

**MIDDLE FORK NEWAUKUM WATERSHED PATHWAYS
FISH PASSAGE PROJECT
CENTRALIA ALPHA ROAD AT MP 15.79**

HYDRAULIC MEMO

Prepared for:

Lewis County Public Works
Chehalis, WA

On behalf of:

PBS, Inc.
Issaquah, WA

Prepared by:

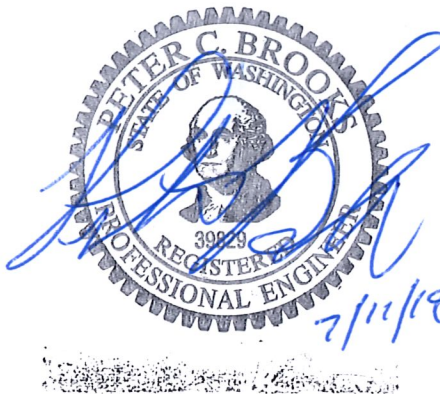
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Seattle, WA

11 July 2019

Prepared by or under the direct supervision of:



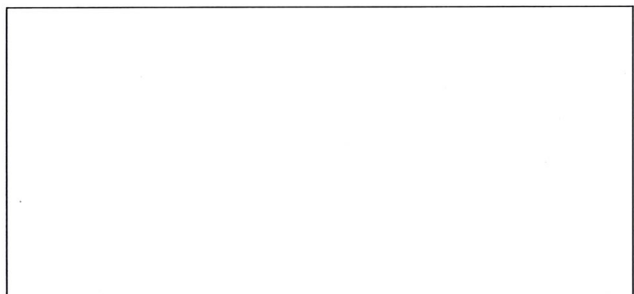
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1 INTRODUCTION

1.1 Background and Overview

Lewis County (County) intends to improve fish passage, stream function, and floodplain connectivity along the Middle Fork Newaukum River (Middle Fork) by replacing the existing culvert that conveys the river beneath Centralia Alpha Road at mile post (MP) 15.79. The County retained PBS Engineering and Environmental, Inc. (PBS) to develop design drawings and provide related engineering services for the project. Northwest Hydraulic Consultants, Inc. (NHC) is partnering with PBS to provide specialized hydrologic, hydraulic, and geomorphic services, as well as assist in developing the conceptual designs following Washington Department of Fish and Wildlife's (WDFW) stream simulation guidelines (Barnard et al, 2013). This report documents findings of the existing conditions assessment and evaluation of the conceptual design conducted by NHC.

2 EXISTING CONDITIONS

2.1 Project Site Description

The project site is approximately 15 miles southeast of the City of Chehalis in Lewis County, WA (Section 15, Township 13N, Range 1E) where the Middle Fork Newaukum River crosses Centralia Alpha Road at MP 15.79 (Figure 1). The crossing is located approximately nine miles upstream of the confluence with the mainstem Newaukum River. The roadway embankment spans the approximately 200-foot wide river corridor and is elevated 7 to 9 feet above adjacent floodplains. The existing culvert structure is a 57-foot long, 5-foot by 7-foot arch corrugated metal pipe (CMP) with approximately 5 feet of cover below the relatively level roadway grade.

2.2 Reach Characterization

Channel gradients, as measured from available LiDAR and topographic survey data, show some variations in the stream profile in the vicinity of the Centralia Alpha Road (Figure 2). The stream bed slopes generally range from 0.4% to 0.7% 1,500 feet downstream of the culvert; upstream of the culvert the average stream bed slopes range from 0.4% to 1.3% over about 1,500 feet of stream length. Two short steep sections, one upstream and one downstream, with average slopes over 2% are shown in the LiDAR. The steep reach downstream of the crossings may be associated with a short segment armored by large boulders, likely lag materials (see Photograph 4); and upstream, the steep reach appears to be controlled by in-stream large woody debris or roots of mature cedars. More detailed ground survey (Foresight Survey, 2019) in the immediate vicinity of the culvert shows a stream bed profile of approximately 0.9%. The LiDAR based reach gradient is approximate, but it suggests that the channel may be prone to adjustment were either boulder or vegetative controls disturbed.

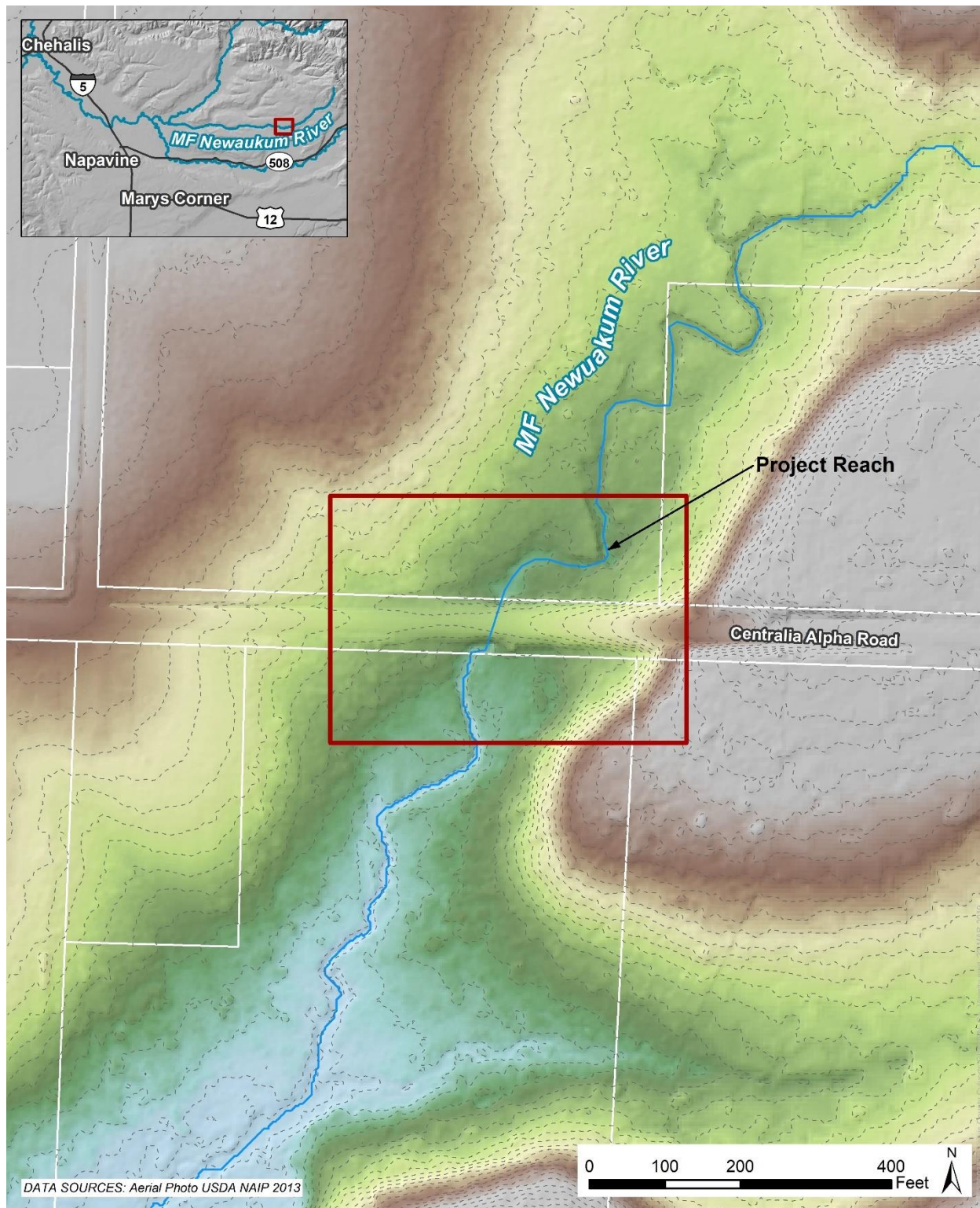


Figure 1 Middle Fork Newaukum River at Centralia Alpha Road vicinity map

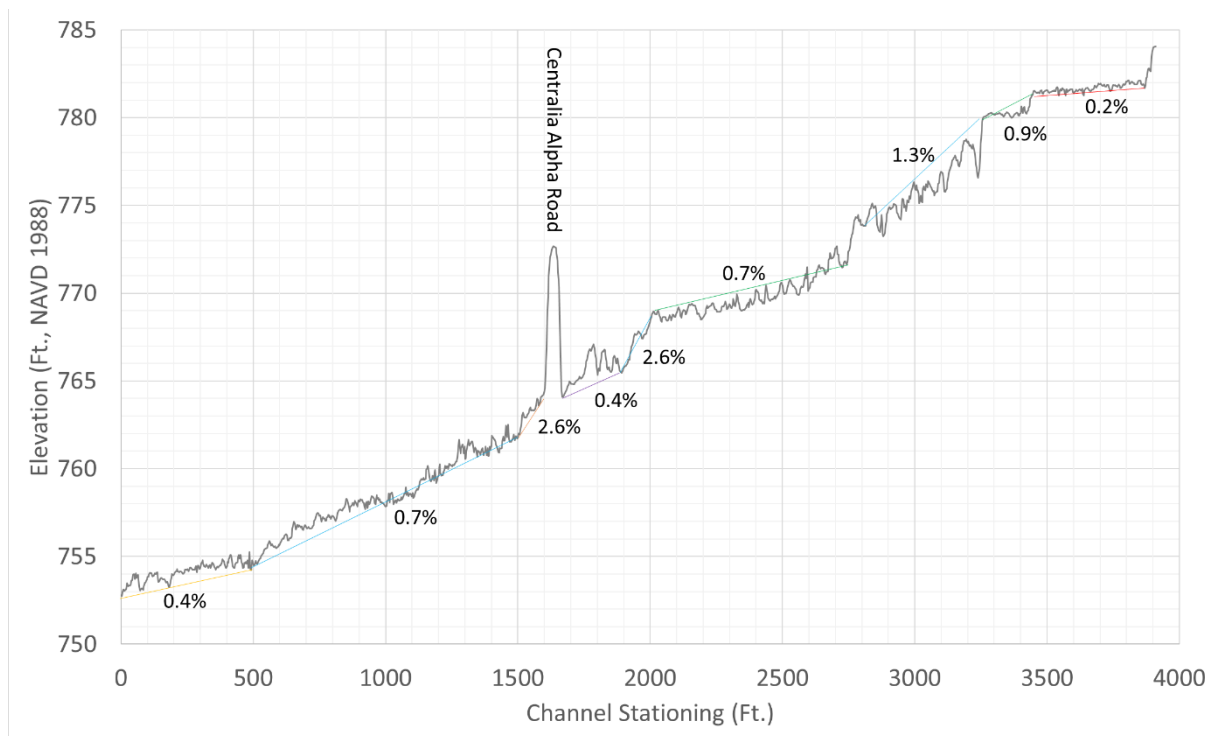


Figure 2 Middle Fork Newaukum River longitudinal bed profile (DNR LiDAR, 2017)

The culvert inlet is in good condition; the stream has a minor alignment change to enter the culvert and there are no major instabilities noted. The upstream roadway embankment is vegetated well and does not have any visible reinforcement. The culvert outlet is also in good condition with grasses along the roadway embankment. Immediately downstream of the outlet is a scour hole where the channel makes an abrupt meander to the west, but the profile in this location appears stable.

Upstream of the road, the Middle Fork flows through a well-established forest. The floodplain is vegetated with mature conifers, primarily cedars, and a sparse understory of grasses and ferns. In some areas, the channel has migrated into and flows through tree root systems, as seen at the upstream most debris jam observed about 315 upstream of the culvert, which is evidence of relatively slow morphologic processes. Large channel spanning logs, from naturally fallen timber, were observed in several locations 115, 275, and 315 feet upstream of the culvert crossing and appear to be collecting smaller debris as shown in Photograph 1; these logs and small jams are likely providing vertical grade control. The project reach exhibits a relatively uniform rectangular channel shape with near vertical or undercut outer banks and inner banks with more mild slopes connecting to the floodplain (Photograph 2). The channel banks range in height from two to four feet and are supported in some locations by root systems. The well-established condition of vegetation in the overbanks suggests that the culvert crossing does not cause dramatic backwater effects during frequent flood events. Channel conditions exhibit a plane bed or wood-forced pool-riffle morphology, with coarser particles embedded within finer silts and clays. Minimal gravel bars were observed through the reach, indicating relatively low sediment supply.



Photograph 1 Debris approximately 250 feet upstream of culvert crossing



Photograph 2 Typical section upstream

Downstream of the road, the channel emerges from the culvert and abruptly bends 90 degrees right (west) then parallels the road for approximately 30 feet before taking another 90 degree bend to the south. It's unclear why the river follows this alignment downstream of the culvert; however, it may be a remnant of the original pre-road channel. Overbanks are less forested than upstream. Tree species downstream are primarily alder and ground cover vegetation is predominately grasses. LiDAR data shows evidence of a relic channel towards the east valley wall. The difference in vegetation and stream character downstream of the crossing may indicate the channel migration zone prior to roadway embankment construction; however, the difference may also be attributed to other influences related to land management practices or a change in groundwater levels compared to the upstream reach. The downstream channel section is generally narrower, has steeper vertical banks, and is more entrenched than the upstream reach. Photograph 3 illustrates the more narrow channel section and the relatively detached floodplain. Banks are vegetated and comprise semi-cohesive material. Although generally appearing stable, some block failures were observed, indicating that the downstream reach may be slowly widening. Photograph 4 shows where coarse bed material appears to be maintaining the channel profile.



Photograph 3 Typical section downstream



Photograph 4 Coarse bed material downstream

2.2.1 Bankfull Width

NHC measured bankfull width at six locations along the Middle Fork, three upstream and three downstream of the road crossing (Figure 2.3). Measured values range from 12 to 17 feet downstream and 17 to 22 feet upstream, showing a general narrowing trend in the downstream direction. WDFW visited the site on April 7, 2016 and February 15, 2018, determining the bankfull width as 15 feet.

2.2.2 Sediment Composition

NHC attempted to collect pebble counts, but the air and water temperatures were prohibitively cold at the time of the site visit. Sediment composition at the Centralia Alpha reach was observed to be very similar to that at the Middle Fork Road crossing, approximately 1.5 miles downstream. Similarities include the presence of an armored cobble bed embedded with fines and lack of active gravel bars. Large cobbles both upstream and downstream are covered in moss, as shown in the photographs below, indicating limited mobility of material larger than 128 mm in the current hydrologic regime. Smaller sediments are limited to fines. Overall, field observations suggest that sediment transport through the reach is relatively low. Evaluation of LiDAR and aerial photos suggests there may be limited upstream sediment sources. In the project reach, the bed is armored primarily by cobbles eroded from the bank. Low stream gradient, lack of gravel bars (or gravel deposition upstream of debris jams), and presence of stable large woody debris log jams indicate the Middle Fork has relatively low stream power to transport sediment.



