Oak Creek Pedestrian Crossing

Drainage Report

Prepared For:

CITY OF SEDONA

Prepared By:

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January 2022

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LYONS
Date Signed 1/12/2022
ARIZONA, U. S. A.

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I. INTRODUCTION

JE Fuller (JEF) is contracted with WSP, under contract to the City of Sedona to design a Pedestrian Crossing under the SR179 bridge over Oak Creek. The project name is also know as the Oak Creek Pedestrian Crossing (OCPC). The path is intended to route pedestrians underneath the existing SR179 Bridge and Pedestrian Bridge over Oak Creek to make a connection from Tlaquepaque south to Tlaquepaque north. The path is envisioned to improve traffic congestion through the area due to the existing cross walk that connects the two sides. A feasibility study[1] was performed as a precursor to the final design and reviewed various alternative to improve pedestrian and traffic flow. The recommended alternative was the OCPC which is the basis for this design. **Figure 1** shows the alignment or route of the proposed pedestrian path. WSP prepared a cross sectional rendering as part of the feasibility study reproduced below in **Figure 2**.

JE Fuller is on the team to evaluate and design for drainage and erosion protection. The primary drainage features associated with the project include Oak Creek conveyance under the bridge, an existing 36-inch storm drain pipe outfall at the west bridge abutment, and direct stormwater on the proposed pedestrian path. This report will summarize the drainage analysis and design.

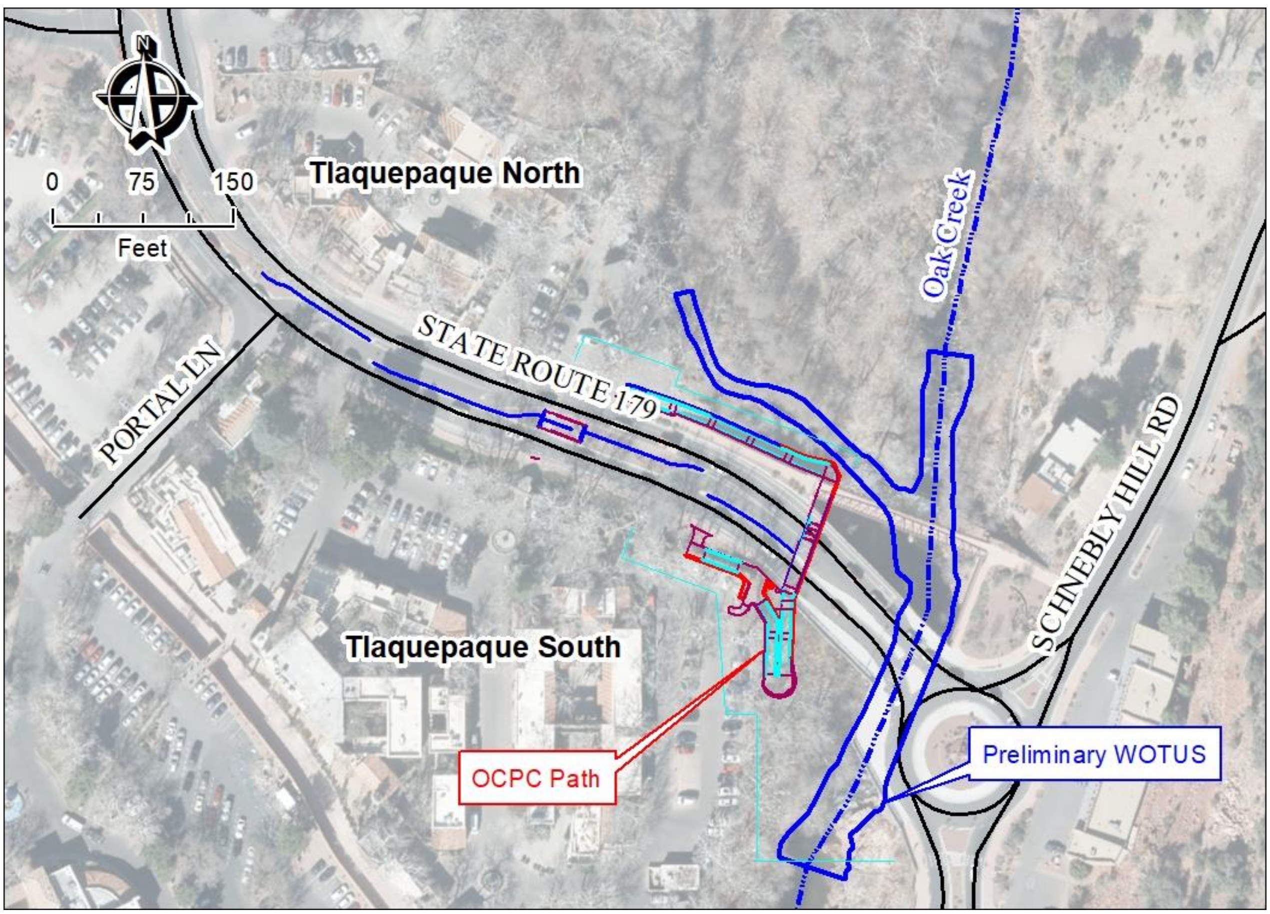


Figure 1 Pedestrian Path Alignment

[1] WSP, JE Fuller, Final Feasibility Report State Route 179 at Tlaquepaque Pedestrian Crossing, June 2019

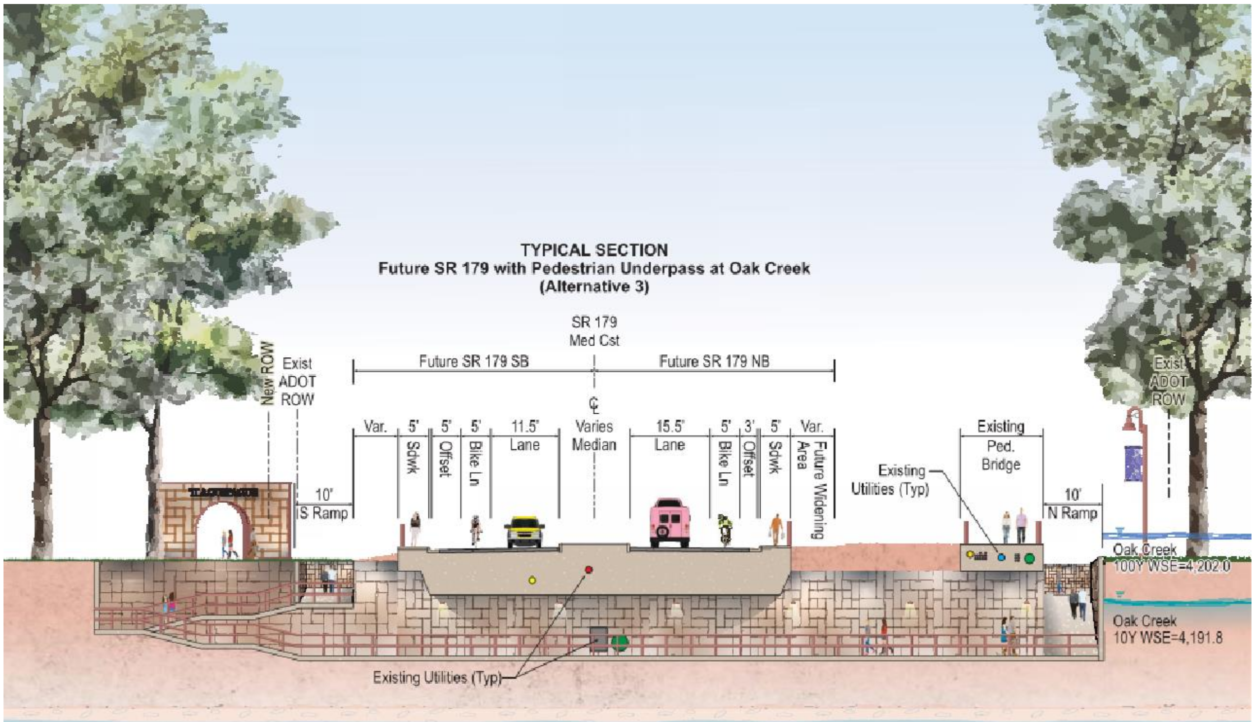


Figure 2. OCPC Concept from Feasibility Report

JE Fuller also developed a preliminary jurisdiction Waters of the US (WOTUS) compliant with the Clean Water Act Section 404 as shown in **Figure 1**. The design goal of the OCPC will be to avoid disturbance to the WOTUS that might trigger the need for environmental permitting.

II. OAK CREEK HYDRAULIC ANALYSIS AND DESIGN

The proposed pedestrian path will be routed down the west bank of Oak Creek at Tlaquepaque south then routed north along the west abutment of the SR179 and Pedestrian bridge to back up the west bank of Oak Creek to Tlaquepaque north. The path all by itself will reduce the cross-sectional area of Oak Creek underneath the bridge and downstream of the bridge, thus reducing the hydraulic capacity. The objective of the project is to create additional conveyance area as part of the project to ensure that the hydraulic capacity is not reduced. This will be achieved by excavating a portion of the right overbank of Oak Creek adjacent to the proposed path.

A HEC-RAS hydraulic design model was prepared as part of the original design of SR179 and Pedestrian bridge as documented in the ADOT Drainage Report[2]. This model was not considered for use given the date of the model, date of topographic mapping, and may not reflect As-built conditions. There are some other concerns with this design model that will be discussed later. The final HEC-RAS hydraulic model from the 2018 Oak Creek Floodplain Delineation Study[3] (FDS) was considered given the model will eventually be the FEMA Effective Model for the watercourse. This model was developed as part of a

[2] July 2006, Final Drainage Report SR179 North Forest Boundary to City of Sedona, J2
[3] July 2018, Oak Creek Floodplain Delineation Study Technical Support Data Notebook, Atkins

FEMA Cooperative Technical Partner grant obtained by Yavapai County to restudy Oak Creek and Tributaries. The LiDAR mapping used for the model was flown March 7th and March 13th, 2016 and to a point density sufficient to produce 1-foot contours (although only 2-foot contours were produced for the study). As-built drawings for all bridge crossings were obtained for implementation in the model. This HEC-RAS model will be referred to as the Effective Model since it will be the basis of the FEMA floodplain on Federal Insurance Rate Map (FIRM) panels once the Physical Map Revision is complete. JE Fuller reviewed the model and has concerns outlined below.

Concerns with 2006 Design Model and 2018 Effective Model

There are two primary concerns with the 2006 Design Model and the 2018 Effective Model as follows:

- The SR179 Bridge has a 26-degree skew relative to the primary flow path of Oak Creek, pier bents, and bridge abutments. Both hydraulic models have adjacent cross section alignments parallel to the skewed bridge rather than perpendicular to Oak Creek and the bridge abutments. Refer to **Figure 3** and **Figure 4**. There was no adjustment for width or any geometry made in either model. This results in a conveyance width or bridge opening width larger than the actual cross-sectional area under the bridge. The actual width between bridge abutments is approximately 147-feet where the skewed hydraulic models use a width between 160- to 165-feet. This would result in a lower estimated water surface profile that would indicate the bridge has more freeboard (or any freeboard) than is really does.
- The Manning's roughness coefficient used for the main channel in the 2006 Design model and the 2018 Effective model is 0.063 and 0.068, respectively. This high roughness coefficient is probably appropriate for flow depths in the range of 3- to maybe even as high as 10-feet. However, the 100-Year flow depth in Oak Creek through the bridge ranges between 22- and 24-feet. The roughness of a channel decreases with flow depth, therefore, there is concern these roughness values are very conservative. A lower roughness coefficient for low frequency flood events (e.g. 50- and 100-Year) would have the effect of lowering the depth or water surface profile through the bridge and increasing channel velocities. This would be a less significant concern than the skewed channel widths previously discussed.

Therefore, the design team felt it prudent to develop another hydraulic model with more conventional perpendicular cross sections to the primary flow direction. The model was developed using a combination of SR179 As-built drawings, the Oak Creek FDS 2016 LiDAR, and new topographic mapping collected for the purpose of the OCPC design. The new mapping was obtained via traditional ground survey methods on December 16th, 2019 by Trace Consulting. Cross sections were strategically placed at locations through the bridge to accurately depict changes in geometry for existing conditions and for consideration of proposed conditions (with project). No bridge routines were included in this model to simplify the comparative analysis and because it is expected that the 50- and 100-year flood levels don't come in contact with the low chord of either the existing Pedestrian/Utility Bridge or the SR179 Bridge. This model will be used as the basis to measure hydraulic changes resulting from the construction of the OCPC pedestrian path. All mapping sources previously mentioned and the As-Built drawings for existing bridges at Oak Creek are all on the North American Vertical Datum of 1988 (NAVD88).

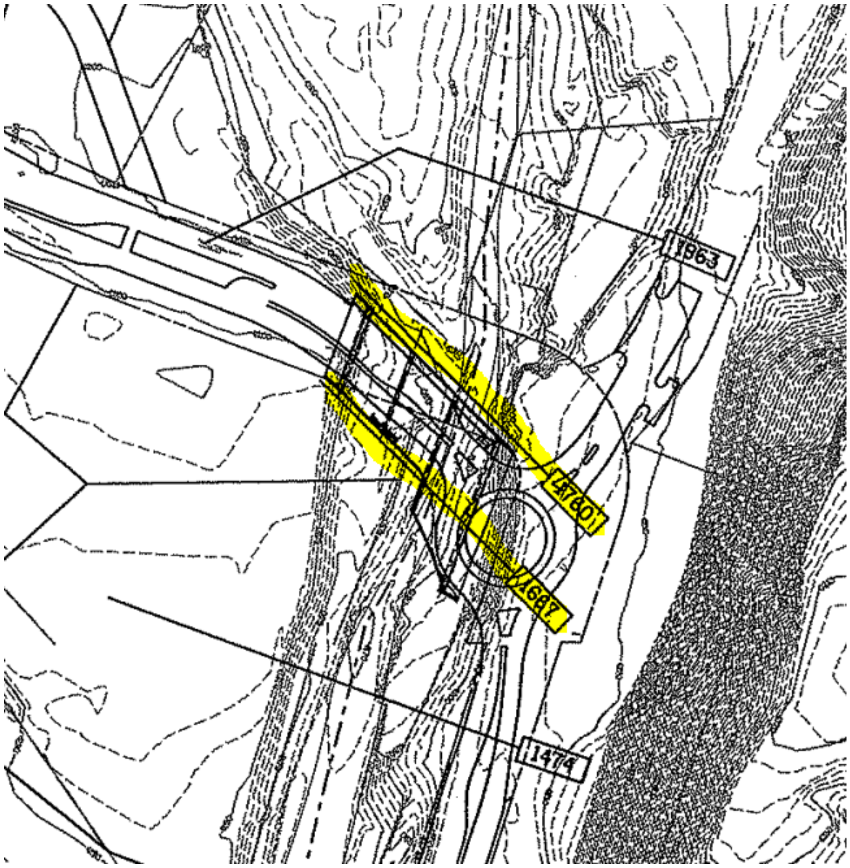


Figure 3 Excerpt from 2006 ADOT Drainage Report Hydraulic Workmap

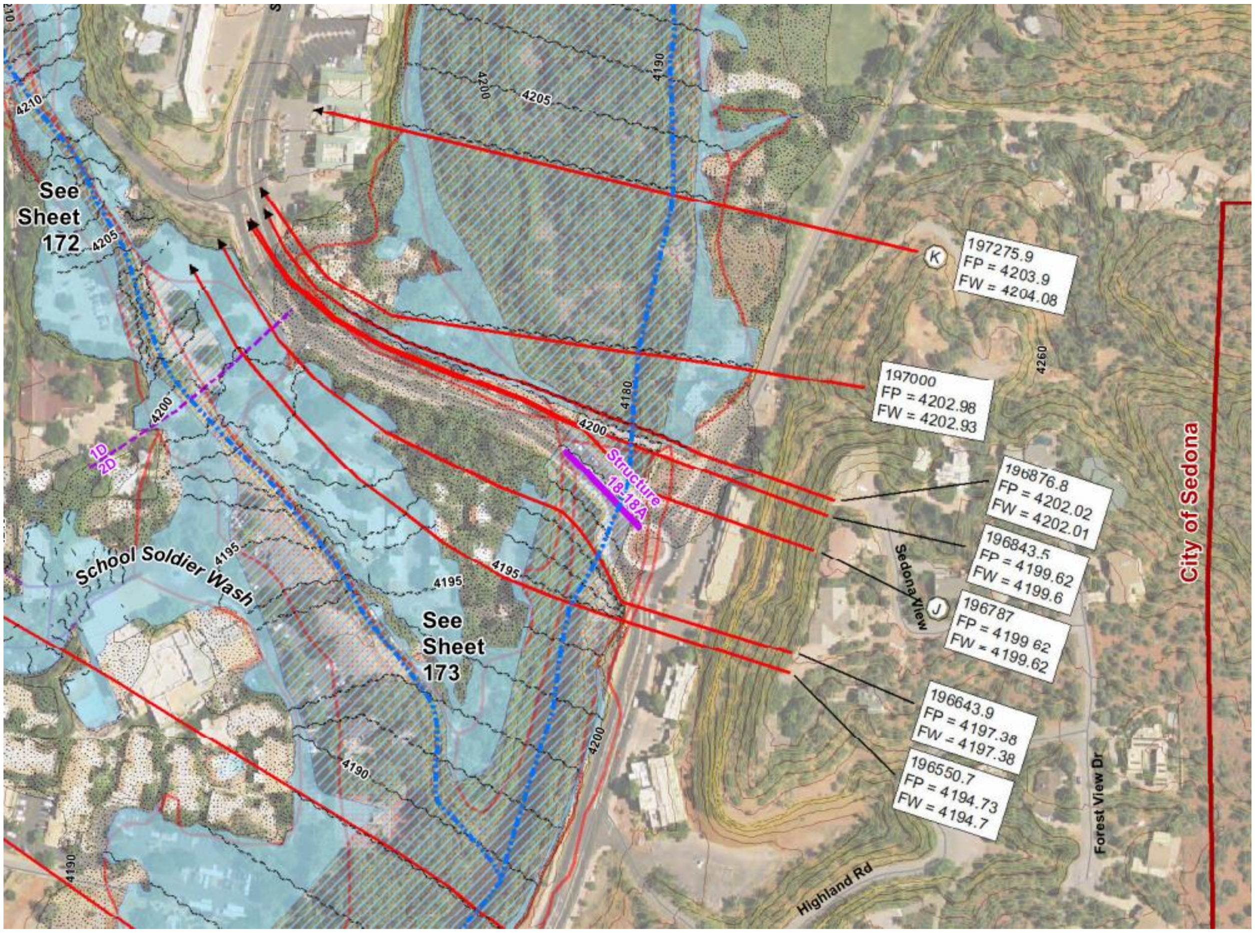


Figure 4 Excerpt of 2018 FDS Oak Creek Floodplain Workmap

Table 1 lists a summary of the estimated flow rates in Oak Creek for both the 2018 FDS and the original 2006 Bridge Design. The SR179 Bridge was designed for the 50-year flood with a minimum of 1-feet of freeboard per the ADOT Drainage Report. There was no mention of the Pedestrian Bridge and it doesn't appear to be in the design model. The design model results in the ADOT Drainage Report indicate the SR179 Bridge had over 1-feet of freeboard for the 100-year flood. Excerpts are included in the Appendix.

