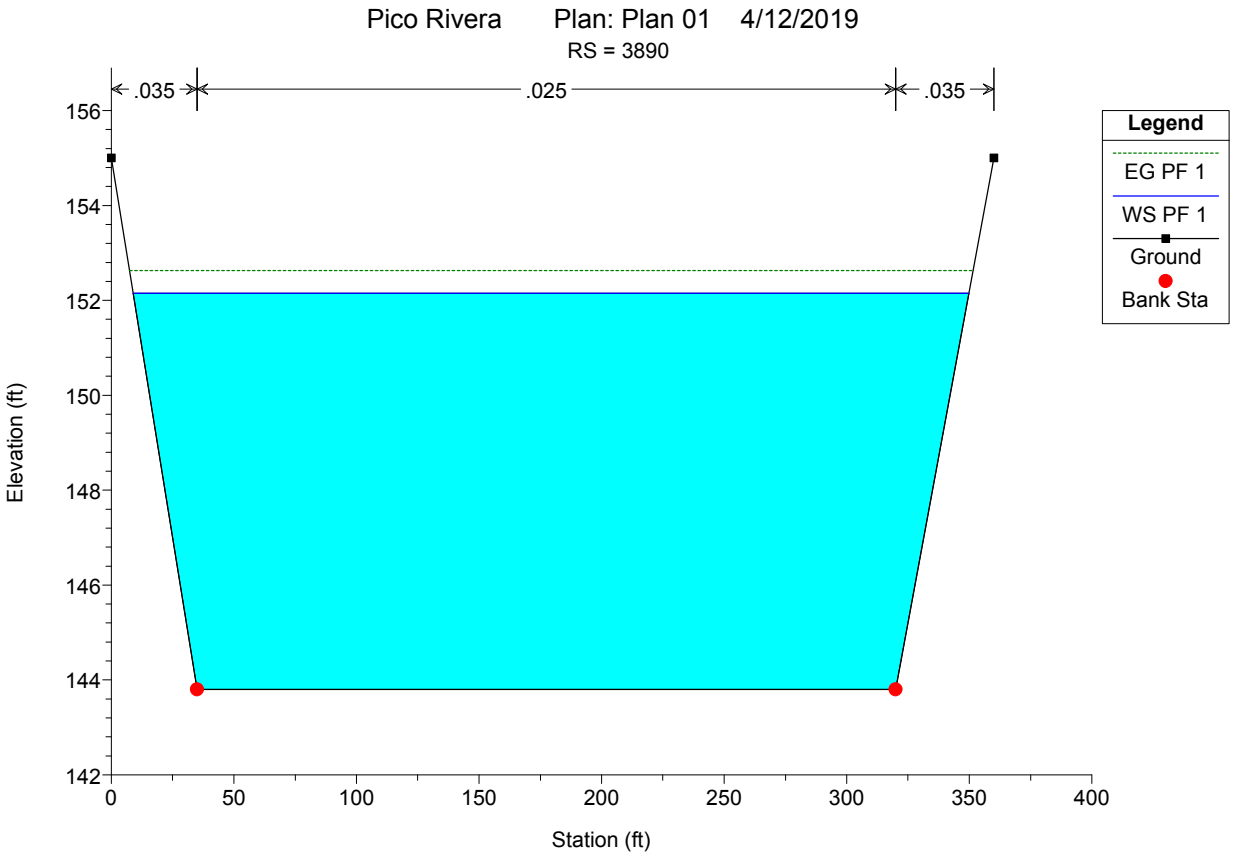

Pico Rivera Plan: Plan 01 4/12/2019
RS = 5710
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400

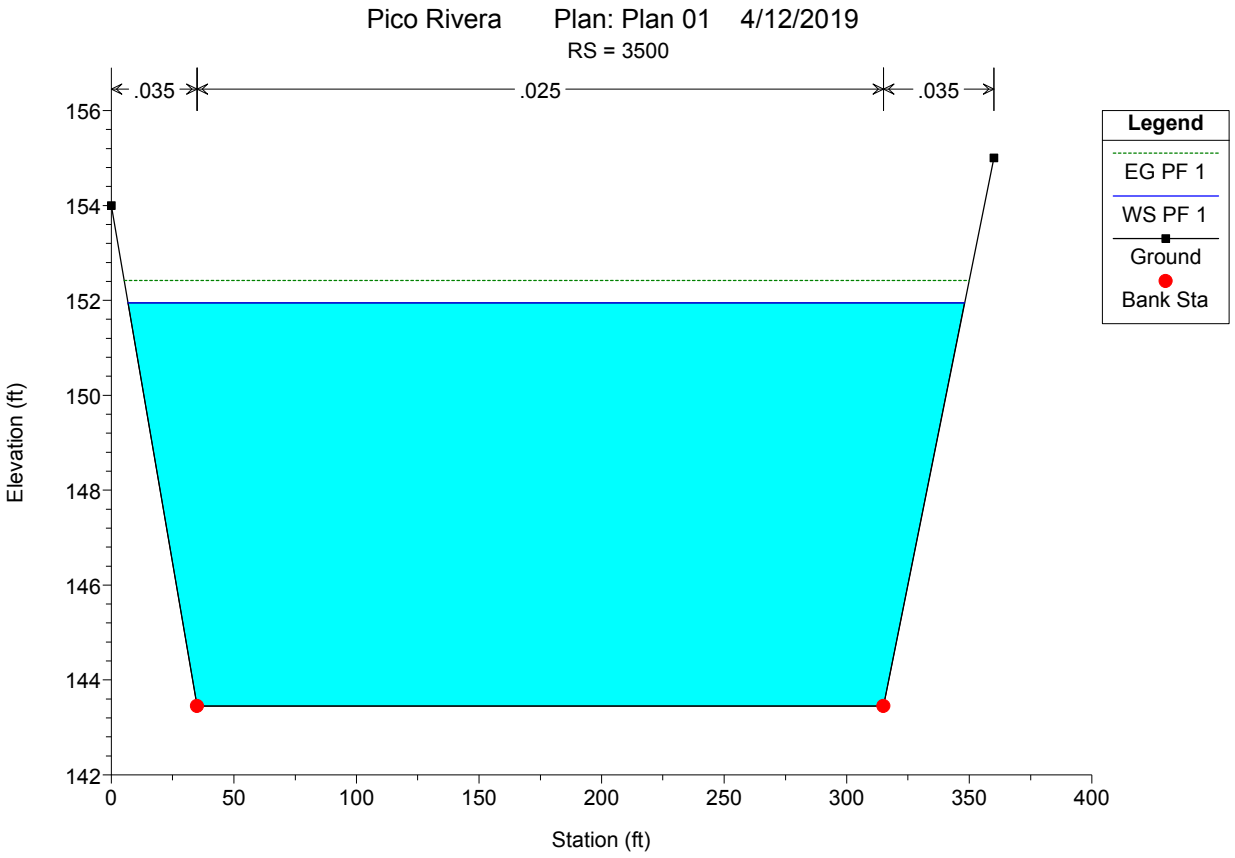

Pico Rivera Plan: Plan 01 4/12/2019
RS = 5350
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
158
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400

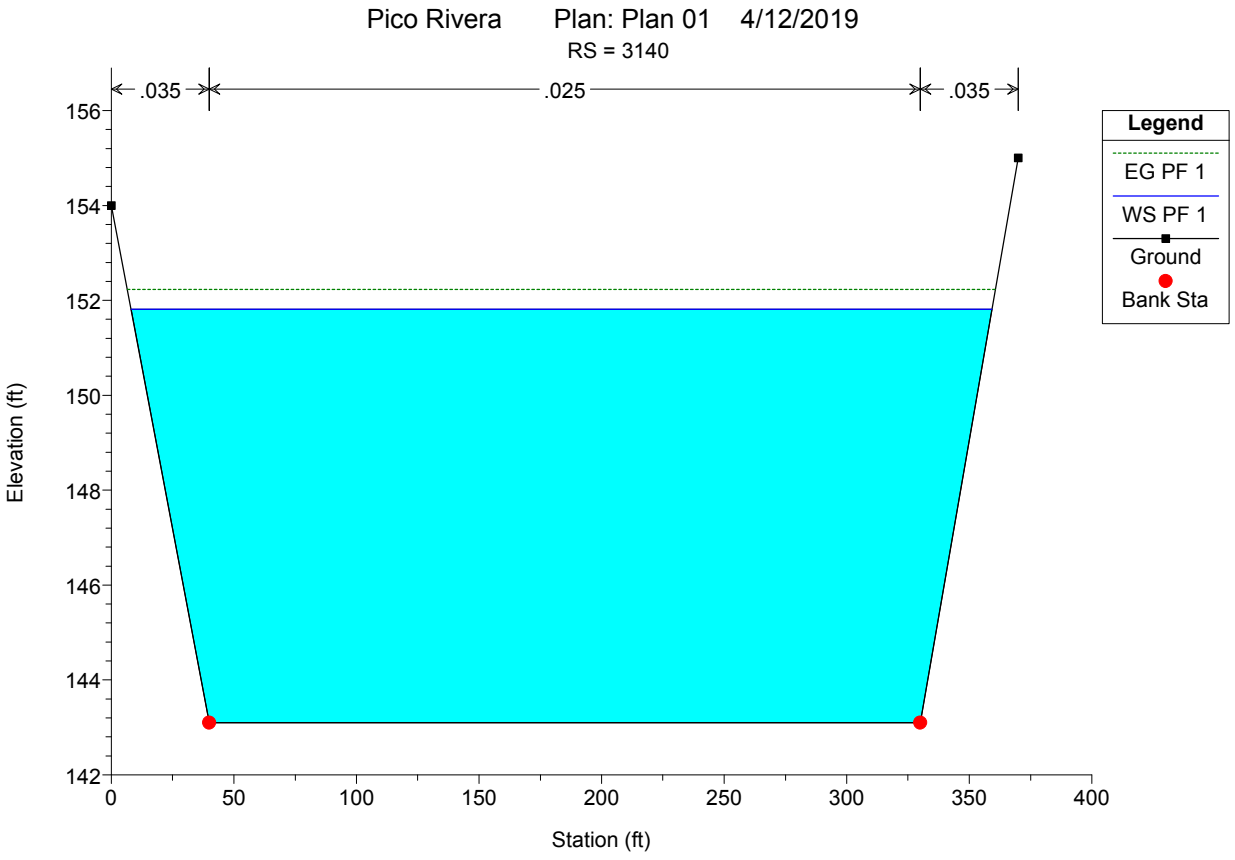

Pico Rivera Plan: Plan 01 4/12/2019
RS = 4980
.035
.025
.035
158
156
154
152
150
148
146
144
Elevation (ft)
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

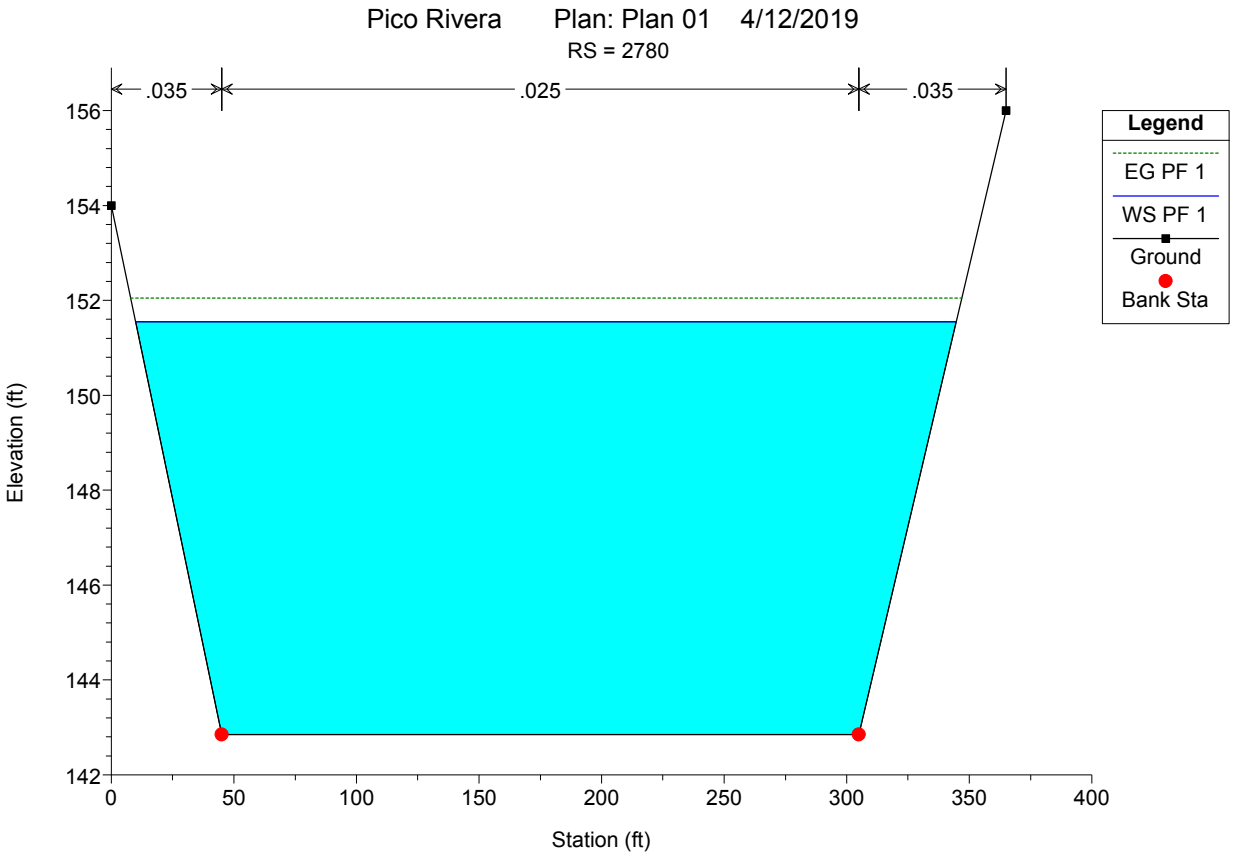

Pico Rivera Plan: Plan 01 4/12/2019
RS = 4615
.035
.025
.035
156
154
152
150
148
146
144
Elevation (ft)
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

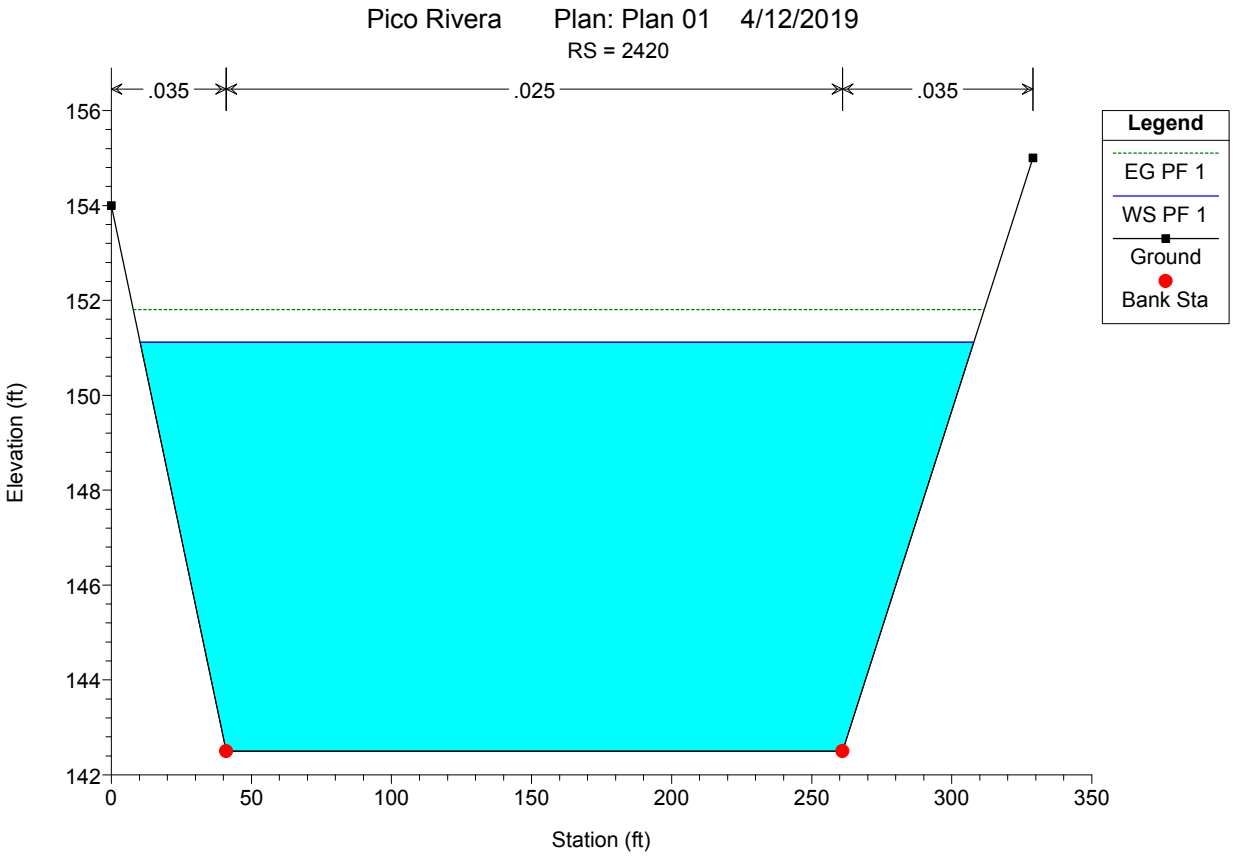

Pico Rivera Plan: Plan 01 4/12/2019
RS = 4250
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400
Station (ft)

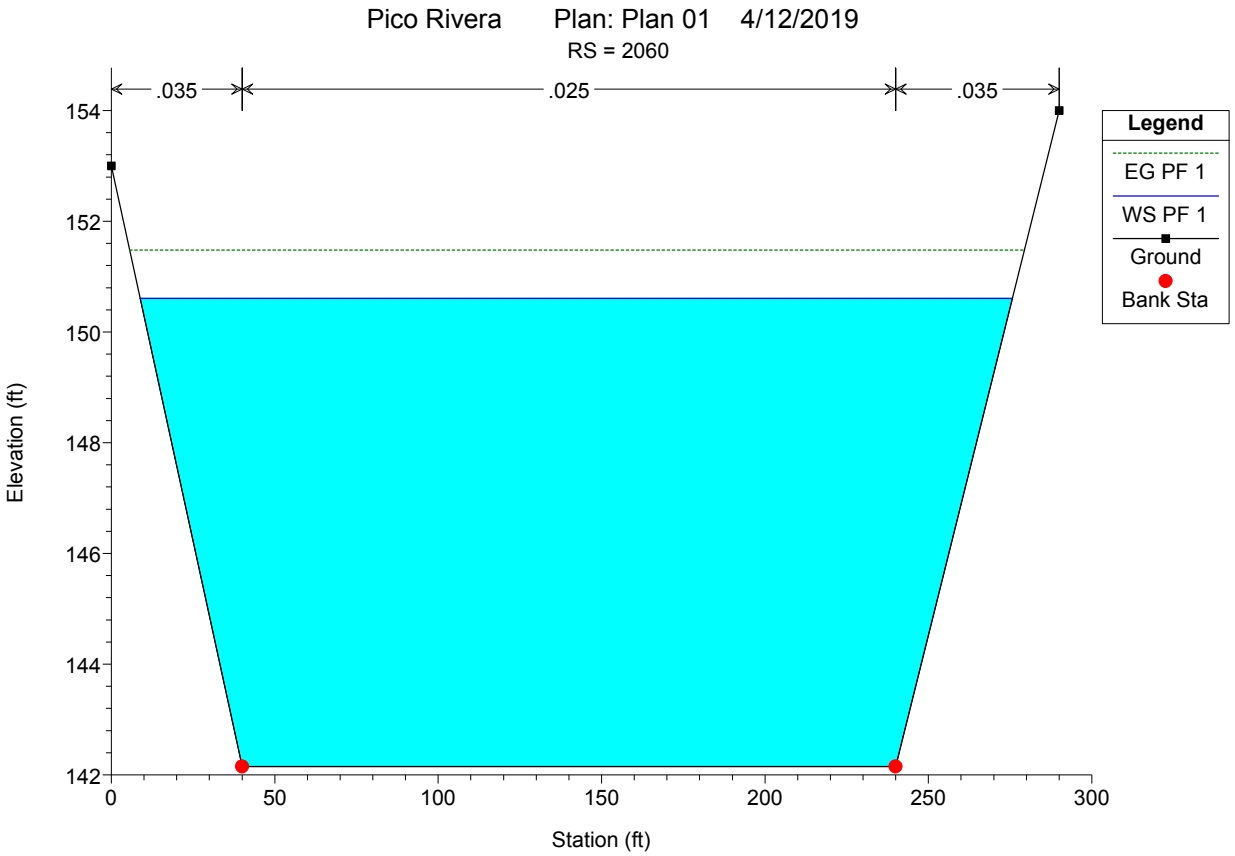

Pico Rivera Plan: Plan 01 4/12/2019
RS = 3890
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