Photograph 5 Bed material upstream



Photograph 6 Bed material downstream

Since pebble counts could not be collected during the site visit to the Centralia Alpha crossing, and owing to the previously mentioned similarity, NHC utilized two samples collected on the Middle Fork at Middle Fork Road to characterize surface bed material grain size distributions for this analysis. Both samples were collected from mid-channel bars using an adapted random walk Wolman (1954) procedure. Locations for these measurements were approximately 200 feet upstream and downstream of the Middle Fork Road crossing. Figure 3 shows grain size distributions from collected samples, and for comparison purposes, the specified size distribution range for WSDOT Streambed Sediment [9-03.11(1)] and 12-inch Cobbles and [9-03.11(2)]. Table 1 reports characteristic grains sizes from each sample.

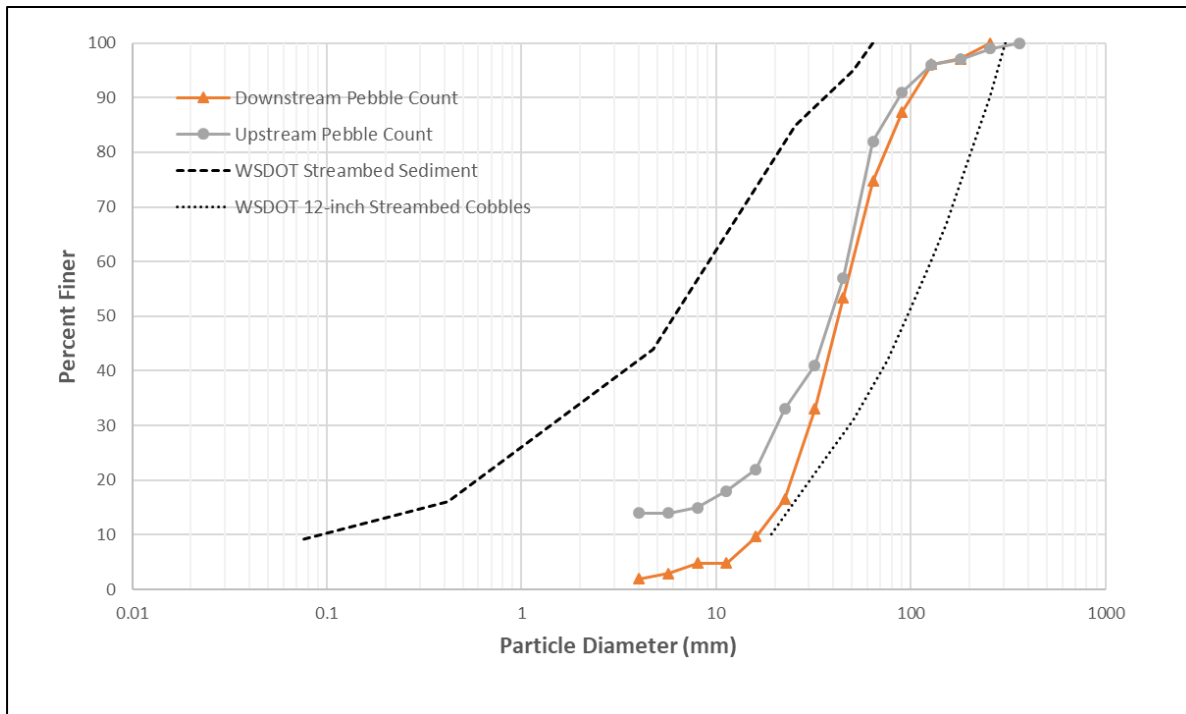


Figure 3 Grain size distributions from Middle Fork Newaukum River pebble counts

Table 1 Middle Fork Newaukum River Characteristic Grain Sizes at Middle Fork Road

Characteristic Particle Size (mm)	
D ₉₀	89 – 100
D ₅₀	38 – 40
D ₁₀	4 – 16



FIGURE 4
Bankfull Width Measurements of MF Newaukum River at Centralia Alpha Road

0 50 100 Feet

nhc
northwest hydraulic consultants



2.3 Risk Assessment

Based on existing basin and reach conditions, the geomorphic risks associated with installing a stream simulation culvert on the Middle Fork at Centralia Alpha Road are considered low. That said, the existing planform, namely, the abrupt 90 degree bend immediately downstream of the culvert and the downstream segment paralleling the road should be addressed with proper energy dissipation, grade control and possibly minor channel realignment. Given bank height (relative to flood depths), composition, and vegetative root strength, downstream avulsion is not considered a significant risk.

Upstream channel degradation is unlikely given controls imposed by LWD and root structures of mature cedar trees. Regardless, the lack of private or public infrastructure upstream near the channel indicate little risk were minor downcutting to occur if the LWD were disturbed. The forested conditions upstream of the crossing present the possibility for future loading of LWD; however, downstream transport of pieces large enough to pose risk to the crossing is limited given the small size and stream power of the river relative to the large mature trees.

3 HYDROLOGY

3.1 Basin Characteristics

NHC developed peak flows for the Middle Fork using the Washington Department of Ecology’s Western Washington Hydrology model (WWHM) (DOE, 2016). This model generates flows based on a continuous rainfall record and basin characteristics including area, land cover and soil types, and effective impervious area. Using available LiDAR sources (DNR, 2017), the Middle Fork watershed at the project site was delineated to be 1.6 square miles. The NRCS soil survey data (SSURGO) were intersected with Ecology’s land use layer to determine soil-land cover combinations. The SSURGO hydrologic soil group attribute corresponding to each soil type was reviewed to determine WWHM modeling classifications as outwash (A/B), till (C), or saturated. Aerial images were then reviewed to assign WWHM pervious land cover categories (forest, pasture or lawn) to each land use category and to determine effective impervious percentages. The basin is primarily forested with small areas of low density residential development; soils are predominately till-derived. The total effective basin imperviousness is three percent. Table 2 shows the basin properties used in the model.

Table 2 Middle Fork Newaukum River – Soil and Land Cover Summary

WWHM Soil Type	Forest	Pasture	Lawn	Total ¹
A/B	2%	-	-	2%
C	78%	10%	3%	91%
SAT	5%	<1%	2%	7%
Impervious	-	-	-	1%

Note 1: Total over 100% due to rounding

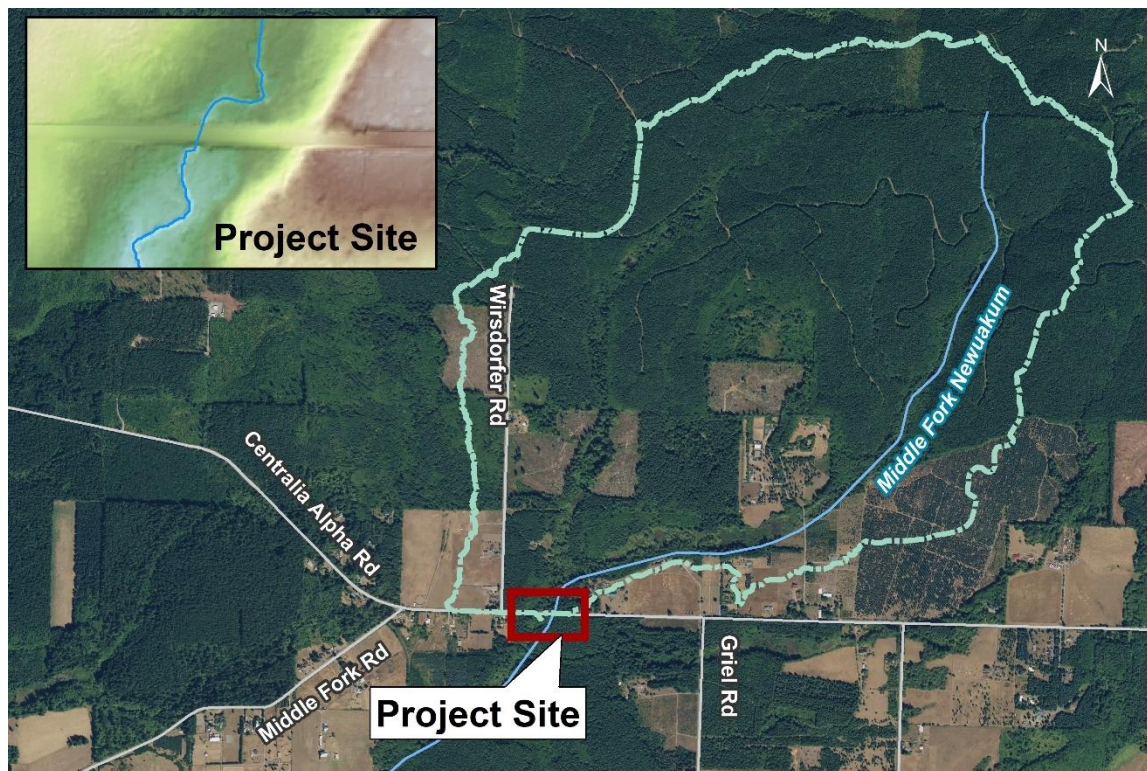


Figure 5 Middle Fork Newaukum River at Centralia Alpha Road basin map

3.2 Design Flows

The WWHM model was used to simulate existing conditions flows over the entire WWHM rainfall record. WWHM associated the Olympia rain gage to this project site. Frequency analysis was performed to estimate 2-, 5-, 10-, 25-, and 100-year flows with a Log Pearson III distribution using the Method of Moments. A summary of the calculated design flows is shown in Table 2. The complete WWHM input and output is presented in Appendix A.

Table 3 Middle Fork Newaukum Hydrologic Model Results

Event	2-year	5-year	10-year	25-year	100-year
Flow (cfs)	36	53	63	73	86

4 HYDRAULICS

4.1 Model Description

Hydraulic analysis of existing and proposed conditions was performed using the U.S. Army Corps of Engineers' one-dimensional HEC-RAS modeling software (v5.0.5, Corps 2018). The model reach extends approximately 500 feet upstream and downstream of the existing culvert structure. Existing condition geometry was constructed using survey data collected for the project by Foresight Survey in March 2019 integrated with 2017 Lewis County LiDAR data (DNR, 2017). The hydraulic model includes 35 cross-sections, roadway embankment, and culvert geometry. Without observed highwater marks to calibrate the model, Manning roughness values (n) were estimated based on field observations and engineering judgment. Roughness values of 0.05 and 0.075 were selected for the channel and overbanks, respectively. Downstream water surface boundary conditions were computed assuming normal depth with estimated slope of 0.006.

To simulate proposed conditions, channel grading and culvert structure data, provided by PBS, were used to revise the model geometry. Flood profiles were computed for the range of flows reported in Table 3.2.

4.2 Model Results

Hydraulic modeling demonstrates that the existing culvert is undersized. Figure 7 shows computed flood profiles for existing conditions at Centralia Alpha Road; at flows greater than a 2-year return interval, backwater conditions begin extending upstream of the culvert. Overtopping of Centralia Alpha Road is not anticipated up to and including the 100-year event. Figure 8 shows computed flood profiles for proposed conditions assuming placement of a 22-foot wide box culvert and channel regrading in the culvert vicinity. Under existing conditions, 100-year velocities are approximately 3 and 7 feet per second, upstream and downstream of the culvert, respectively. The proposed conditions model indicates 100-year velocities range from approximately 1 to 5 feet per second throughout the reach. Additionally, under proposed conditions, upstream inundation extents are expected to decrease to ranges predicted downstream, which generally remain within the channel up to the 100-year event.

The backwater conditions created by the existing undersized culvert at Centralia Alpha Road have important implications with regard to possible culvert replacement. Specifically, by removing the undersized culvert and replacing with an oversized stream simulation structure, upstream hydraulic gradients are expected to steepen and velocities increase. With this change comes the possibility of increased sediment transport and possible upstream channel degradation. An incipient motion analysis following Shield's methodology (USACE, 1994) suggests that under existing conditions, sediment transport upstream of Centralia Alpha is muted at any flows greater than a 2-year event as a result of backwater conditions created by the culvert. Under proposed conditions, this hydraulic control is removed and incipient motion analysis suggests that existing particles, less than 32 mm in diameter, could be mobilized at flows as low as a 2-year flood. Incipient motion analysis indicates particles in the

128-256 mm (5-10 inch) range are generally stable through the full range of flows. Augmentation of streambed material with cobble and small boulder-sized material would assist in ensuring streambed stability, as well as mimic overall channel composition in the reach. An additional consideration to inhibit channel degradation is incorporating buried woody debris into the channel bed.