Table 1 Summary of Discharges (cfs)

2018 Oak Creek FDS						2006 ADOT Design	
100-Yr	**500-Yr**	**50-Yr**	**25-Yr**	**10-Yr**	***2-Yr**	**100-Yr**	**50-Yr**
28,600	52,200	21,500	15,600	10,300	5,150	27,200	20,770

** The 2-Yr flow rate was extrapolated logarithmically using the 2018 FDS recurrence interval discharges*

The 100-Year discharge estimated from the 2018 Oak Creek FDS was selected to be the basis of the OCPC. As stated previously, excavation will occur within the channel or river right channel overbank to offset the reduction in conveyance area from the OCPC. This excavation will primarily be in the shape of a trapezoidal channel and has been termed the Compensatory Channel or Comp Channel. An excerpt of from the 90% Design Plans is shown on **Figure 5** and depicts the cross section of the Comp Channel.

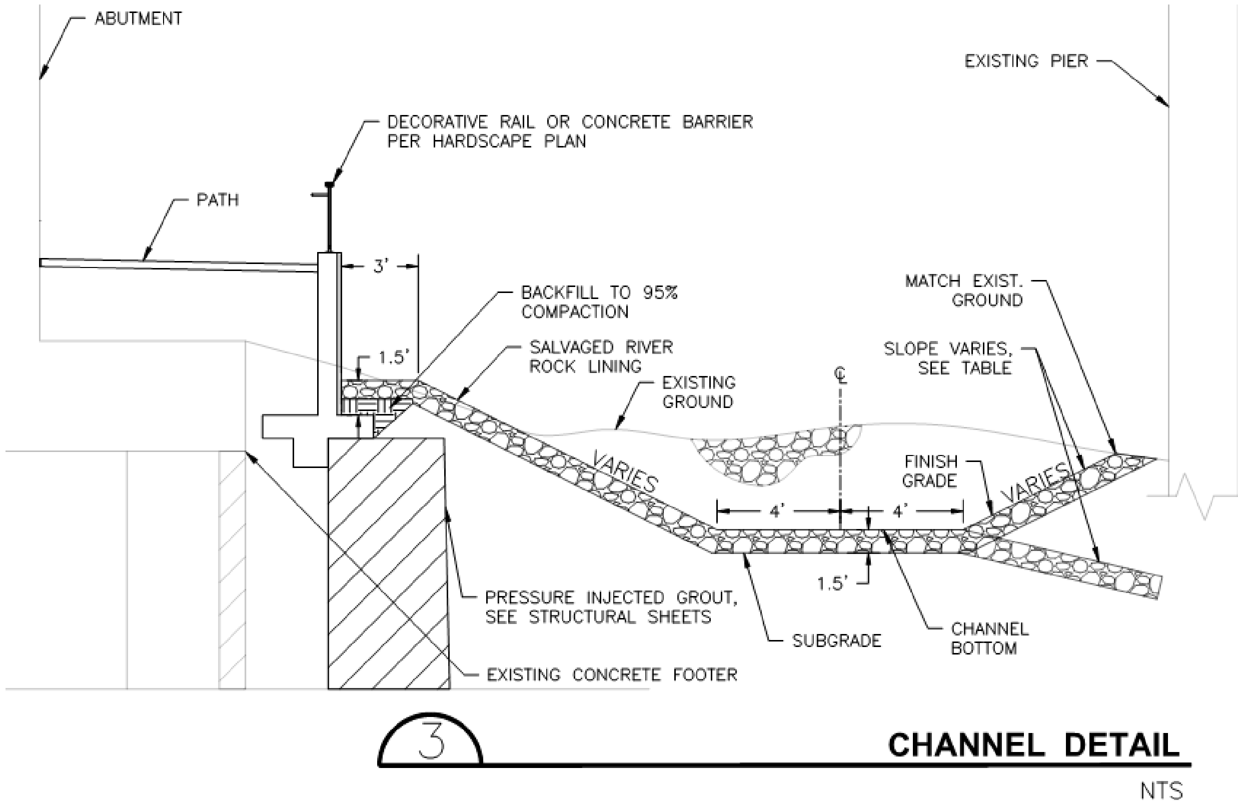


Figure 5 Compensatory Channel Configuration

The HEC-RAS model hydraulic baseline and cross sections are shown on the hydraulic workmap (Figure 6). An existing conditions geometry file was developed using the topographic data sources and ADOT as-built drawings previously mentioned. The proposed conditions geometry file was developed by "burning in" the proposed surfaces of both the proposed OCPC and Comp Channel. The design objective is to maintain existing conditions 100-year water surface elevations with insignificant increases to velocity.

HEC-RAS output is provided in the Appendix along with cross section plots showing a comparison of the Existing Conditions geometry to the Proposed Conditions geometry. An example cross section comparison is shown on Figure 7. The hydraulic differences from the Proposed Conditions (OCPC improvements) to Existing Conditions is summarized in Table 2. Detailed hydraulic output is included in the Appendix.

It can be seen from Table 2 that there are no increases to the 100-year water surface elevation and the changes in channel velocity are not significant.

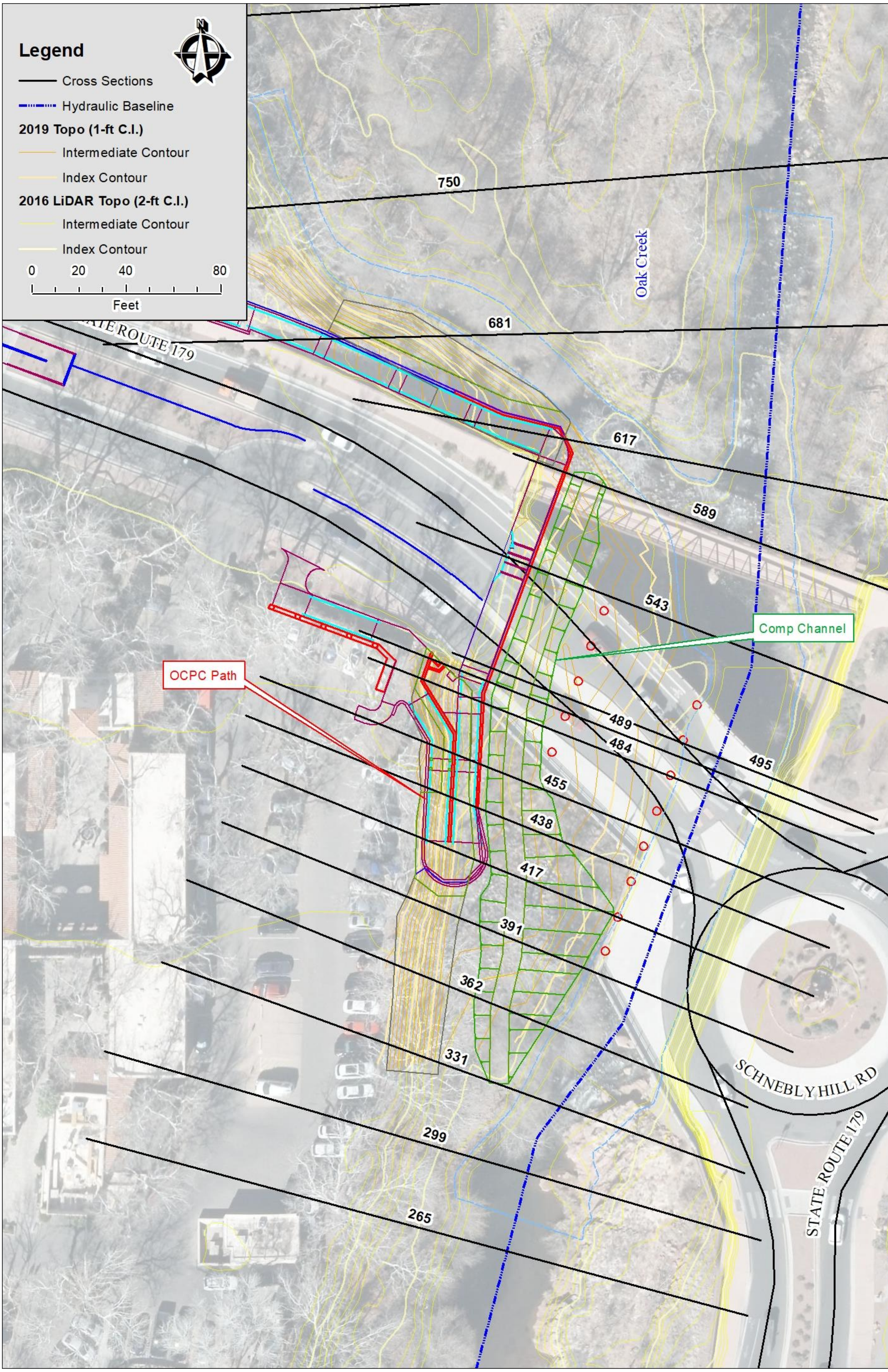


Figure 6 Hydraulic Workmap

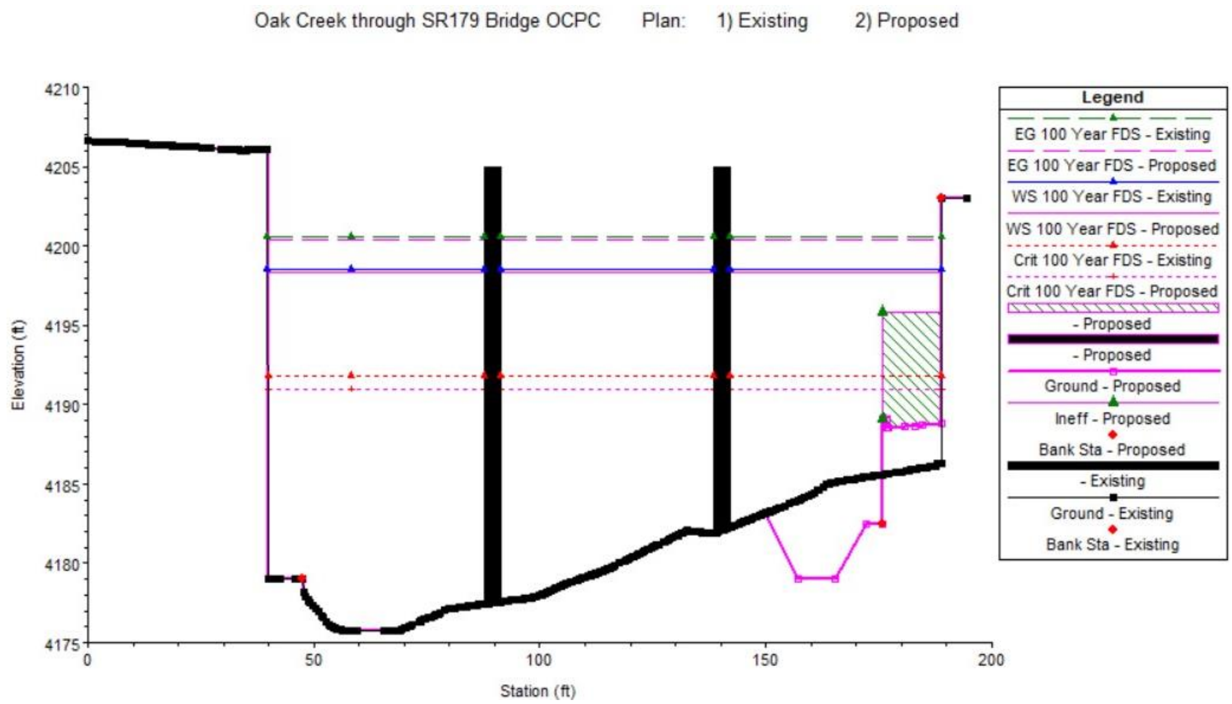


Figure 7 Example Cross Section Comparison at RS 495

Table 2 Summary Hydraulic Comparison

Cross Section	Q100	Difference WSE (ft)	Difference Velocity (fps)
915	28,600	-0.1	0.0
829	28,600	-0.1	0.1
750	28,600	-0.1	0.1
681	28,600	-0.2	0.2
617	28,600	-0.1	0.1
589	28,600	-0.4	0.8
543	28,600	-0.4	0.6
495	28,600	-0.2	0.4
489	28,600	-0.1	0.2
484	28,600	0.0	-0.1
455	28,600	-0.1	0.1
438	28,600	0.0	0.1
417	28,600	0.0	0.3
391	28,600	0.0	0.0
362	28,600	0.0	0.0
331	28,600	0.0	0.0
299	28,600	0.0	0.0
265	28,600	0.0	0.0

Note: Difference is measured by Proposed Hydraulic Value less the Corrected Effective Value

III. SCOUR AND EROSION PROTECTION

As shown in **Table 2**, the changes in channel velocity are not significant. Therefore, the design approach is to ensure that the existing erosion protection installed during the construction of the SR179 bridge over Oak Creek is either maintained in place, or replaced with an equivalent level of erosion protection. It was determined through ADOT as-built drawing review and communications with ADOT construction inspection staff at the time of that pressure injected grout was performed adjacent to the west bridge abutment and gabion mattress with a gabion basket footer was used up- and downstream of the abutment. The mattress can be observed in the field. ADOT correspondence is included in the Appendix.

The proposed erosion protection in areas of disturbance will be replaced in kind with gabion mattress or pressure injected grout as designed and specified by WSP. Refer to the construction plans submitted under separate cover. It is understood that the bridge abutments and piers are founded on drilled shafts constructed by Hayward Baker that were drilled down until refusal at bedrock.

IV. EXISTING 36-IN STORM DRAIN PIPE OUTFALL

The hydraulics of the existing 36" storm drain (SD) outlet at the proposed pedestrian path/scupper interface were investigated to determine the conditions at the path when the pipe has storm water discharges. The proposed pedestrian path profile at the SD outlet is approximately 0.30-feet below the pipe invert with the path offset 2-ft away from the SD outlet/abutment face (refer to the Construction Plans under separate cover). Horizontal pipe jet distances were calculated to determine if stormwater would land on the path and how much, refer to **Figure 8**.

The 2006 Drainage Design Report for the storm drain system was reviewed and revealed the pipe was designed for the 50-year storm and resulted in a flow depth of approximately 1.2-feet or 40% full (no reliable flow depths or elevations could be obtained from the report or as-built construction drawings). A table within the 2006 Report indicates the 50-year discharge at the pipe outlet is 15.3 cfs although it is not explicitly stated in the report narrative.

Therefore, the jet distances were computed for when the SD is flowing ½ full, ¼ full, and the design flow (approximately 40% full). The results are summarized in **Table 3**. It can be seen that the path will not be effected with the proposed 2' offset. The discharge at which the jet would reach the path was back calculated to be 31 cfs (likely an event much larger than the 50- or 100-year storm event). Therefore, the path is expected to remain dry or mostly dry during common rainfall events. These discharges are intended to drain into the apron between the path and abutment face, and then drain under the path in the proposed scupper to the Oak Creek overbank under the existing bridge.

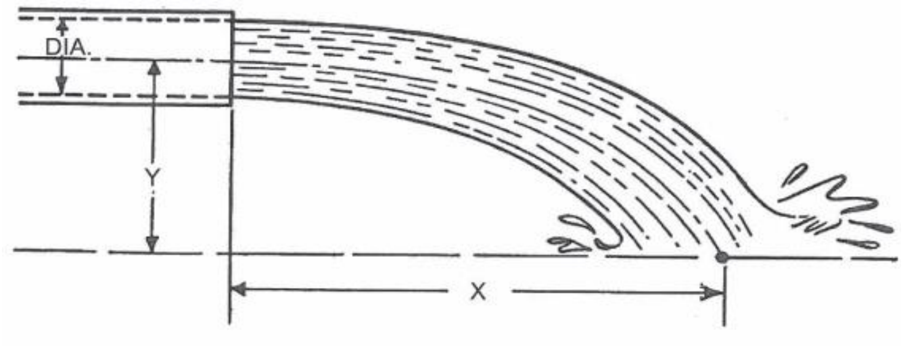


Figure 8 Pipe Jet Schematic Diagram

Table 3 36" Dia Storm Drain Pipe Jet Distances

Hydraulic Scenario	Pipe Inv Height - Y (ft)	Pipe Flow (cfs)	Pipe Jet Distance - X (ft)
1/2 Full	1	19.1	0.67
Design (Approx.40% Full)	1	15.3	0.54
1/4 Full	1	9.6	0.34

The proposed scuppers were sized using an approximate 100-year discharge of 25 cfs estimated from a ratio to the 50-year discharge. A uniform flow calculation was computed to determine the required width of the scuppers assuming a 50% clogging factor. The resulting width is 12-feet which will be accomplished using the 2020 MAG Standard Detail 206-1. Calculations are included in the Appendix.

The proposed scupper will also serve to drain the OCPC from inundation from Oak Creek at flood stage. It is anticipated as flood levels rise in Oak Creek, the proposed Concrete Barrier will overtop and the path will become flooded. This water is anticipated to be mostly ineffective or in a slack water condition. As the flood recedes, the water on the path will drain through the scupper.

V. OCPC PATH DRAINAGE

Rainwater on the path itself will be drained through small scuppers installed in the Concrete Barrier, see Figure 9. These scuppers will be placed at every landing along the path. Very conservative tributary drainage areas were delineated for the path on both the north and south side of SR 179 as shown on Figure 10. The largest tributary area is at the top of the path on the south side of SR179 and was calculated to be 0.065 acres. This area is tributary to the scupper at the first landing after the switch back of the OCPC.