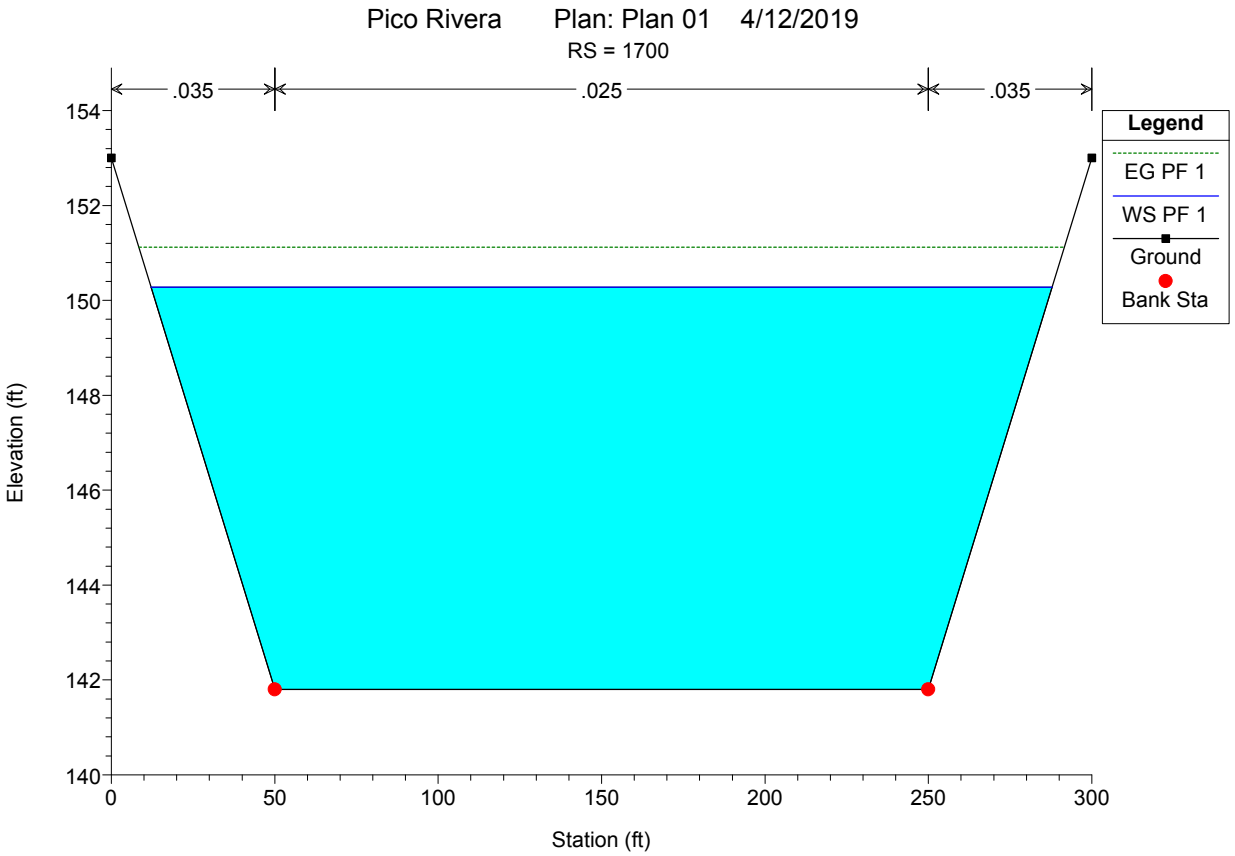

Pico Rivera Plan: Plan 01 4/12/2019
RS = 3500
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

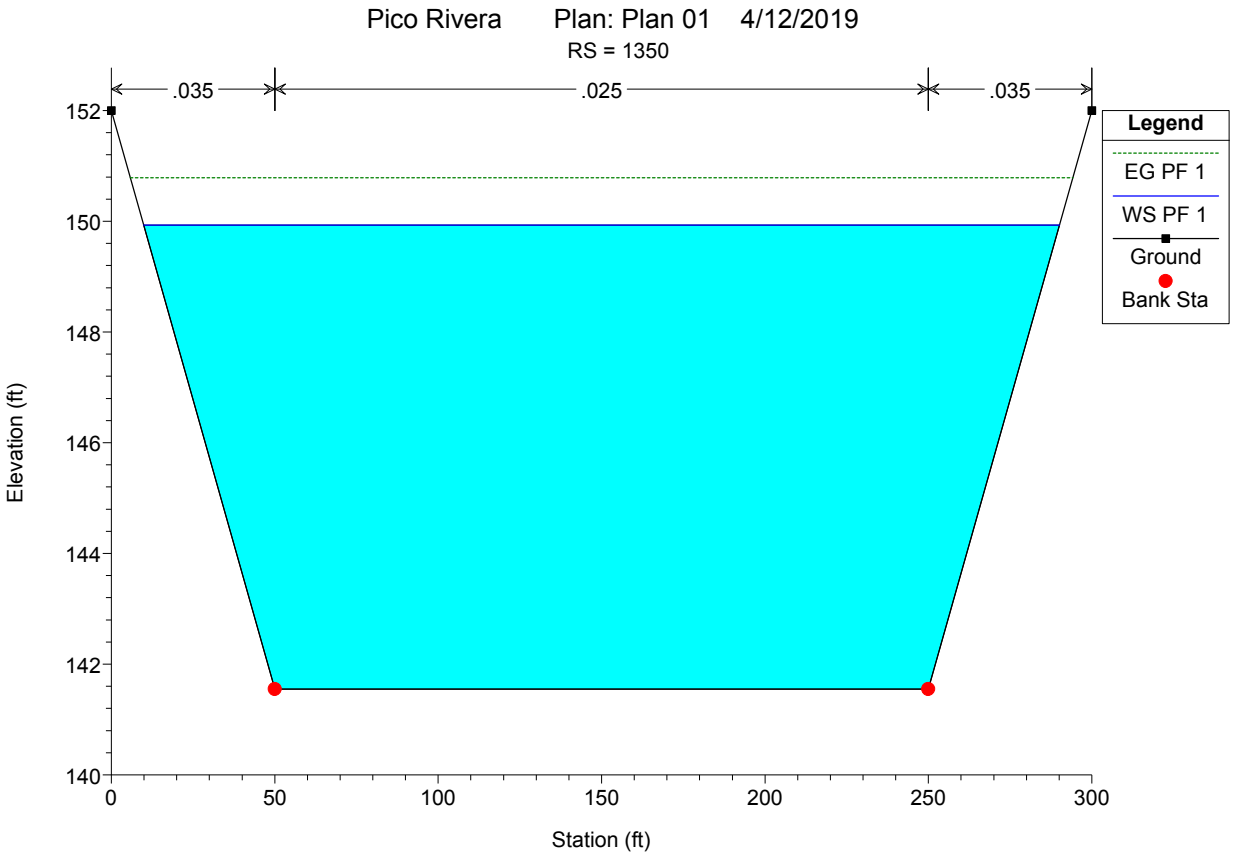

Pico Rivera Plan: Plan 01 4/12/2019
RS = 3140
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

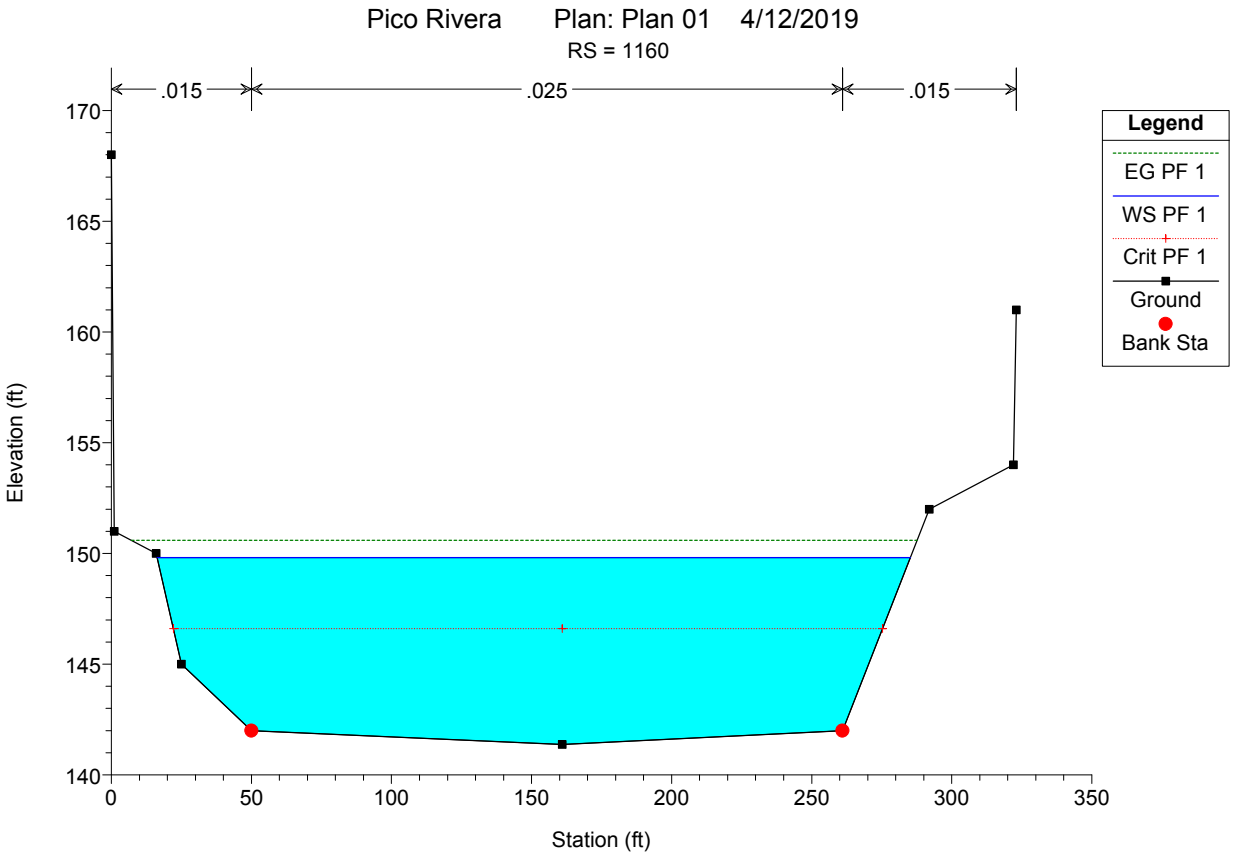

Pico Rivera Plan: Plan 01 4/12/2019
RS = 2780
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

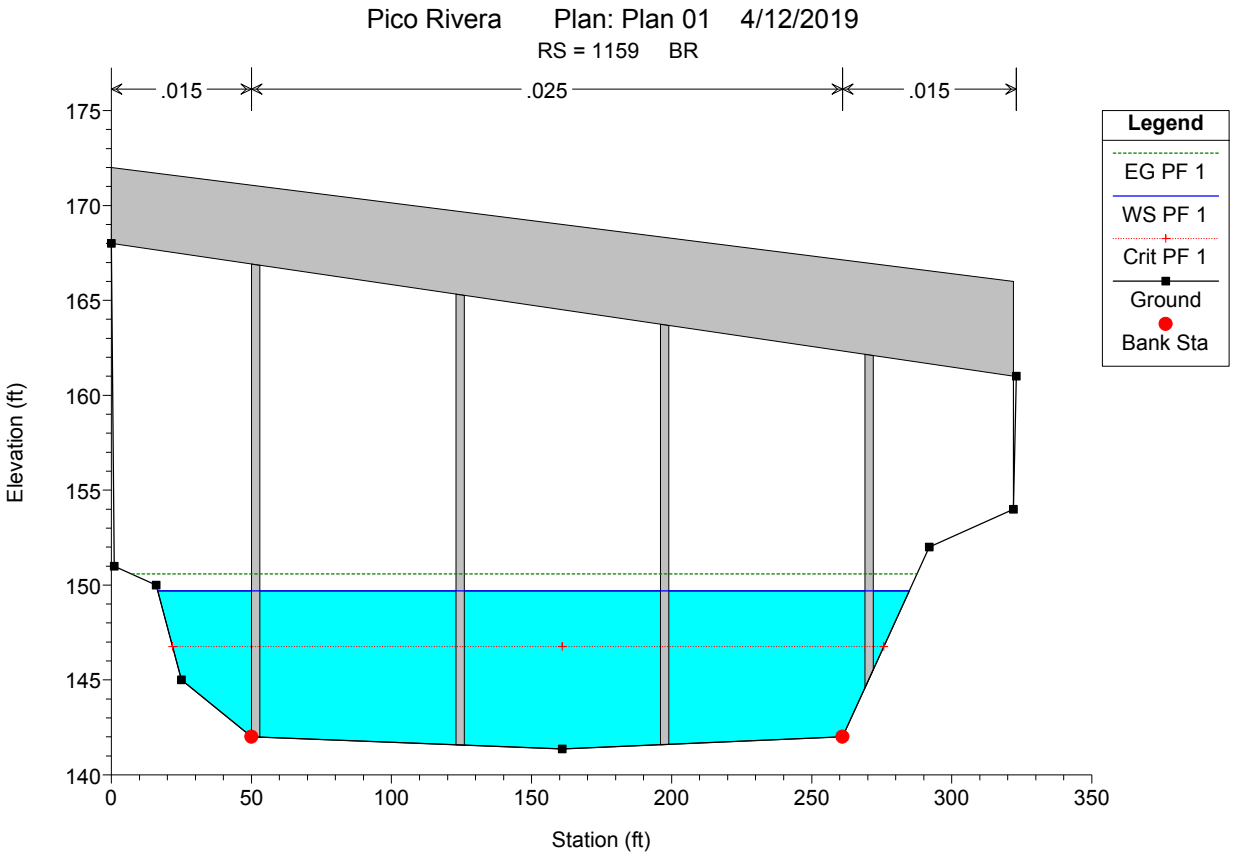

Pico Rivera Plan: Plan 01 4/12/2019
RS = 2420
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
Station (ft)

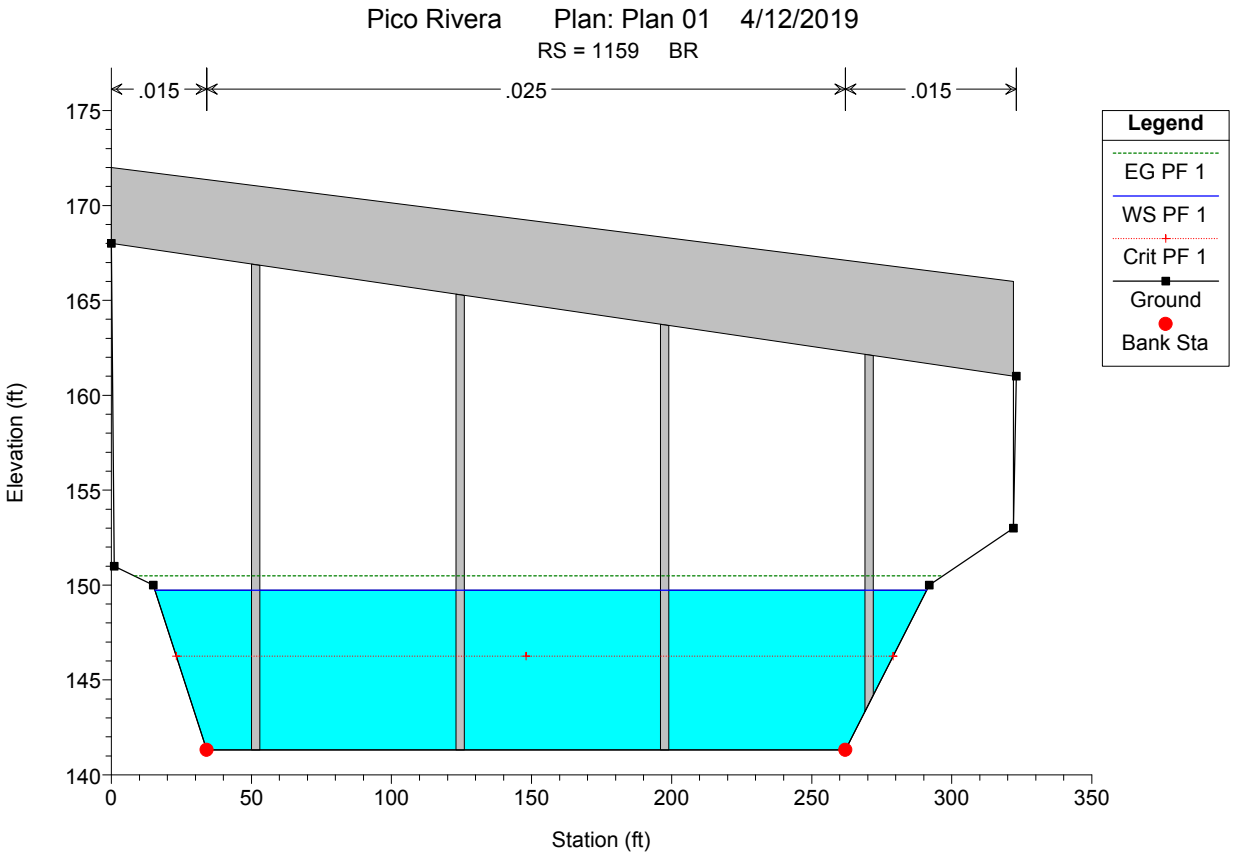

Pico Rivera Plan: Plan 01 4/12/2019
RS = 2060
.035
.025
.035
154
152
150
148
146
144
142
Elevation (ft)
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

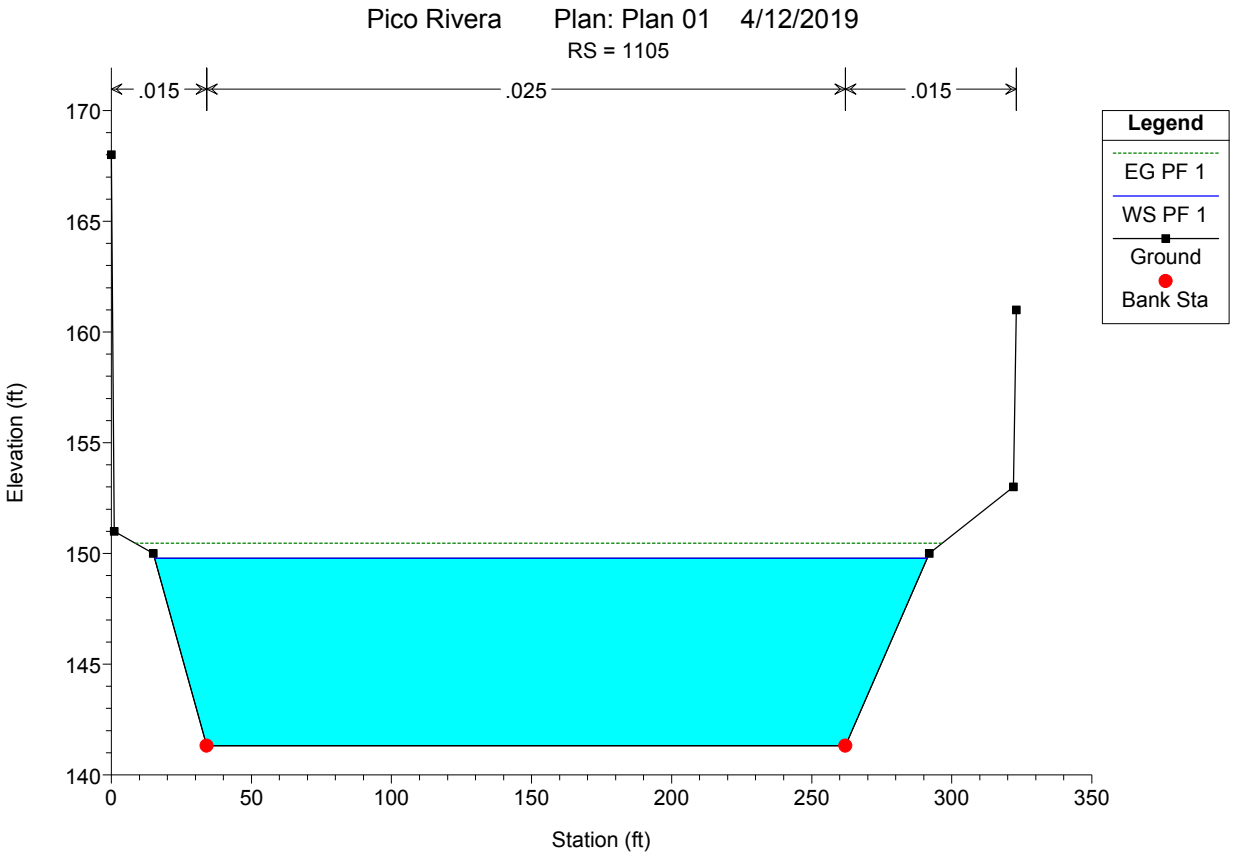

Pico Rivera Plan: Plan 01 4/12/2019
RS = 1700
.035
.025
.035
154
152
150
148
146
144
142
140
Elevation (ft)
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