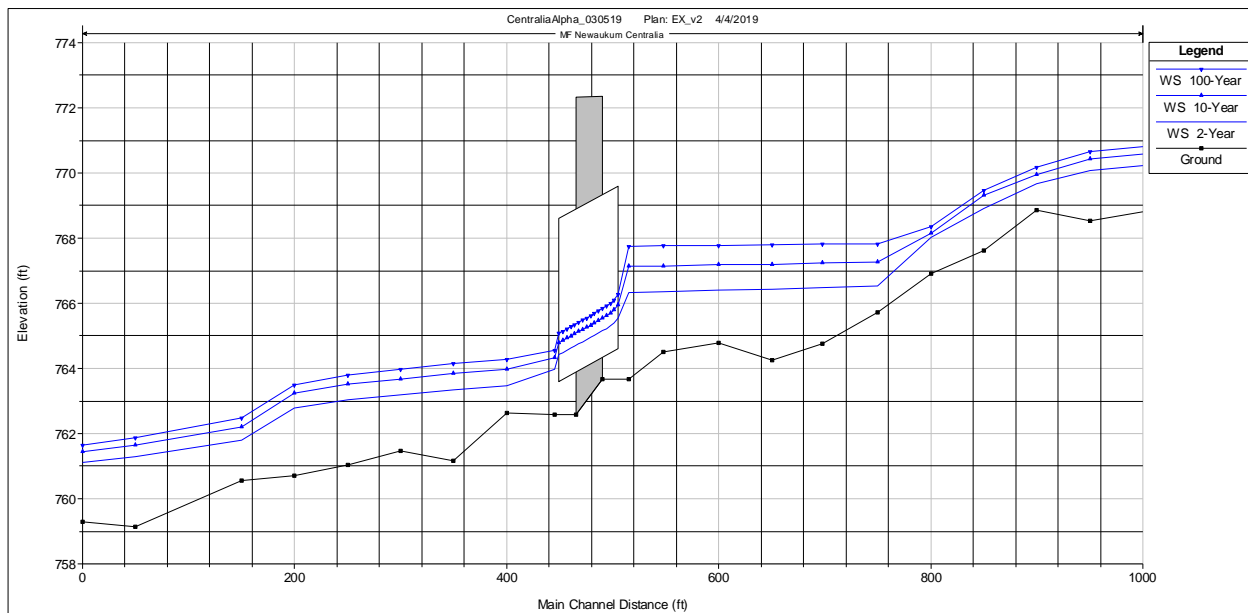


Figure 6 Computed event profiles for existing conditions

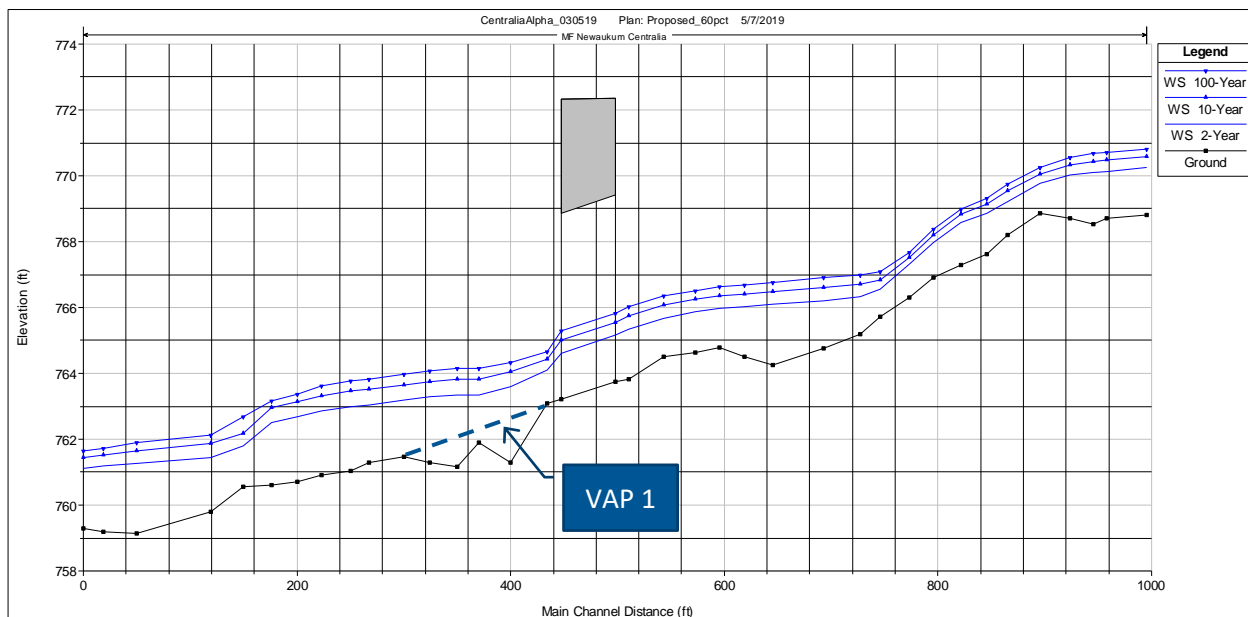


Figure 7 Computed event profiles for proposed conditions with vertical adjustment potential (VAP) line

5 STREAM SIMULATION CULVERT DESIGN

5.1 Alignment and Grading

The culvert replacement will alter the stream alignment. Bank and channel grading with a compound cross section will enhance hydraulic complexity by providing a more defined low flow channel and improving connectivity to the floodplain.

5.2 Bankfull Width

The recommended bankfull width for design is 15 feet based on field observations by NHC and WDFW. A corresponding 22 foot wide box culvert was selected for design, which accounts for climate variability.

5.3 Profile Adjustment

The Middle Fork will be regraded for approximately 20 feet upstream and 60 feet downstream of the existing culvert to provide connectivity to the existing stream profile (Figure 9). On average the longitudinal slope of the stream will be 1.09% to match the prevailing stream gradient in the project vicinity (0.9%).

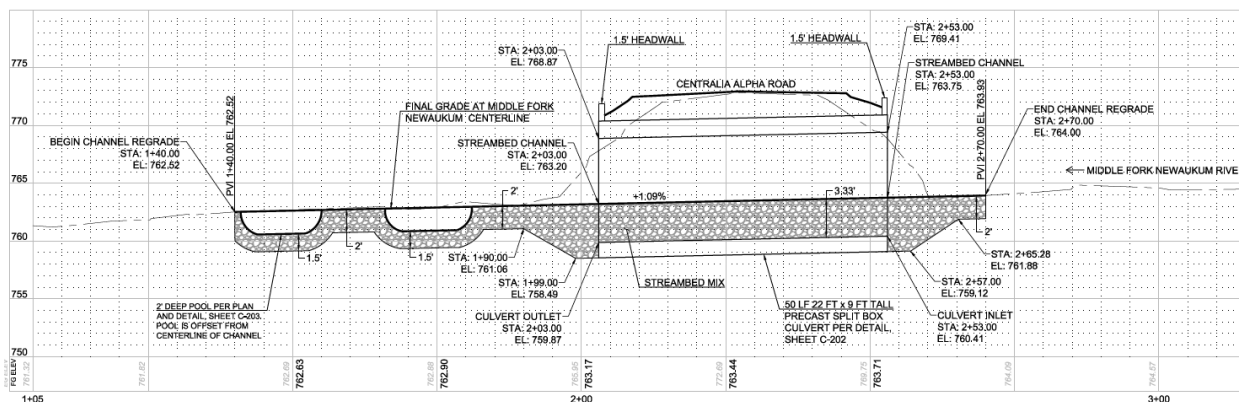


Figure 8 Proposed longitudinal profile

5.4 Bed Material Gradation

Pebble count characteristics documented downstream of the existing culvert were used as a basis for developing a streambed gradation. A mix of 50% streambed sediment and 50% 8-inch cobbles is recommended to provide a well graded mix in the regraded section of channel and in the proposed culvert. Figure 10 illustrates the proposed streambed gradation compared to those observed and measured by pebble counts. The proposed streambed mix has larger percentages of fines and coarser material but matches well with the central portion (e.g D30-D70) with the distribution measured in the field. Additional fine materials will help ensure proper sealing of the channel to prevent subsurface flow

after placement and the coarser material will provide a framework similar to that observed in riffles upstream and downstream of the crossing. As previously noted in Section 2.2.2, this segment of the Middle Fork appears to have a relatively limited upstream sediment supply and low active transport through the reach; thus, inclusion of the coarse framework material may assist in maintaining reach gradients already provided by existing bed material composition, wood, and vegetative controls.

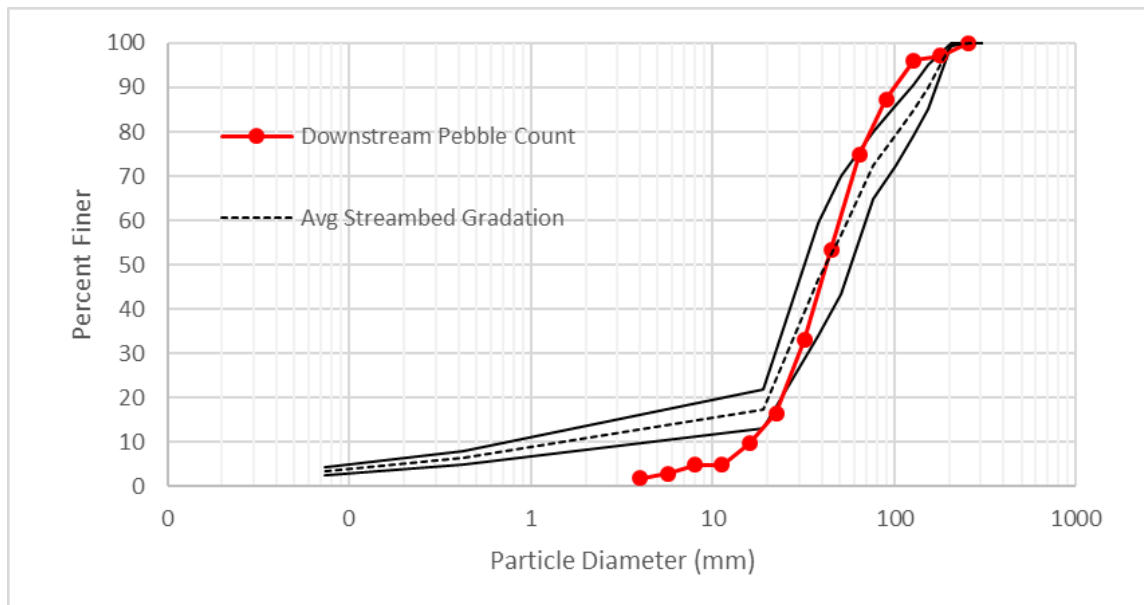


Figure 9 Proposed streambed gradation

5.5 Culvert Design

The box culvert design is based on the observed bankfull channel sections downstream of the existing culvert. The design proposes a 22-foot wide by 9-foot box culvert with a 16-foot wide compound channel preformed in the bed material. The culvert will be countersunk approximately 35%, placing the structure base 3.3 feet below the bed. The culvert provides 3.6 feet of headroom for the 100-year storm and 4 feet of headroom for the 2-year storm. The supply of mobile wood in the basin is relatively limited and not considered a great risk to the structure; the provided headroom reduces the risk of debris accumulation and flooding potential along Centralia Alpha Road.

Past Maintenance Records

Lewis County Maintenance was contacted by PBS to determine whether or not there were ongoing maintenance problems at the existing structure due to debris racking at the inlet or sedimentation. The maintenance representative indicated there was not a record of debris blockage and/or removal, or sediment removal at this crossing (Communication with Tim McCoy, Lewis County, 2019).

Wood and Sediment Supply

As described in Section 2.3, the risk of downstream transport of wood sizeable enough to require additional freeboard is considered low on the Middle Fork. Narrower channel conditions compared to tree size in the culvert vicinity would limit debris conveyance capacity. Furthermore, computed flow depths are relatively shallow (see Figure 4.2), thus even during high flow events the transport capacity of the stream to move large pieces is likely limited. Similarly, the sediment supply on the Middle Fork appears to be limited (Section 2.2.2). Combined with the improved hydraulic conditions created by the larger crossing, significant aggradation would not be expected, nor warrant additional freeboard.

5.6 Anticipated Geomorphic Response

Replacement of the existing arch CMP culvert with a 22-foot wide box culvert is not expected to have a significant morphologic impact to the channel itself. Minimal profile adjustment, if any, is anticipated as discussed in Section 2.3. Removal of the existing hydraulic constriction, may however, reduce frequency and extent of upstream floodplain inundation during high flow events.

6 REFERENCES

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APPENDIX A HYDROLOGY

WWHM2012
PROJECT REPORT

General Model Information

Project Name: Berwick Creek
Site Name: Lewis County
Site Address:
City: Chehalis
Report Date: 5/17/2019
Gage: Olympia
Data Start: 1955/10/01
Data End: 2008/09/30
Timestep: 15 Minute
Precip Scale: 0.80
Version Date: 2016/02/25
Version: 4.2.12

POC Thresholds

MF Newaukum - Centralia Alpha

Bypass: No

GroundWater: No

Pervious Land Use	acre
A B, Forest, Steep	16.8
C, Forest, Flat	155.6
C, Forest, Mod	342.5
C, Forest, Steep	299.7
C, Pasture, Flat	67.3
C, Pasture, Mod	20.2
C, Pasture, Steep	10
C, Lawn, Flat	21.9
C, Lawn, Mod	8.3
C, Lawn, Steep	3.2
SAT, Forest, Flat	45.1
SAT, Forest, Mod	1
SAT, Pasture, Flat	23
SAT, Lawn, Flat	0.5
Pervious Total	1015.1
Impervious Land Use	acre
ROADS FLAT	5.7
ROADS MOD	1.2
ROADS STEEP	0.1
Impervious Total	7
Basin Total	1022.1

Element Flows To:

Surface

Interflow

Groundwater

MF Newuakum_Centralia Alpha

MF Newuakum_Centralia Alpha

MF Newuakum_Centralia Alpha

Bottom Length: 13200.00 ft.
 Bottom Width: 8.00 ft.
 Manning's n: 0.035
 Channel bottom slope 1: 0.01 To 1
 Channel Left side slope 0: 3 To 1
 Channel right side slope 2: 3 To 1
 Discharge Structure
 Riser Height: 0 ft.
 Riser Diameter: 0 in.
 Element Flows To:
 Outlet 1 Outlet 2

Channel Hydraulic Table

Stage(feet)	Area(ac.)	Volume(ac-ft.)	Discharge(cfs)	Infilt(cfs)
0.0000	2.424	0.000	0.000	0.000
0.0444	2.505	0.109	0.190	0.000
0.0889	2.585	0.222	0.608	0.000
0.1333	2.666	0.339	1.202	0.000
0.1778	2.747	0.459	1.952	0.000
0.2222	2.828	0.583	2.848	0.000
0.2667	2.909	0.711	3.882	0.000
0.3111	2.989	0.842	5.049	0.000
0.3556	3.070	0.976	6.347	0.000
0.4000	3.151	1.115	7.772	0.000
0.4444	3.232	1.257	9.324	0.000
0.4889	3.313	1.402	11.00	0.000
0.5333	3.393	1.551	12.80	0.000
0.5778	3.474	1.704	14.72	0.000
0.6222	3.555	1.860	16.77	0.000
0.6667	3.636	2.020	18.95	0.000
0.7111	3.717	2.183	21.25	0.000
0.7556	3.798	2.350	23.67	0.000
0.8000	3.878	2.521	26.22	0.000
0.8444	3.959	2.695	28.90	0.000
0.8889	4.040	2.873	31.70	0.000
0.9333	4.121	3.054	34.63	0.000
0.9778	4.202	3.239	37.69	0.000
1.0222	4.282	3.428	40.88	0.000
1.0667	4.363	3.620	44.19	0.000
1.1111	4.444	3.815	47.64	0.000
1.1556	4.525	4.015	51.23	0.000
1.2000	4.606	4.218	54.94	0.000
1.2444	4.686	4.424	58.80	0.000
1.2889	4.767	4.634	62.78	0.000
1.3333	4.848	4.848	66.91	0.000
1.3778	4.929	5.065	71.17	0.000
1.4222	5.010	5.286	75.57	0.000
1.4667	5.090	5.511	80.12	0.000
1.5111	5.171	5.739	84.80	0.000
1.5556	5.252	5.970	89.63	0.000
1.6000	5.333	6.206	94.60	0.000
1.6444	5.414	6.444	99.72	0.000
1.6889	5.495	6.687	104.9	0.000
1.7333	5.575	6.933	110.3	0.000