A single rational method calculation (Q=CiA) was made using the Upper Limit rainfall statistics from Table 3.3 of the City of Sedona Design Manual[4]. The 100-year, 5-minute duration of 0.90 inches was

[4] Sedona Design Review, Engineering, and Administrative Manual, February 2020

used to compute the intensity of 10.8 inch/hour. The resulting discharge is 0.67 cubic feet per second (0.95*10.8*0.065).

A simple uniform flow calculation for the scupper shown in **Figure 9** using a clogging factor of 50%. The resulting capacity for each scupper is 1.1 cfs (see Appendix). Therefore, there are more than enough scuppers to drain the 100-year rainfall.

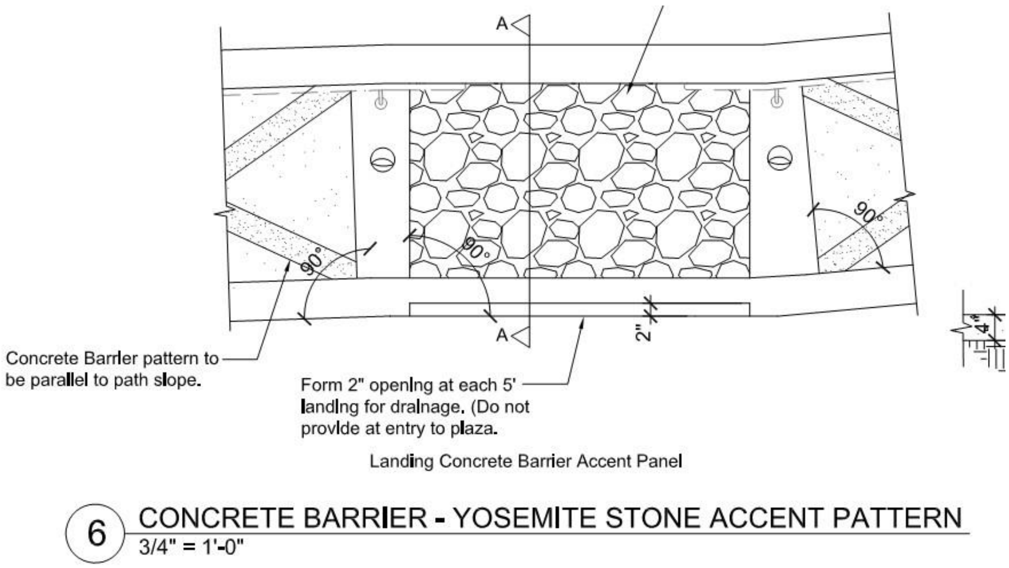


Figure 9 Scupper through Concrete Barrier

VI. CONCLUSIONS

The Design Plans meet the drainage, hydraulic, and erosion protection objectives of the project.

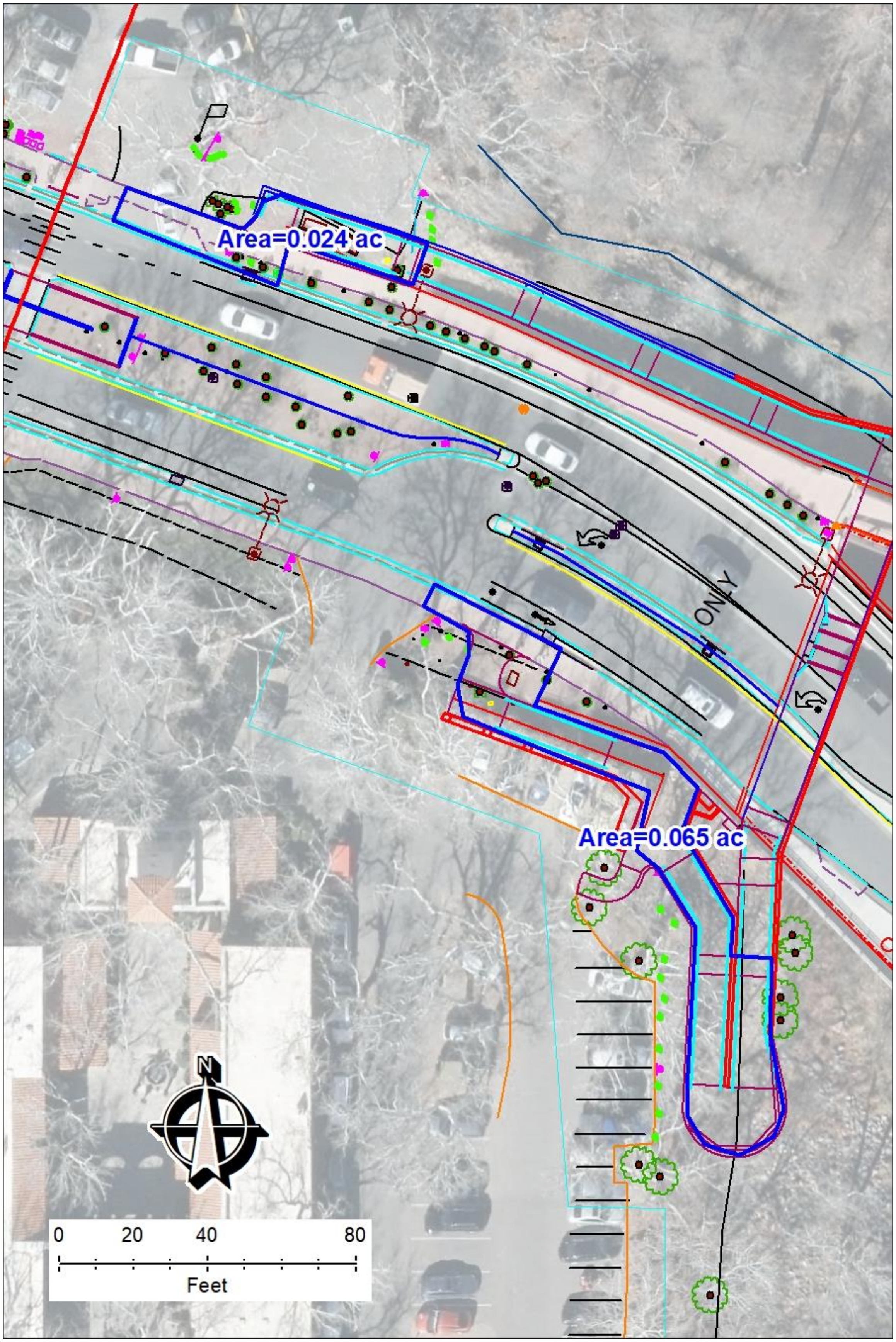
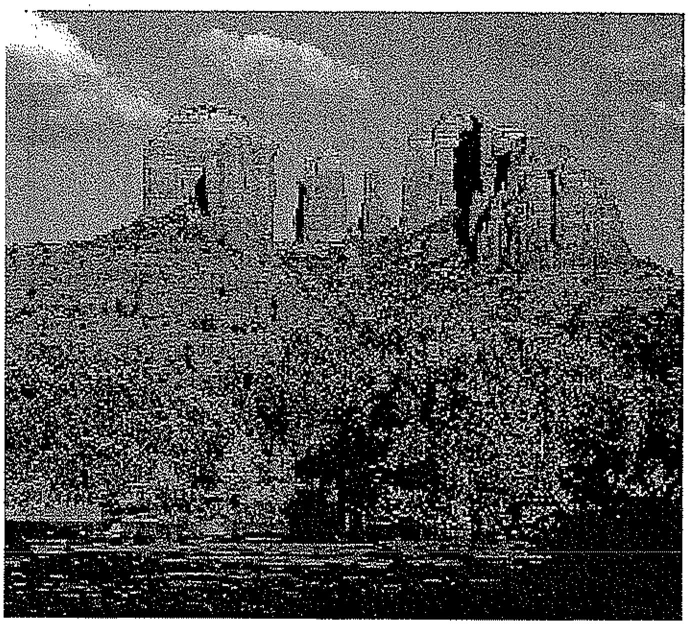


Figure 10 Tributary Basin Delineations for OCPC Drainage

APPENDIX

Final Drainage Report

SR 179 North Forest Boundary to City of Sedona



Registered Professional Engineer (Civil)
CERTIFICATE NO
28178
ANTHONY J.
REGIS
Date Signed 7/28/06
ARIZONA U.S.A.

July 2006

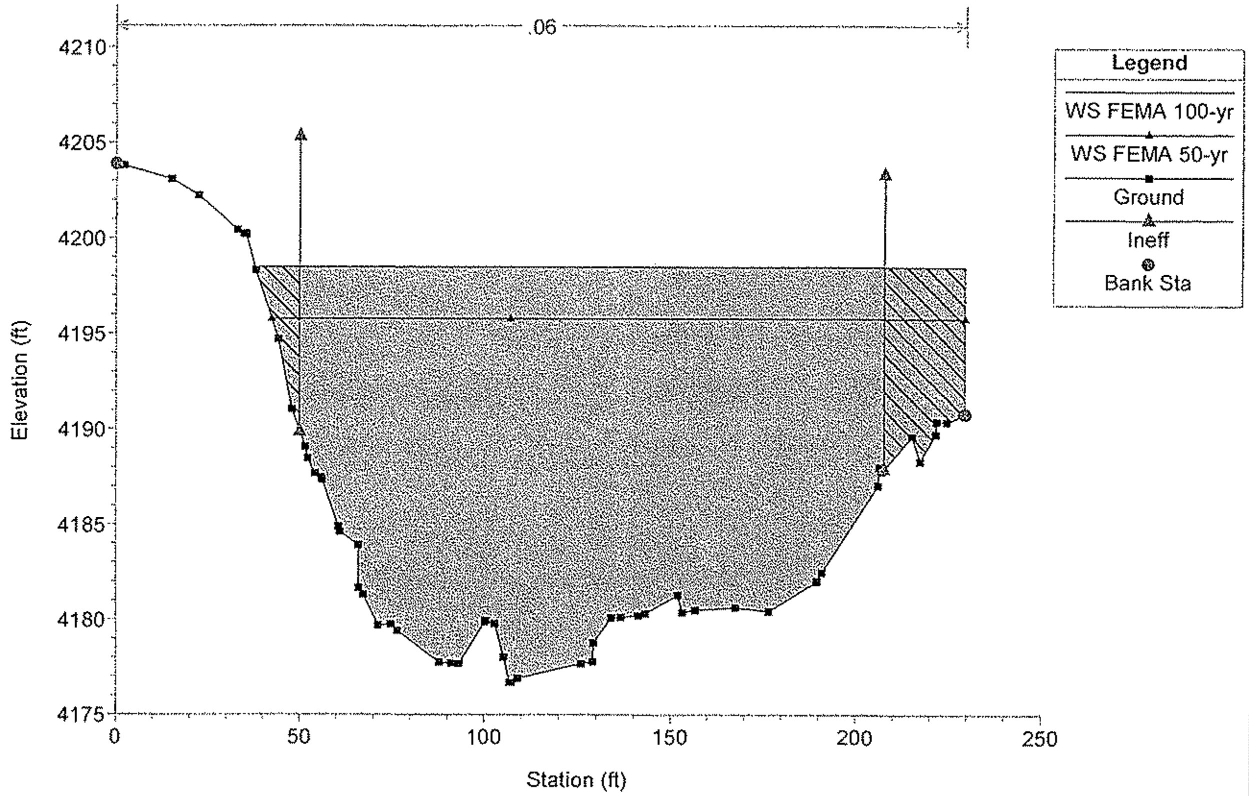
ADOT

DMJM HARRIS | AECOM

J2
engineering and environmental design

Oak Creek Bridge Plan: new brdg - xs skewed at bridge 021306 2/14/2006

RS = 1760



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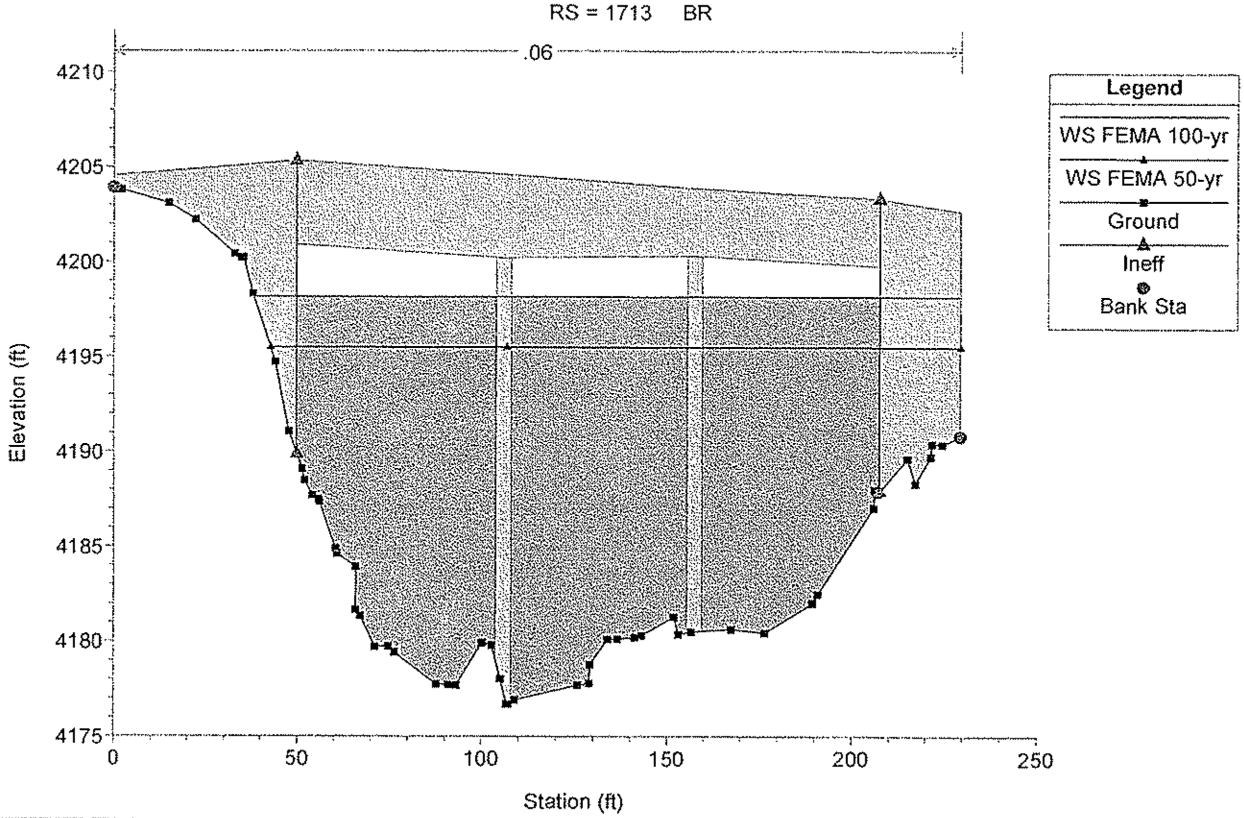