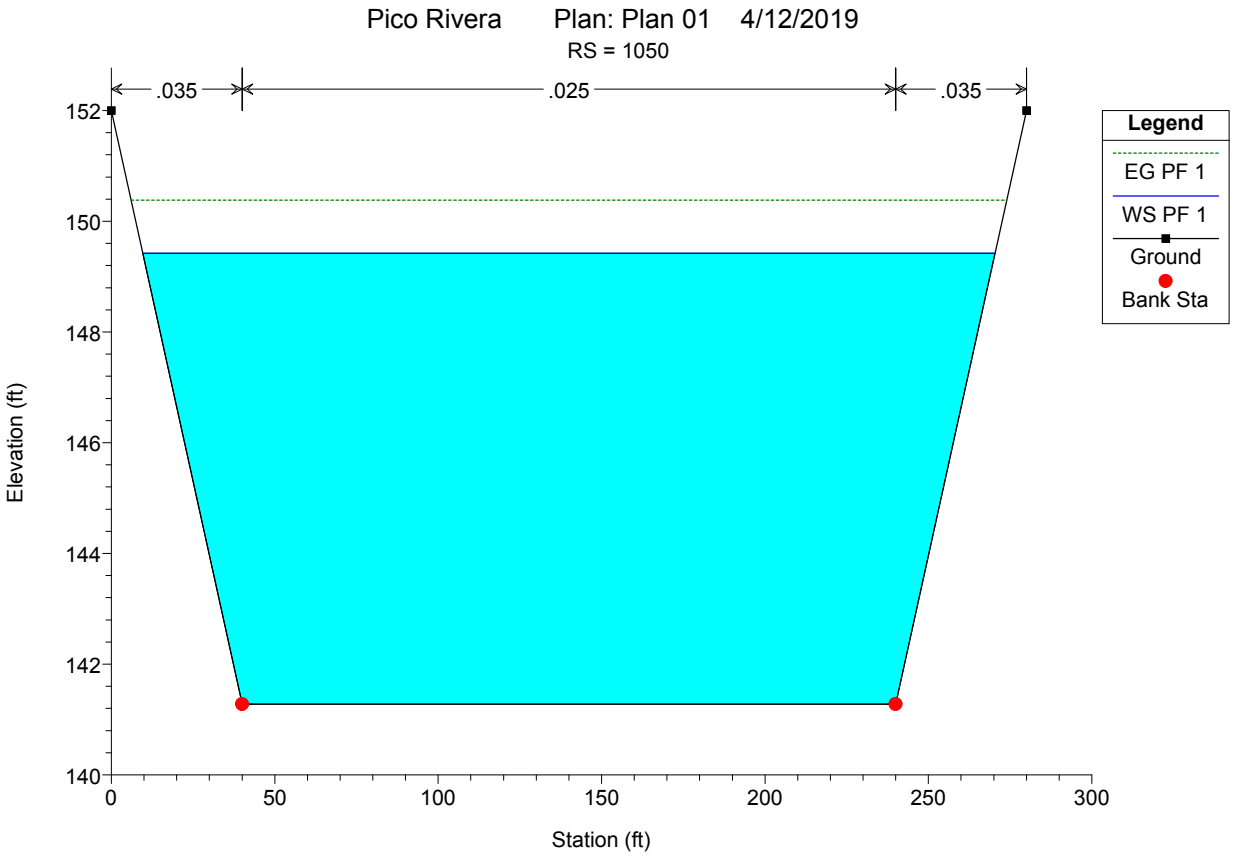

Pico Rivera Plan: Plan 01 4/12/2019
RS = 1350
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250
300

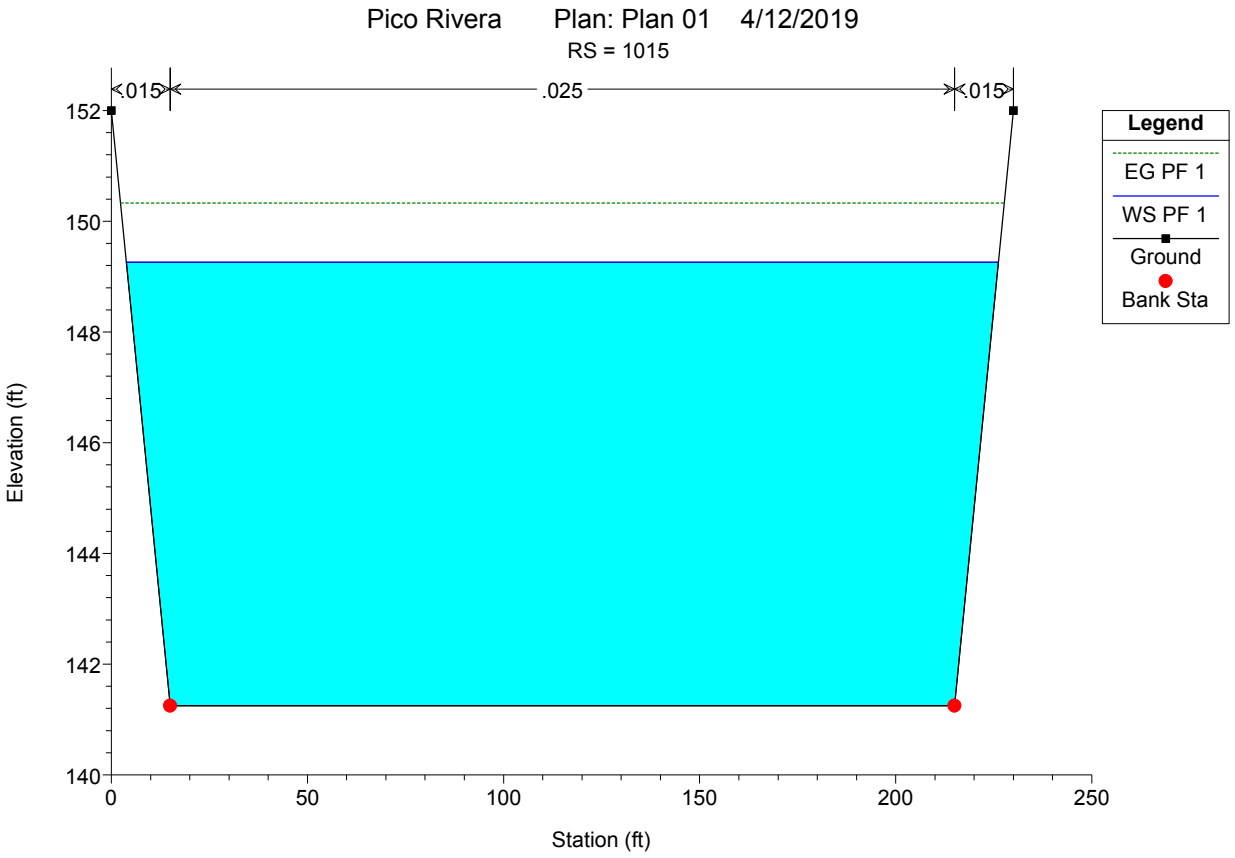

Pico Rivera Plan: Plan 01 4/12/2019
RS = 1160
.015
.025
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350

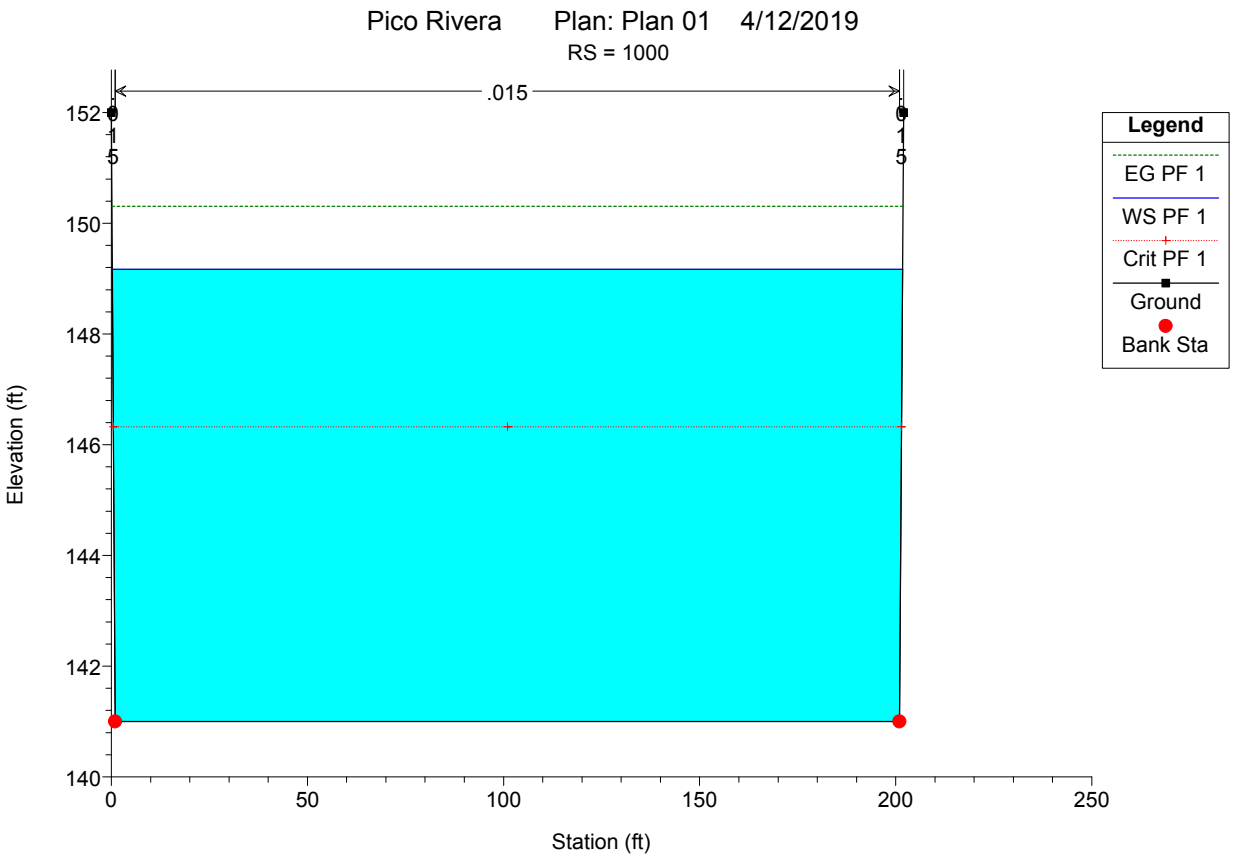

Pico Rivera Plan: Plan 01 4/12/2019
RS = 1159 BR
.015
.025
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
175
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350


Pico Rivera Plan: Plan 01 4/12/2019
RS = 1159 BR
.015
.025
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
175
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350


Pico Rivera Plan: Plan 01 4/12/2019
RS = 1105
.015
.025
.015
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350
Station (ft)


Pico Rivera Plan: Plan 01 4/12/2019
RS = 1050
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250
300
Station (ft)


Pico Rivera Plan: Plan 01 4/12/2019
RS = 1015
.015
.025
.015
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250
Station (ft)

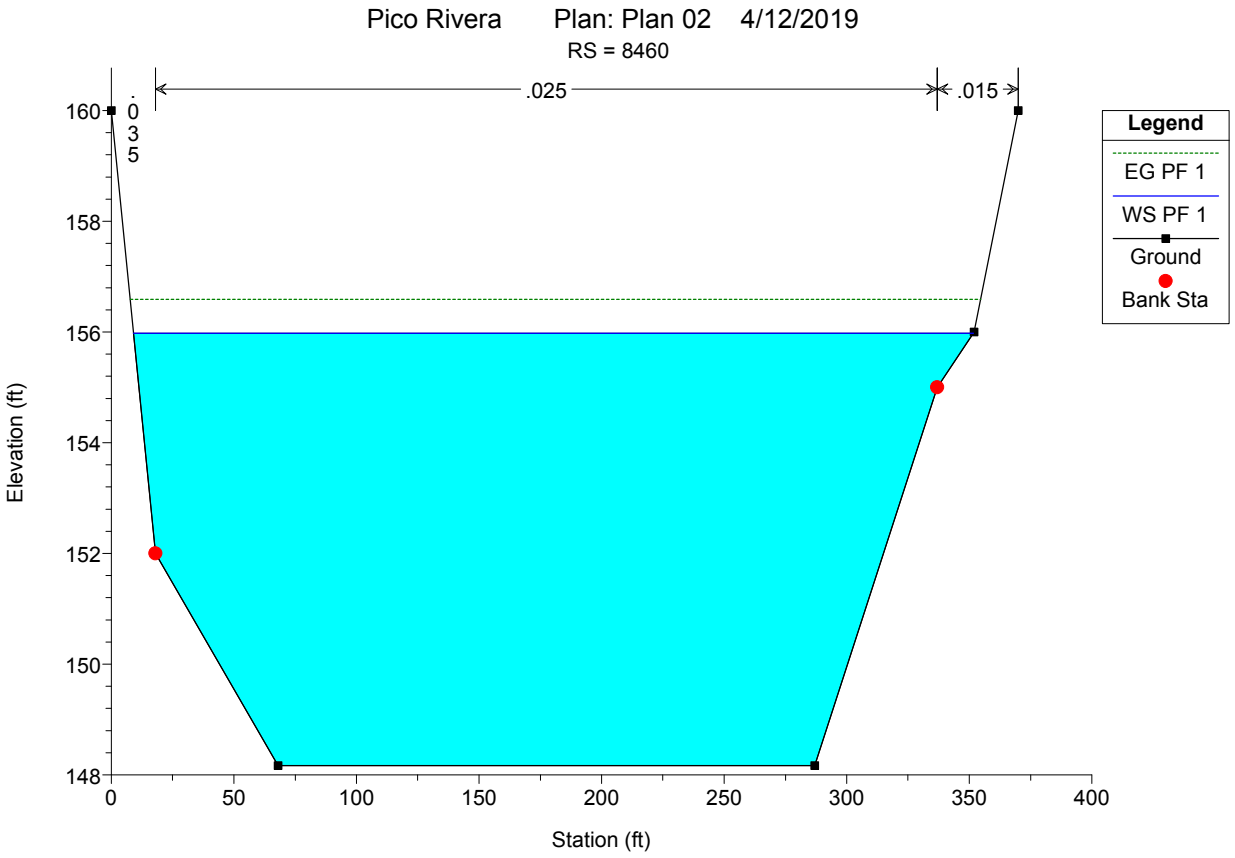

Pico Rivera Plan: Plan 01 4/12/2019
RS = 1000
.015
.015
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250
Station (ft)

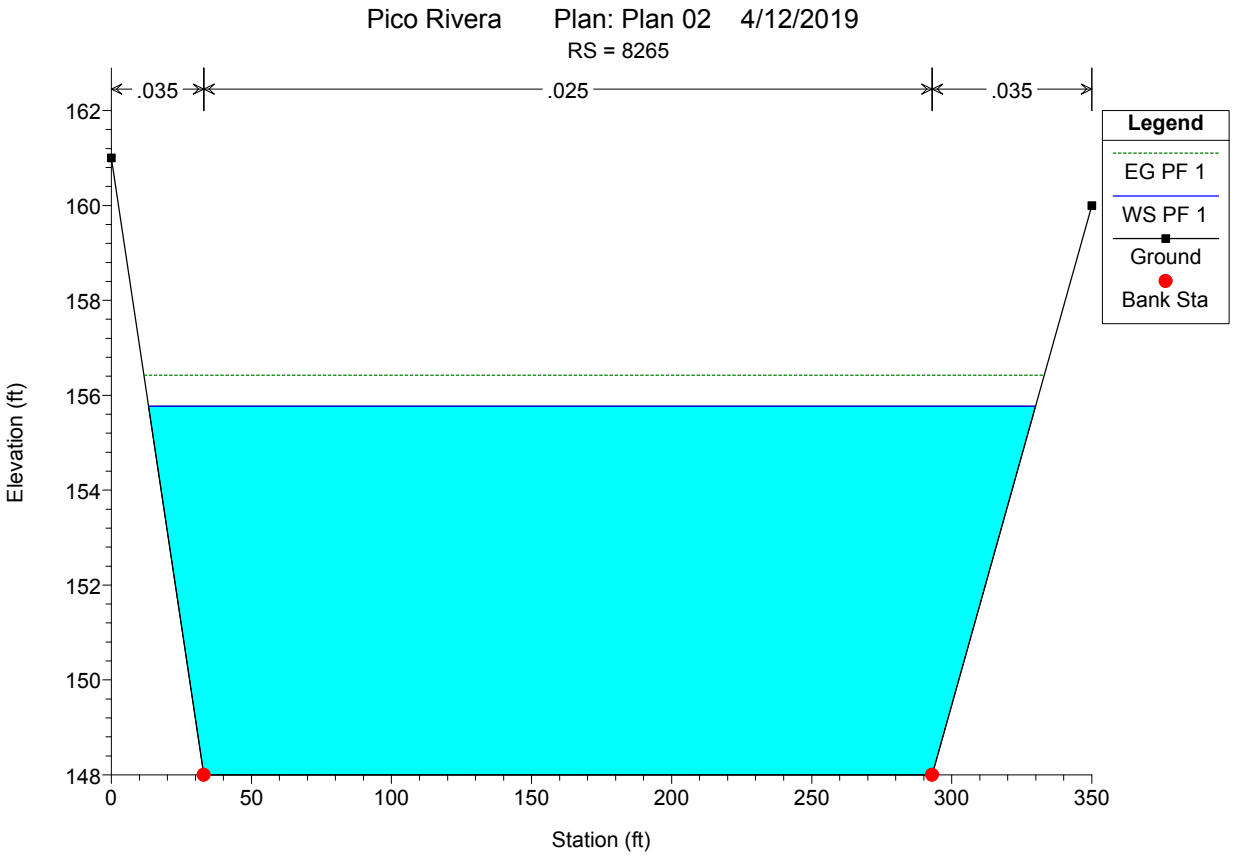
BkF 100+ YEARS
ENGINEERS . SURVEYORS . PLANNERS