1.7778	5.656	7.183	115.9	0.000
1.8222	5.737	7.436	121.6	0.000
1.8667	5.818	7.692	127.5	0.000
1.9111	5.899	7.953	133.5	0.000
1.9556	5.979	8.217	139.7	0.000
2.0000	6.060	8.484	146.0	0.000
2.0444	6.141	8.756	152.5	0.000
2.0889	6.222	9.030	159.1	0.000
2.1333	6.303	9.309	165.9	0.000
2.1778	6.383	9.591	172.9	0.000
2.2222	6.464	9.876	180.0	0.000
2.2667	6.545	10.16	187.3	0.000
2.3111	6.626	10.45	194.7	0.000
2.3556	6.707	10.75	202.3	0.000
2.4000	6.787	11.05	210.1	0.000
2.4444	6.868	11.35	218.0	0.000
2.4889	6.949	11.66	226.1	0.000
2.5333	7.030	11.97	234.4	0.000
2.5778	7.111	12.29	242.9	0.000
2.6222	7.191	12.60	251.5	0.000
2.6667	7.272	12.92	260.3	0.000
2.7111	7.353	13.25	269.3	0.000
2.7556	7.434	13.58	278.4	0.000
2.8000	7.515	13.91	287.7	0.000
2.8444	7.596	14.25	297.2	0.000
2.8889	7.676	14.59	306.9	0.000
2.9333	7.757	14.93	316.8	0.000
2.9778	7.838	15.28	326.8	0.000
3.0222	7.919	15.63	337.1	0.000
3.0667	8.000	15.98	347.5	0.000
3.1111	8.080	16.34	358.1	0.000
3.1556	8.161	16.70	368.9	0.000
3.2000	8.242	17.06	379.8	0.000
3.2444	8.323	17.43	391.0	0.000
3.2889	8.404	17.80	402.4	0.000
3.3333	8.484	18.18	413.9	0.000
3.3778	8.565	18.56	425.7	0.000
3.4222	8.646	18.94	437.6	0.000
3.4667	8.727	19.32	449.7	0.000
3.5111	8.808	19.71	462.0	0.000
3.5556	8.888	20.11	474.6	0.000
3.6000	8.969	20.50	487.3	0.000
3.6444	9.050	20.91	500.2	0.000
3.6889	9.131	21.31	513.3	0.000
3.7333	9.212	21.72	526.6	0.000
3.7778	9.293	22.13	540.2	0.000
3.8222	9.373	22.54	553.9	0.000
3.8667	9.454	22.96	567.8	0.000
3.9111	9.535	23.38	582.0	0.000
3.9556	9.616	23.81	596.3	0.000
4.0000	9.697	24.24	610.9	0.000
4.0444	9.777	24.67	625.6	0.000

Appendix

Predeveloped Schematic



Disclaimer

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APPENDIX B HYDRAULICS

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Centralia	1600	2-Year	36.00	768.81	770.23		770.25	0.002041	1.51	34.75	63.78	0.24
Centralia	1600	5-Year	53.00	768.81	770.47		770.50	0.001823	1.61	53.64	88.31	0.24
Centralia	1600	10-Year	63.00	768.81	770.59		770.62	0.001706	1.64	64.35	95.82	0.23
Centralia	1600	25-Year	73.00	768.81	770.70		770.72	0.001616	1.67	75.43	108.29	0.23
Centralia	1600	100-Year	86.00	768.81	770.81		770.84	0.001574	1.72	88.65	124.67	0.23
Centralia	1550	2-Year	36.00	768.53	770.08	769.48	770.13	0.002979	1.83	24.58	48.29	0.29
Centralia	1550	5-Year	53.00	768.53	770.31	769.65	770.37	0.003319	2.17	32.26	96.27	0.32
Centralia	1550	10-Year	63.00	768.53	770.42	769.75	770.49	0.003475	2.33	36.90	122.42	0.33
Centralia	1550	25-Year	73.00	768.53	770.52	769.83	770.60	0.003665	2.50	41.71	141.93	0.34
Centralia	1550	100-Year	86.00	768.53	770.65	769.92	770.73	0.003417	2.53	57.26	168.32	0.33
Centralia	1500	2-Year	36.00	768.87	769.68	769.53	769.82	0.018425	3.12	12.44	22.99	0.67
Centralia	1500	5-Year	53.00	768.87	769.86	769.69	770.05	0.017262	3.54	16.82	31.98	0.67
Centralia	1500	10-Year	63.00	768.87	769.96	769.77	770.16	0.016585	3.73	19.51	38.16	0.67
Centralia	1500	25-Year	73.00	768.87	770.05	769.86	770.27	0.015890	3.88	22.12	51.20	0.67
Centralia	1500	100-Year	86.00	768.87	770.17	769.97	770.40	0.014894	4.03	25.73	65.63	0.66
Centralia	1450	2-Year	36.00	767.61	768.92	768.60	769.05	0.013100	2.89	12.46	15.37	0.57
Centralia	1450	5-Year	53.00	767.61	769.21	768.82	769.36	0.010954	3.08	17.49	21.07	0.54
Centralia	1450	10-Year	63.00	767.61	769.31	768.92	769.48	0.011316	3.32	19.49	22.61	0.55
Centralia	1450	25-Year	73.00	767.61	769.38	769.01	769.58	0.012157	3.59	21.06	23.73	0.58
Centralia	1450	100-Year	86.00	767.61	769.48	769.12	769.71	0.012983	3.91	23.07	29.05	0.61
Centralia	1400	2-Year	36.00	766.92	768.03	767.92	768.20	0.023136	3.31	11.26	21.32	0.73
Centralia	1400	5-Year	53.00	766.92	768.08	768.08	768.39	0.039723	4.54	12.21	21.86	0.97
Centralia	1400	10-Year	63.00	766.92	768.16	768.16	768.51	0.038390	4.80	14.00	24.02	0.97
Centralia	1400	25-Year	73.00	766.92	768.25	768.25	768.61	0.033475	4.86	16.49	26.65	0.93
Centralia	1400	100-Year	86.00	766.92	768.35	768.35	768.73	0.030974	5.04	19.21	27.85	0.91
Centralia	1350	2-Year	36.00	765.71	766.52	766.48	766.74	0.037690	3.73	9.66	18.20	0.90
Centralia	1350	5-Year	53.00	765.71	767.01	767.01	767.13	0.009580	2.82	19.13	21.82	0.50
Centralia	1350	10-Year	63.00	765.71	767.27	767.27	767.37	0.006029	2.62	25.21	24.27	0.41
Centralia	1350	25-Year	73.00	765.71	767.51	767.51	767.61	0.004287	2.49	31.92	30.00	0.36
Centralia	1350	100-Year	86.00	765.71	767.83	767.83	767.91	0.002972	2.36	42.09	35.54	0.31
Centralia	1297.395	2-Year	36.00	764.76	766.48	766.48	766.50	0.001164	1.18	31.21	25.74	0.18
Centralia	1297.395	5-Year	53.00	764.76	766.97	766.97	766.99	0.000845	1.24	44.00	26.75	0.17
Centralia	1297.395	10-Year	63.00	764.76	767.24	767.24	767.26	0.000739	1.28	51.24	27.29	0.16
Centralia	1297.395	25-Year	73.00	764.76	767.49	767.49	767.52	0.000659	1.31	60.74	44.00	0.15
Centralia	1297.395	100-Year	86.00	764.76	767.81	767.81	767.84	0.000556	1.31	79.07	69.39	0.14
Centralia	1250	2-Year	36.00	764.26	766.44	766.44	766.46	0.000782	1.15	31.43	19.03	0.15
Centralia	1250	5-Year	53.00	764.26	766.93	766.93	766.96	0.000734	1.32	41.43	23.48	0.16
Centralia	1250	10-Year	63.00	764.26	767.20	767.20	767.23	0.000696	1.39	48.71	36.80	0.15
Centralia	1250	25-Year	73.00	764.26	767.46	767.46	767.49	0.000638	1.42	61.47	54.63	0.15
Centralia	1250	100-Year	86.00	764.26	767.79	767.79	767.81	0.000550	1.42	82.29	77.06	0.14
Centralia	1200	2-Year	36.00	764.78	766.40	766.40	766.42	0.000932	1.16	36.62	37.58	0.17
Centralia	1200	5-Year	53.00	764.78	766.90	766.90	766.92	0.000639	1.17	58.03	46.67	0.15
Centralia	1200	10-Year	63.00	764.78	767.18	767.18	767.20	0.000537	1.17	71.70	60.09	0.14
Centralia	1200	25-Year	73.00	764.78	767.44	767.44	767.46	0.000444	1.15	90.41	77.37	0.13
Centralia	1200	100-Year	86.00	764.78	767.78	767.78	767.79	0.000347	1.10	118.90	92.92	0.12
Centralia	1147.574	2-Year	36.00	764.50	766.35	766.35	766.37	0.000975	1.19	34.39	31.70	0.17
Centralia	1147.574	5-Year	53.00	764.50	766.86	766.86	766.89	0.000705	1.24	54.45	47.69	0.15
Centralia	1147.574	10-Year	63.00	764.50	767.15	767.15	767.17	0.000597	1.24	73.25	90.90	0.14
Centralia	1147.574	25-Year	73.00	764.50	767.42	767.42	767.44	0.000462	1.18	100.46	107.39	0.13
Centralia	1147.574	100-Year	86.00	764.50	767.76	767.76	767.77	0.000329	1.08	140.42	125.52	0.11
Centralia	1115.212	2-Year	36.00	763.68	766.33	764.56	766.34	0.000358	0.94	43.46	29.38	0.11
Centralia	1115.212	5-Year	53.00	763.68	766.85	764.75	766.86	0.000353	1.08	57.44	41.93	0.11
Centralia	1115.212	10-Year	63.00	763.68	767.13	764.86	767.15	0.000345	1.14	65.03	64.79	0.12
Centralia	1115.212	25-Year	73.00	763.68	767.40	764.95	767.42	0.000338	1.19	72.28	88.87	0.12
Centralia	1115.212	100-Year	86.00	763.68	767.73	765.05	767.76	0.000326	1.25	81.39	105.87	0.12
Centralia	1079.257		Culvert									
Centralia	1045.523	2-Year	36.00	762.59	763.97	763.47	764.10	0.007351	2.92	12.35	35.99	0.46
Centralia	1045.523	5-Year	53.00	762.59	764.20	763.69	764.40	0.008971	3.61	14.67	36.82	0.53
Centralia	1045.523	10-Year	63.00	762.59	764.32	763.80	764.57	0.009644	3.96	15.92	37.24	0.55
Centralia	1045.523	25-Year	73.00	762.59	764.44	763.91	764.72	0.010243	4.27	17.08	37.60	0.58
Centralia	1045.523	100-Year	86.00	762.59	764.56	764.05	764.91	0.011300	4.70	18.30	37.95	0.61
Centralia	1000	2-Year	36.00	762.63	763.47	763.47	763.61	0.016876	2.95	12.20	17.89	0.63
Centralia	1000	5-Year	53.00	762.63	763.81	763.81	763.94	0.009644	2.91	18.54	19.82	0.51
Centralia	1000	10-Year	63.00	762.63	763.97	763.97	764.10	0.008416	2.99	21.72	20.79	0.48
Centralia	1000	25-Year	73.00	762.63	764.11	764.11	764.25	0.007744	3.08	25.24	40.83	0.47
Centralia	1000	100-Year	86.00	762.63	764.27	764.27	764.41	0.006821	3.13	34.80	71.89	0.45

HEC-RAS Plan: ex2 River: MF Newaukum Reach: Centralia (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Centralia	950.0002	2-Year	36.00	761.16	763.35		763.39	0.001605	1.61	23.61	18.36	0.22
Centralia	950.0002	5-Year	53.00	761.16	763.68		763.74	0.001856	1.95	32.10	40.08	0.24
Centralia	950.0002	10-Year	63.00	761.16	763.85		763.91	0.001877	2.06	39.25	46.87	0.25
Centralia	950.0002	25-Year	73.00	761.16	764.00		764.06	0.001881	2.16	46.64	53.79	0.25
Centralia	950.0002	100-Year	86.00	761.16	764.16		764.23	0.001880	2.26	56.31	61.92	0.25
Centralia	900.0002	2-Year	36.00	761.46	763.19		763.26	0.004582	2.12	17.57	17.92	0.35
Centralia	900.0002	5-Year	53.00	761.46	763.52		763.61	0.004162	2.40	23.82	21.66	0.35
Centralia	900.0002	10-Year	63.00	761.46	763.68		763.77	0.004091	2.55	27.38	26.16	0.35
Centralia	900.0002	25-Year	73.00	761.46	763.82		763.92	0.004041	2.68	31.65	33.16	0.36
Centralia	900.0002	100-Year	86.00	761.46	763.98		764.10	0.003977	2.82	38.36	52.80	0.36
Centralia	849.9999	2-Year	36.00	761.05	763.03		763.08	0.002691	1.85	19.95	17.25	0.28
Centralia	849.9999	5-Year	53.00	761.05	763.35		763.43	0.002847	2.19	26.06	24.36	0.30
Centralia	849.9999	10-Year	63.00	761.05	763.51		763.60	0.002904	2.35	30.12	27.08	0.30
Centralia	849.9999	25-Year	73.00	761.05	763.65		763.74	0.002975	2.49	34.41	32.93	0.31
Centralia	849.9999	100-Year	86.00	761.05	763.81		763.91	0.003082	2.67	40.06	40.47	0.32
Centralia	800.0001	2-Year	36.00	760.70	762.79	762.11	762.88	0.006267	2.43	14.84	13.08	0.40
Centralia	800.0001	5-Year	53.00	760.70	763.09	762.40	763.22	0.006577	2.80	19.05	16.16	0.42
Centralia	800.0001	10-Year	63.00	760.70	763.24	762.52	763.38	0.006647	3.00	21.50	18.19	0.43
Centralia	800.0001	25-Year	73.00	760.70	763.37	762.62	763.52	0.006709	3.18	24.22	22.81	0.44
Centralia	800.0001	100-Year	86.00	760.70	763.51		763.68	0.006918	3.41	27.65	25.94	0.45
Centralia	749.9998	2-Year	36.00	760.55	761.81	761.81	762.19	0.043786	4.94	7.28	9.74	1.01
Centralia	749.9998	5-Year	53.00	760.55	762.06	762.06	762.51	0.041103	5.39	9.83	10.94	1.00
Centralia	749.9998	10-Year	63.00	760.55	762.19	762.19	762.67	0.040487	5.54	11.37	12.01	1.00
Centralia	749.9998	25-Year	73.00	760.55	762.31	762.31	762.81	0.039753	5.68	12.86	12.94	1.00
Centralia	749.9998	100-Year	86.00	760.55	762.48	762.48	762.98	0.035648	5.69	15.56	22.20	0.96
Centralia	650	2-Year	36.00	759.15	761.30		761.34	0.001794	1.58	22.72	14.56	0.22
Centralia	650	5-Year	53.00	759.15	761.54		761.60	0.002437	2.00	27.89	27.90	0.27
Centralia	650	10-Year	63.00	759.15	761.66		761.73	0.002734	2.20	31.79	38.43	0.28
Centralia	650	25-Year	73.00	759.15	761.76		761.84	0.002974	2.38	36.15	48.17	0.30
Centralia	650	100-Year	86.00	759.15	761.88		761.97	0.003199	2.57	42.32	54.65	0.31
Centralia	600.0001	2-Year	36.00	759.29	761.12	760.43	761.18	0.006010	1.99	18.17	24.10	0.38
Centralia	600.0001	5-Year	53.00	759.29	761.34	760.82	761.42	0.006010	2.29	24.72	36.00	0.40
Centralia	600.0001	10-Year	63.00	759.29	761.44	760.91	761.53	0.006006	2.44	28.56	38.57	0.40
Centralia	600.0001	25-Year	73.00	759.29	761.54	760.99	761.64	0.006010	2.57	32.53	45.42	0.41
Centralia	600.0001	100-Year	86.00	759.29	761.65	761.08	761.76	0.006008	2.72	37.97	51.16	0.41