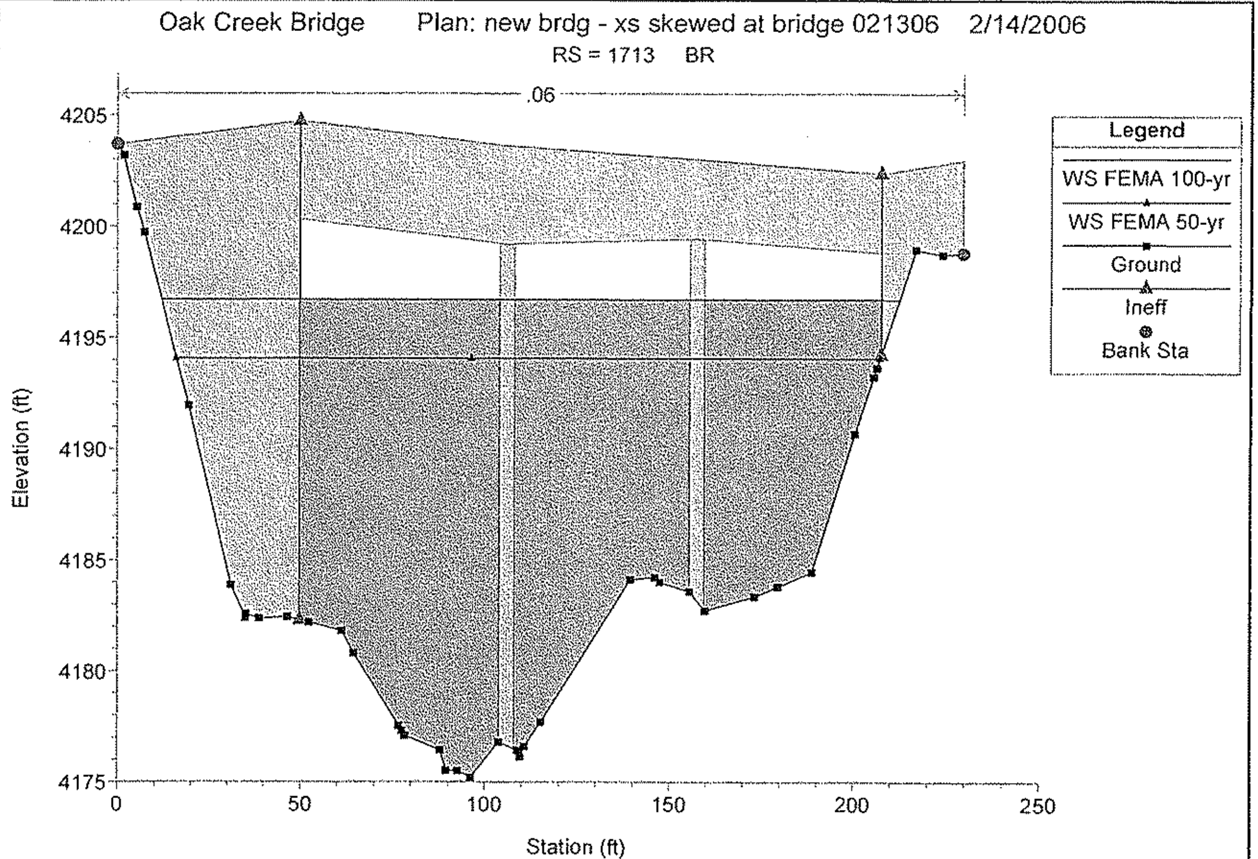
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WS FEMA 50-yr
Ground
Ineff
Bank Sta
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Station (ft)
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100
150
200
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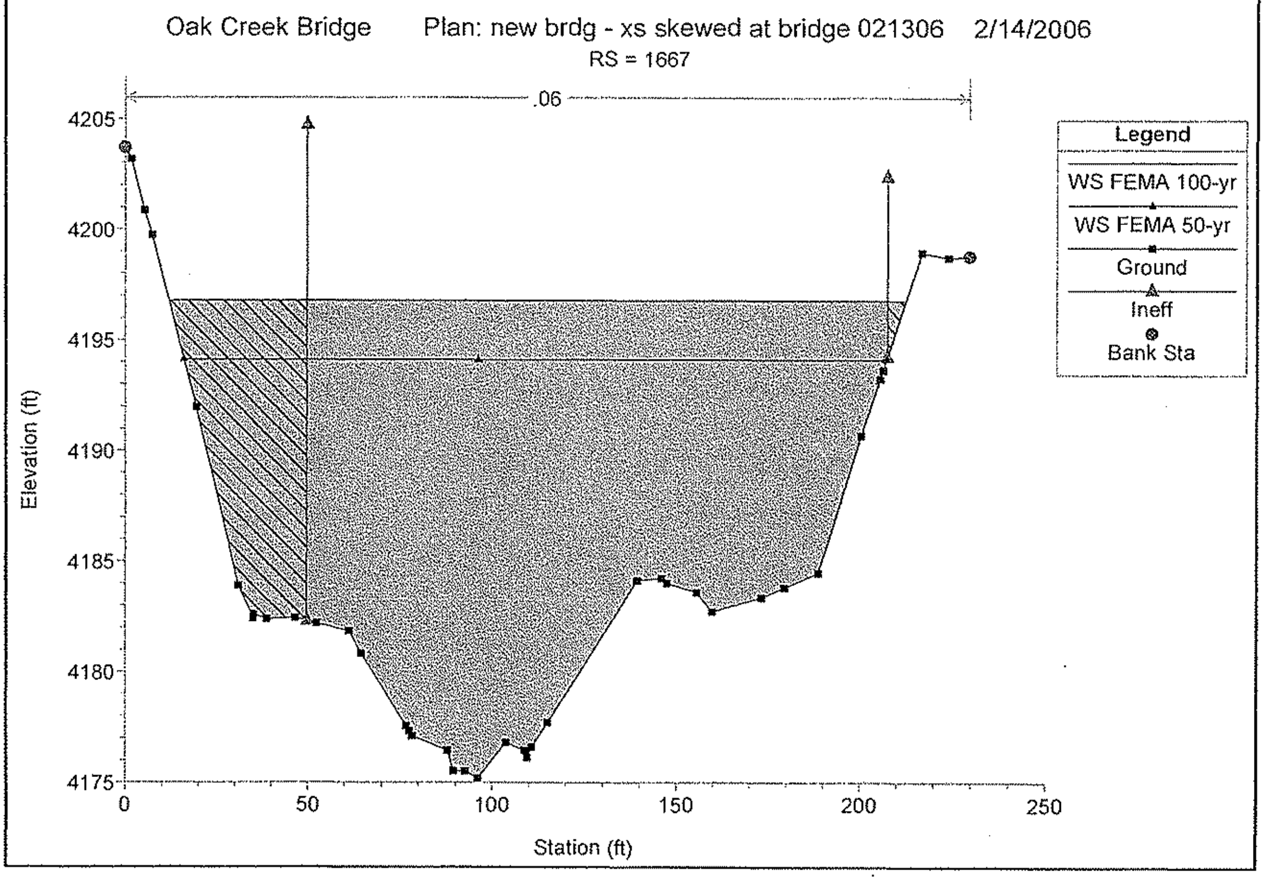
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Ineff
Bank Sta
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Station (ft)
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4195
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4205
0
50
100
150
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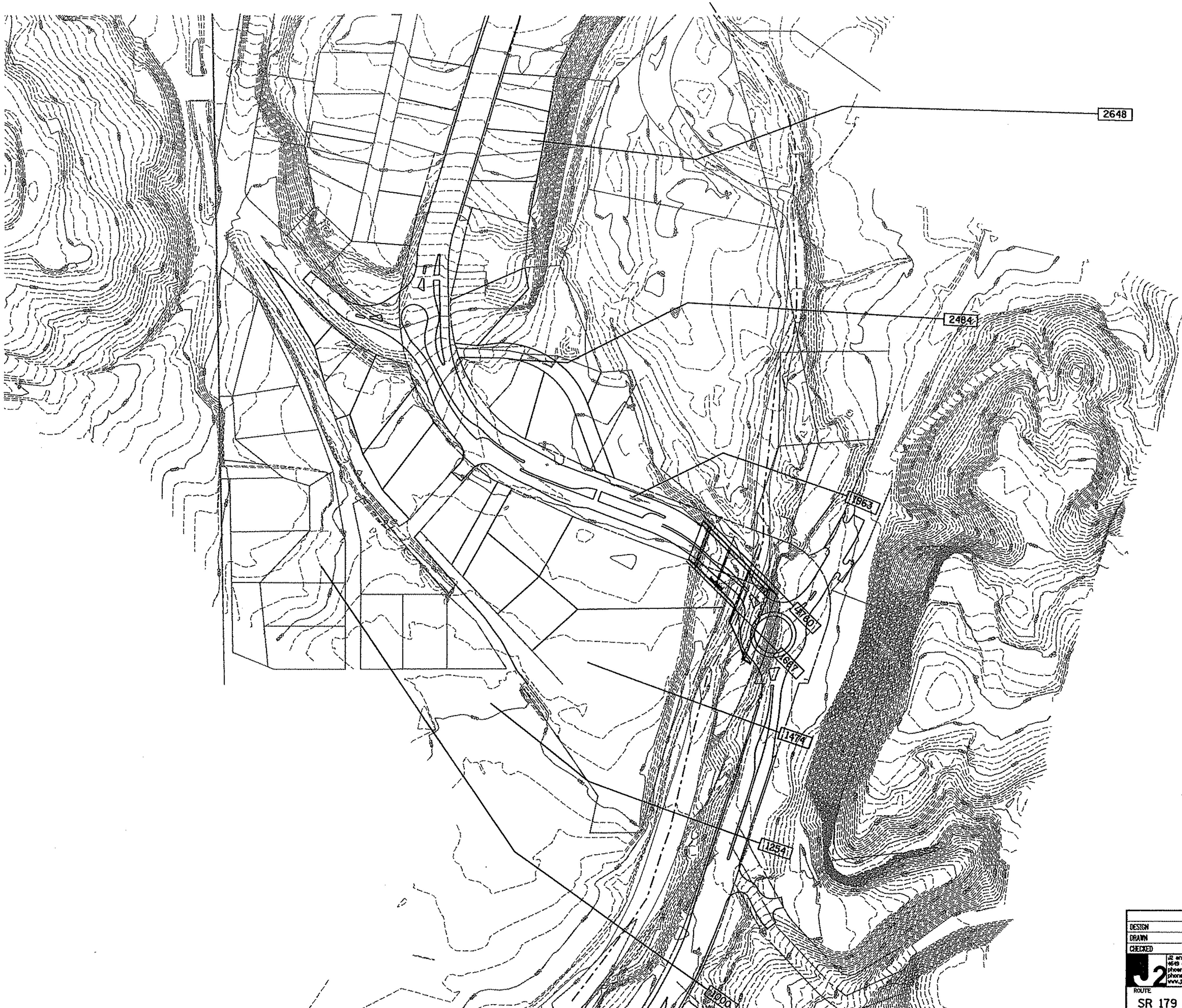
179 YV 310



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LEGEND

XXXX HEC-RAS CROSS SECTION

50 0 50 100
Scale In Feet

	NAME	DATE
DESIGN	ML	02/06
DRAWN	ML, KD	02/06
CHECKED	TR	02/06

J2 engineering and environmental design
4649 east cotton gin loop, suite B2
phoenix, arizona 85040
phone: 602.438.2221
www.j2design.us

ARIZONA DEPARTMENT OF TRANSPORTATION
INTERMODAL TRANSPORTATION DIVISION
ROADWAY DESIGN SERVICES

PLATE 3 - OAK CREEK BRIDGE
PROPOSED - ADOT TOPO MAPPING &
HEC-RAS CROSS SECTIONS

PRELIMINARY
STAGE III
Review
NOT FOR
CONSTRUCTION
OR RECORDING

ROUTE SR 179

LOCATION NORTH FOREST BOUNDARY TO CITY OF SEDONA

DWG. NO.

TRACS NO. H 3414 03C | 179-A-(002) | 2 OF 2

DATE- LOCATION- REVISIONS- FINISHED PLANS- SURVEY NO.
DATE- LOCATION- REVISIONS- FINISHED PLANS- SURVEY NO.

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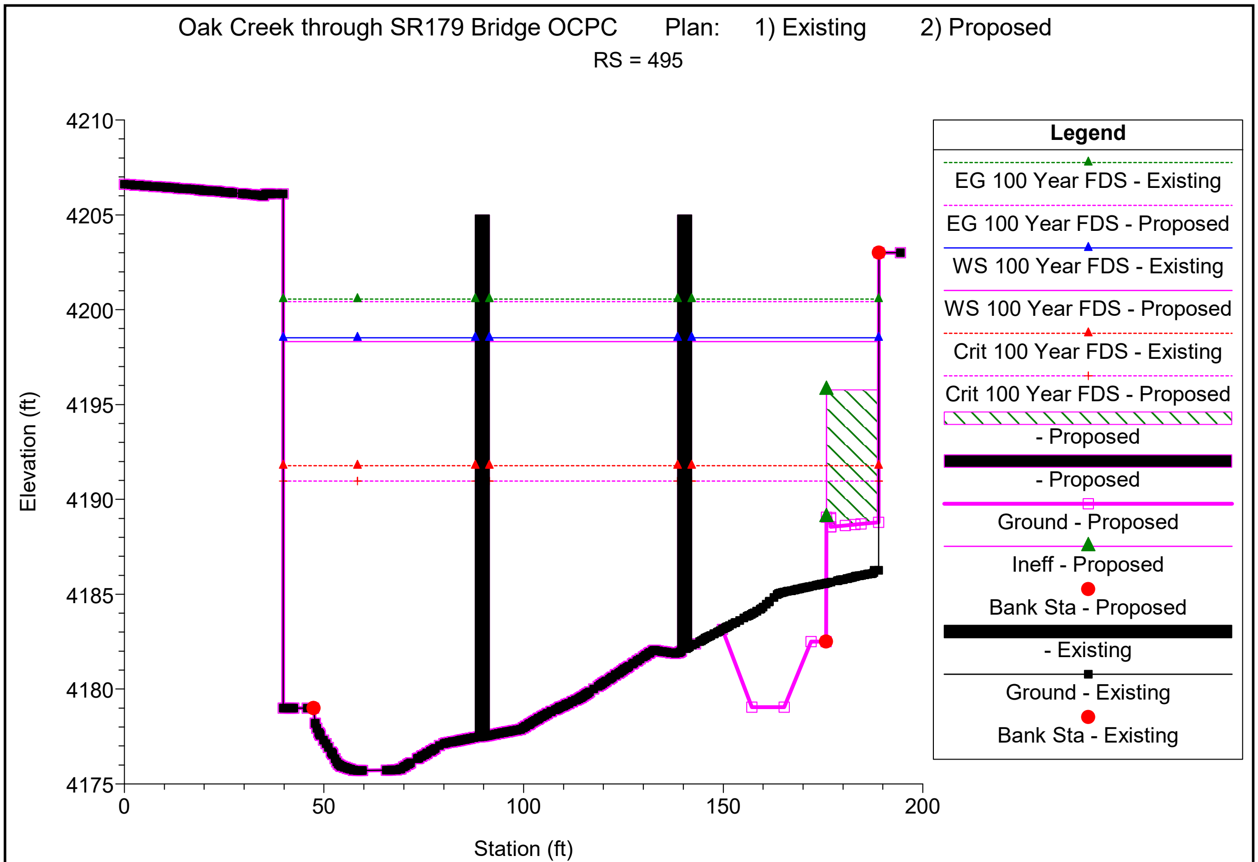
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4180
4175
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Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
- Proposed
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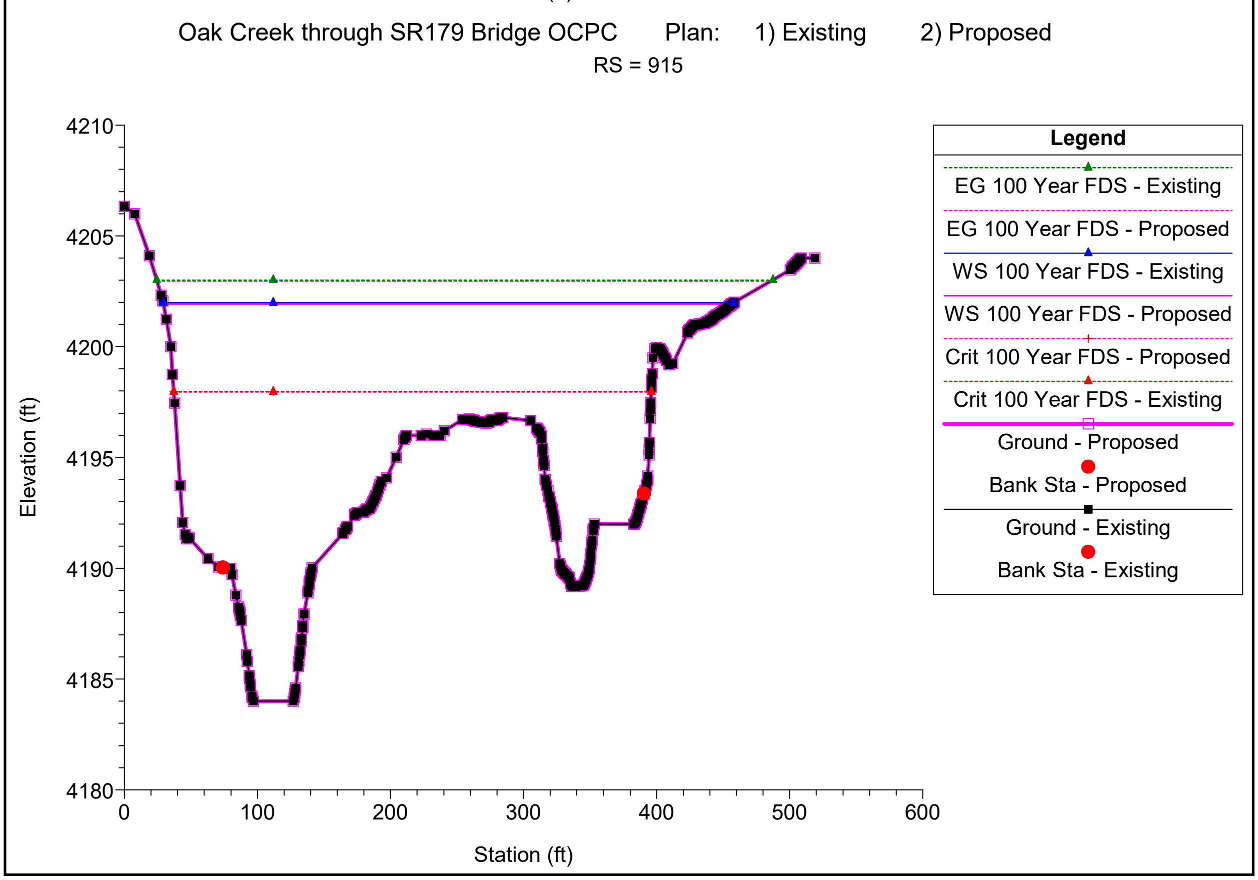
Bank Sta - Proposed
- Existing
Ground - Existing
Bank Sta - Existing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400
500
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EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
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Crit 100 Year FDS - Existing
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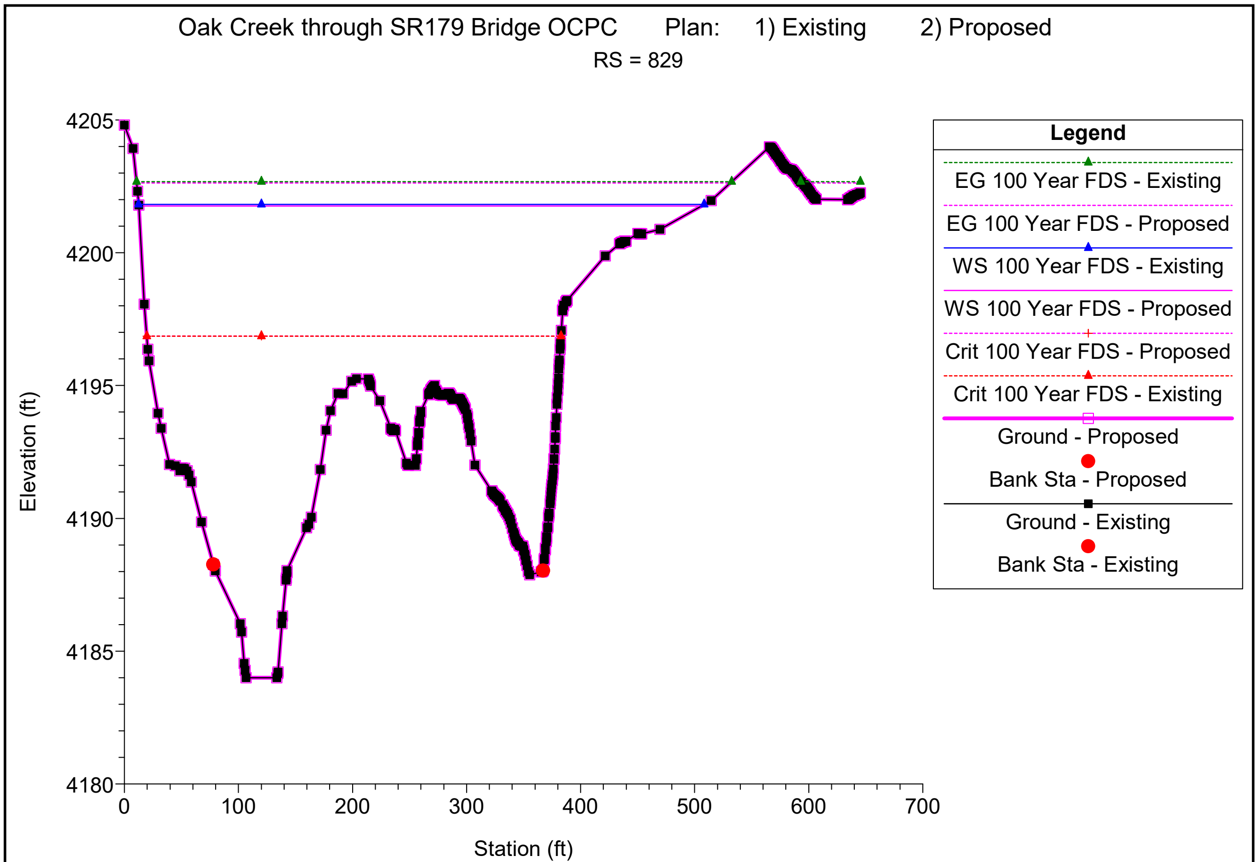
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing