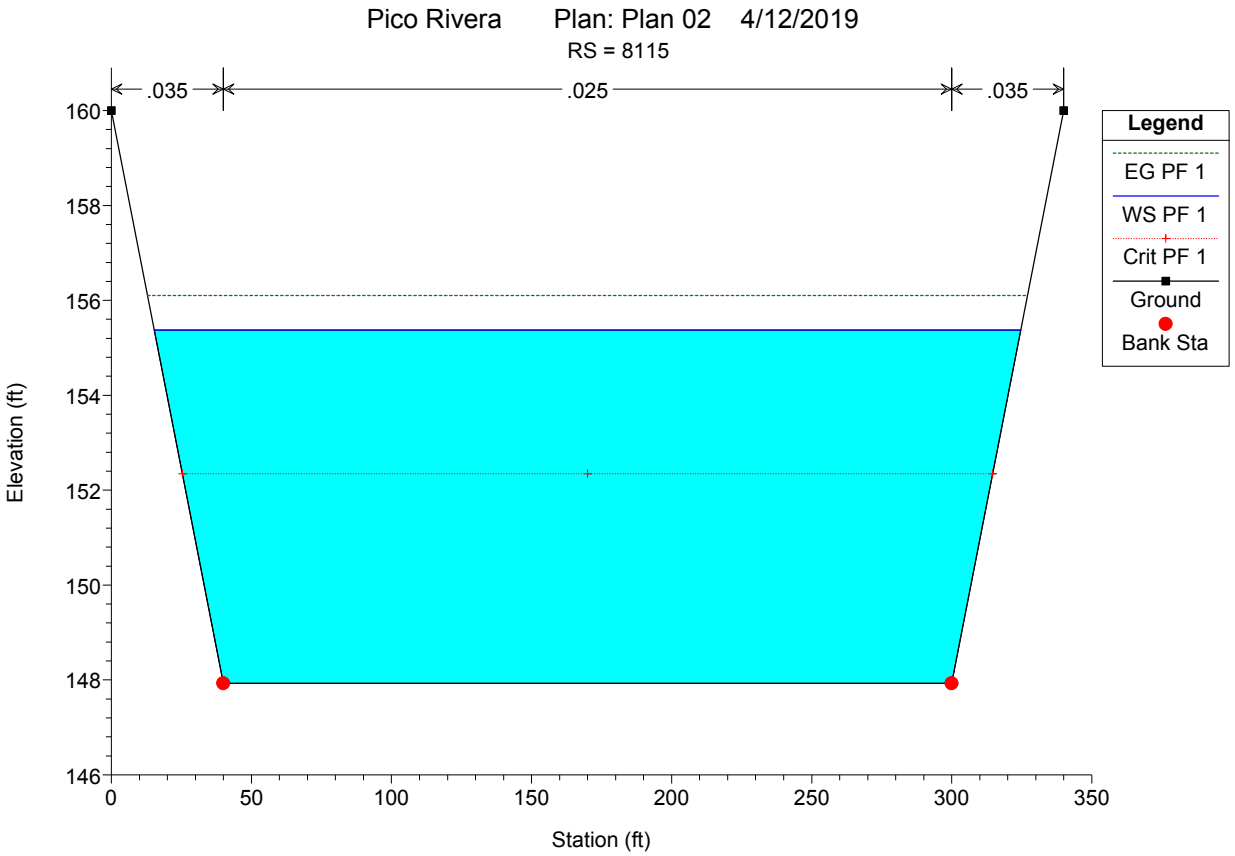
Post-Project
HEC-RAS Analysis

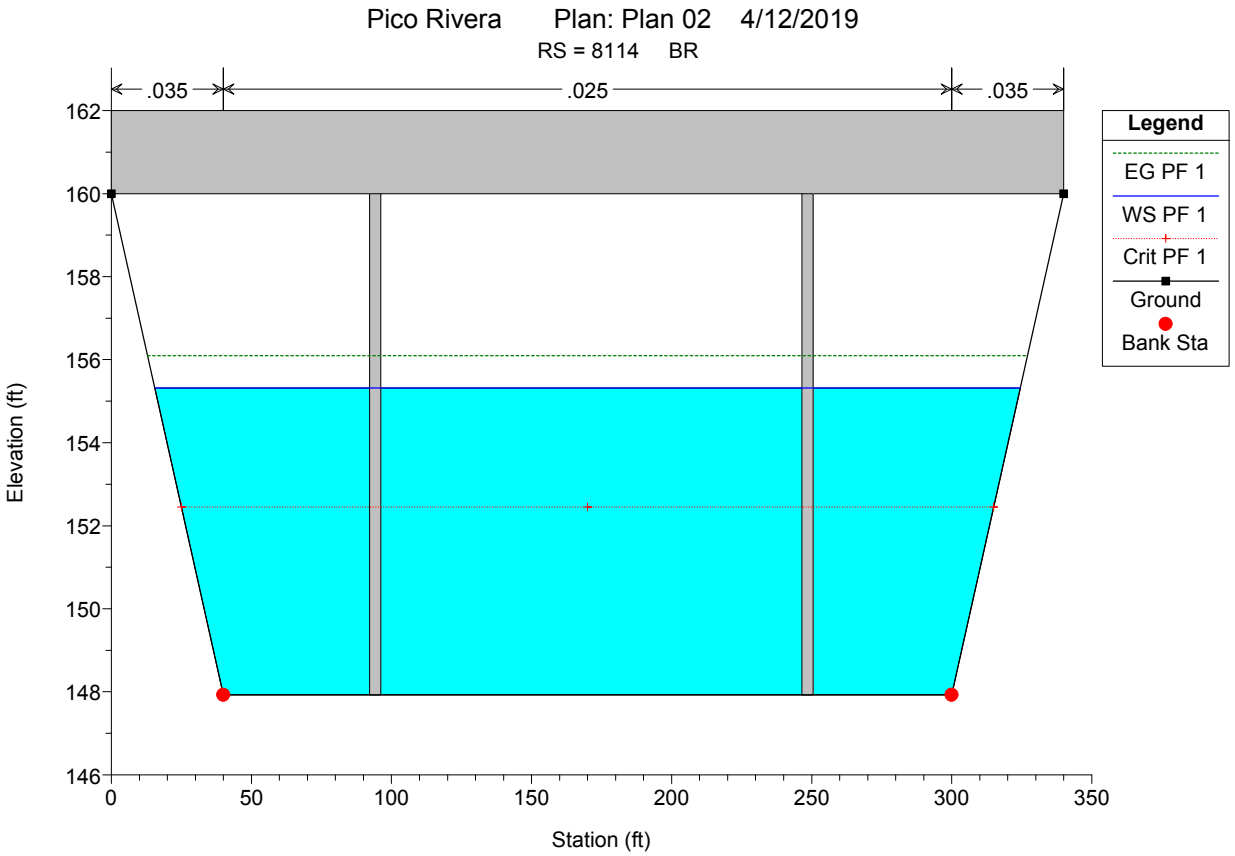
HEC-RAS Plan: Plan 02 River: SG Reach: 01 Profile: PF 1

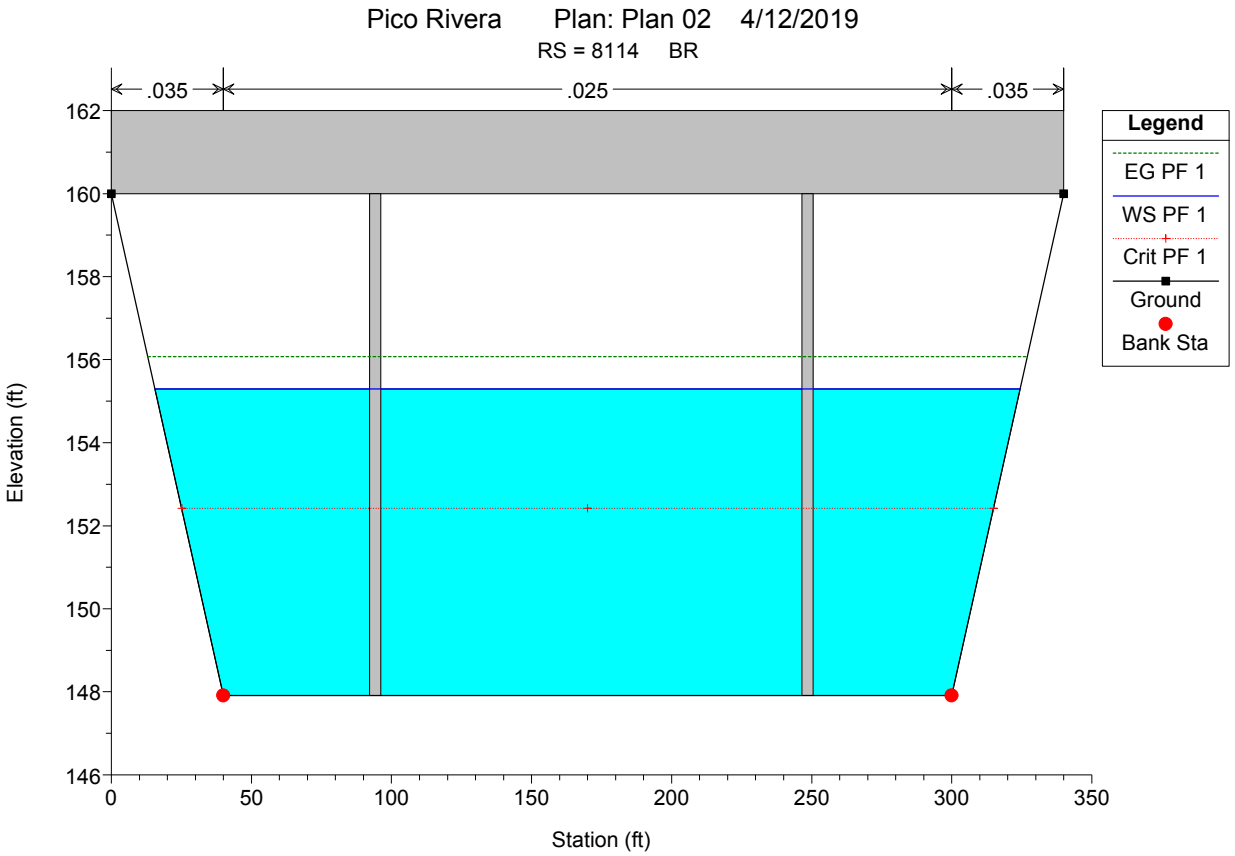
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
01	8460	PF 1	14000.00	148.17	155.98		156.59	0.000838	6.27	2249.38	342.63	0.42
01	8265	PF 1	14000.00	148.00	155.77		156.42	0.000805	6.62	2239.70	316.62	0.42
01	8115	PF 1	14000.00	147.93	155.38	152.35	156.10	0.000939	6.94	2119.61	309.35	0.45
01	8114		Bridge									
01	8095	PF 1	14000.00	147.91	155.33		156.06	0.000951	6.97	2110.74	309.09	0.45
01	7900	PF 1	14000.00	147.65	155.06		155.78	0.000937	6.91	2123.62	310.38	0.45
01	7535	PF 1	14000.00	147.30	154.79		155.43	0.000821	6.52	2257.75	327.52	0.42
01	7170	PF 1	14000.00	146.95	154.49		155.13	0.000824	6.56	2259.30	329.36	0.42
01	6805	PF 1	14000.00	146.60	154.21		154.83	0.000794	6.48	2296.91	333.95	0.41
01	6440	PF 1	14000.00	146.25	153.89		154.54	0.000817	6.59	2252.95	324.99	0.42
01	6075	PF 1	14000.00	145.90	153.57		154.23	0.000833	6.67	2231.30	321.84	0.42
01	5710	PF 1	14000.00	145.55	153.28		153.93	0.000813	6.62	2246.28	321.51	0.42
01	5350	PF 1	14000.00	145.20	153.11		153.64	0.000627	5.91	2471.60	335.03	0.37
01	4980	PF 1	14000.00	144.85	152.76		153.38	0.000744	6.44	2324.35	327.73	0.40
01	4615	PF 1	14000.00	144.50	152.51		153.10	0.000713	6.35	2360.22	329.62	0.40
01	4250	PF 1	14000.00	144.15	152.32		152.84	0.000605	5.93	2507.62	338.99	0.37
01	3890	PF 1	14000.00	143.80	152.15		152.63	0.000532	5.64	2612.03	340.89	0.34
01	3500	PF 1	14000.00	143.45	151.95		152.42	0.000515	5.61	2639.66	341.30	0.34
01	3140	PF 1	14000.00	143.10	151.81		152.23	0.000443	5.30	2793.16	351.25	0.32
01	2780	PF 1	14000.00	142.85	151.55		152.05	0.000536	5.82	2586.74	334.79	0.35
01	2420	PF 1	14000.00	142.50	151.12		151.80	0.000752	6.85	2230.01	297.60	0.41
01	2060	PF 1	14000.00	142.15	150.60		151.48	0.000977	7.71	1973.49	266.84	0.47
01	1700	PF 1	14000.00	141.80	150.28		151.12	0.000951	7.62	2015.78	275.67	0.46
01	1350	PF 1	14000.00	141.55	149.93		150.78	0.000979	7.67	2011.58	280.18	0.47
01	1160	PF 1	14000.00	141.37	149.81	146.60	150.59	0.000828	6.91	1987.41	268.87	0.43
01	1159		Bridge									
01	1105	PF 1	14000.00	141.32	149.79		150.46	0.000706	6.56	2132.79	275.80	0.40
01	1050	PF 1	14000.00	141.28	149.42		150.38	0.001123	8.06	1875.30	260.75	0.50
01	1015	PF 1	14000.00	141.25	149.26		150.33	0.001220	8.31	1692.04	222.36	0.52
01	1000	PF 1	14000.00	141.00	149.17	146.32	150.31	0.000454	8.56	1640.07	201.49	0.53

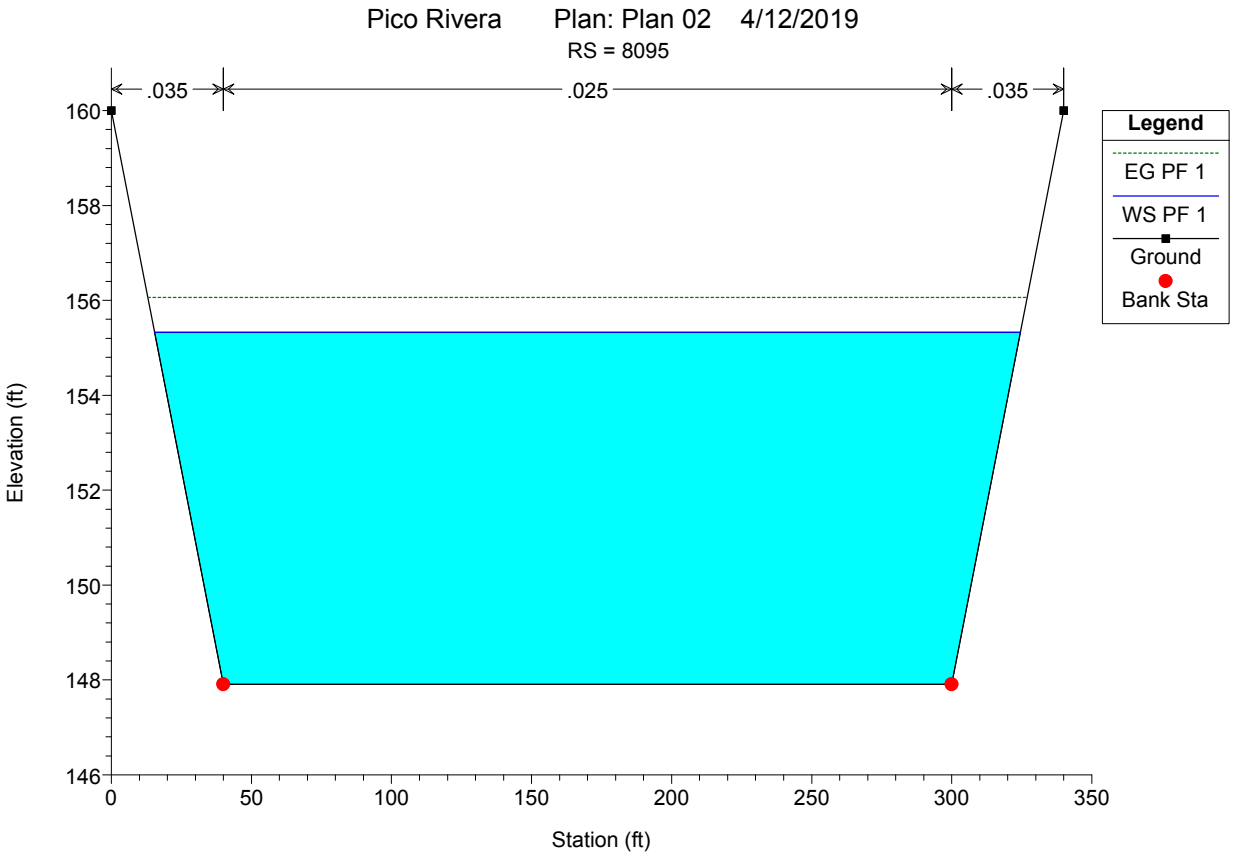

Pico Rivera Plan: Plan 02 4/12/2019
RS = 8460
.035
.025
.015
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
160
158
156
154
152
150
148
0
50
100
150
200
250
300
350
400

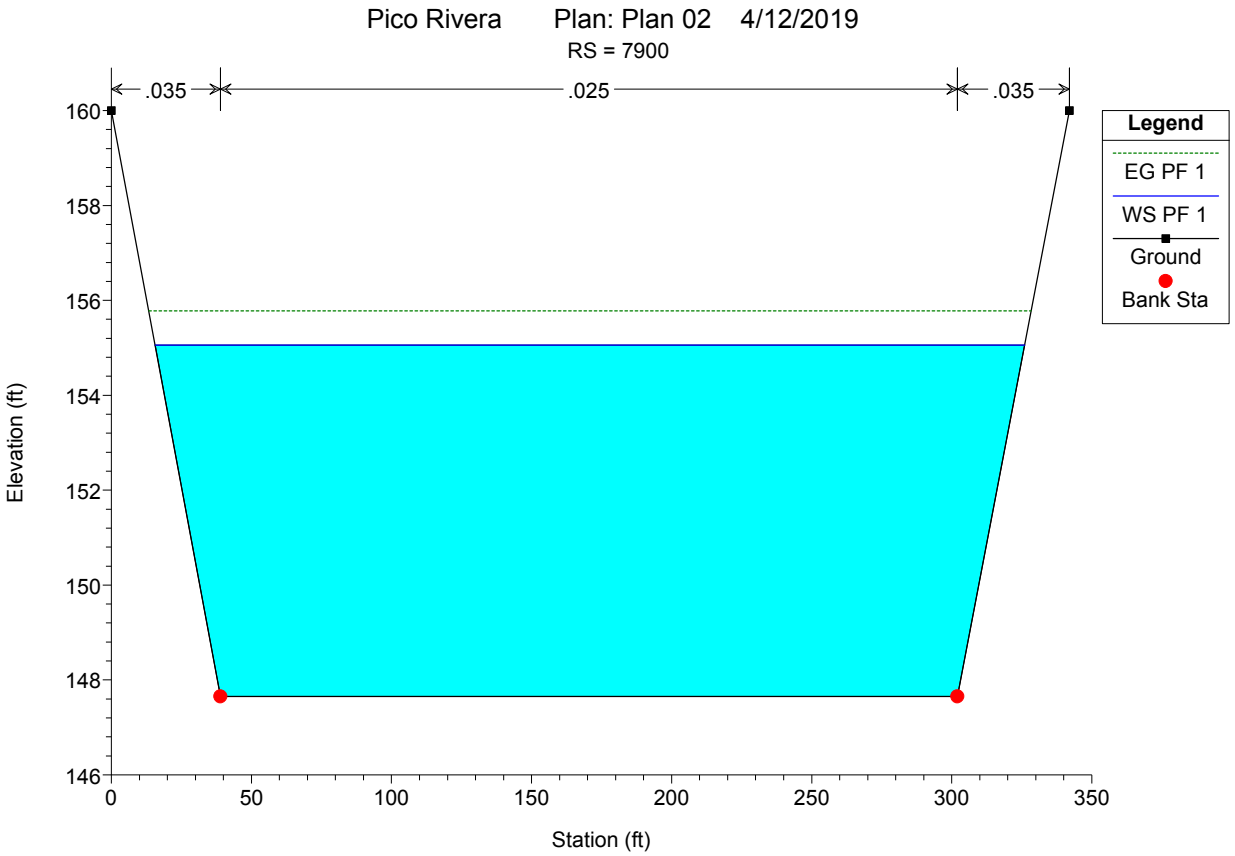

Pico Rivera Plan: Plan 02 4/12/2019
RS = 8265
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
0
50
100
150
200
250
300
350

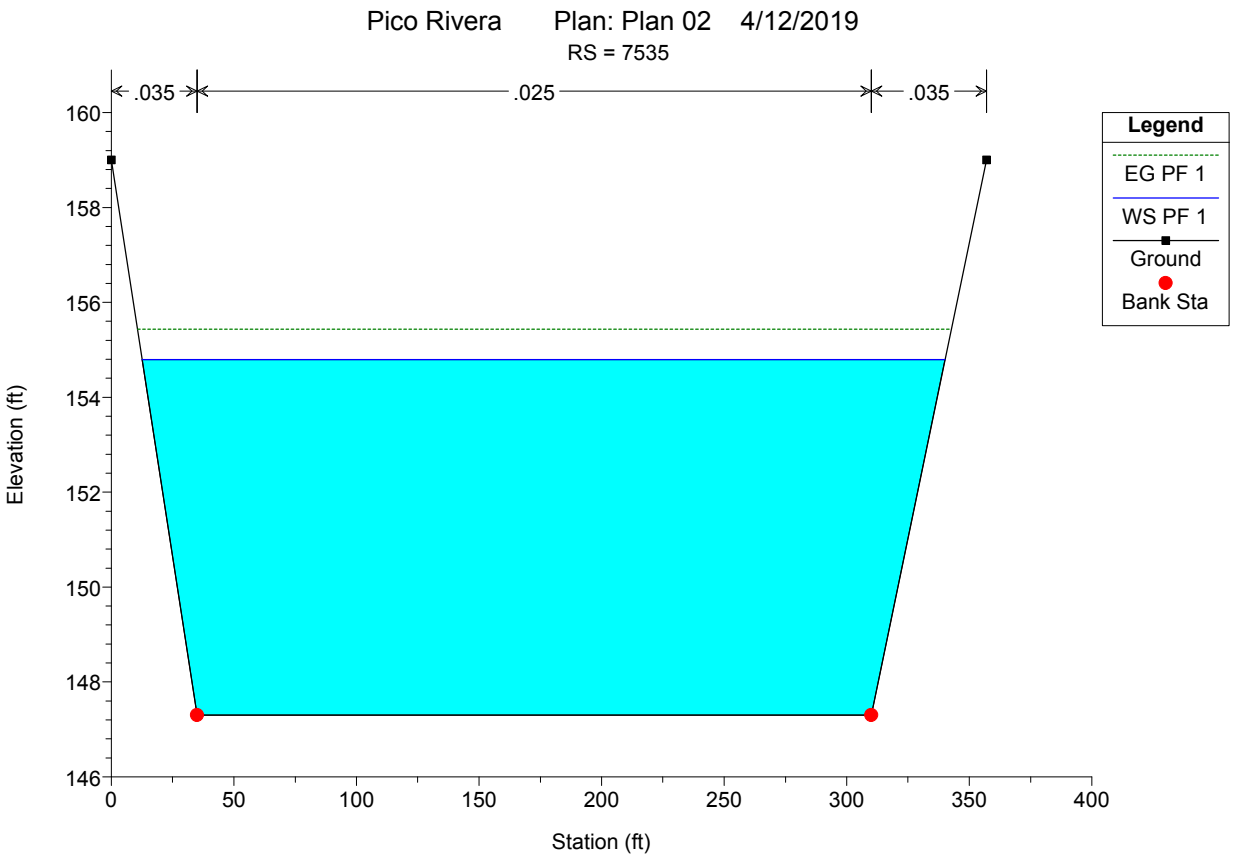

Pico Rivera Plan: Plan 02 4/12/2019
RS = 8115
.035
.025
.035
160
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