HEC-RAS Plan: Proposed_60pct River: MF Newaukum Reach: Centralia

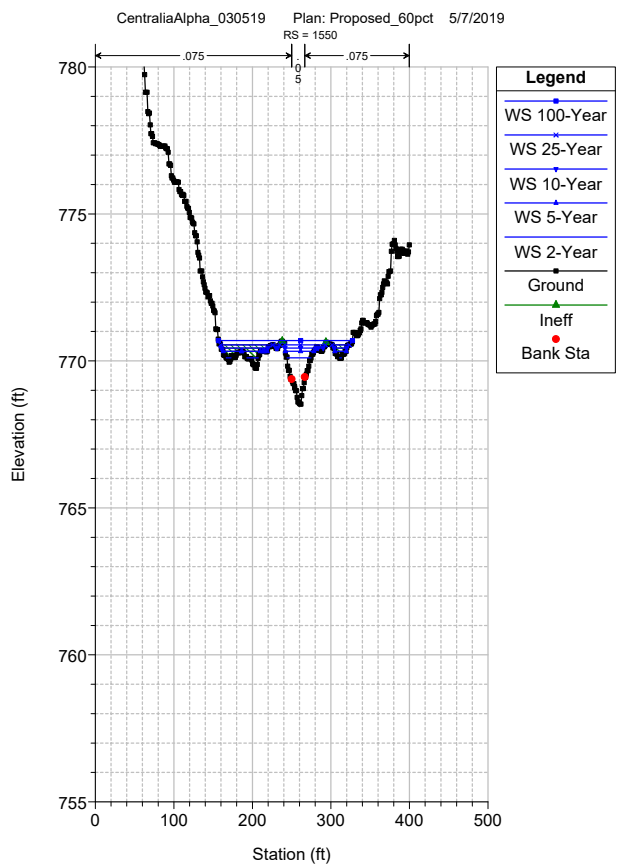
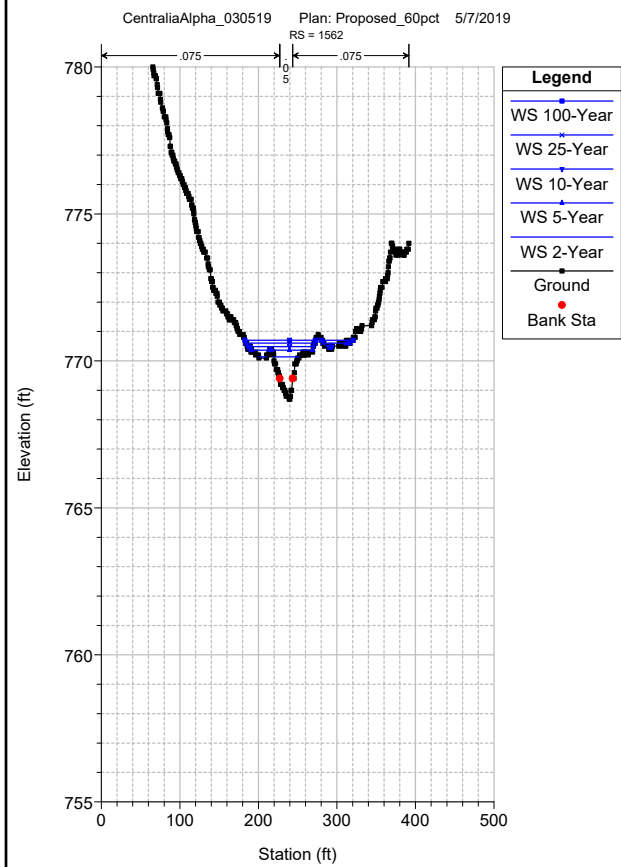
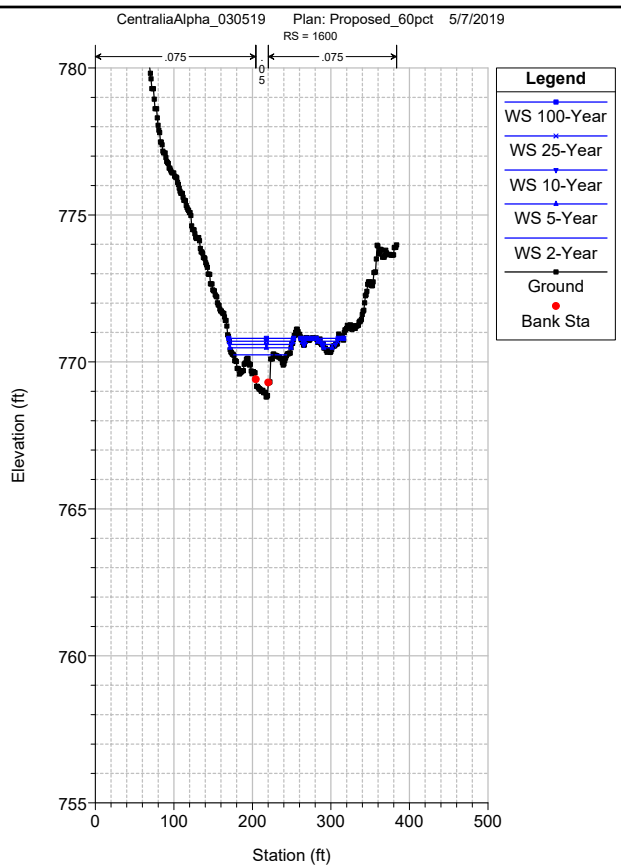
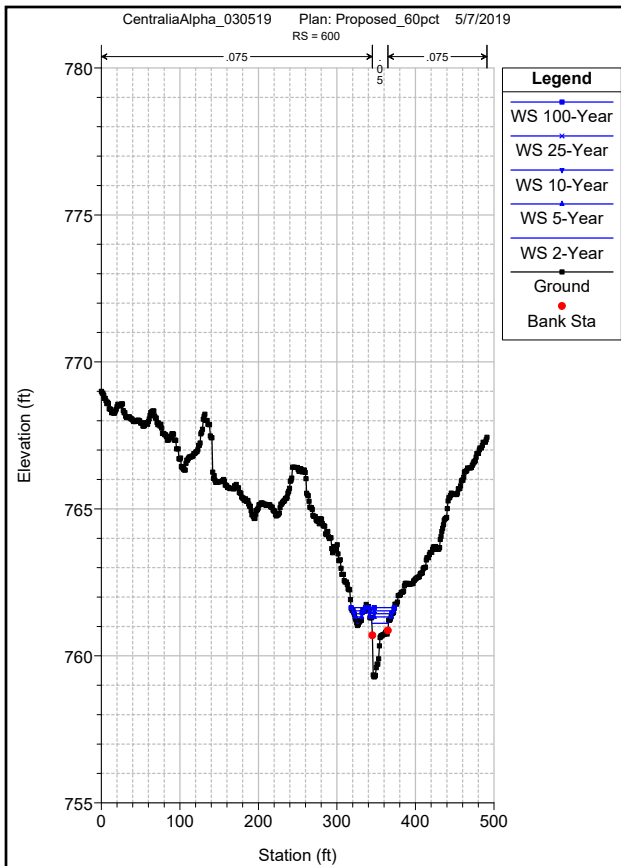
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Centralia	1600	2-Year	36.00	768.81	770.24		770.27	0.001933	1.48	35.68	65.19	0.24
Centralia	1600	5-Year	53.00	768.81	770.48		770.51	0.001773	1.59	54.31	88.51	0.23
Centralia	1600	10-Year	63.00	768.81	770.59		770.62	0.001683	1.63	64.74	97.16	0.23
Centralia	1600	25-Year	73.00	768.81	770.70		770.73	0.001587	1.66	76.04	108.70	0.23
Centralia	1600	100-Year	86.00	768.81	770.80		770.83	0.001618	1.74	87.51	122.89	0.23
Centralia	1562	2-Year	36.00	768.70	770.14		770.18	0.002871	1.74	24.93	42.15	0.29
Centralia	1562	5-Year	53.00	768.70	770.37		770.42	0.002952	1.99	38.73	76.26	0.30
Centralia	1562	10-Year	63.00	768.70	770.49		770.54	0.002785	2.05	48.42	86.04	0.29
Centralia	1562	25-Year	73.00	768.70	770.60		770.65	0.002521	2.05	60.89	119.86	0.28
Centralia	1562	100-Year	86.00	768.70	770.71		770.75	0.002441	2.10	73.42	130.15	0.28
Centralia	1550	2-Year	36.00	768.53	770.10	769.47	770.14	0.002633	1.67	25.25	53.44	0.27
Centralia	1550	5-Year	53.00	768.53	770.33	769.62	770.38	0.002976	2.00	32.77	101.88	0.30
Centralia	1550	10-Year	63.00	768.53	770.44	769.72	770.50	0.003128	2.16	37.46	124.32	0.31
Centralia	1550	25-Year	73.00	768.53	770.54	769.80	770.62	0.003217	2.29	42.79	149.07	0.32
Centralia	1550	100-Year	86.00	768.53	770.69	769.89	770.72	0.001825	1.83	95.73	170.64	0.24
Centralia	1528	2-Year	36.00	768.70	770.01	769.52	770.07	0.004208	1.95	21.32	37.40	0.34
Centralia	1528	5-Year	53.00	768.70	770.23	769.68	770.30	0.004533	2.29	27.90	74.69	0.36
Centralia	1528	10-Year	63.00	768.70	770.33	769.76	770.41	0.004702	2.46	31.49	87.22	0.38
Centralia	1528	25-Year	73.00	768.70	770.43	769.84	770.53	0.004941	2.65	35.82	116.07	0.39
Centralia	1528	100-Year	86.00	768.70	770.55	769.94	770.65	0.004963	2.80	43.40	145.67	0.40
Centralia	1500	2-Year	36.00	768.87	769.78	769.53	769.89	0.010931	2.62	14.85	28.14	0.52
Centralia	1500	5-Year	53.00	768.87	769.97	769.69	770.11	0.011160	3.06	19.73	38.75	0.55
Centralia	1500	10-Year	63.00	768.87	770.06	769.77	770.22	0.011142	3.25	22.45	52.73	0.56
Centralia	1500	25-Year	73.00	768.87	770.15	769.85	770.32	0.011062	3.42	25.21	64.15	0.56
Centralia	1500	100-Year	86.00	768.87	770.26	769.90	770.45	0.010937	3.62	29.00	79.36	0.57
Centralia	1470	2-Year	36.00	768.20	769.23	769.12	769.41	0.024792	3.39	10.66	18.05	0.76
Centralia	1470	5-Year	53.00	768.20	769.42	769.29	769.64	0.021570	3.79	14.41	20.75	0.74
Centralia	1470	10-Year	63.00	768.20	769.53	769.36	769.77	0.019635	3.94	16.79	21.89	0.72
Centralia	1470	25-Year	73.00	768.20	769.63	769.45	769.89	0.018643	4.10	19.00	23.98	0.71
Centralia	1470	100-Year	86.00	768.20	769.75	769.55	770.03	0.017631	4.29	22.02	33.23	0.71
Centralia	1450	2-Year	36.00	767.61	768.87	768.60	769.02	0.015219	3.15	11.61	15.13	0.62
Centralia	1450	5-Year	53.00	767.61	769.05	768.82	769.27	0.016726	3.78	14.46	16.37	0.67
Centralia	1450	10-Year	63.00	767.61	769.14	768.92	769.40	0.017688	4.12	16.03	19.51	0.70
Centralia	1450	25-Year	73.00	767.61	769.22	769.00	769.52	0.018340	4.40	17.68	21.22	0.72
Centralia	1450	100-Year	86.00	767.61	769.32	769.11	769.66	0.019103	4.74	19.69	22.76	0.74
Centralia	1426	2-Year	36.00	767.30	768.58		768.68	0.011564	2.58	13.95	19.35	0.53
Centralia	1426	5-Year	53.00	767.30	768.75		768.89	0.012586	3.09	17.56	23.33	0.57
Centralia	1426	10-Year	63.00	767.30	768.83		769.00	0.012944	3.33	19.63	23.95	0.59
Centralia	1426	25-Year	73.00	767.30	768.91		769.11	0.013383	3.56	21.51	24.66	0.61
Centralia	1426	100-Year	86.00	767.30	768.99		769.22	0.014414	3.88	23.54	25.60	0.64
Centralia	1400	2-Year	36.00	766.92	767.97	767.93	768.18	0.038055	3.62	9.95	20.46	0.90
Centralia	1400	5-Year	53.00	766.92	768.11	768.07	768.38	0.035380	4.13	13.01	22.27	0.91
Centralia	1400	10-Year	63.00	766.92	768.19	768.15	768.49	0.033923	4.37	14.85	24.74	0.91
Centralia	1400	25-Year	73.00	766.92	768.27	768.24	768.58	0.032473	4.56	16.78	26.79	0.90
Centralia	1400	100-Year	86.00	766.92	768.37	768.33	768.70	0.029187	4.69	19.63	28.01	0.87
Centralia	1377	2-Year	36.00	766.30	767.31	767.20	767.48	0.024153	3.40	11.11	19.83	0.75
Centralia	1377	5-Year	53.00	766.30	767.45	767.36	767.69	0.025942	4.03	14.02	20.71	0.80
Centralia	1377	10-Year	63.00	766.30	767.53	767.43	767.81	0.026552	4.34	15.65	22.48	0.83
Centralia	1377	25-Year	73.00	766.30	767.59	767.53	767.91	0.027552	4.64	17.14	23.19	0.85
Centralia	1377	100-Year	86.00	766.30	767.67	767.62	768.04	0.029222	5.04	19.00	25.03	0.89
Centralia	1350	2-Year	36.00	765.71	766.57		766.75	0.028478	3.46	10.48	18.33	0.80
Centralia	1350	5-Year	53.00	765.71	766.74		766.98	0.026614	3.93	13.65	18.82	0.80
Centralia	1350	10-Year	63.00	765.71	766.84		767.10	0.024679	4.12	15.62	20.48	0.79
Centralia	1350	25-Year	73.00	765.71	766.94		767.22	0.023359	4.23	17.80	21.53	0.77
Centralia	1350	100-Year	86.00	765.71	767.08		767.37	0.019693	4.34	20.73	23.18	0.73
Centralia	1331	2-Year	36.00	765.20	766.32		766.41	0.011083	2.42	14.90	21.79	0.51
Centralia	1331	5-Year	53.00	765.20	766.57		766.68	0.008500	2.61	20.47	22.44	0.47
Centralia	1331	10-Year	63.00	765.20	766.71		766.82	0.007667	2.71	23.52	22.79	0.46
Centralia	1331	25-Year	73.00	765.20	766.84		766.96	0.007081	2.80	26.45	23.30	0.45
Centralia	1331	100-Year	86.00	765.20	766.99		767.12	0.006536	2.92	30.12	23.97	0.44
Centralia	1297	2-Year	36.00	764.76	766.19		766.23	0.002769	1.53	23.86	25.11	0.27
Centralia	1297	5-Year	53.00	764.76	766.47		766.51	0.002627	1.75	30.82	25.71	0.28
Centralia	1297	10-Year	63.00	764.76	766.61		766.66	0.002580	1.87	34.53	26.01	0.28
Centralia	1297	25-Year	73.00	764.76	766.74		766.80	0.002549	1.97	38.02	26.29	0.28
Centralia	1297	100-Year	86.00	764.76	766.91		766.97	0.002523	2.10	42.29	26.62	0.28
Centralia	1250	2-Year	36.00	764.26	766.10		766.13	0.001616	1.44	25.08	18.19	0.21