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EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Ground - Proposed
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing
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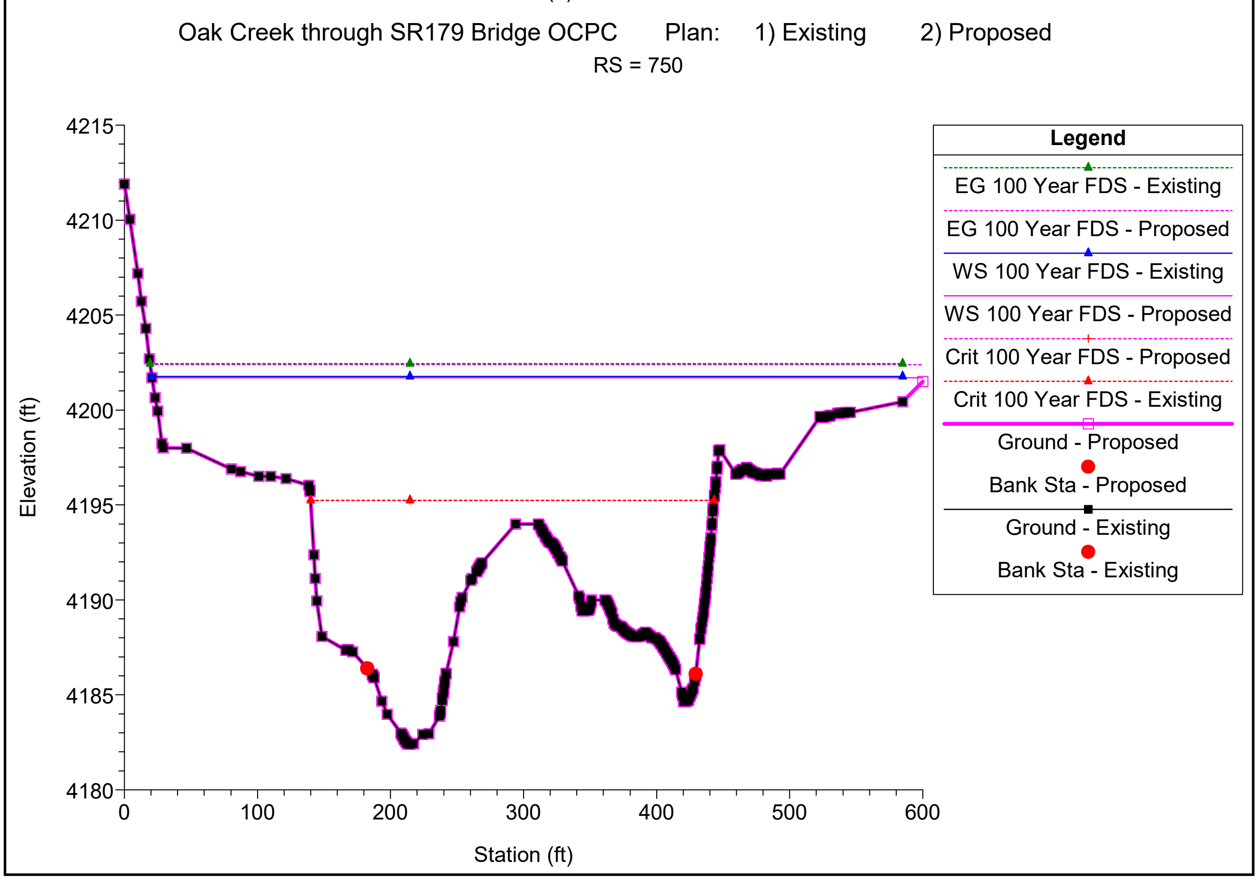
700
Station (ft)



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Crit 100 Year FDS - Existing
Ground - Proposed
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing
Elevation (ft)
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400
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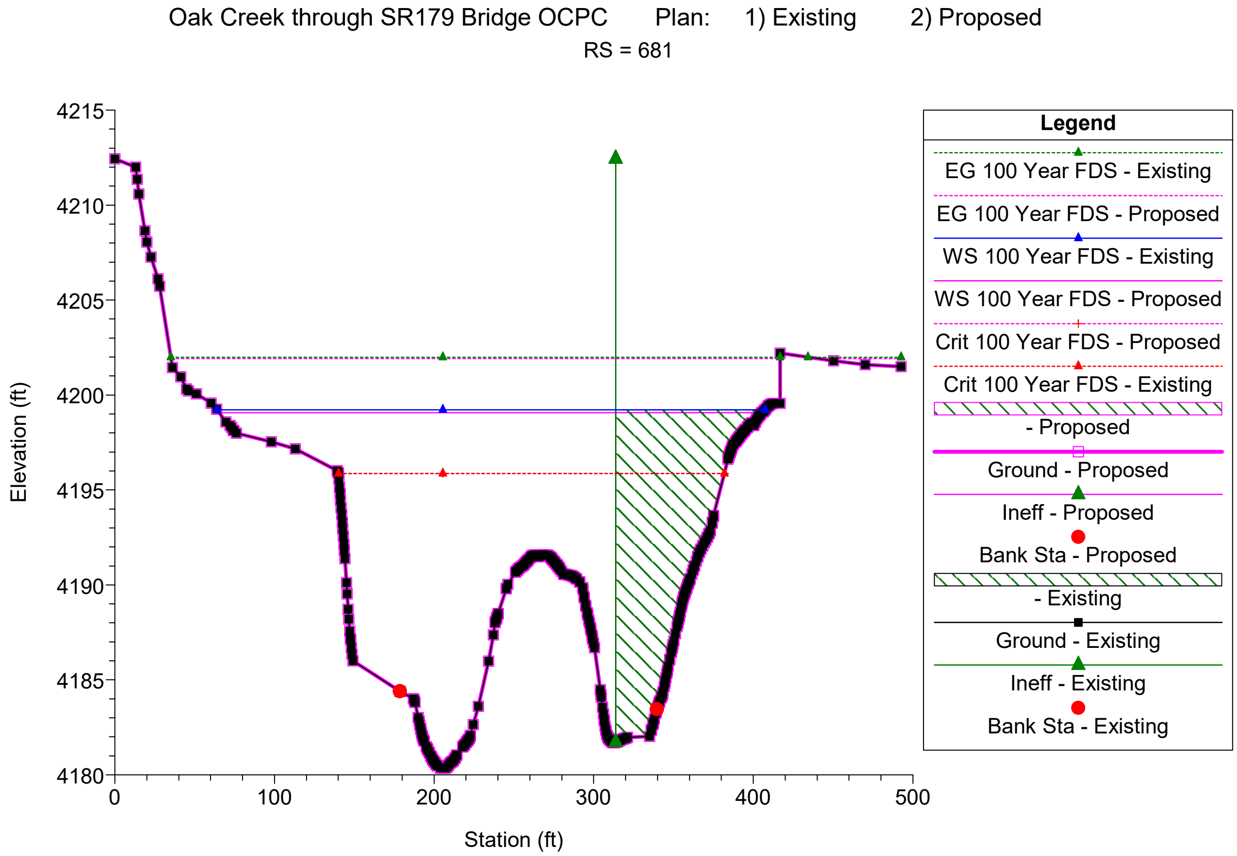
600
Station (ft)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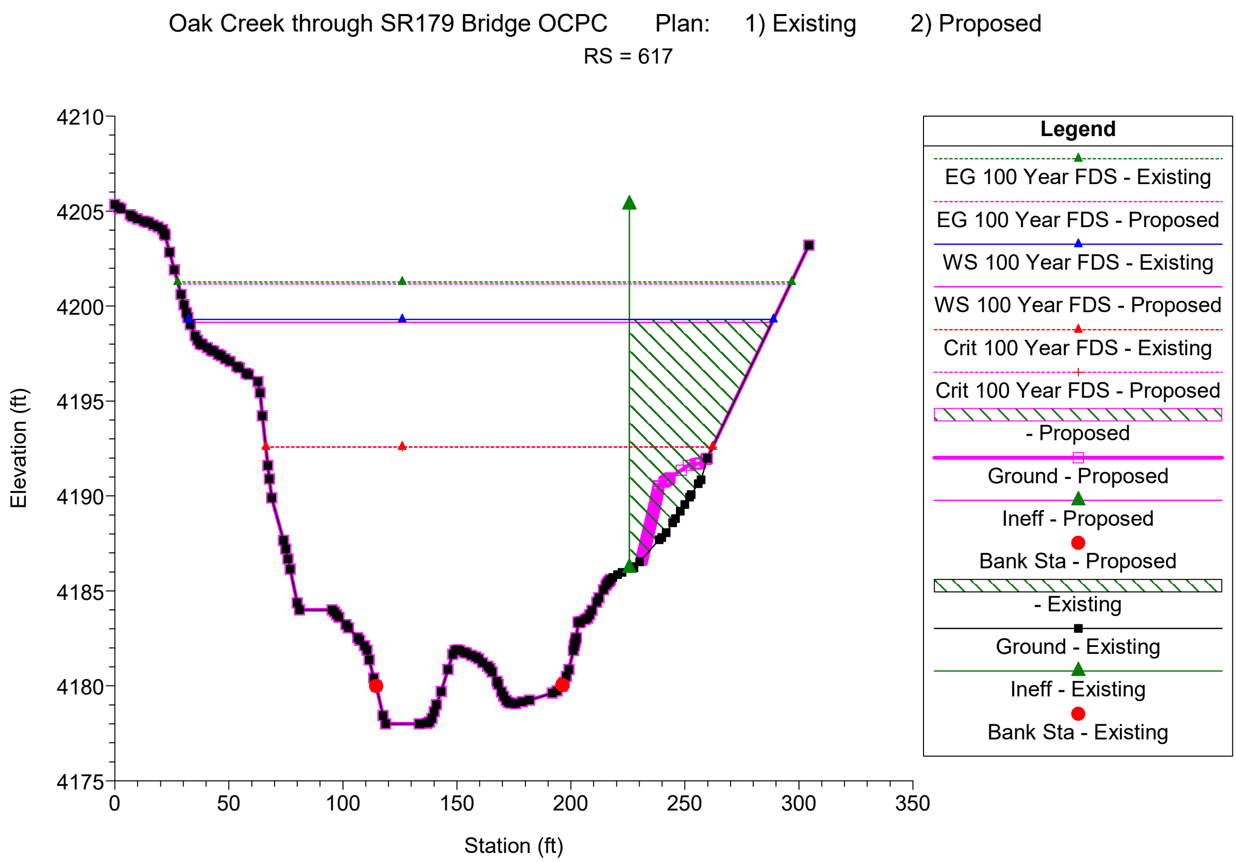
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
Ground - Existing
Ineff - Existing
Bank Sta - Existing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Legend
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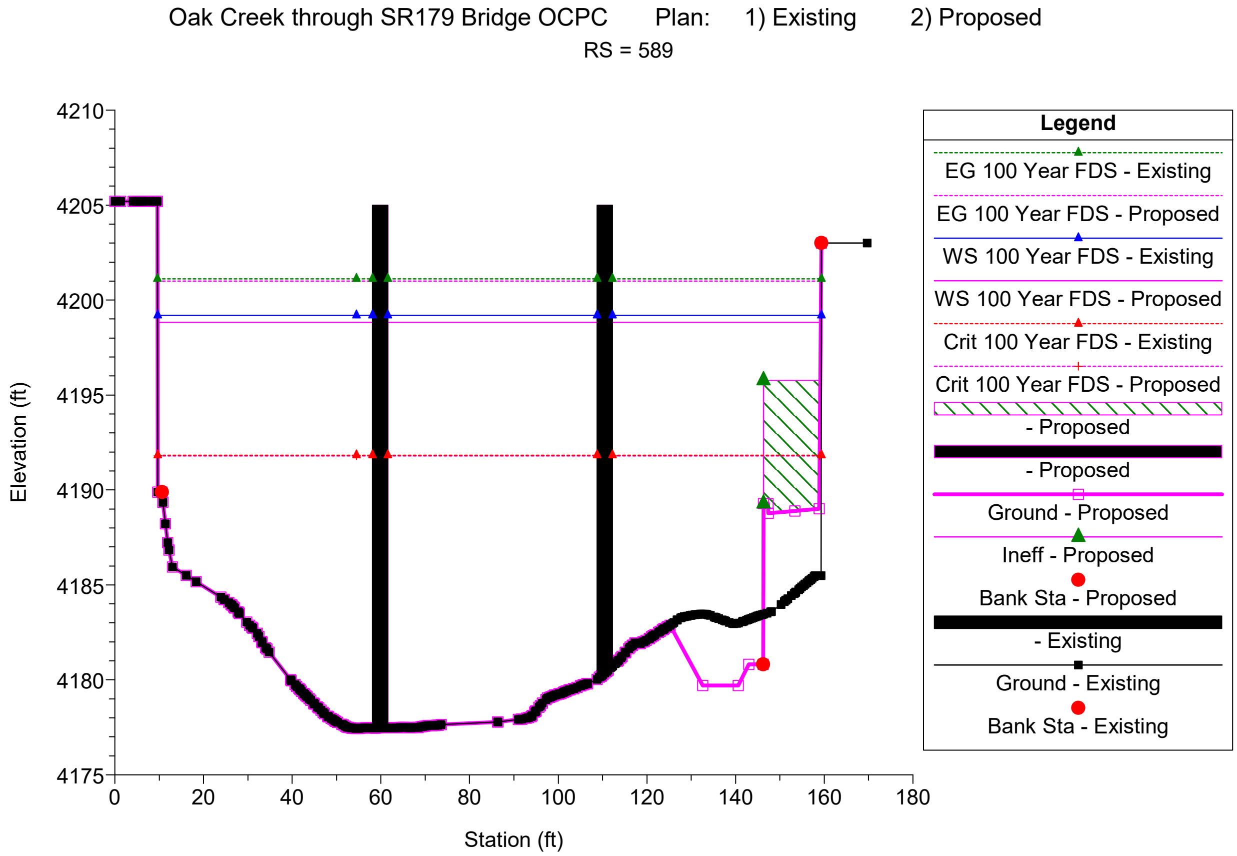
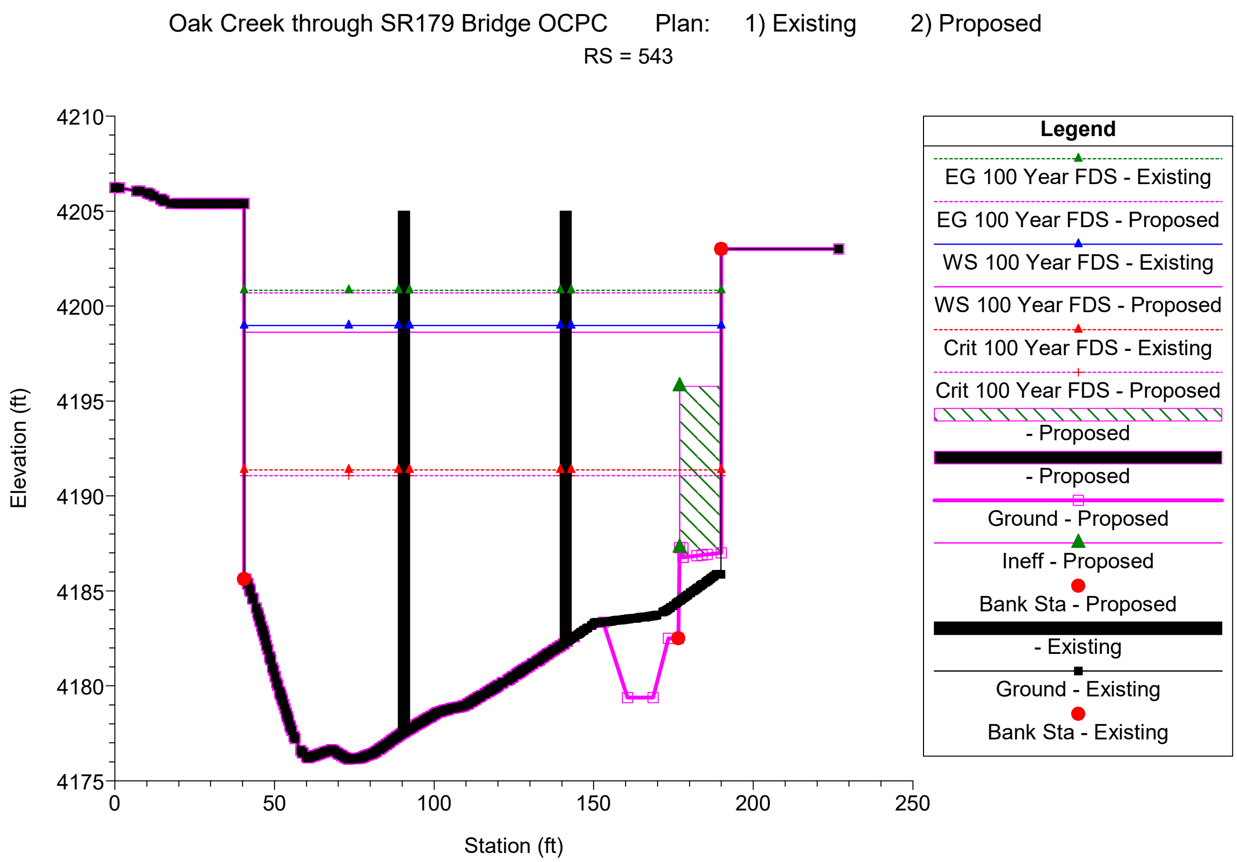
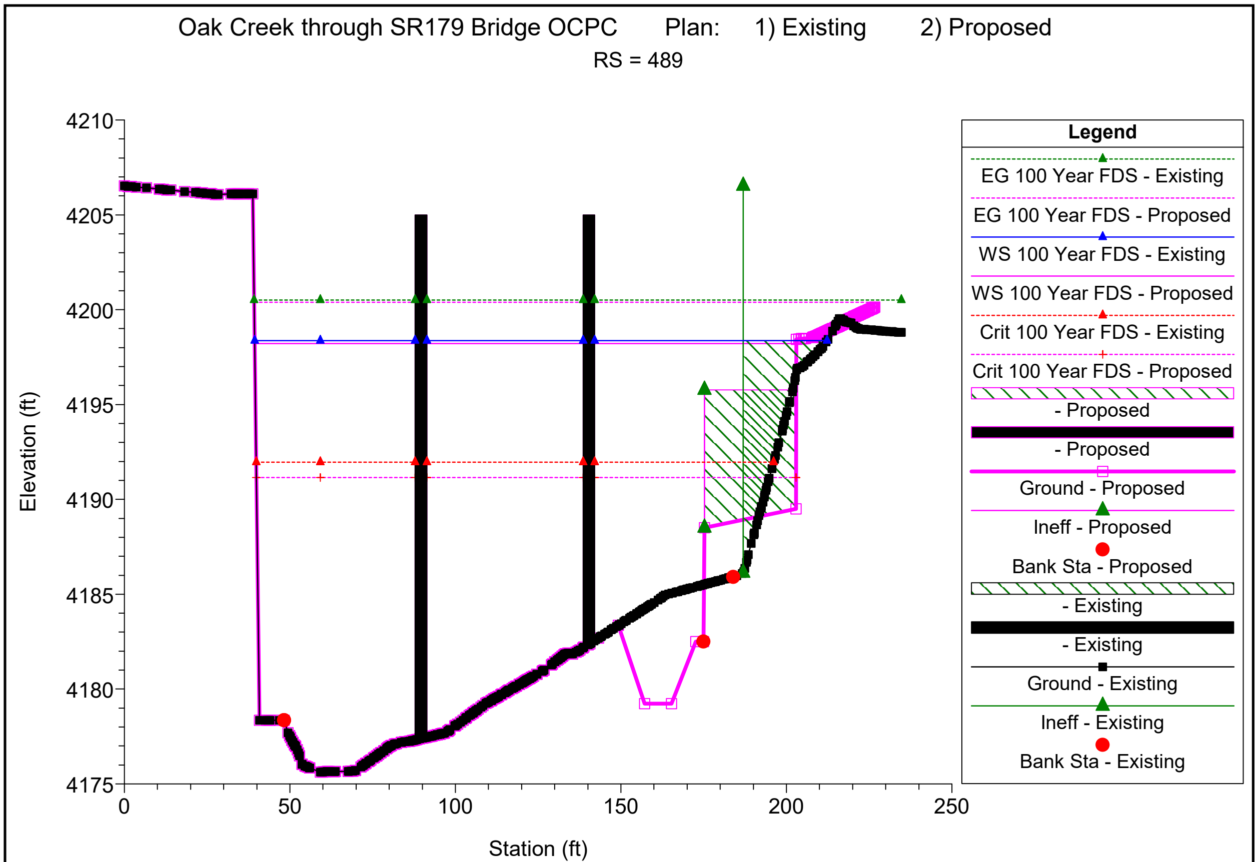
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
Ground - Existing
Ineff - Existing
Bank Sta - Existing