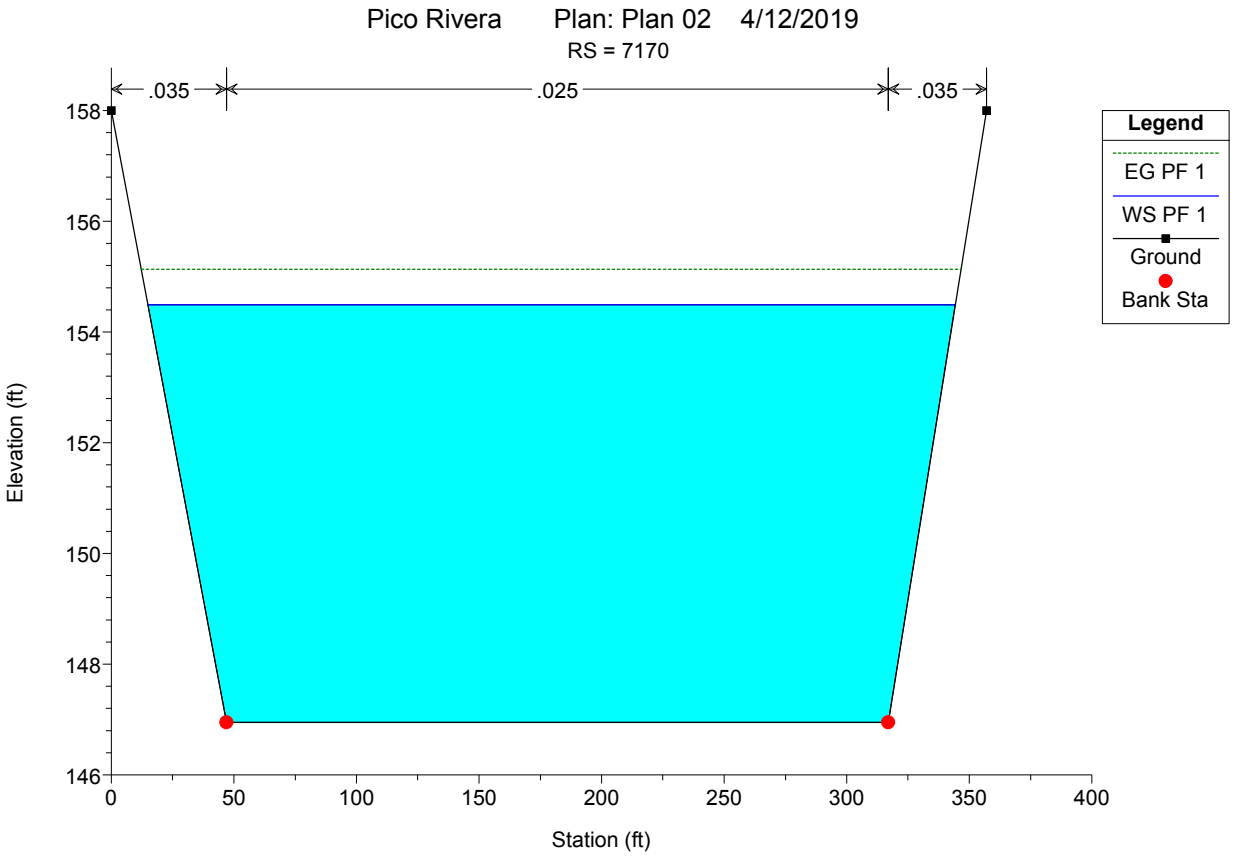

Pico Rivera Plan: Plan 02 4/12/2019
RS = 8114 BR
.035
.025
.035
162
160
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta

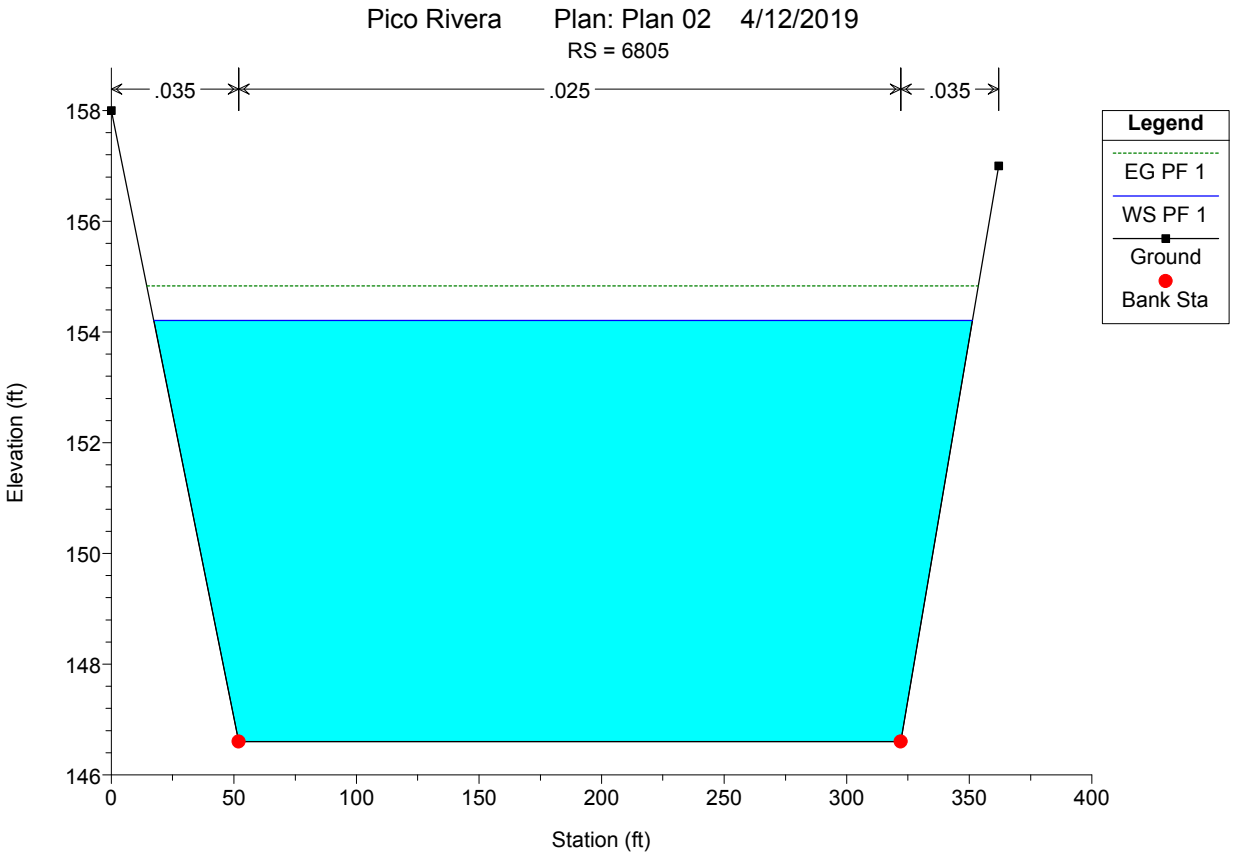

Pico Rivera Plan: Plan 02 4/12/2019
RS = 8114 BR
.035
.025
.035
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350

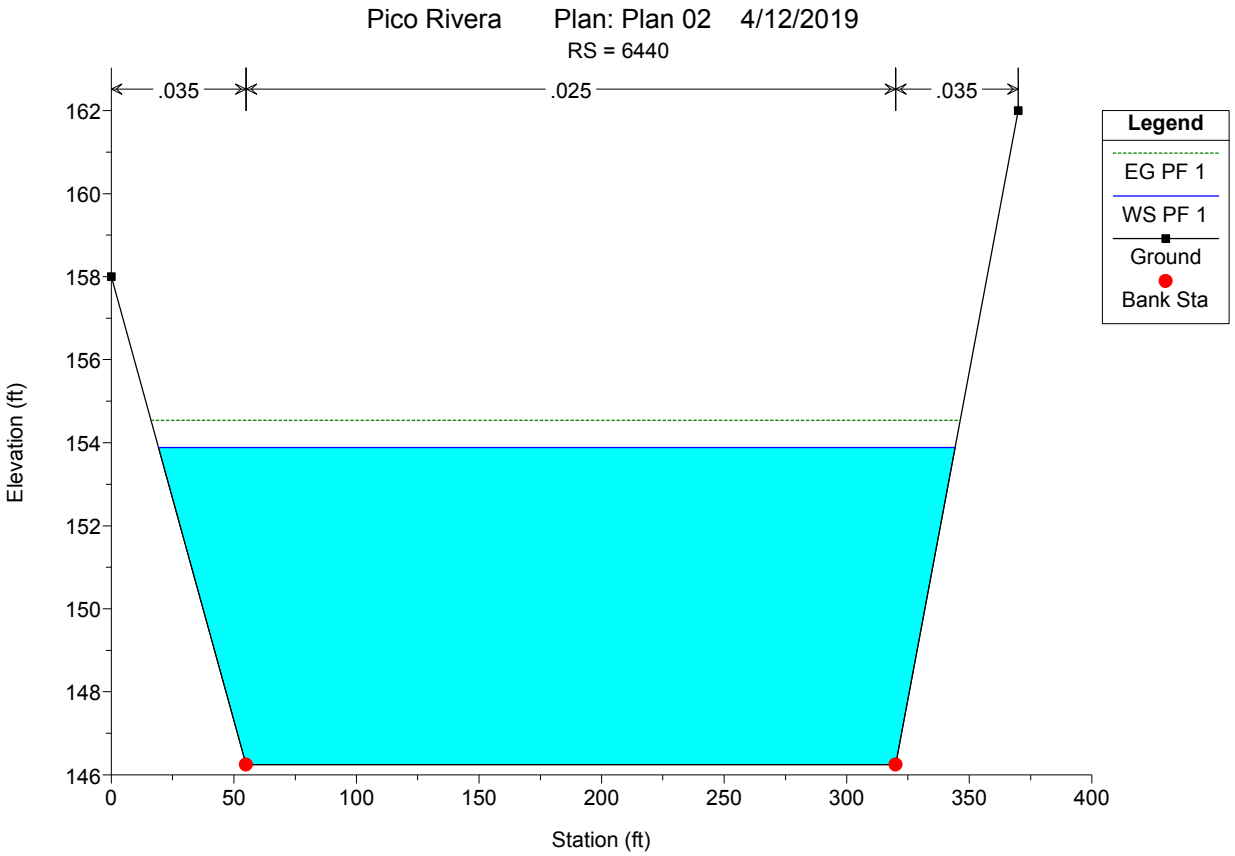

Pico Rivera Plan: Plan 02 4/12/2019
RS = 8095
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350

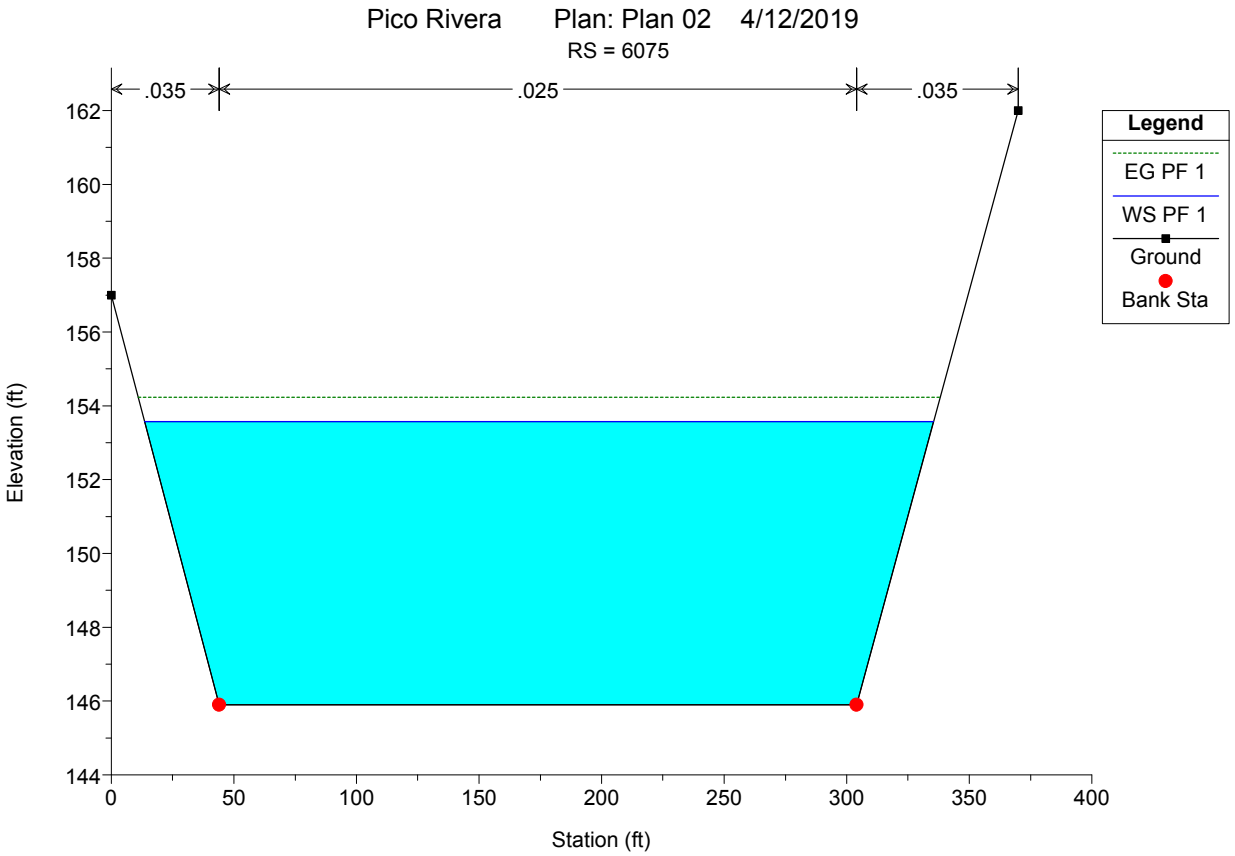

Pico Rivera Plan: Plan 02 4/12/2019
RS = 7900
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350
Station (ft)

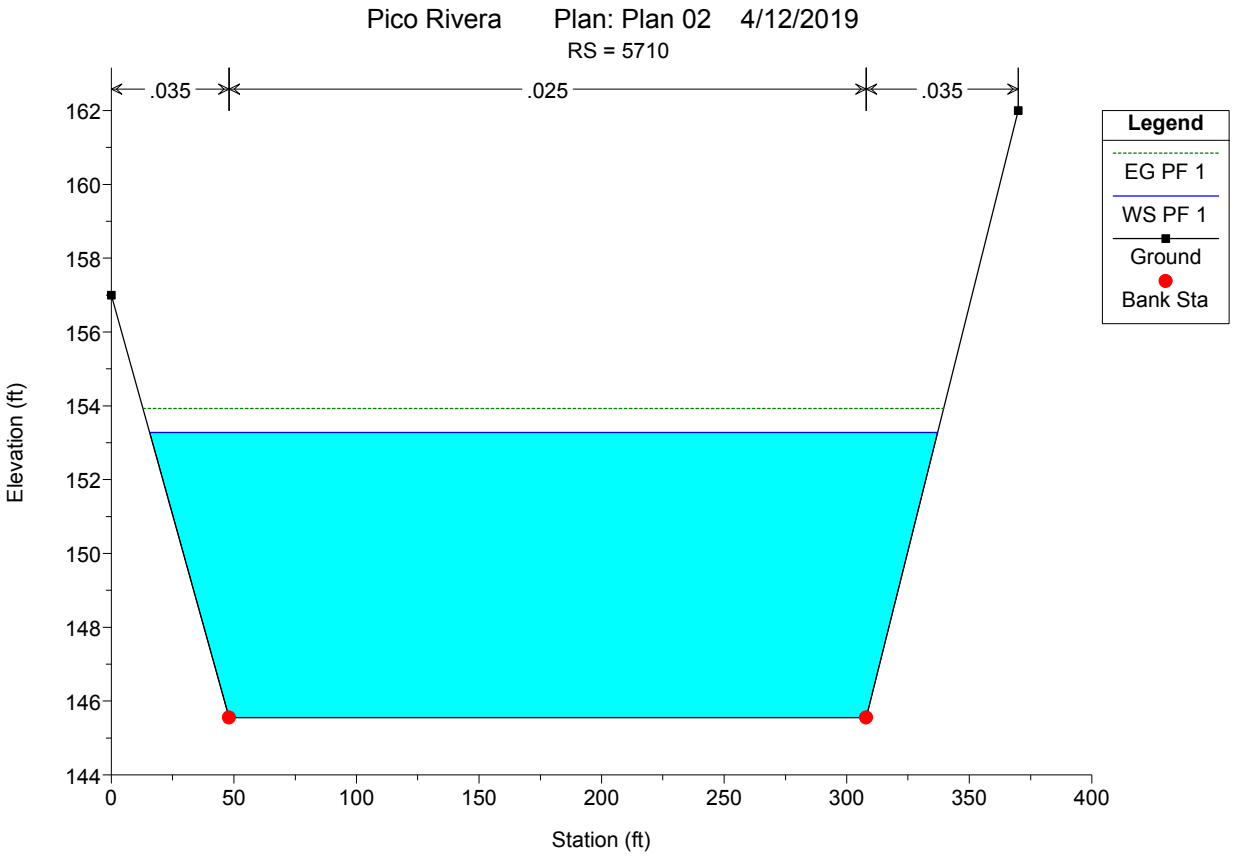

Pico Rivera Plan: Plan 02 4/12/2019
RS = 7535
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350
400
Station (ft)

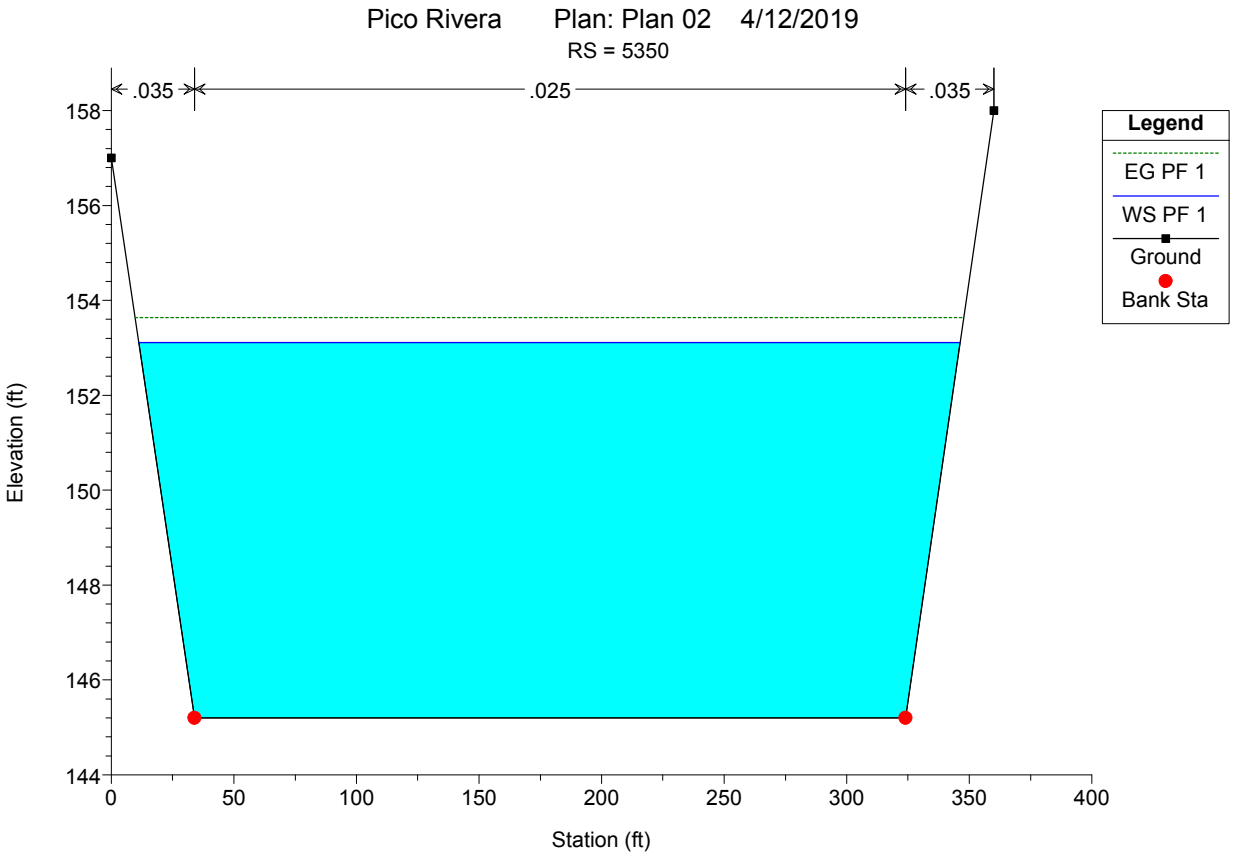

Pico Rivera Plan: Plan 02 4/12/2019
RS = 7170
.035
.025
.035
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