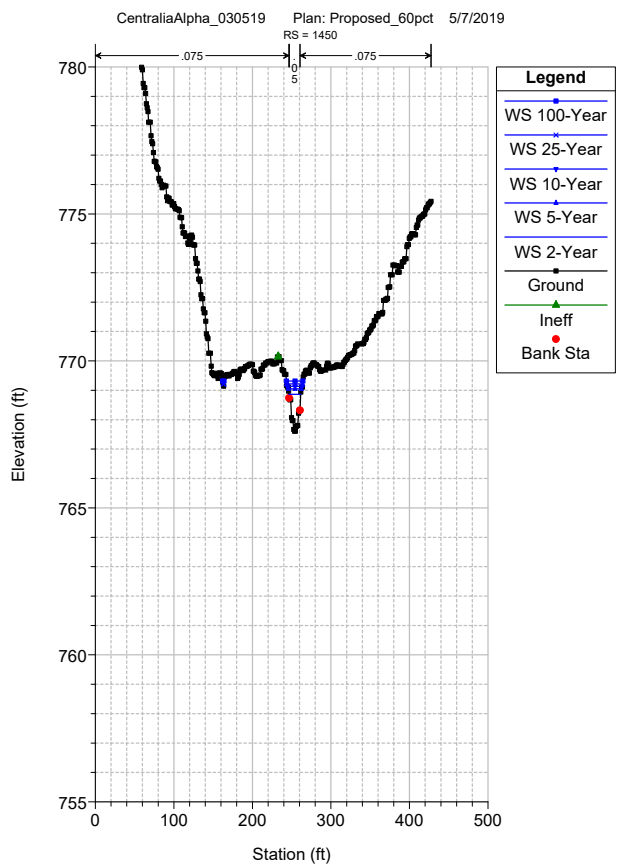
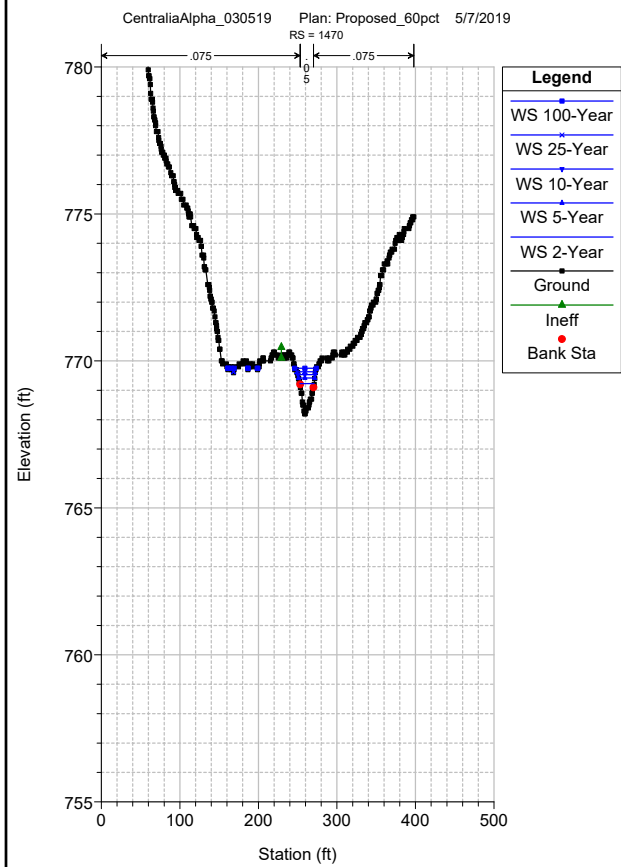
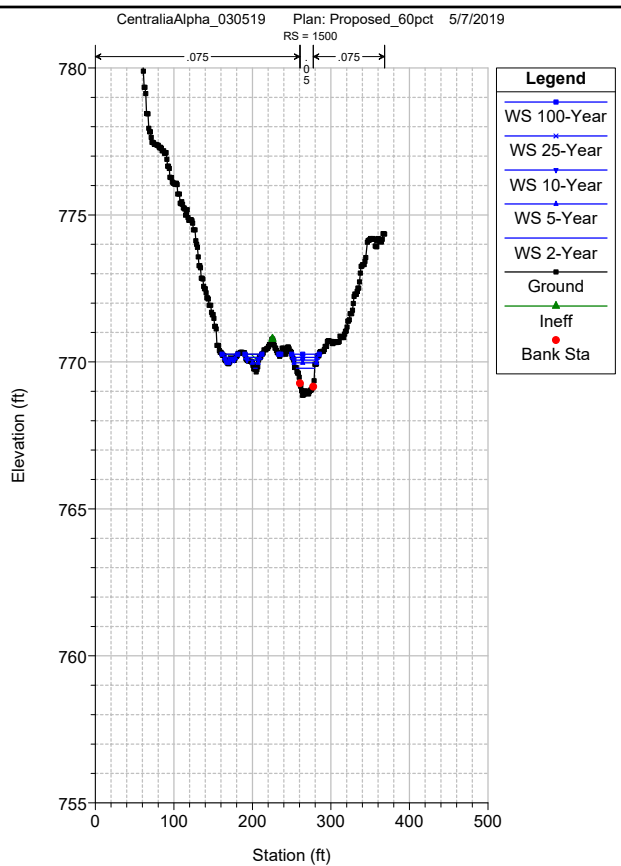
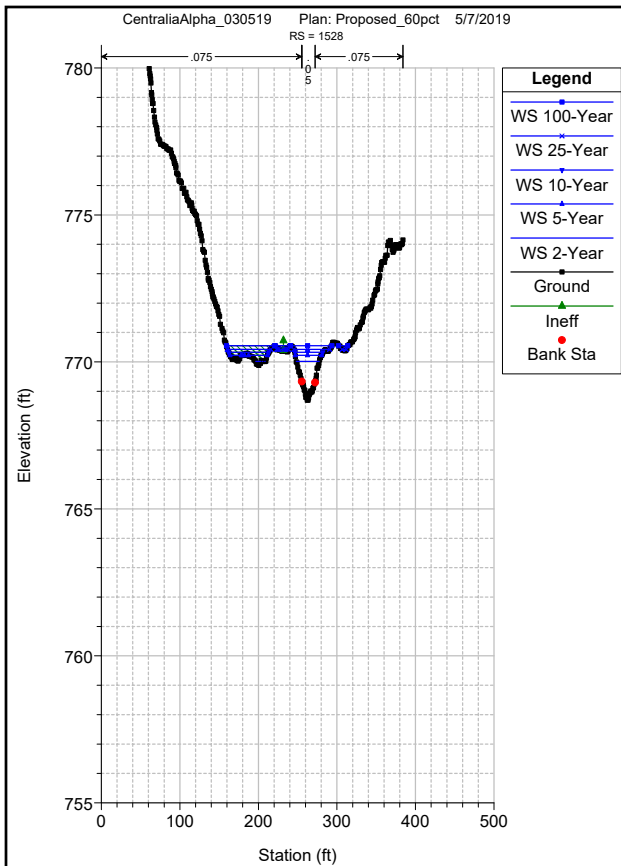
HEC-RAS Plan: Proposed_60pct River: MF Newaukum Reach: Centralia (Continued)