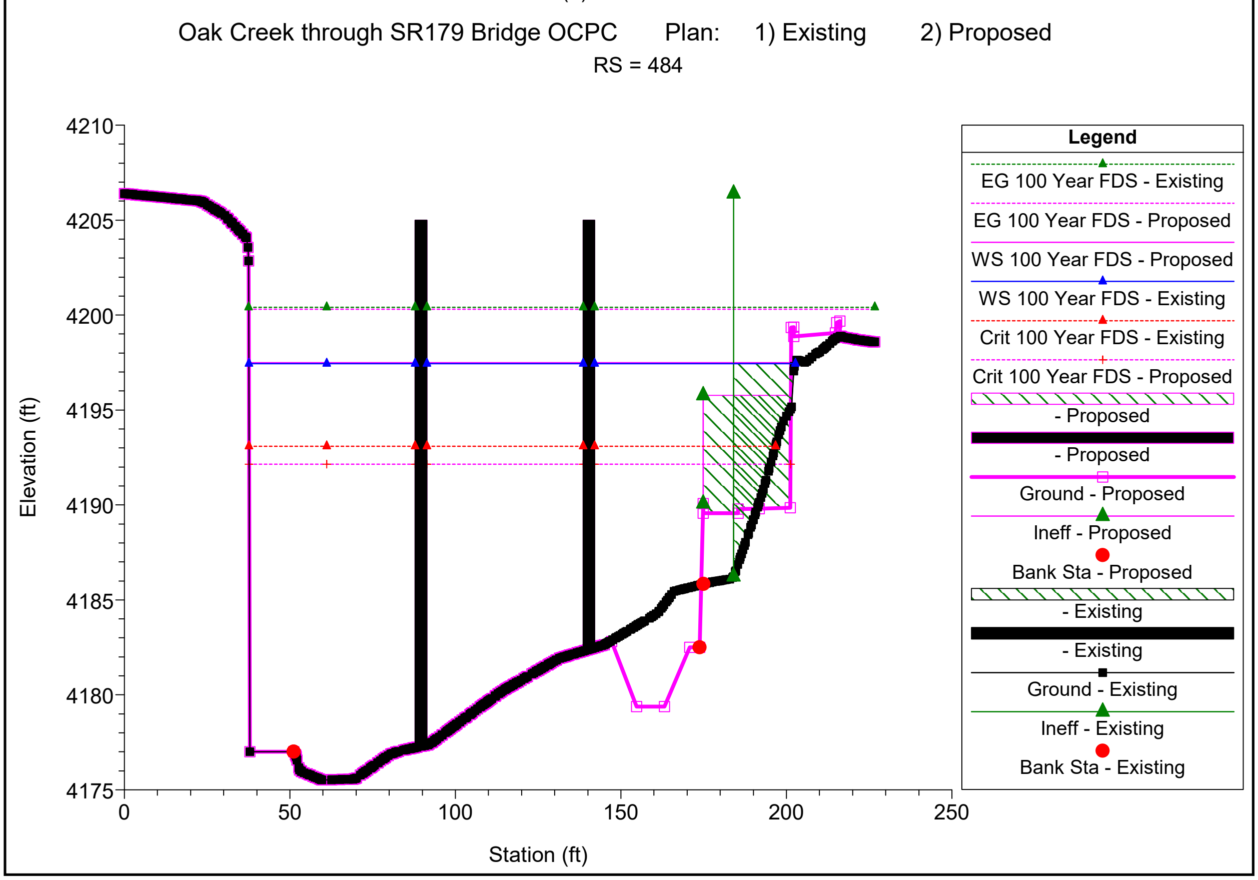


Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 589
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
0
20
40
60
80
100
120
140
160
180
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
Ground - Existing
Bank Sta - Existing



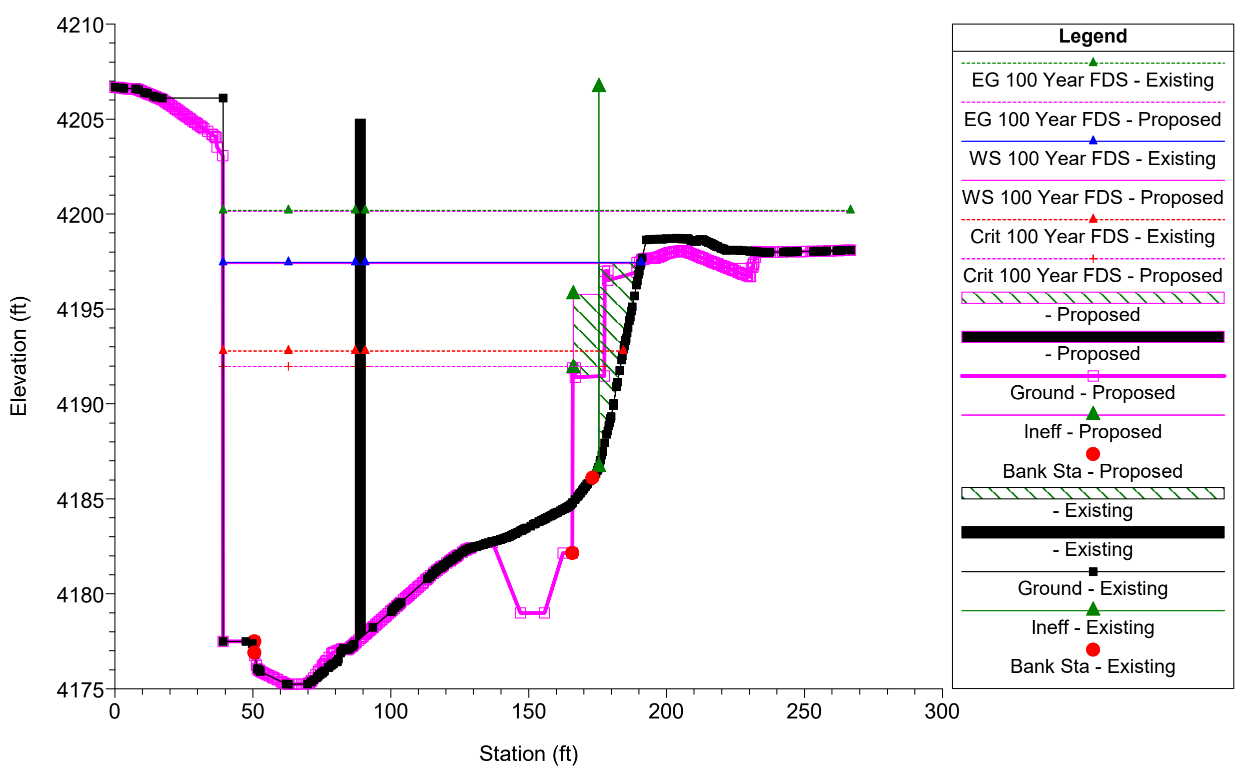
Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 543
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
0
50
100
150
200
250
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
Ground - Existing
Bank Sta - Existing


Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 489
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
0
50
100
150
200
250
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
- Existing
Ground - Existing
Ineff - Existing
Bank Sta - Existing


Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 484
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
0
50
100
150
200
250
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Proposed
WS 100 Year FDS - Existing
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
- Existing
Ground - Existing
Ineff - Existing
Bank Sta - Existing

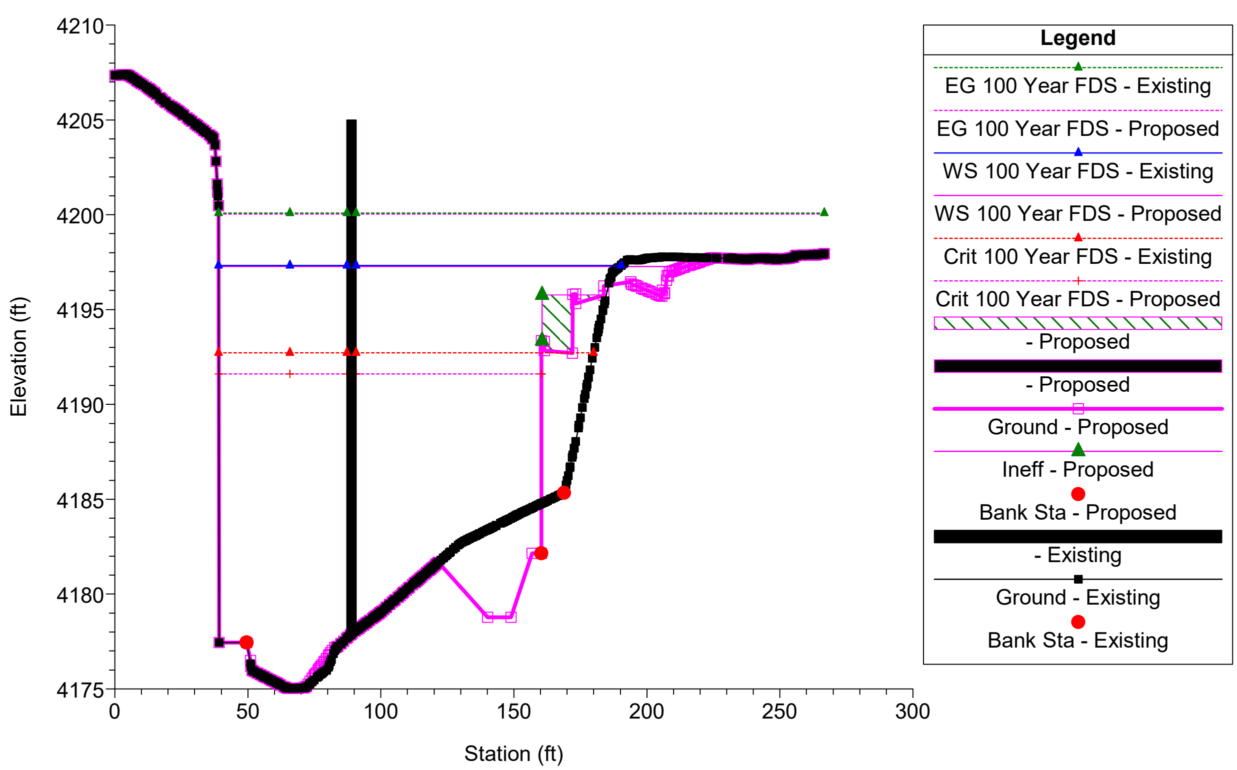
Oak Creek through SR179 Bridge OCPC   Plan: 1) Existing   2) Proposed

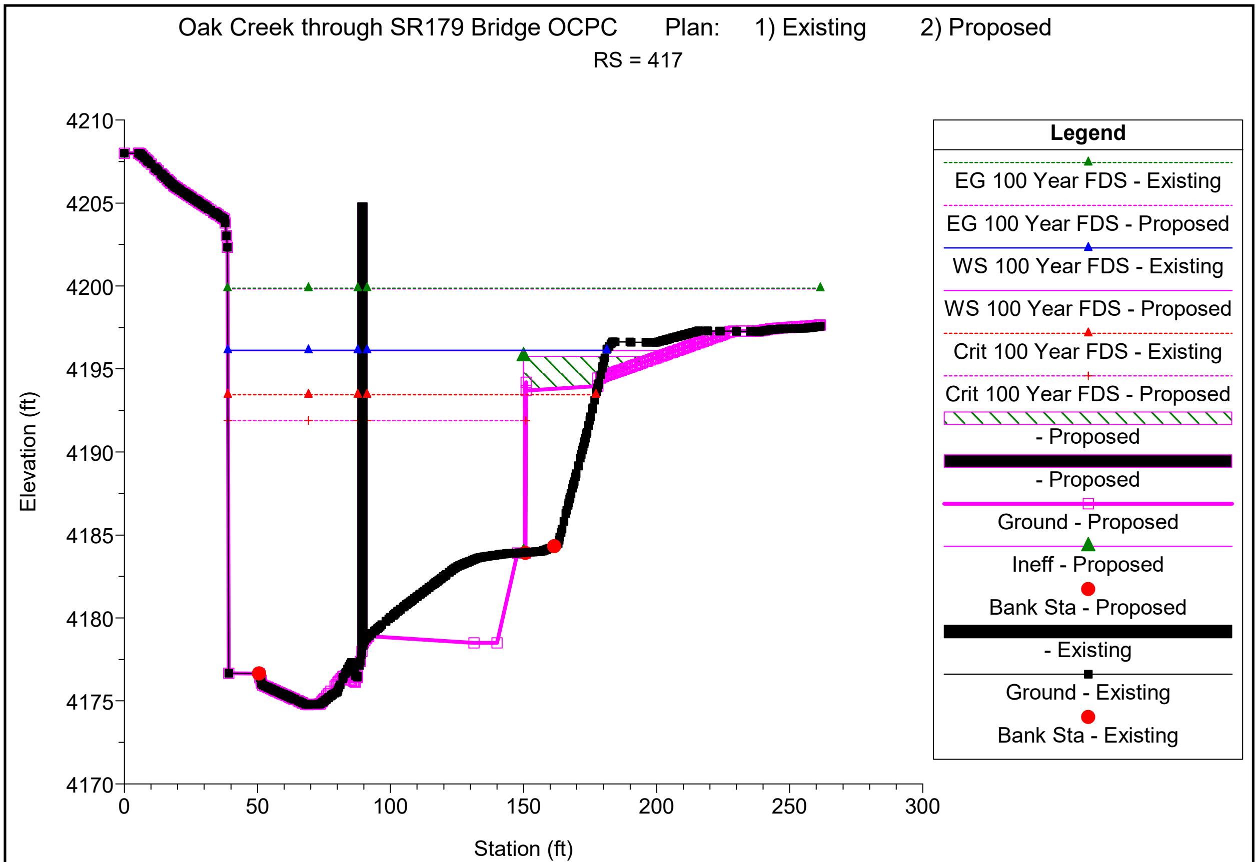
RS = 455



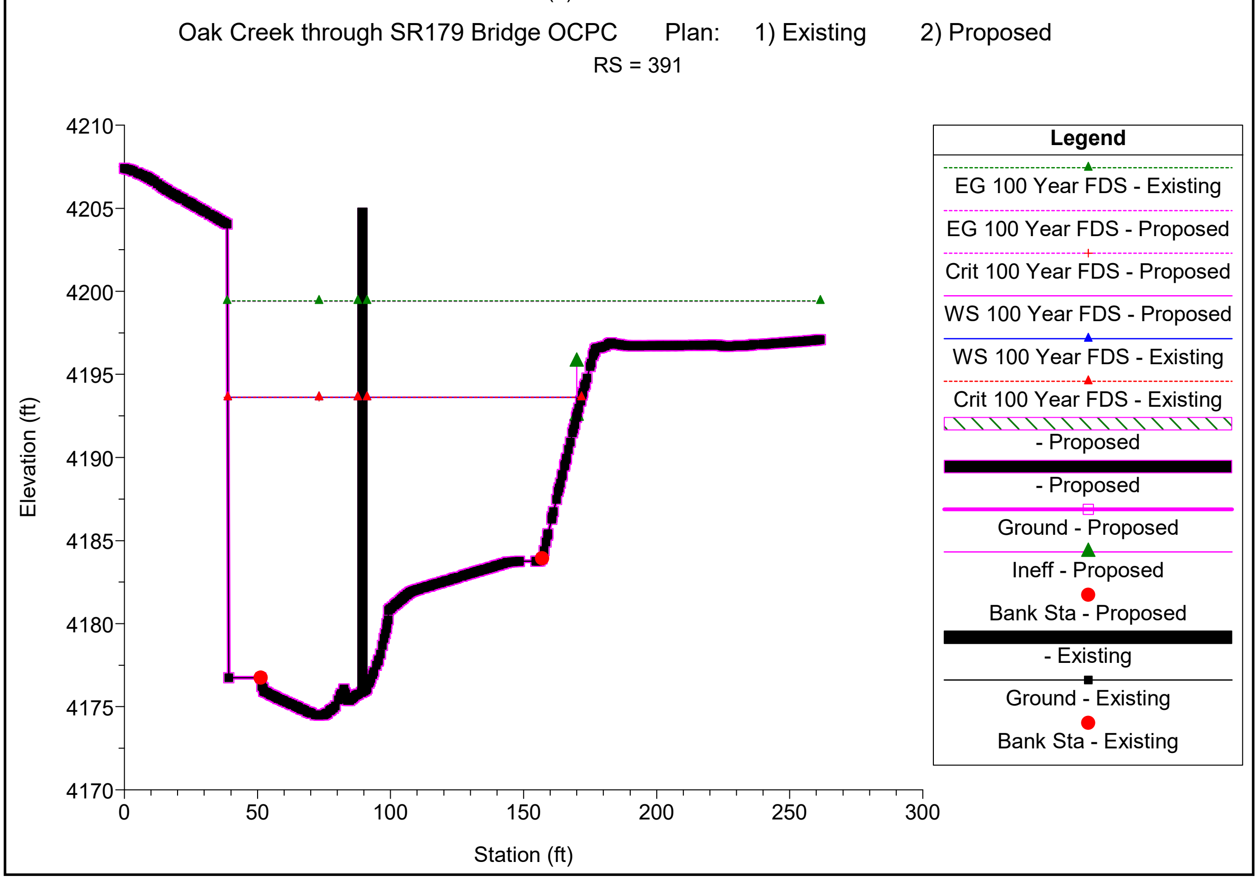
Oak Creek through SR179 Bridge OCPC   Plan: 1) Existing   2) Proposed