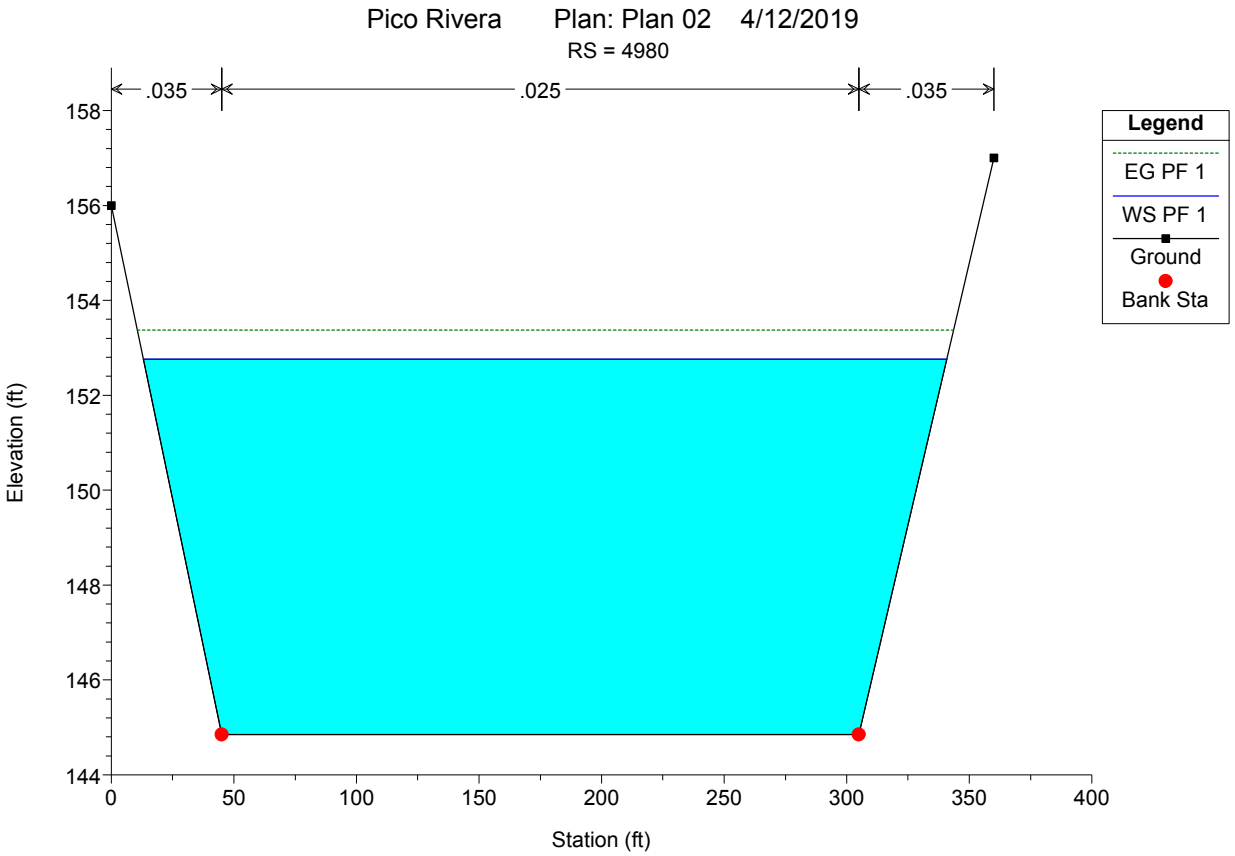

Pico Rivera Plan: Plan 02 4/12/2019
RS = 6805
.035
.025
.035
158
156
154
152
150
148
146
Elevation (ft)
0
50
100
150
200
250
300
350
400
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

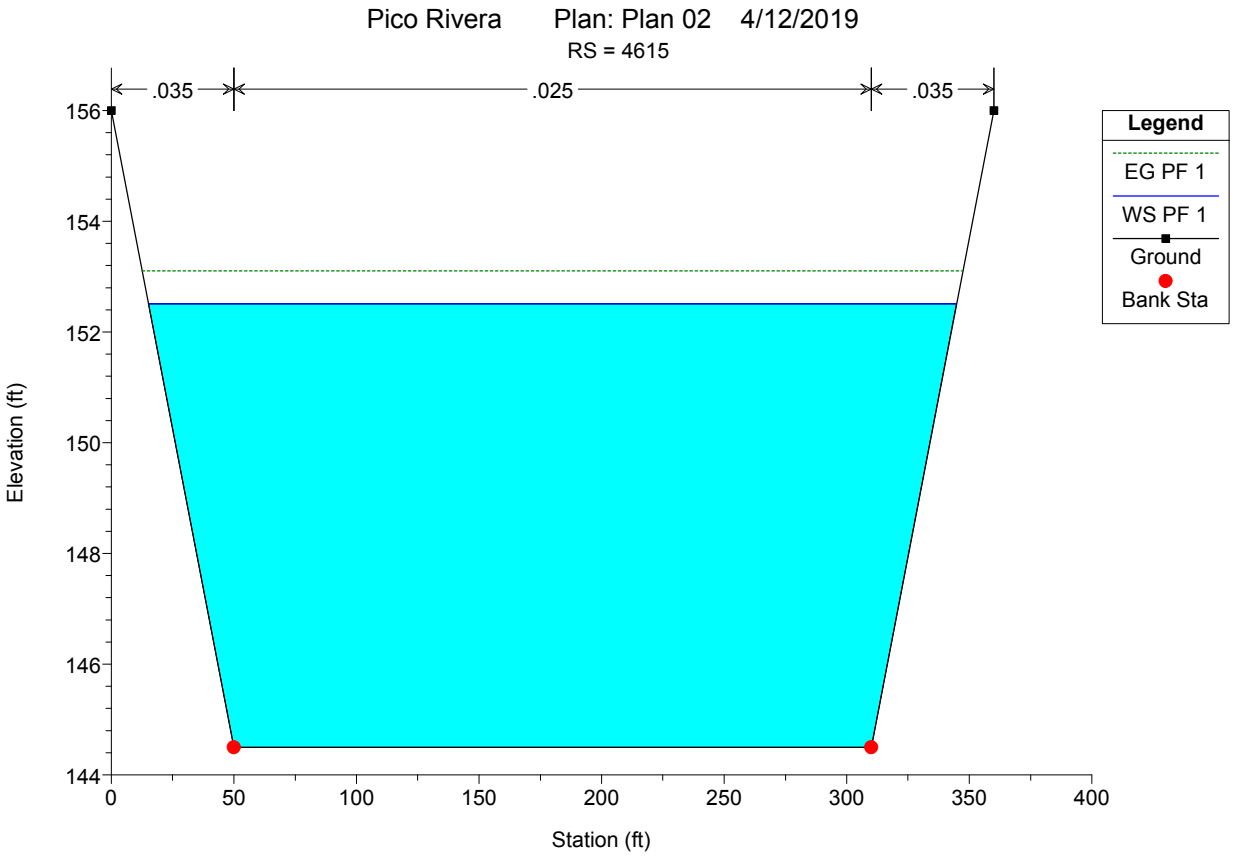

Pico Rivera Plan: Plan 02 4/12/2019
RS = 6440
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
146
0
50
100
150
200
250
300
350
400

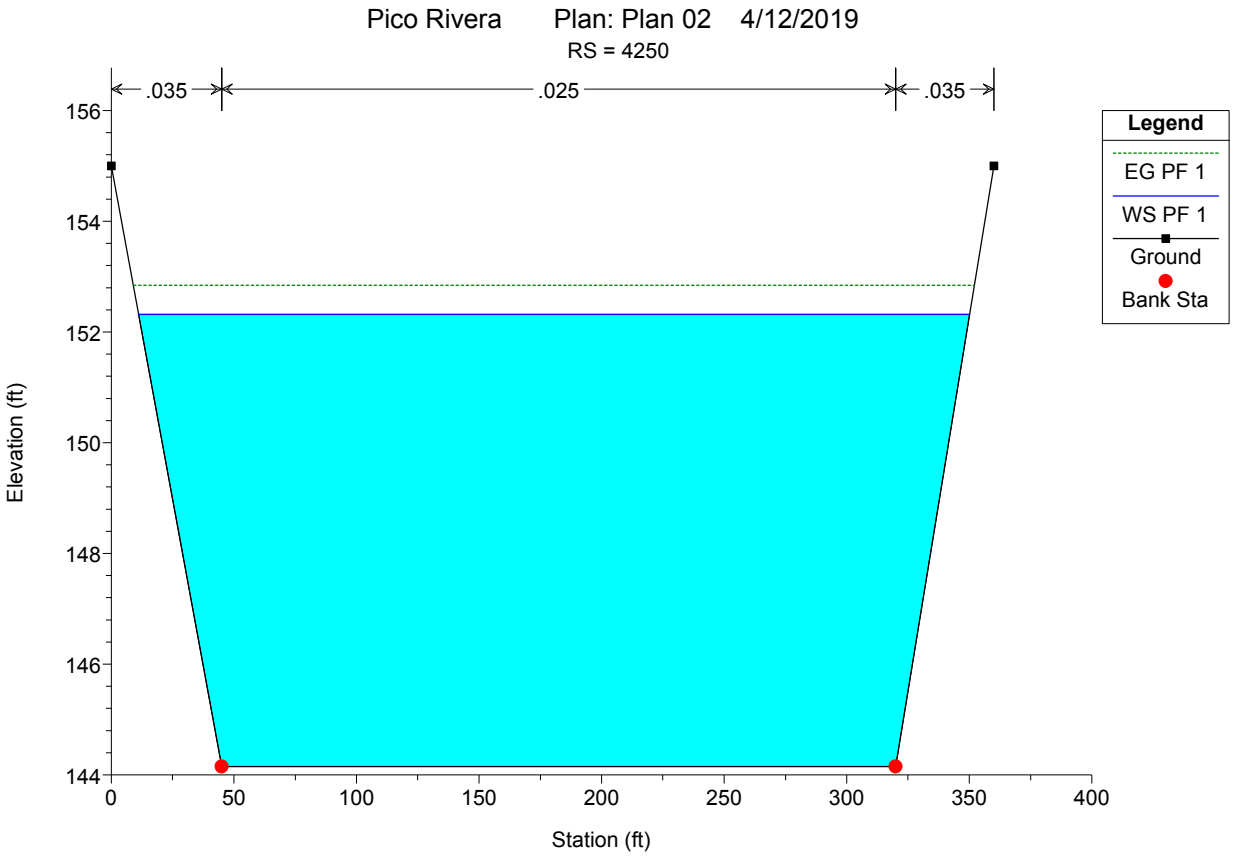

Pico Rivera Plan: Plan 02 4/12/2019
RS = 6075
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
162
160
158
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400

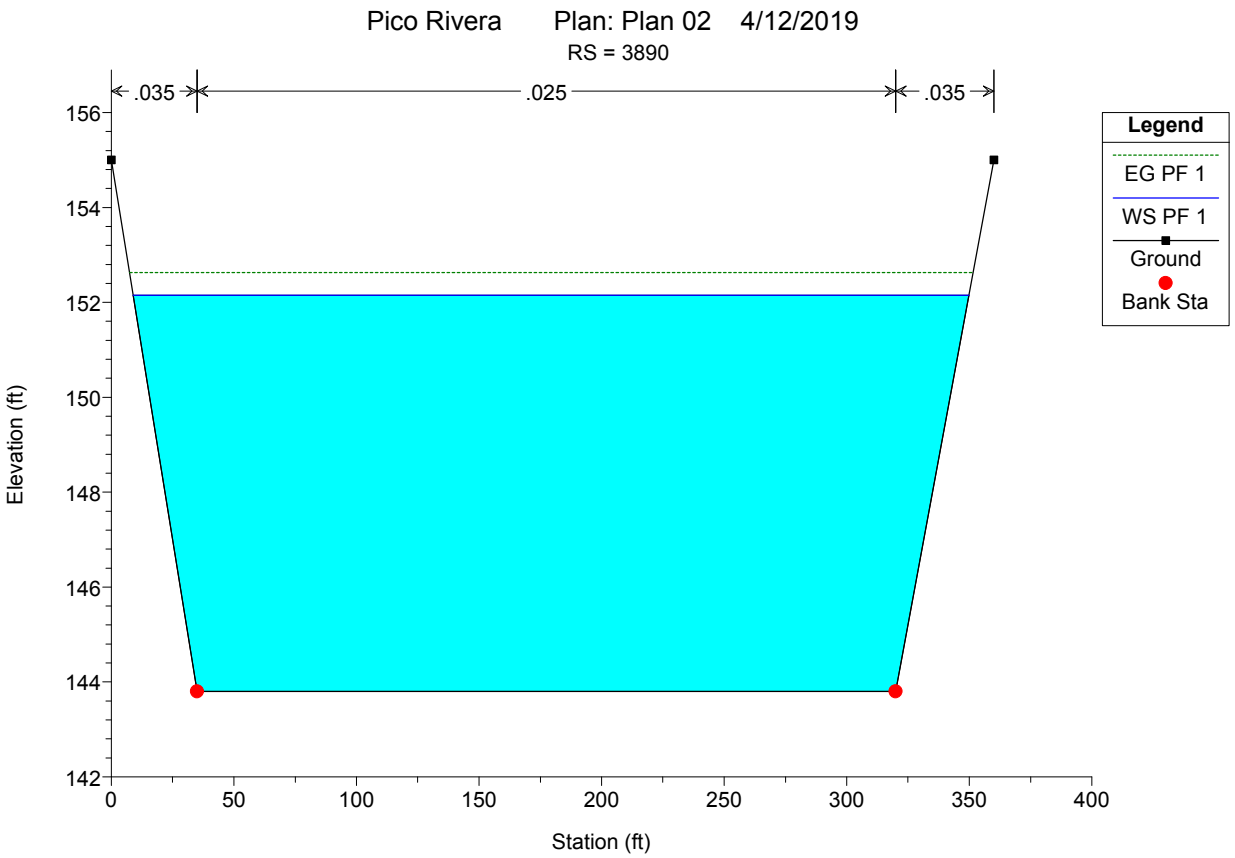

Pico Rivera Plan: Plan 02 4/12/2019
RS = 5710
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
144
146
148
150
152
154
156
158
160
162
0
50
100
150
200
250
300
350
400

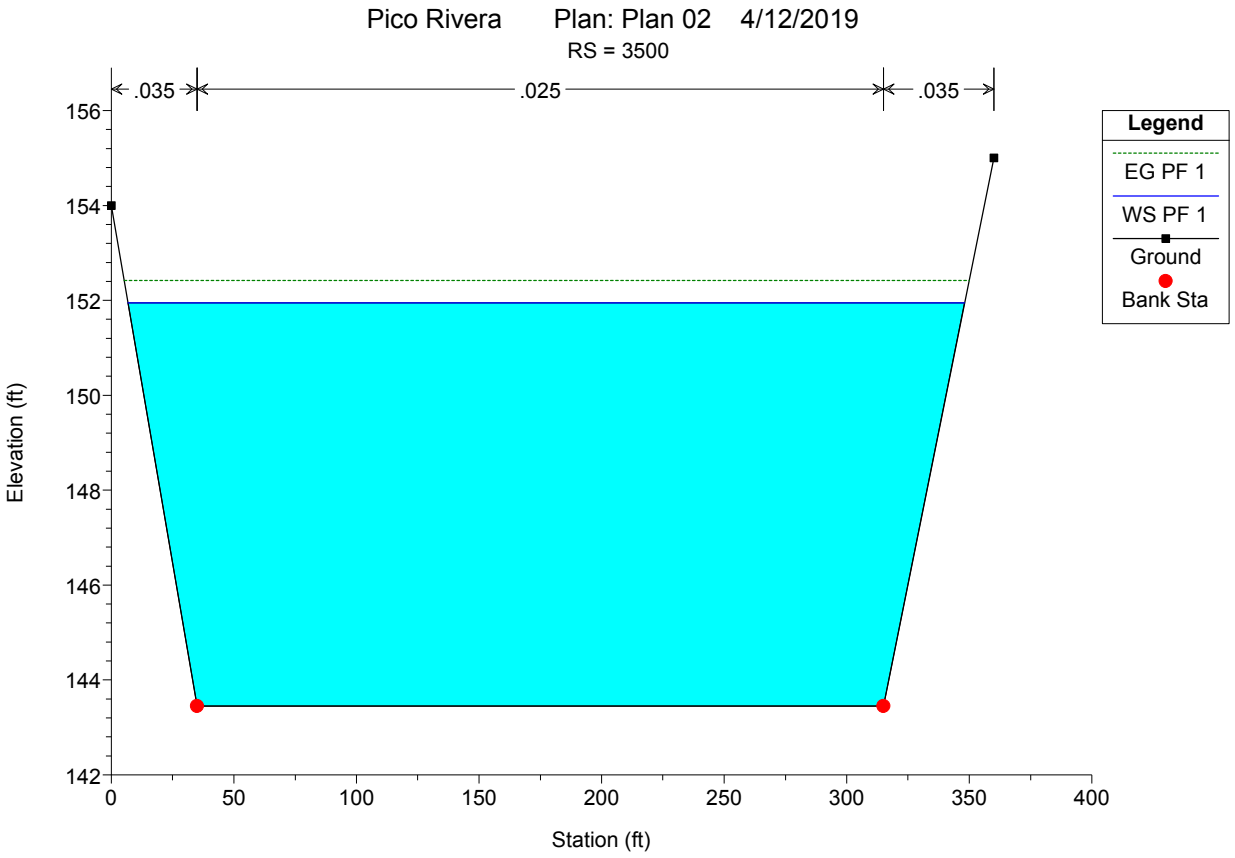

Pico Rivera Plan: Plan 02 4/12/2019
RS = 5350
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
144
146
148
150
152
154
156
158
0
50
100
150
200
250
300
350
400

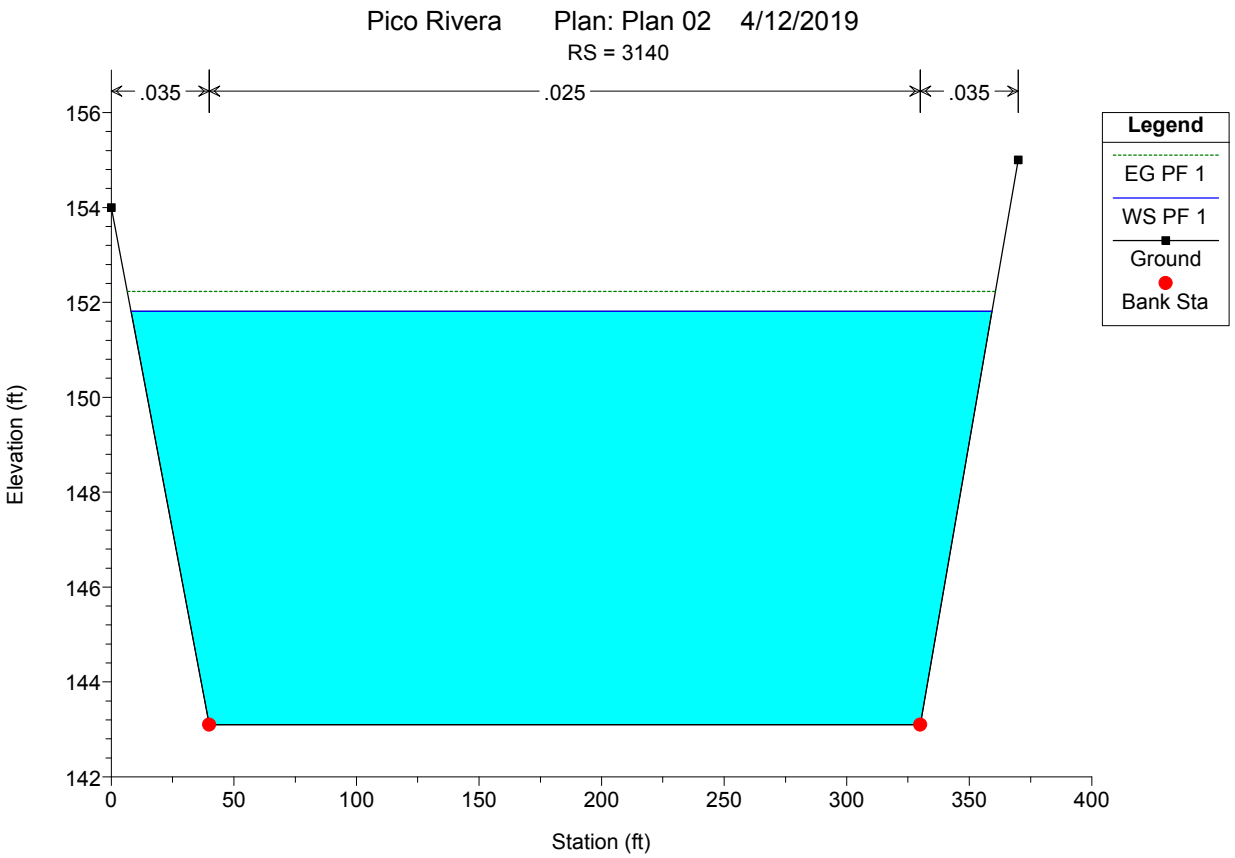

Pico Rivera Plan: Plan 02 4/12/2019
RS = 4980
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
158
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400
Station (ft)