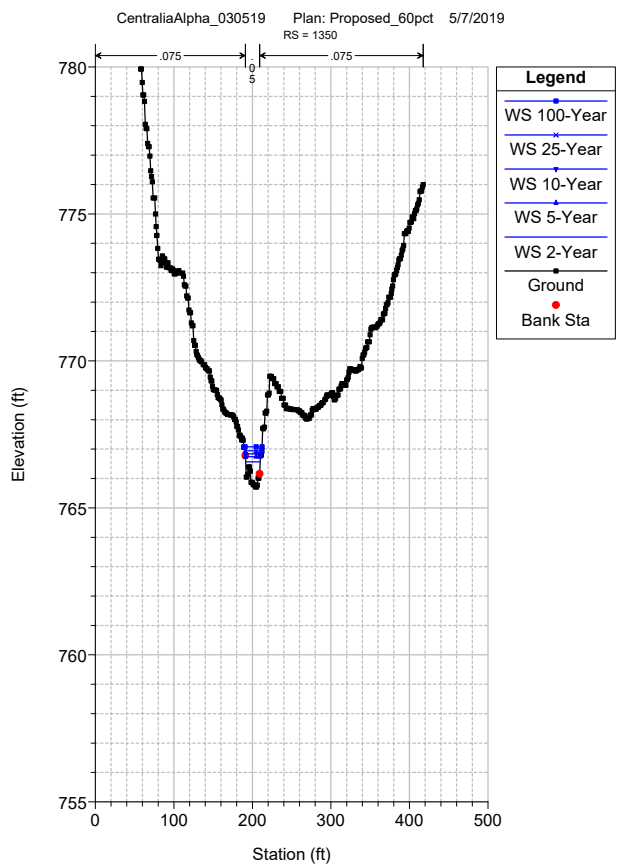
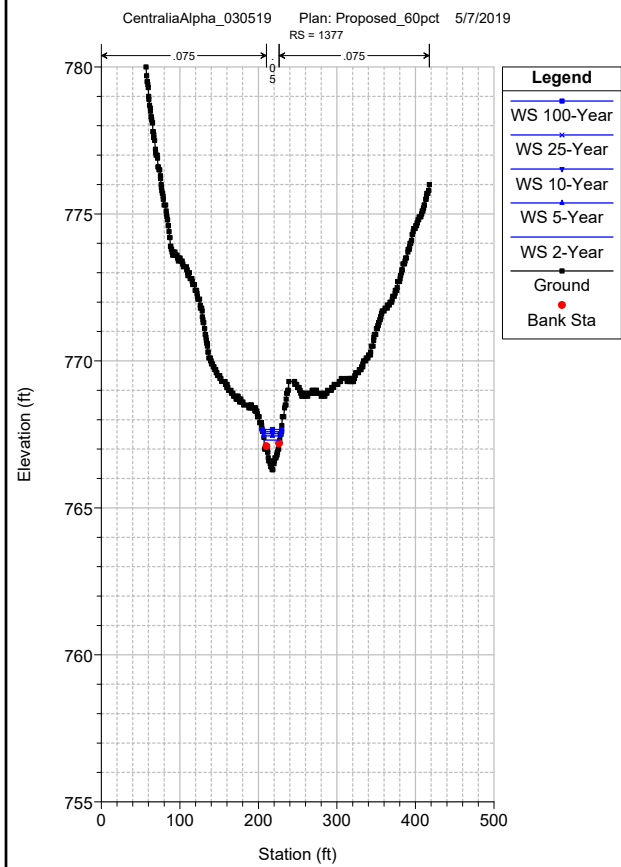
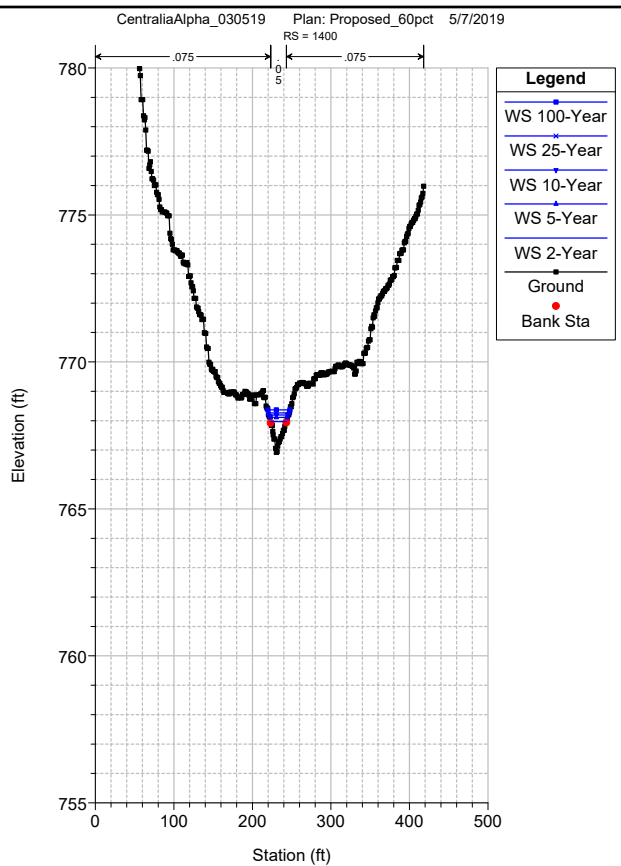
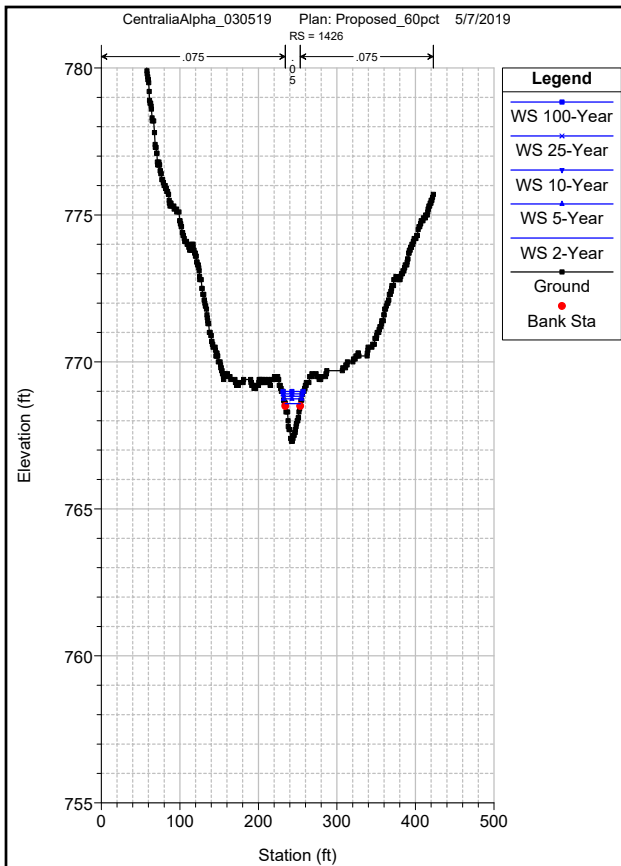
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Centralia	1250	5-Year	53.00	764.26	766.36		766.41	0.001986	1.78	29.90	18.83	0.24
Centralia	1250	10-Year	63.00	764.26	766.49		766.55	0.002160	1.96	32.46	19.16	0.26
Centralia	1250	25-Year	73.00	764.26	766.62		766.69	0.002310	2.12	34.90	19.47	0.27
Centralia	1250	100-Year	86.00	764.26	766.77		766.85	0.002486	2.31	37.94	20.91	0.28
Centralia	1223	2-Year	36.00	764.50	766.04		766.08	0.002410	1.60	22.59	19.98	0.26
Centralia	1223	5-Year	53.00	764.50	766.29		766.34	0.002759	1.95	27.80	22.30	0.29
Centralia	1223	10-Year	63.00	764.50	766.42		766.48	0.002895	2.11	30.88	24.00	0.30
Centralia	1223	25-Year	73.00	764.50	766.54		766.62	0.002992	2.26	33.88	24.85	0.31
Centralia	1223	100-Year	86.00	764.50	766.69		766.78	0.003087	2.43	37.67	25.83	0.32
Centralia	1200	2-Year	36.00	764.78	765.96		766.01	0.003440	1.75	22.04	29.14	0.31
Centralia	1200	5-Year	53.00	764.78	766.21		766.27	0.003352	2.00	30.00	34.14	0.31
Centralia	1200	10-Year	63.00	764.78	766.35		766.41	0.003266	2.11	34.72	36.64	0.31
Centralia	1200	25-Year	73.00	764.78	766.47		766.54	0.003169	2.20	39.50	39.04	0.31
Centralia	1200	100-Year	86.00	764.78	766.63		766.70	0.003046	2.30	45.76	42.03	0.31
Centralia	1177	2-Year	36.00	764.64	765.87		765.92	0.004139	1.87	19.83	23.18	0.33
Centralia	1177	5-Year	53.00	764.64	766.11		766.19	0.004140	2.18	25.83	25.57	0.35
Centralia	1177	10-Year	63.00	764.64	766.24		766.33	0.004101	2.32	29.26	26.86	0.35
Centralia	1177	25-Year	73.00	764.64	766.37		766.46	0.004050	2.44	32.69	28.42	0.35
Centralia	1177	100-Year	86.00	764.64	766.52		766.62	0.004020	2.59	37.16	32.13	0.36
Centralia	1148	2-Year	36.00	764.50	765.67		765.75	0.008159	2.31	16.07	22.77	0.45
Centralia	1148	5-Year	53.00	764.50	765.93		766.03	0.006698	2.52	22.51	26.07	0.43
Centralia	1148	10-Year	63.00	764.50	766.07		766.18	0.006149	2.62	26.29	27.87	0.42
Centralia	1148	25-Year	73.00	764.50	766.21		766.32	0.005703	2.70	30.13	29.72	0.41
Centralia	1148	100-Year	86.00	764.50	766.37		766.48	0.005292	2.80	35.04	32.05	0.40
Centralia	1115	2-Year	36.00	763.81	765.35	764.87	765.46	0.009023	2.72	13.25	13.79	0.48
Centralia	1115	5-Year	53.00	763.81	765.61	765.11	765.76	0.008884	3.16	17.07	15.56	0.50
Centralia	1115	10-Year	63.00	763.81	765.74	765.23	765.92	0.008911	3.38	19.19	16.79	0.51
Centralia	1115	25-Year	73.00	763.81	765.86	765.33	766.06	0.008920	3.58	21.42	20.19	0.52
Centralia	1115	100-Year	86.00	763.81	766.02	765.45	766.24	0.008639	3.77	25.01	23.92	0.52
Centralia	1079.257		Bridge									
Centralia	1046	2-Year	36.00	763.09	764.10	764.10	764.45	0.041188	4.74	7.63	11.34	0.99
Centralia	1046	5-Year	53.00	763.09	764.32	764.32	764.76	0.036436	5.32	10.20	12.53	0.98
Centralia	1046	10-Year	63.00	763.09	764.44	764.44	764.92	0.034326	5.59	11.69	13.08	0.97
Centralia	1046	25-Year	73.00	763.09	764.54	764.54	765.06	0.033416	5.87	13.05	13.56	0.97
Centralia	1046	100-Year	86.00	763.09	764.67	764.67	765.24	0.031669	6.15	14.89	14.19	0.96
Centralia	1000	2-Year	36.00	761.29	763.59		763.68	0.006189	2.38	15.14	13.75	0.40
Centralia	1000	5-Year	53.00	761.29	763.90		764.02	0.005963	2.74	19.53	14.81	0.40
Centralia	1000	10-Year	63.00	761.29	764.06		764.19	0.005915	2.93	21.90	15.33	0.41
Centralia	1000	25-Year	73.00	761.29	764.19		764.34	0.005918	3.09	26.38	17.61	0.42
Centralia	1000	100-Year	86.00	761.29	764.33		764.49	0.005829	3.24	34.39	19.40	0.42
Centralia	970	2-Year	36.00	761.90	763.35		763.47	0.008079	2.71	13.34	13.01	0.46
Centralia	970	5-Year	53.00	761.90	763.67		763.82	0.007267	3.05	17.79	14.93	0.46
Centralia	970	10-Year	63.00	761.90	763.83		763.99	0.007075	3.23	20.75	29.99	0.46
Centralia	970	25-Year	73.00	761.90	763.99		764.15	0.006583	3.32	26.76	46.78	0.45
Centralia	970	100-Year	86.00	761.90	764.15		764.31	0.005923	3.35	35.93	60.33	0.43
Centralia	950	2-Year	36.00	761.16	763.34		763.38	0.001606	1.65	23.41	18.26	0.22
Centralia	950	5-Year	53.00	761.16	763.66		763.72	0.001943	2.03	31.28	39.07	0.25
Centralia	950	10-Year	63.00	761.16	763.83		763.90	0.001959	2.15	38.49	46.29	0.25
Centralia	950	25-Year	73.00	761.16	763.99		764.06	0.001939	2.23	46.17	53.33	0.25
Centralia	950	100-Year	86.00	761.16	764.15		764.22	0.001963	2.35	55.47	61.23	0.26
Centralia	924	2-Year	36.00	761.30	763.28		763.33	0.002426	1.82	20.87	18.11	0.27
Centralia	924	5-Year	53.00	761.30	763.60		763.67	0.002627	2.16	27.10	21.37	0.29
Centralia	924	10-Year	63.00	761.30	763.76		763.84	0.002725	2.33	32.13	34.66	0.30
Centralia	924	25-Year	73.00	761.30	763.91		763.99	0.002730	2.45	38.07	46.27	0.30
Centralia	924	100-Year	86.00	761.30	764.07		764.16	0.002685	2.55	45.79	49.00	0.30
Centralia	900	2-Year	36.00	761.46	763.18		763.25	0.004807	2.15	17.29	17.86	0.36
Centralia	900	5-Year	53.00	761.46	763.49		763.58	0.004445	2.45	23.25	21.36	0.36
Centralia	900	10-Year	63.00	761.46	763.66		763.75	0.004257	2.57	28.86	22.78	0.36
Centralia	900	25-Year	73.00	761.46	763.80		763.91	0.004200	2.71	31.08	32.58	0.36
Centralia	900	100-Year	86.00	761.46	763.96		764.08	0.004109	2.85	37.42	48.06	0.36
Centralia	867	2-Year	36.00	761.30	763.03		763.10	0.004396	2.13	17.11	16.34	0.35
Centralia	867	5-Year	53.00	761.30	763.35		763.44	0.004143	2.44	22.96	20.86	0.35
Centralia	867	10-Year	63.00	761.30	763.52		763.62	0.004027	2.58	26.67	24.26	0.35
Centralia	867	25-Year	73.00	761.30	763.67		763.78	0.003914	2.69	30.45	25.70	0.35
Centralia	867	100-Year	86.00	761.30	763.82		763.94	0.004044	2.89	35.03	34.90	0.36

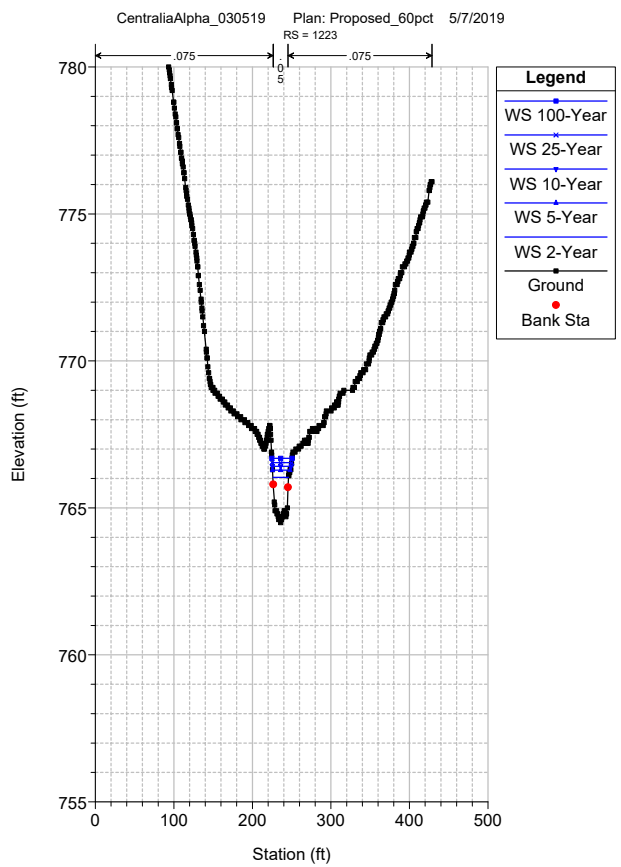
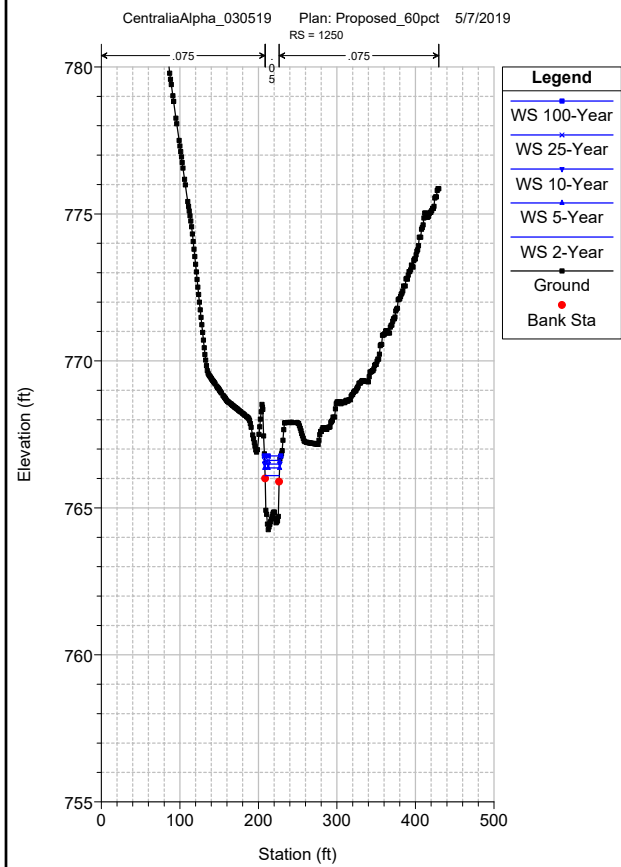
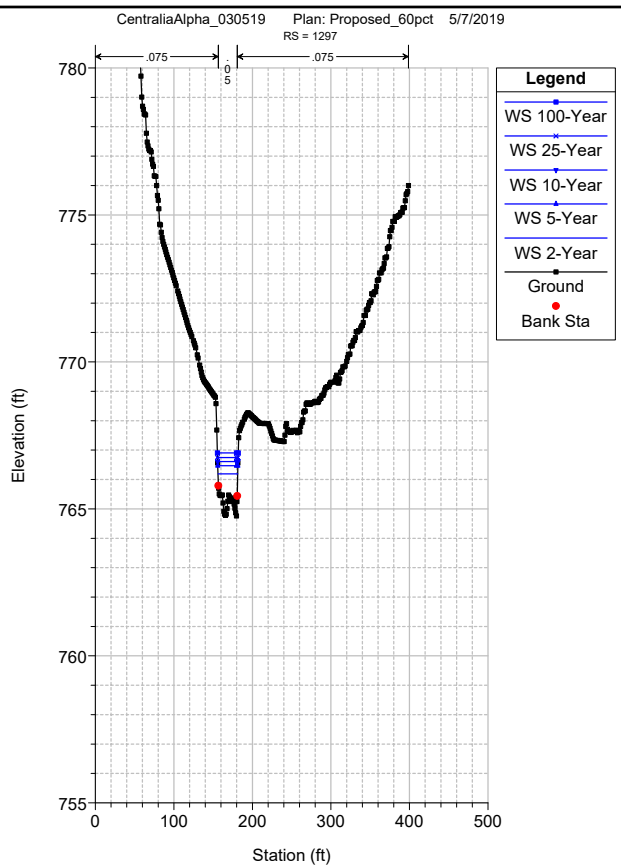
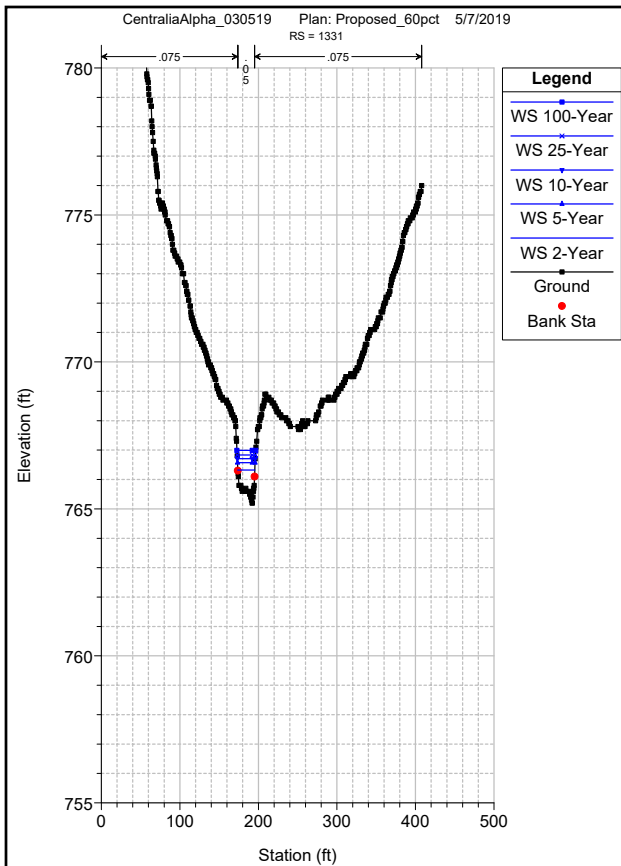
HEC-RAS Plan: Proposed_60pct River: MF Newaukum Reach: Centralia (Continued)