RS = 438

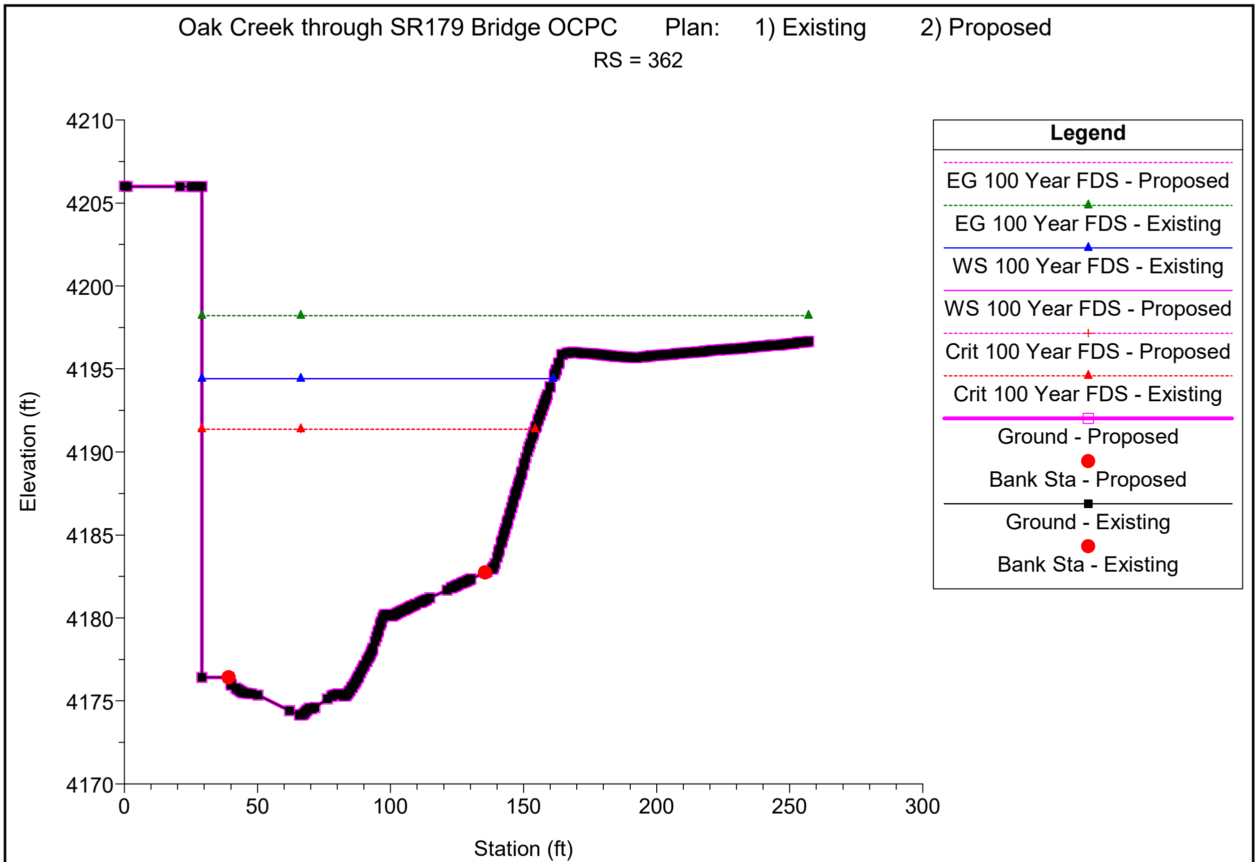




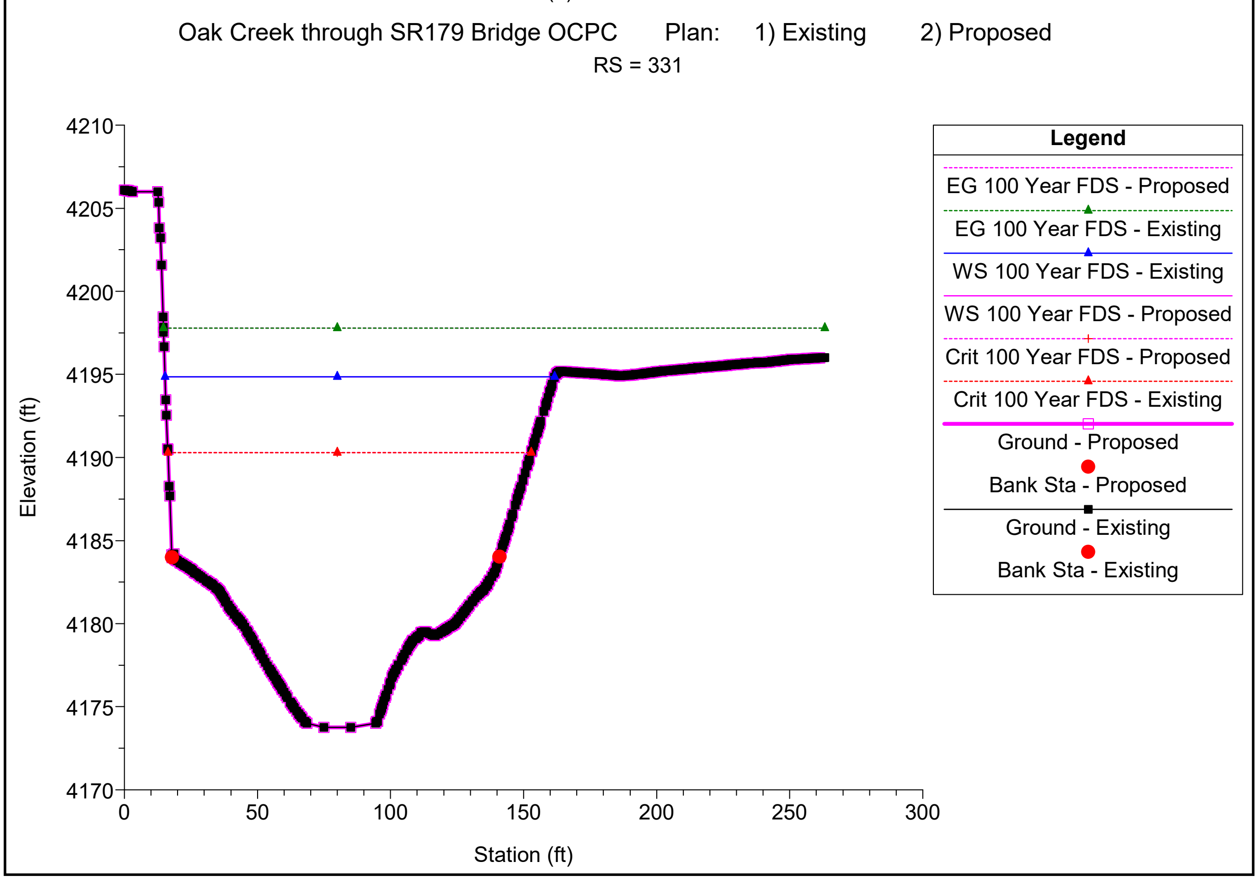
Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 417
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
4170
0
50
100
150
200
250
300
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Crit 100 Year FDS - Proposed
- Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
Ground - Existing
Bank Sta - Existing



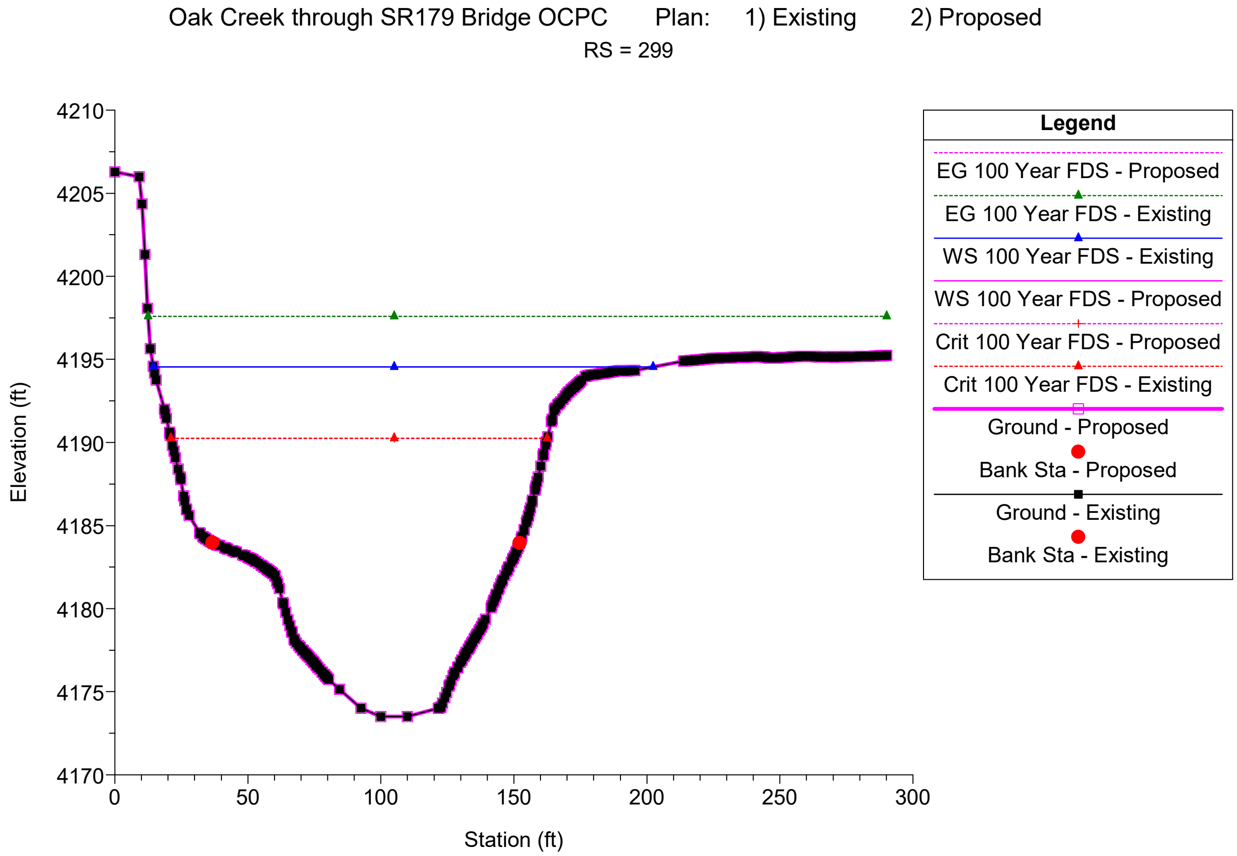
Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 391
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
4170
0
50
100
150
200
250
300
Legend
EG 100 Year FDS - Existing
EG 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
WS 100 Year FDS - Proposed
WS 100 Year FDS - Existing
Crit 100 Year FDS - Existing
- Proposed
- Proposed
Ground - Proposed
Ineff - Proposed
Bank Sta - Proposed
- Existing
Ground - Existing
Bank Sta - Existing

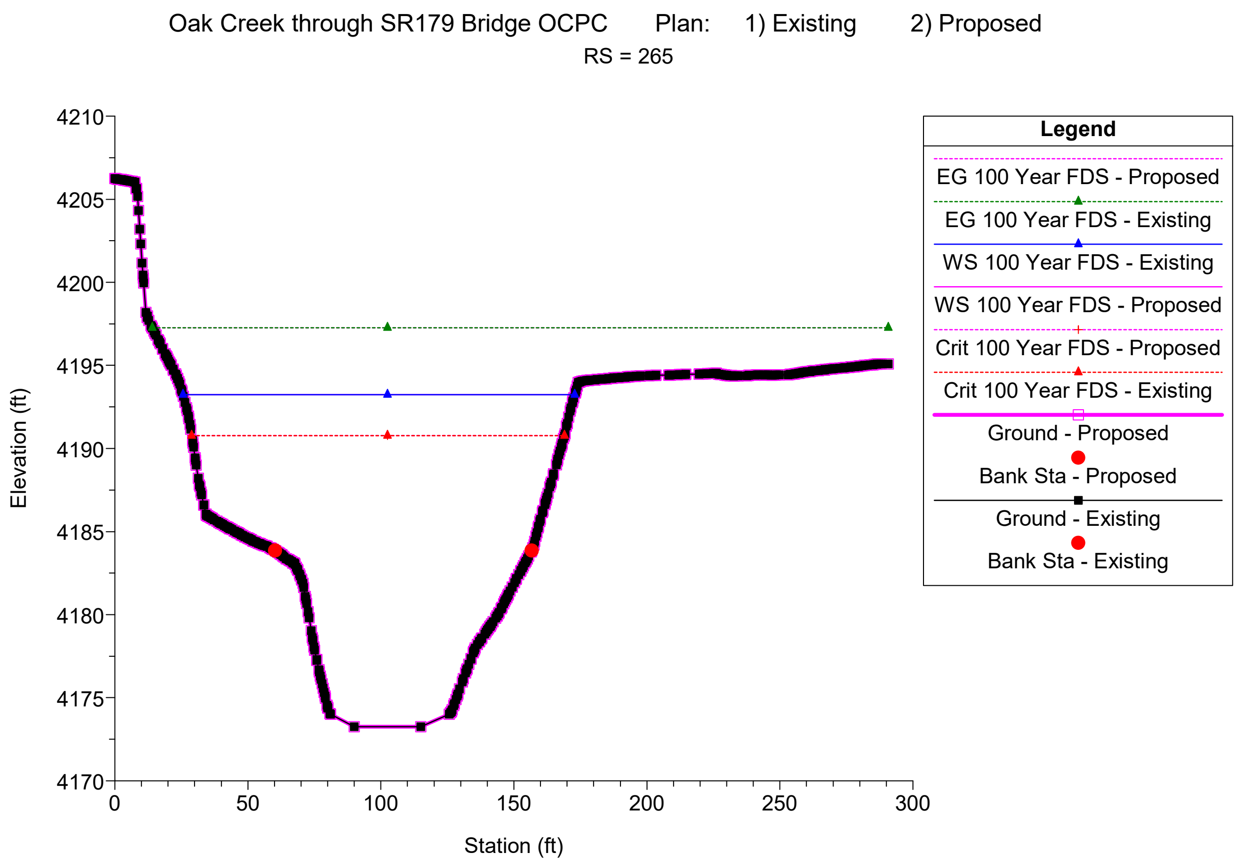


Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 362
Legend
EG 100 Year FDS - Proposed
EG 100 Year FDS - Existing
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Ground - Proposed
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
4170
0
50
100
150
200
250
300



Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 331
Legend
EG 100 Year FDS - Proposed
EG 100 Year FDS - Existing
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Ground - Proposed
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing
Elevation (ft)
Station (ft)
4210
4205
4200
4195
4190
4185
4180
4175
4170
0
50
100
150
200
250
300


Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 299
Elevation (ft)
4210
4205
4200
4195
4190
4185
4180
4175
4170
0
50
100
150
200
250
300
Station (ft)
Legend
EG 100 Year FDS - Proposed
EG 100 Year FDS - Existing
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Ground - Proposed
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing


Oak Creek through SR179 Bridge OCPC Plan: 1) Existing 2) Proposed
RS = 265
Elevation (ft)
4210
4205
4200
4195
4190
4185
4180
4175
4170
0
50
100
150
200
250
300
Station (ft)
Legend
EG 100 Year FDS - Proposed
EG 100 Year FDS - Existing
WS 100 Year FDS - Existing
WS 100 Year FDS - Proposed
Crit 100 Year FDS - Proposed
Crit 100 Year FDS - Existing
Ground - Proposed
Bank Sta - Proposed
Ground - Existing
Bank Sta - Existing