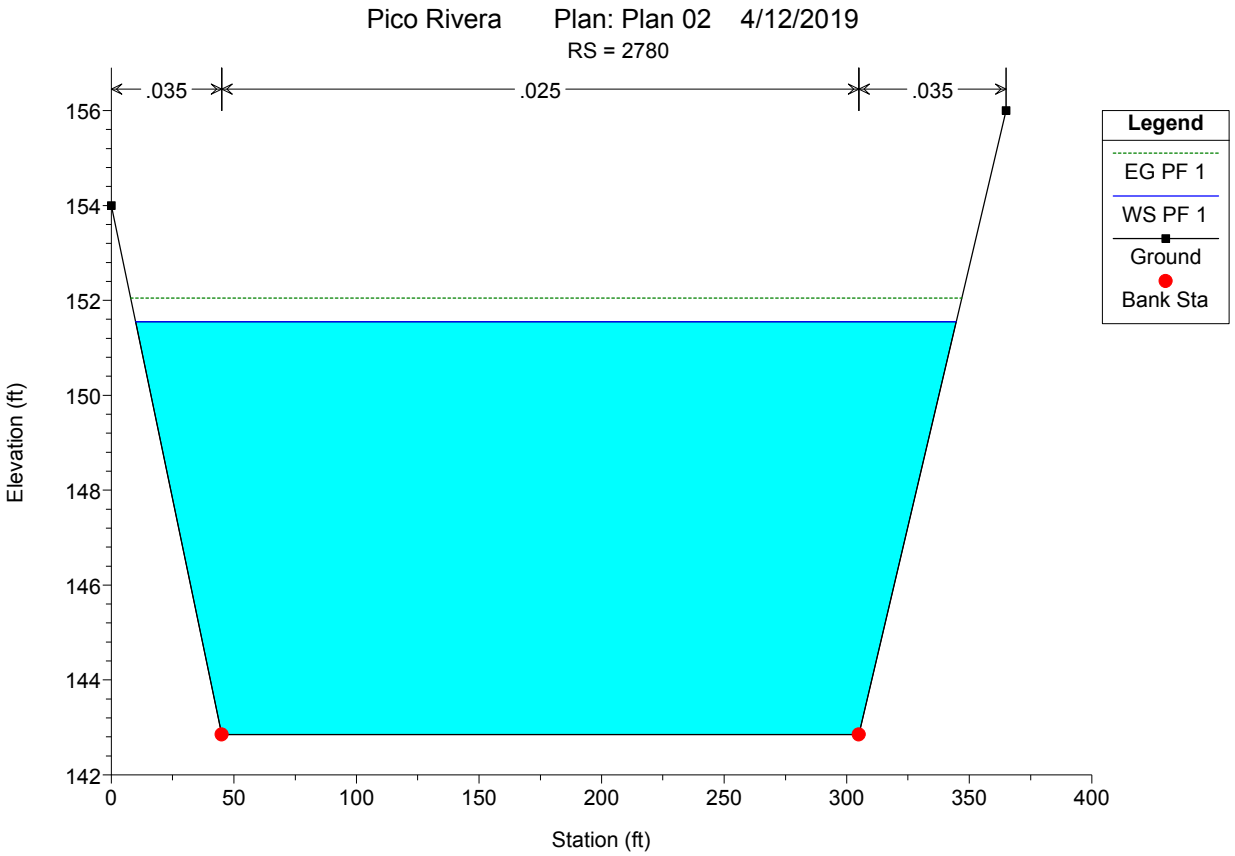

Pico Rivera Plan: Plan 02 4/12/2019
RS = 4615
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400
Station (ft)

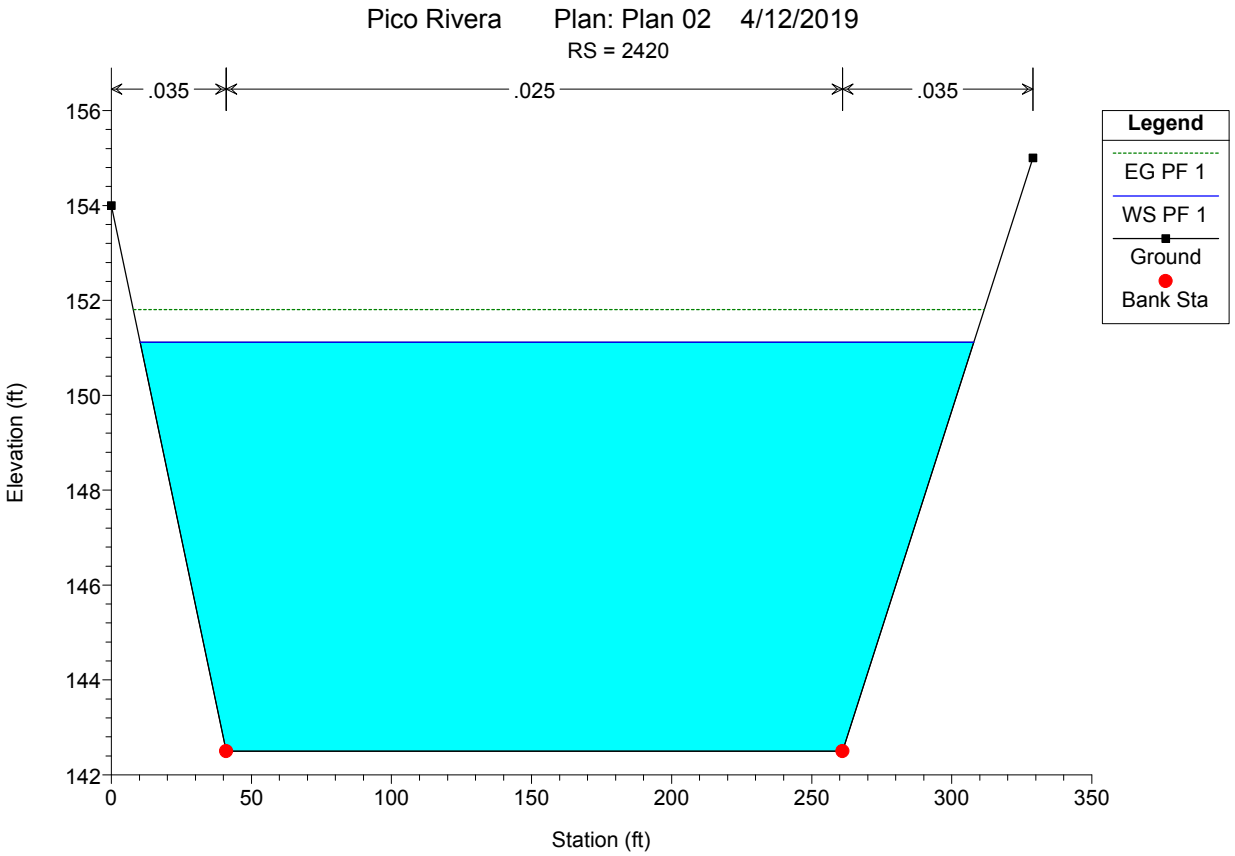

Pico Rivera Plan: Plan 02 4/12/2019
RS = 4250
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
0
50
100
150
200
250
300
350
400
Station (ft)

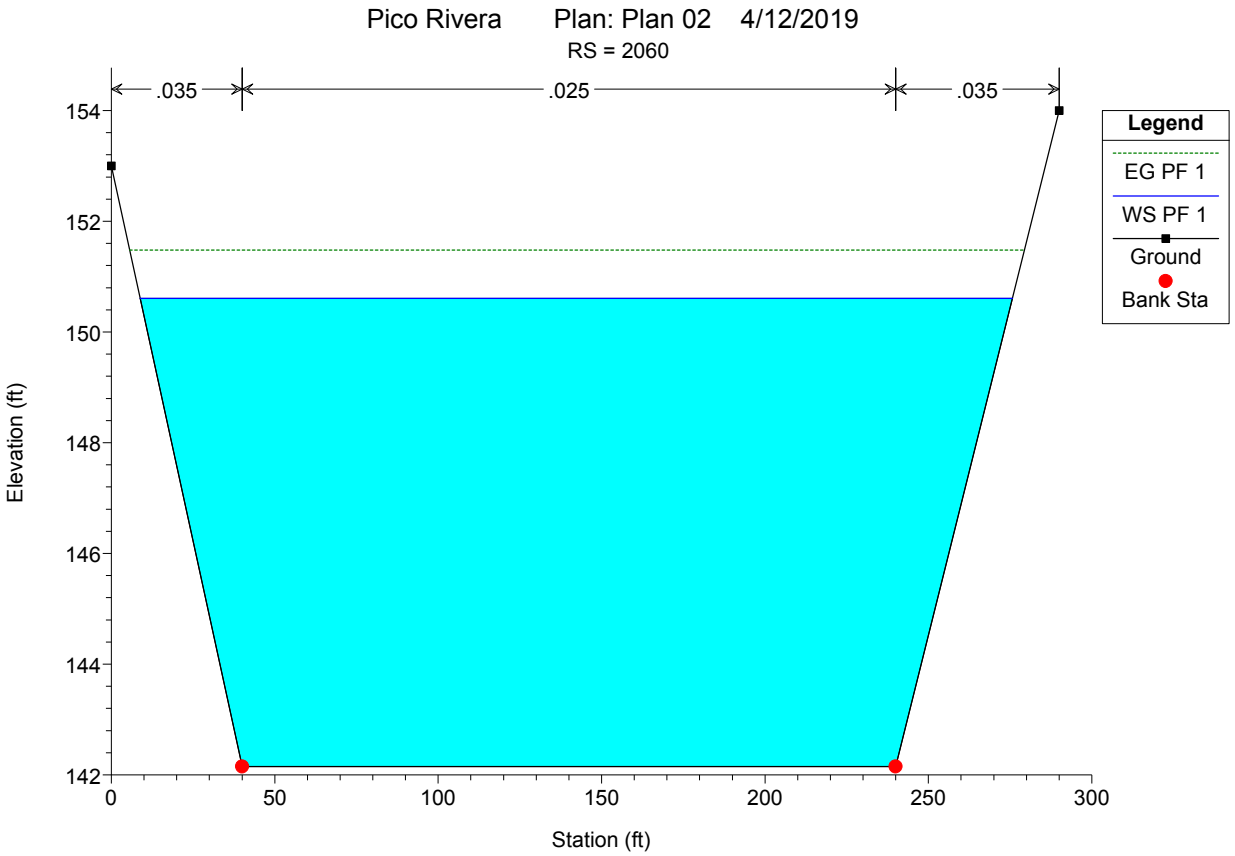

Pico Rivera Plan: Plan 02 4/12/2019
RS = 3890
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

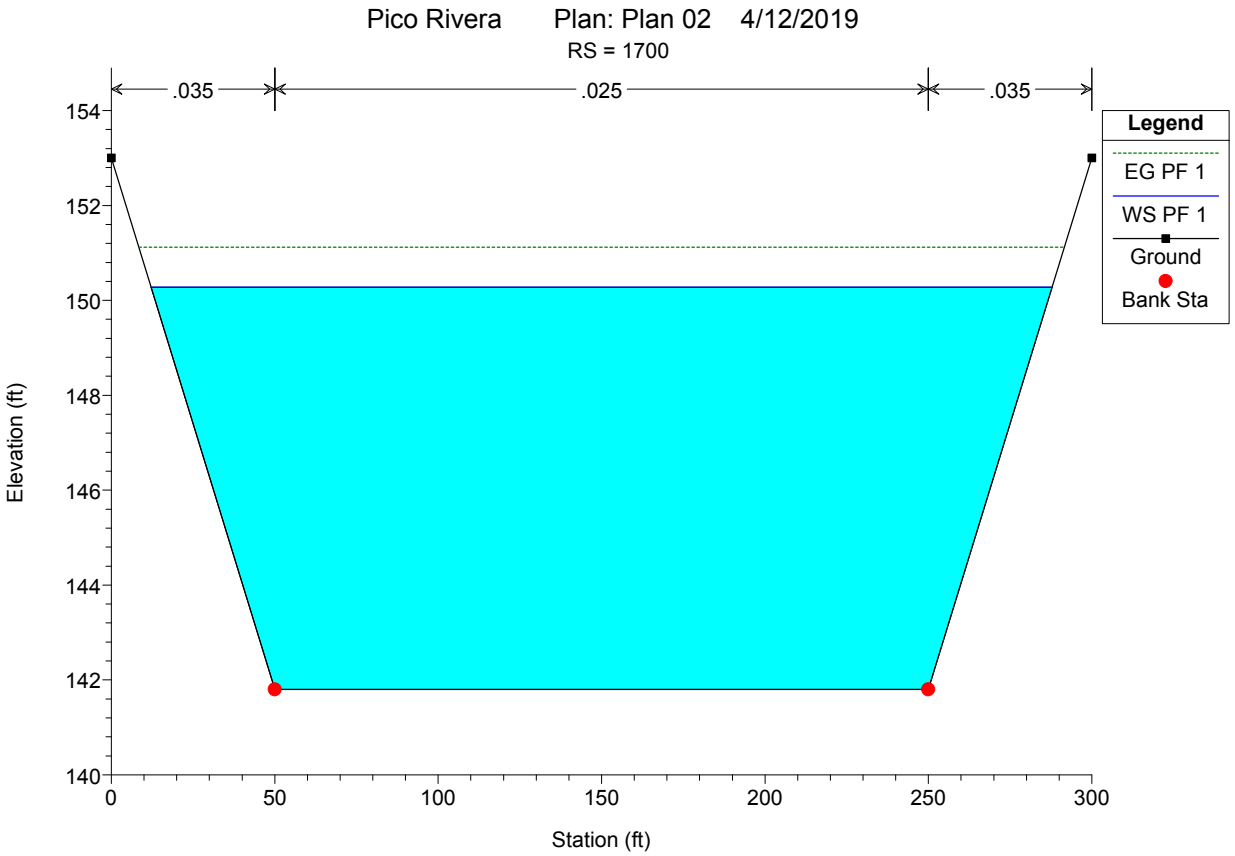

Pico Rivera Plan: Plan 02 4/12/2019
RS = 3500
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

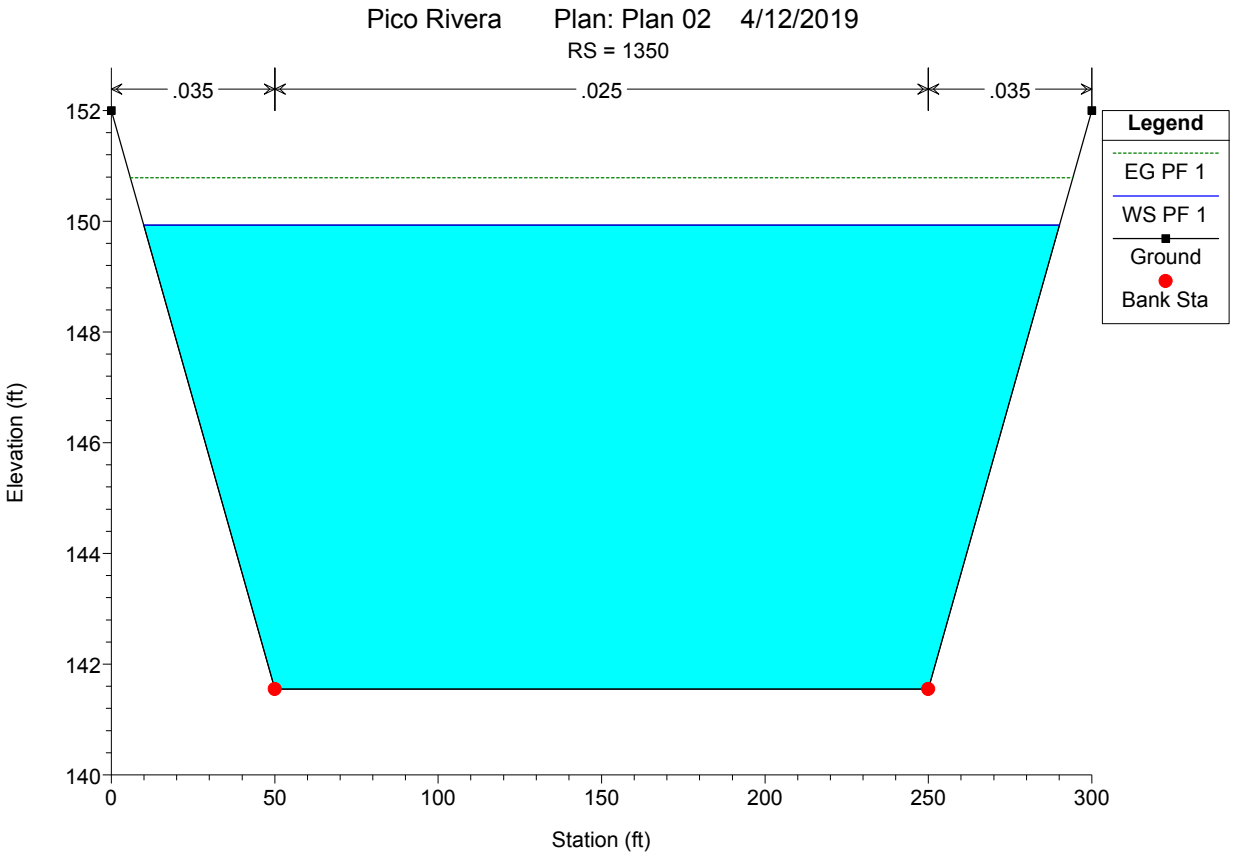

Pico Rivera Plan: Plan 02 4/12/2019
RS = 3140
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400
Station (ft)

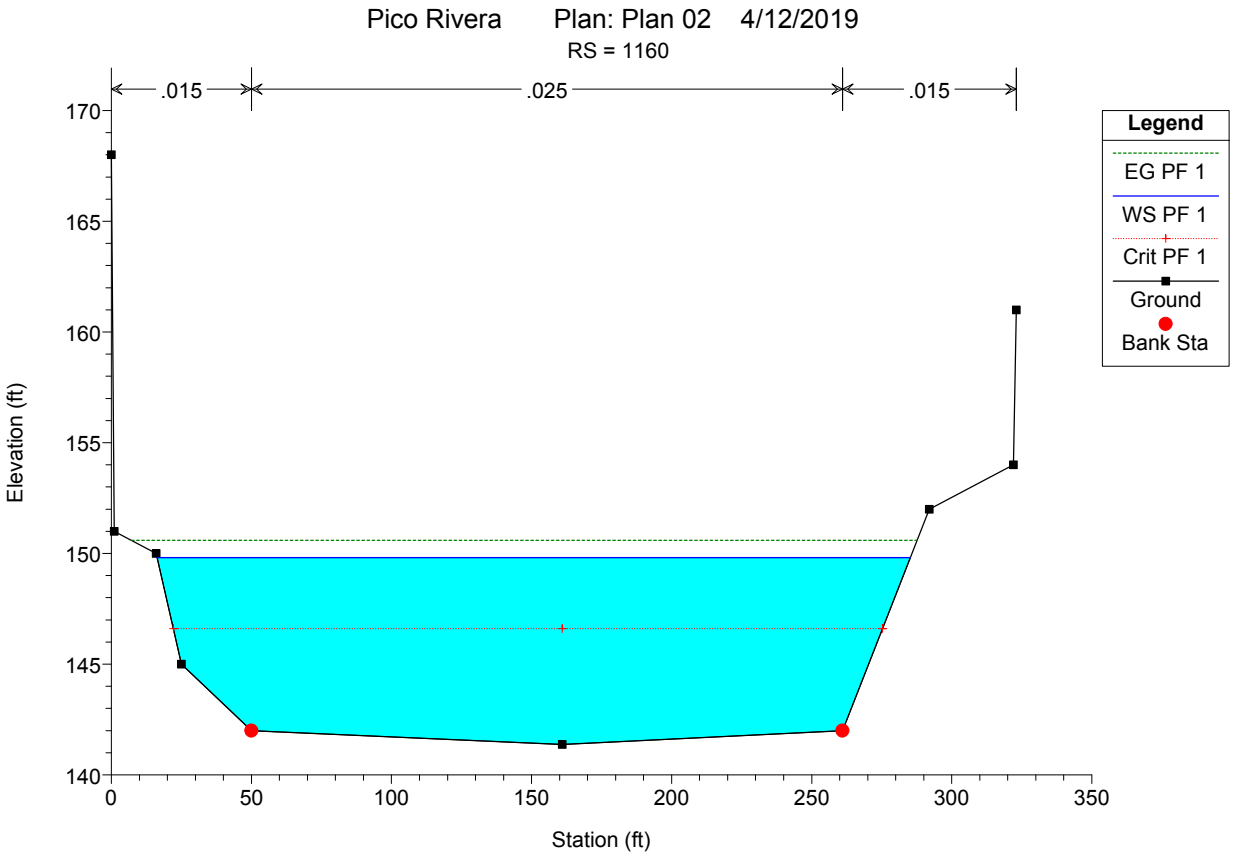

Pico Rivera Plan: Plan 02 4/12/2019
RS = 2780
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350
400

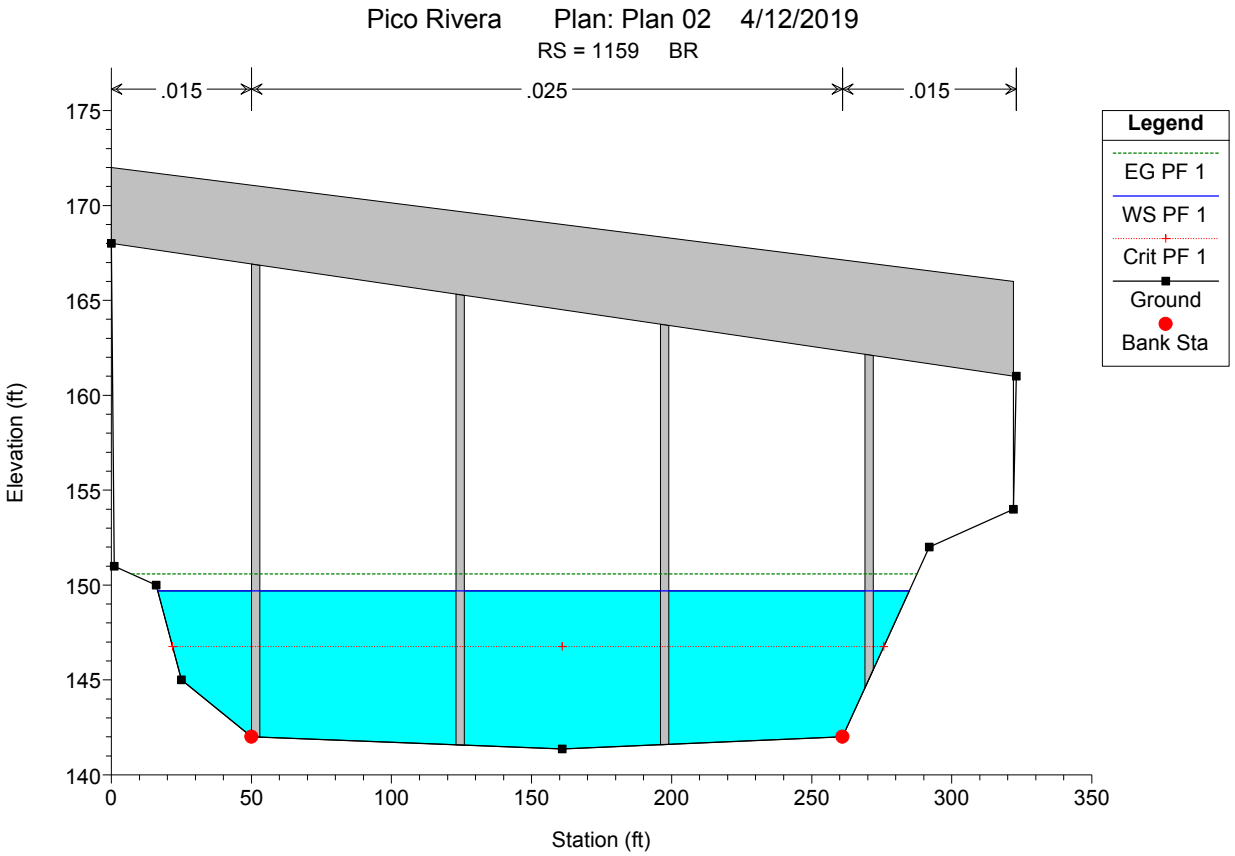

Pico Rivera Plan: Plan 02 4/12/2019
RS = 2420
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
156
154
152
150
148
146
144
142
0
50
100
150
200
250
300
350

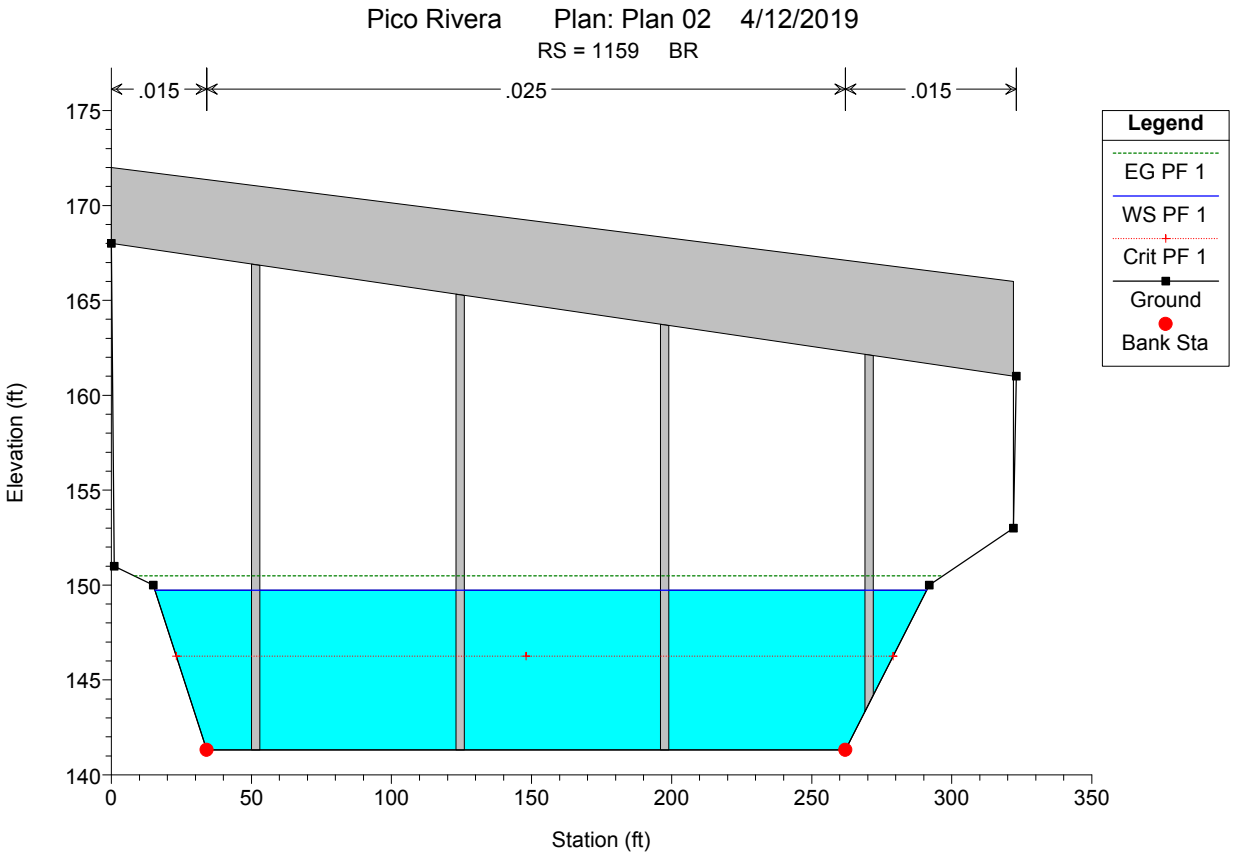

Pico Rivera Plan: Plan 02 4/12/2019
RS = 2060
.035
.025
.035
154
152
150
148
146
144
142
Elevation (ft)
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

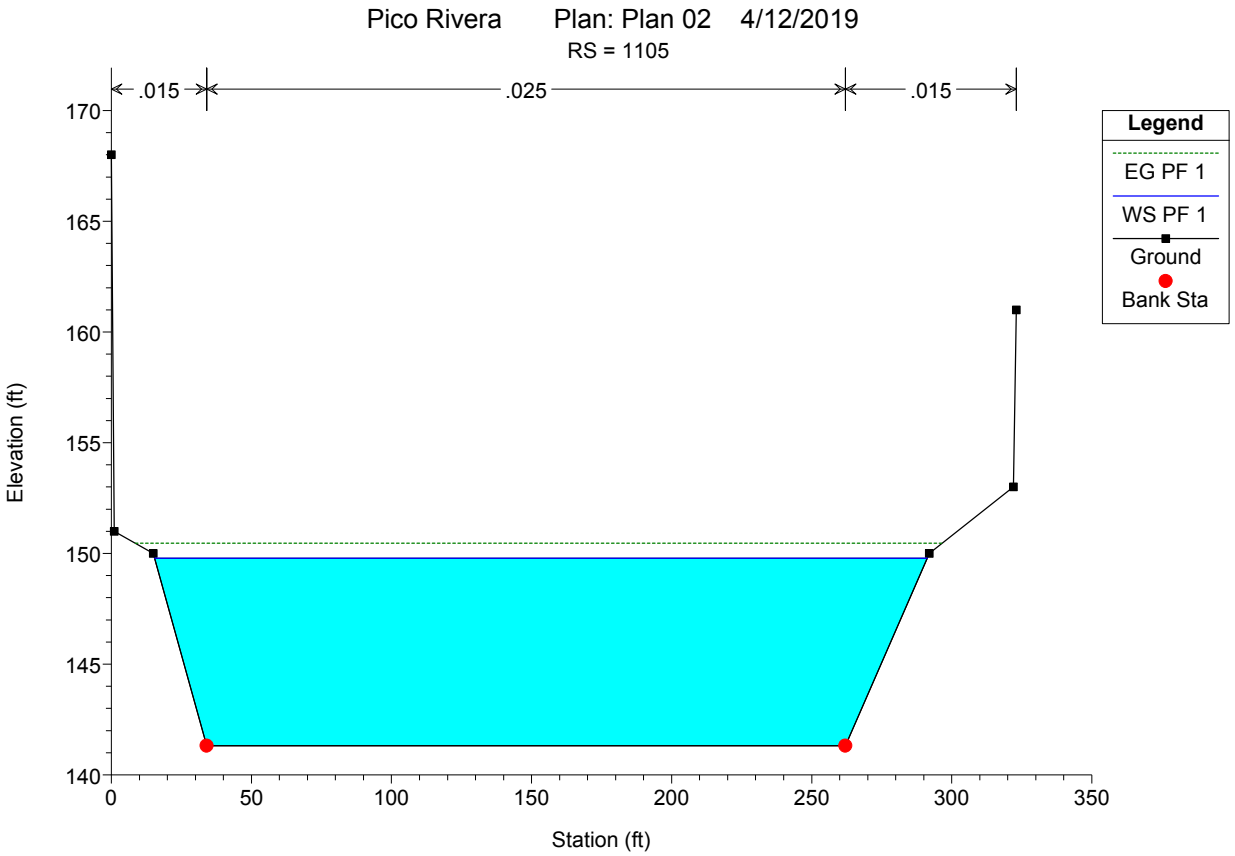

Pico Rivera Plan: Plan 02 4/12/2019
RS = 1700
.035
.025
.035
154
152
150
148
146
144
142
140
Elevation (ft)
0
50
100
150
200
250
300
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta

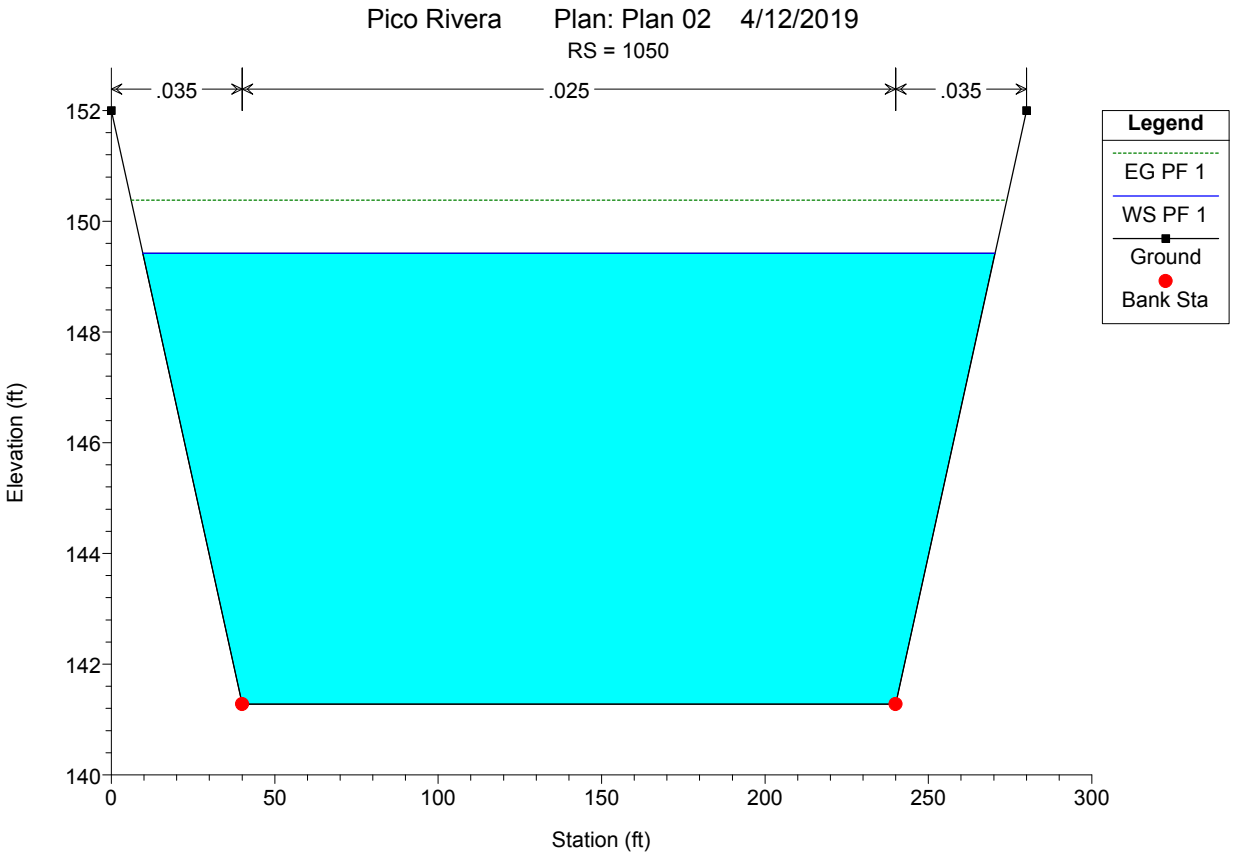

Pico Rivera Plan: Plan 02 4/12/2019
RS = 1350
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250
300

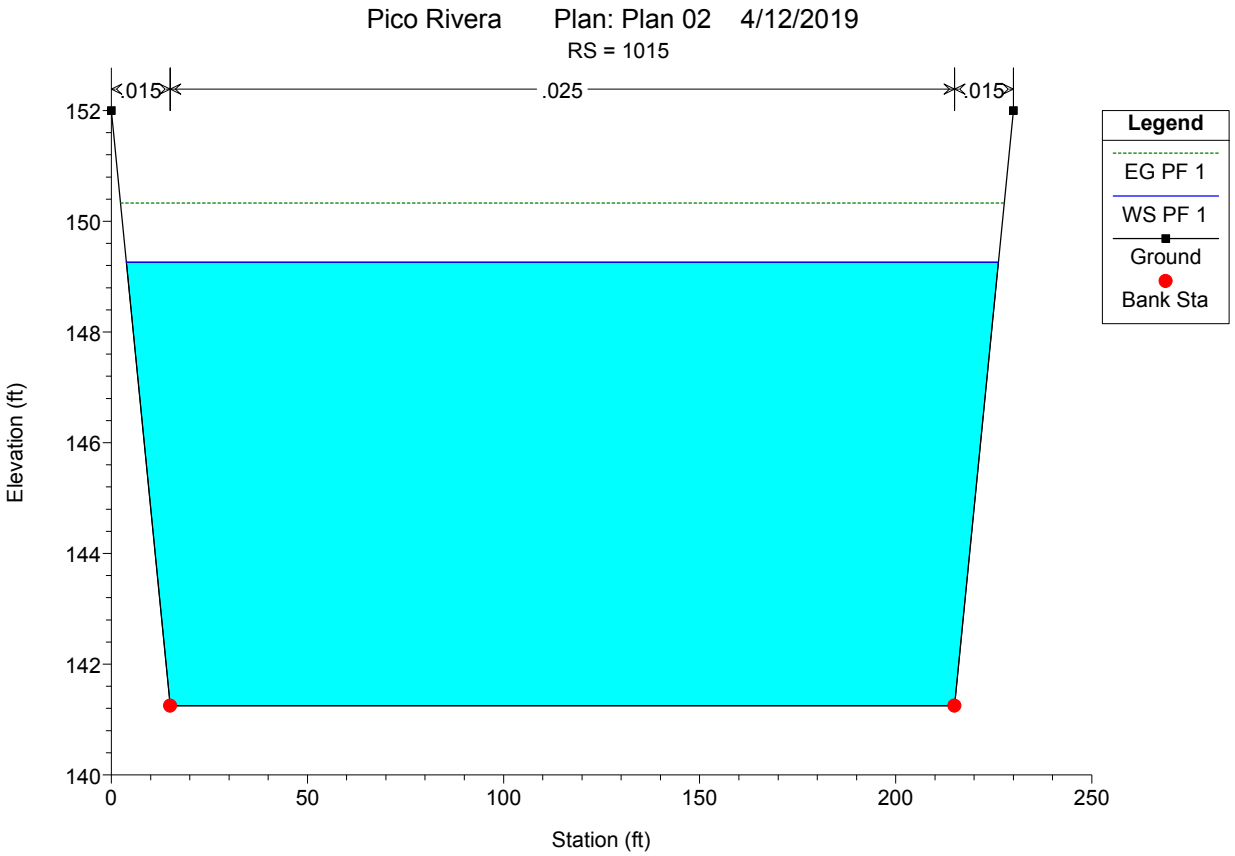

Pico Rivera Plan: Plan 02 4/12/2019
RS = 1160
.015
.025
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350

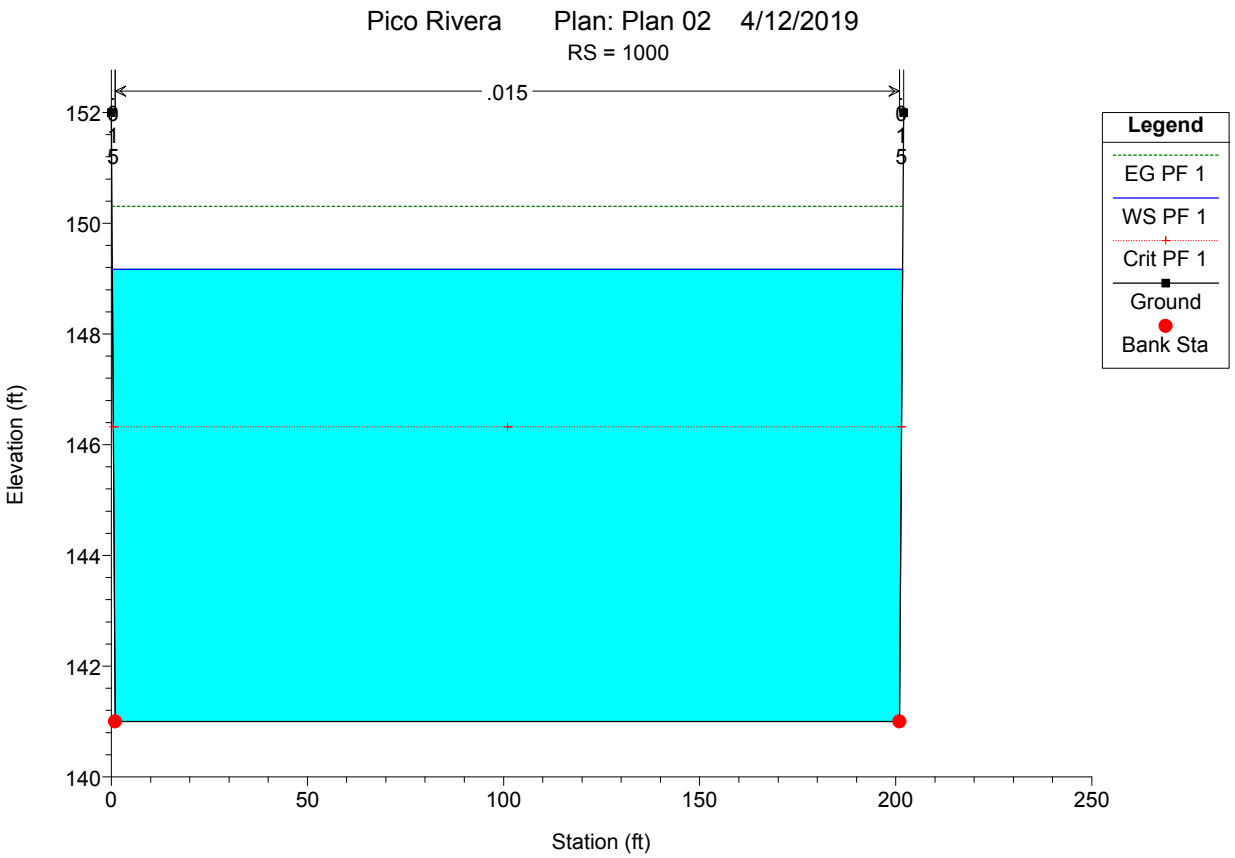

Pico Rivera Plan: Plan 02 4/12/2019
RS = 1159 BR
.015
.025
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
175
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350


Pico Rivera Plan: Plan 02 4/12/2019
RS = 1159 BR
.015
.025
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
175
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350


Pico Rivera Plan: Plan 02 4/12/2019
RS = 1105
.015
.025
.015
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
170
165
160
155
150
145
140
0
50
100
150
200
250
300
350
Station (ft)


Pico Rivera Plan: Plan 02 4/12/2019
RS = 1050
.035
.025
.035
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250
300
Station (ft)


Pico Rivera Plan: Plan 02 4/12/2019
RS = 1015
.015
.025
.015
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250


Pico Rivera Plan: Plan 02 4/12/2019
RS = 1000
.015
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
152
150
148
146
144
142
140
0
50
100
150
200
250