HEC-RAS Plan: Existing River: Oak Creek Reach: Oak Creek Profile: 100 Year FDS

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)	
Oak Creek	915	100 Year FDS	28600.00	4184.00	4201.98	4197.96	4203.01	0.003859	8.38	3631.01	428.64	0.47
Oak Creek	829	100 Year FDS	28600.00	4184.00	4201.82	4196.86	4202.68	0.002838	7.77	4129.67	495.95	0.41
Oak Creek	750	100 Year FDS	28600.00	4182.39	4201.77	4195.24	4202.44	0.001878	7.11	4991.54	564.36	0.35
Oak Creek	681	100 Year FDS	28600.00	4180.35	4199.23	4195.87	4201.99	0.007741	14.14	2381.46	343.35	0.69
Oak Creek	617	100 Year FDS	28600.00	4178.00	4199.29	4192.58	4201.27	0.003479	12.65	2845.58	256.47	0.50
Oak Creek	589	100 Year FDS	28600.00	4177.44	4199.20	4191.83	4201.11	0.005900	11.09	2583.99	142.72	0.46
Oak Creek	543	100 Year FDS	28600.00	4176.15	4198.97	4191.37	4200.83	0.005443	10.94	2614.89	142.48	0.45
Oak Creek	495	100 Year FDS	28600.00	4175.70	4198.53	4191.77	4200.56	0.005418	10.74	2576.77	142.19	0.45
Oak Creek	489	100 Year FDS	28600.00	4175.62	4198.37	4191.96	4200.51	0.005238	10.90	2527.69	165.92	0.45
Oak Creek	484	100 Year FDS	28600.00	4175.53	4197.44	4193.09	4200.41	0.005362	10.65	2413.89	158.13	0.45
Oak Creek	455	100 Year FDS	28600.00	4175.24	4197.45	4192.79	4200.18	0.005107	11.65	2303.93	148.11	0.49
Oak Creek	438	100 Year FDS	28600.00	4175.03	4197.32	4192.71	4200.09	0.005466	12.02	2312.90	147.79	0.51
Oak Creek	417	100 Year FDS	28600.00	4174.78	4196.12	4193.44	4199.86	0.007138	13.04	2074.46	138.92	0.57
Oak Creek	391	100 Year FDS	28600.00	4174.49	4193.63	4193.63	4199.42	0.011859	15.17	1699.72	129.50	0.72
Oak Creek	362	100 Year FDS	28600.00	4174.16	4194.42	4191.37	4198.22	0.006178	15.04	1936.70	132.03	0.65
Oak Creek	331	100 Year FDS	28600.00	4173.75	4194.85	4190.29	4197.78	0.005337	13.83	2152.92	146.41	0.60
Oak Creek	299	100 Year FDS	28600.00	4173.50	4194.55	4190.25	4197.59	0.005571	14.24	2189.18	187.89	0.61
Oak Creek	265	100 Year FDS	28600.00	4173.25	4193.23	4190.77	4197.26	0.008002	16.65	1911.18	147.29	0.72

HEC-RAS Plan: Proposed River: Oak Creek Reach: Oak Creek Profile: 100 Year FDS

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)	
Oak Creek	915	100 Year FDS	28600.00	4184.00	4201.92	4197.96	4202.97	0.003937	8.43	3606.16	426.92	0.48
Oak Creek	829	100 Year FDS	28600.00	4184.00	4201.76	4196.86	4202.63	0.002896	7.82	4098.52	493.26	0.42
Oak Creek	750	100 Year FDS	28600.00	4182.39	4201.71	4195.24	4202.39	0.001923	7.18	4964.34	579.33	0.35
Oak Creek	681	100 Year FDS	28600.00	4180.35	4199.06	4195.87	4201.92	0.008118	14.36	2340.98	339.83	0.71
Oak Creek	617	100 Year FDS	28600.00	4178.00	4199.14	4192.58	4201.16	0.003583	12.77	2816.73	255.43	0.51
Oak Creek	589	100 Year FDS	28600.00	4177.44	4198.82	4191.79	4201.00	0.006346	11.88	2439.73	142.54	0.49
Oak Creek	543	100 Year FDS	28600.00	4176.15	4198.62	4191.06	4200.70	0.005671	11.58	2497.32	142.49	0.47
Oak Creek	495	100 Year FDS	28600.00	4175.70	4198.31	4190.96	4200.43	0.005227	11.12	2521.86	142.20	0.45
Oak Creek	489	100 Year FDS	28600.00	4175.62	4198.22	4191.15	4200.40	0.005195	11.06	2531.96	156.66	0.45
Oak Creek	484	100 Year FDS	28600.00	4175.53	4197.48	4192.14	4200.31	0.005014	10.59	2458.71	156.83	0.44
Oak Creek	455	100 Year FDS	28600.00	4175.23	4197.40	4191.97	4200.14	0.004967	11.75	2307.66	160.17	0.48
Oak Creek	438	100 Year FDS	28600.00	4175.03	4197.28	4191.61	4200.04	0.005163	12.15	2281.01	172.32	0.50
Oak Creek	417	100 Year FDS	28600.00	4174.78	4196.10	4191.90	4199.83	0.006617	13.32	2000.40	165.09	0.55
Oak Creek	391	100 Year FDS	28600.00	4174.49	4193.63	4193.63	4199.40	0.011804	15.14	1699.23	129.50	0.72
Oak Creek	362	100 Year FDS	28600.00	4174.16	4194.42	4191.37	4198.22	0.006178	15.04	1936.70	132.03	0.65
Oak Creek	331	100 Year FDS	28600.00	4173.75	4194.85	4190.29	4197.78	0.005337	13.83	2152.92	146.41	0.60
Oak Creek	299	100 Year FDS	28600.00	4173.50	4194.55	4190.25	4197.59	0.005571	14.24	2189.18	187.89	0.61
Oak Creek	265	100 Year FDS	28600.00	4173.25	4193.23	4190.77	4197.26	0.008002	16.65	1911.18	147.29	0.72

Rob Lyons

From: Anthony Brozich <abrozich@azdot.gov>
Sent: Wednesday, February 5, 2020 9:30 AM
To: Rob Lyons; Jessica Fly
Subject: Re: FW: SR179 over Oak Creek in Sedona

The following address the second part of your question and was received from the District/inpsector

- Pressure Injected Grout BB (Abutment 2 only) Contractor reached saturated conditions that resulted in an in-situ pressure grout installation.

  - Was the grouting performed on a certain spacing? Yes, every 5' to a depth X? below abutment footing to 5" below subgrade elevation.
  - How was it decided when to stop grouting in each hole? A volume calculation was determined to encapsulate and overlap each cell of 5'X5'X5'. An entire row of set depth must be complete once we started (5' high cell or row).
    - Pressure Injected Grout
    - Was the grouting performed on a certain spacing?
    - How was it decided when to stop grouting in each hole?
    - Any other information on the grout to helps us understand if it's a continuous mass or not would be appreciated.

  area of native cobble. Additionally, gout was injected until a backpressure was achieved. Rate of application was monitoring ensuring deplacement of groundwater and fine materials in annular spaces.

  - Any other information on the grout to helps us understand if it's a continuous mass or not would be appreciated. There was a lot of effort into ensuring continuous mass of grouted creek bed cobble under and adjacent to abutment 2. This included the alignment and configuration of overlapping of injection bore hole locations with the above described methodology. I recall that we injected a volume of grout to overlap each cell (5'X5'X5') by 1'. Hence, the native cobble at abutment 2 where BB was defined is a continuous mass.

Anthony Brozich, P.E.

Assistant State Construction Engineer

Construction Group

1221 N 21st ave
Phoenix, AZ 85009

602.463.3615
www.azdot.gov

On Mon, Feb 3, 2020 at 9:46 AM Anthony Brozich <abrozich@azdot.gov> wrote:

Here is one part of your answer, we are working on the pressure grout

-
- Construction Access

- Were they limited in types of equipment that could get down there? No
- Was any special permitting done? Adot required a full time PE/CPESC to be on the project (Kurt Harris). Kurt worked for Adot not the contractor.
- Where did they access the creek from? The contractor cut in an access road on the Abutment 1 side prior to building the retaining wall (in front of what is now called "The Hike House"). The contractor placed a small precast temporary bridge (military bridge) over the creek in order to access the abutment 2 side.

Anthony Brozich, P.E.

Assistant State Construction Engineer

Construction Group

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Phoenix, AZ 85009

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On Thu, Jan 30, 2020 at 3:58 PM Rob Lyons <rob@jefuller.com> wrote:

Hi Anthony, WSP (prime consulting engineers) had a few more questions if you wouldn't mind running past the construction inspector:

- Pressure Injected Grout
  - Was the grouting performed on a certain spacing?
  - How was it decided when to stop grouting in each hole?
  - Any other information on the grout to helps us understand if it's a continuous mass or not would be appreciated.
- Construction Access
  - Were they limited in types of equipment that could get down there?
  - Was any special permitting done?
  - Where did they access the creek from?

We really appreciate this. BTW, Jessica Fly/WSP is the lead designer on this project. I understand you two have worked together before (or maybe are currently working together).

ROB LYONS | PE, CFM

8400 S Kyrene Rd, Suite 201 | Tempe, AZ 85284
Office: (480) 222-5715

rob@jefuller.com

www.JEFuller.com

From: Anthony Brozich <abrozich@azdot.gov>
Sent: Thursday, January 30, 2020 2:11 PM
To: Rob Lyons <rob@jefuller.com>
Cc: Jesse Gutierrez <jgutierrez@azdot.gov>; Charlene Neish <cneish@azdot.gov>
Subject: Re: FW: SR179 over Oak Creek in Sedona

Rob,

Here is information that I was able to get from an inspector that was on the project

---

The railbank was deleted but we did complete the injected grout at abutment 2. I was on the project when we pressure injected the grout. The grout was injected next to the drilled shafts in the river rock so unless you see drilled shafts, the grouted rip rap will not be visible from the surface.

We did build and install the gabion baskets. They were assembled in place on the abutment 2 side of the Oak Creek bridge in front of Tlaquepaque. If my memory serves me correctly, the baskets were 3' wide x 3' tall x 5' long. There is an "anchor basket" at the bottom of the slope and then the baskets line the rest of the bank as shown in the previously attached plan view drawing.

I can go get the plans out of the morg if this doesn't answer Rob's questions and he needs additional info.

Please let me know if you need me to dig deeper

Take care,

Anthony Brozich, P.E.

Assistant State Construction Engineer

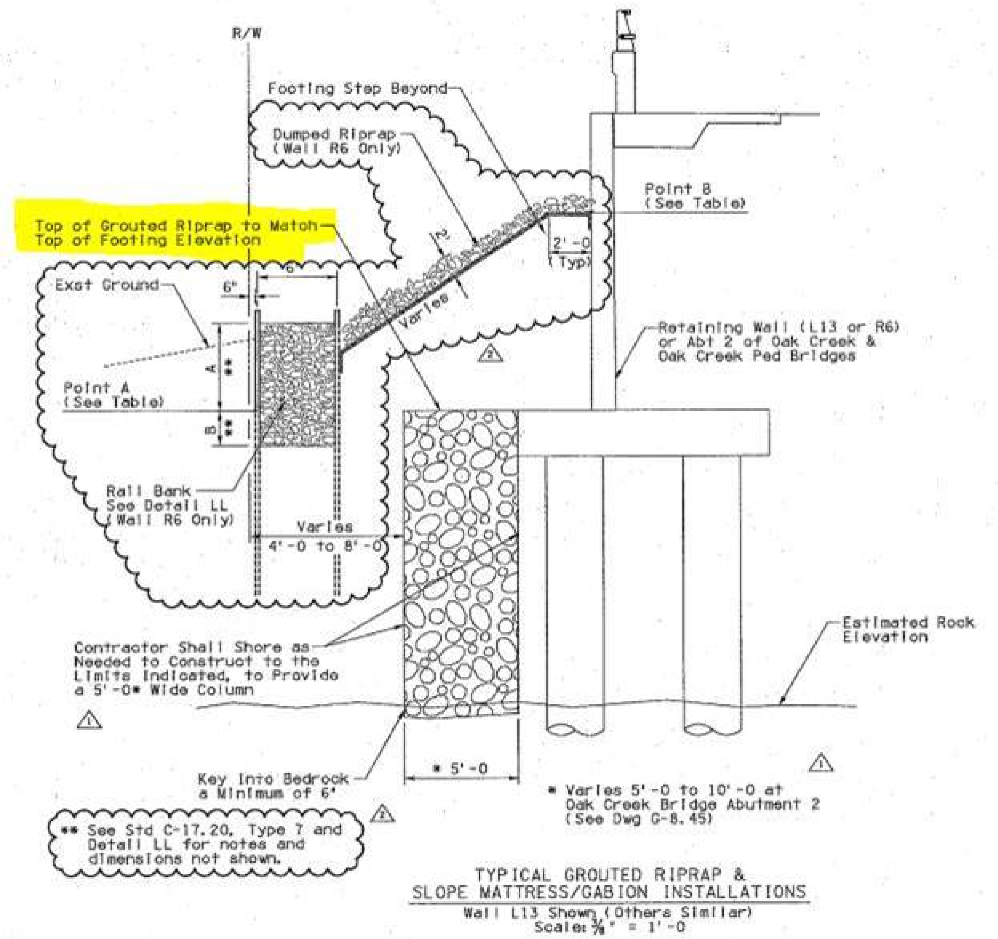
Construction Group

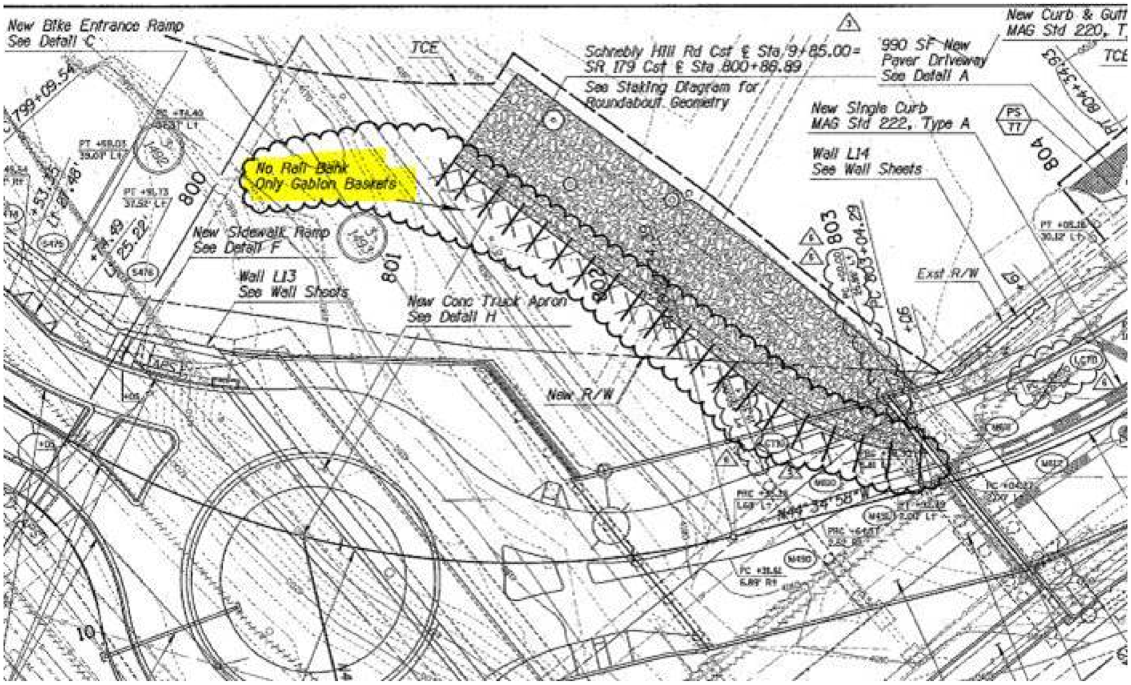
1221 N 21st ave
Phoenix, AZ 85009

602.463.3615
www.azdot.gov

On Wed, Jan 29, 2020 at 9:56 AM Rob Lyons <rob@jefuller.com> wrote:

Hi Tony, I'm forwarding an email I sent to Steve earlier. The attached are excerpts from the As-Built drawings we've been referencing. I've pasted two clips below that show the features I'm interested in verifying. As I said on the phone, I couldn't find the grouted riprap shown. Also, the as-built drawings have a note about replacing rail bank and riprap with gabion baskets, but there's not detail as to the type of baskets, dimensions, horizontal, or vertical extents. Any information (even construction photos) you can provide would be a big help. Thank you.





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rob@jefuller.com

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From: Rob Lyons
Sent: Tuesday, January 21, 2020 2:11 PM
To: SBoschen@azdot.gov
Subject: SR179 over Oak Creek in Sedona

Hi Steve, I just left you a voicemail. I’m trying to help the City of Sedona with a project along Oak Creek at the SR179 bridge. I think some changes to the scour/erosion protection happened during construction that aren’t reflected in the As-built drawings and was wondering if you might be able to shed some light. Can you give me a call at your convenience? I’ve attached some excerpts from the drawings for reference.

Thanks,

ROB LYONS | PE, CFM

8400 S Kyrene Rd, Suite 201 | Tempe, AZ 85284
Office: (480) 222-5715

rob@jefuller.com

www.JEFuller.com

Hydraulic Analysis Report

Project Data

Project Title:
Designer:
Project Date: Wednesday, August 19, 2020
Project Units: U.S. Customary Units
Notes:

Channel Analysis: 36-in SD Scupper

Notes:

Input Parameters

Channel Type: Rectangular
Channel Width: 6.0000 ft
Longitudinal Slope: 0.0340 ft/ft
Manning's n: 0.0150
Flow: 25.0000 cfs

Result Parameters

Depth: 0.4351 ft
Area of Flow: 2.6108 ft^2
Wetted Perimeter: 6.8703 ft
Hydraulic Radius: 0.3800 ft
Average Velocity: 9.5758 ft/s
Top Width: 6.0000 ft
Froude Number: 2.5582
Critical Depth: 0.8139 ft
Critical Velocity: 5.1194 ft/s
Critical Slope: 0.0048 ft/ft
Critical Top Width: 6.00 ft
Calculated Max Shear Stress: 0.9232 lb/ft^2
Calculated Avg Shear Stress: 0.8062 lb/ft^2

Hydraulic Analysis Report

Project Data

Project Title:
Designer:
Project Date: Wednesday, August 19, 2020
Project Units: U.S. Customary Units
Notes:

Channel Analysis: Conc Barrier Scupper

Notes:

Input Parameters

Channel Type: Rectangular
Channel Width: 2.0000 ft
Longitudinal Slope: 0.0150 ft/ft
Manning's n: 0.0150
Depth: 0.1670 ft

Result Parameters

Flow: 1.1087 cfs
Area of Flow: 0.3340 ft^2
Wetted Perimeter: 2.3340 ft
Hydraulic Radius: 0.1431 ft
Average Velocity: 3.3195 ft/s
Top Width: 2.0000 ft
Froude Number: 1.4315
Critical Depth: 0.2121 ft
Critical Velocity: 2.6135 ft/s
Critical Slope: 0.0071 ft/ft
Critical Top Width: 2.00 ft
Calculated Max Shear Stress: 0.1563 lb/ft^2
Calculated Avg Shear Stress: 0.1339 lb/ft^2