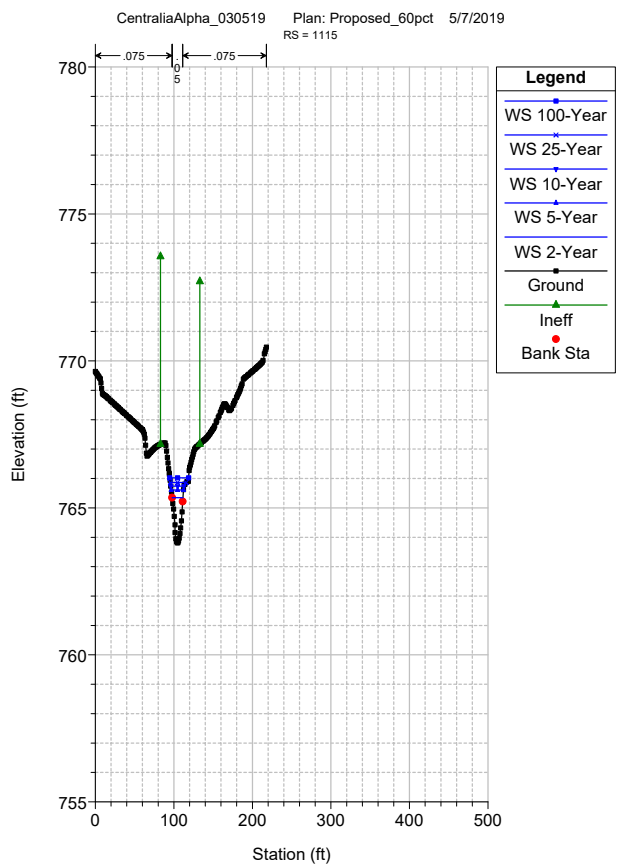
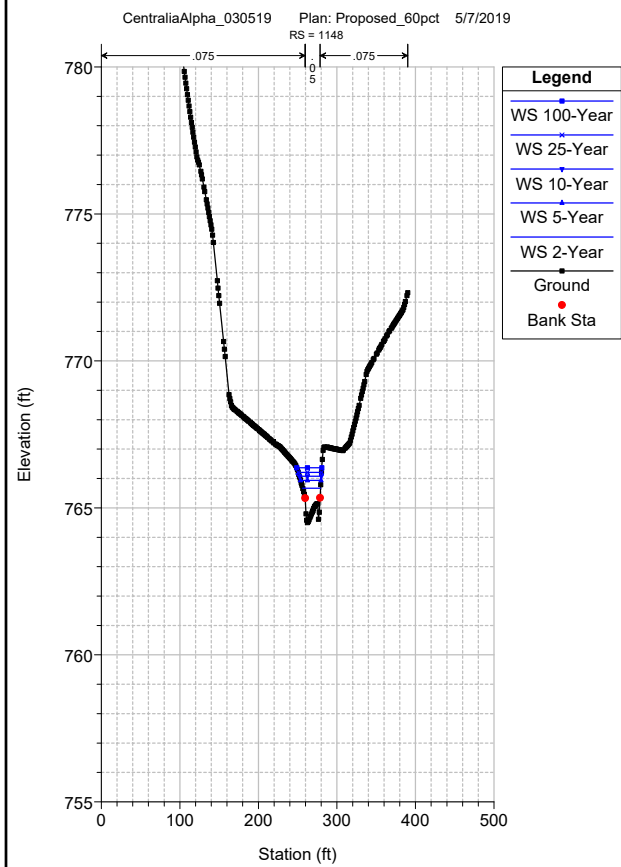
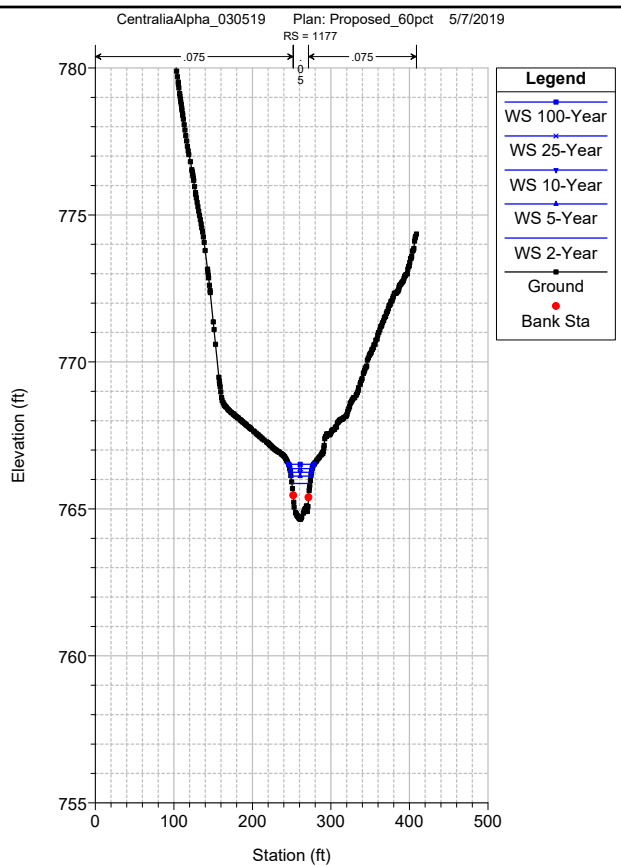
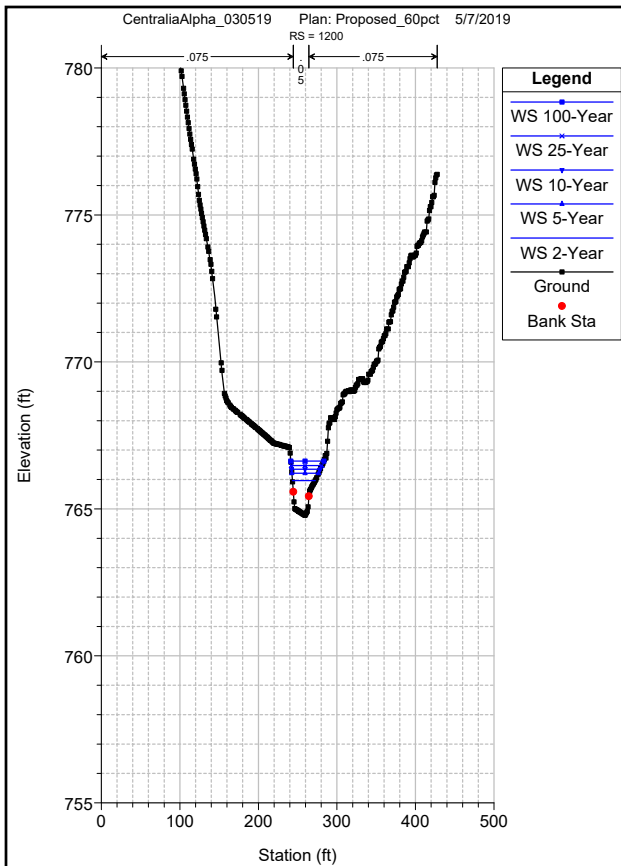
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Centralia	850	2-Year	36.00	761.05	762.97		763.03	0.003104	1.94	18.98	16.82	0.30
Centralia	850	5-Year	53.00	761.05	763.30		763.38	0.003190	2.27	24.78	20.10	0.31
Centralia	850	10-Year	63.00	761.05	763.46		763.55	0.003197	2.42	28.85	26.26	0.32
Centralia	850	25-Year	73.00	761.05	763.62		763.71	0.003195	2.55	33.24	32.46	0.32
Centralia	850	100-Year	86.00	761.05	763.77		763.88	0.003342	2.74	38.43	40.02	0.33
Centralia	823	2-Year	36.00	760.90	762.86		762.94	0.004171	2.23	16.49	14.14	0.34
Centralia	823	5-Year	53.00	760.90	763.17		763.27	0.004377	2.63	21.41	18.11	0.36
Centralia	823	10-Year	63.00	760.90	763.33		763.45	0.004440	2.82	24.50	21.62	0.37
Centralia	823	25-Year	73.00	760.90	763.48		763.61	0.004450	2.98	27.92	24.85	0.38
Centralia	823	100-Year	86.00	760.90	763.61		763.77	0.004782	3.23	31.72	30.30	0.40
Centralia	800	2-Year	36.00	760.70	762.69		762.81	0.007215	2.72	13.56	12.81	0.44
Centralia	800	5-Year	53.00	760.70	762.98		763.14	0.007440	3.19	17.39	13.62	0.46
Centralia	800	10-Year	63.00	760.70	763.13		763.31	0.007535	3.42	19.70	16.41	0.47
Centralia	800	25-Year	73.00	760.70	763.26		763.47	0.007804	3.67	21.97	20.66	0.49
Centralia	800	100-Year	86.00	760.70	763.37		763.61	0.008784	4.04	24.19	22.78	0.52
Centralia	776	2-Year	36.00	760.60	762.51		762.63	0.007854	2.72	13.37	12.97	0.46
Centralia	776	5-Year	53.00	760.60	762.81		762.96	0.007740	3.16	17.28	13.99	0.47
Centralia	776	10-Year	63.00	760.60	762.95		763.13	0.007757	3.38	19.68	18.62	0.48
Centralia	776	25-Year	73.00	760.60	763.09		763.28	0.007728	3.57	22.37	21.14	0.48
Centralia	776	100-Year	86.00	760.60	763.16		763.40	0.009258	4.01	24.21	28.82	0.53
Centralia	750	2-Year	36.00	760.55	761.80	761.80	762.20	0.042206	5.06	7.18	9.71	1.00
Centralia	750	5-Year	53.00	760.55	762.04	762.04	762.54	0.037613	5.69	9.59	10.77	0.99
Centralia	750	10-Year	63.00	760.55	762.17	762.17	762.71	0.035088	5.96	11.09	11.82	0.98
Centralia	750	25-Year	73.00	760.55	762.31	762.31	762.88	0.031623	6.11	12.83	12.92	0.94
Centralia	750	100-Year	86.00	760.55	762.69	762.69	763.07	0.016281	5.19	22.85	39.00	0.71
Centralia	719	2-Year	36.00	759.80	761.44		761.57	0.008305	2.83	12.91	12.78	0.47
Centralia	719	5-Year	53.00	759.80	761.73		761.90	0.008290	3.29	16.72	13.75	0.49
Centralia	719	10-Year	63.00	759.80	761.87		762.06	0.008494	3.54	18.65	14.18	0.50
Centralia	719	25-Year	73.00	759.80	761.99		762.21	0.008736	3.77	21.04	22.76	0.51
Centralia	719	100-Year	86.00	759.80	762.13	761.54	762.37	0.009136	4.06	25.21	37.94	0.53
Centralia	650	2-Year	36.00	759.15	761.27		761.31	0.001813	1.65	22.03	14.44	0.23
Centralia	650	5-Year	53.00	759.15	761.52		761.59	0.002389	2.08	27.05	24.72	0.27
Centralia	650	10-Year	63.00	759.15	761.64		761.72	0.002678	2.30	31.06	38.15	0.29
Centralia	650	25-Year	73.00	759.15	761.76		761.85	0.002870	2.47	35.87	48.10	0.30
Centralia	650	100-Year	86.00	759.15	761.89		761.99	0.003043	2.64	42.65	55.08	0.31
Centralia	619	2-Year	36.00	759.20	761.19		761.24	0.002505	1.93	20.97	17.99	0.27
Centralia	619	5-Year	53.00	759.20	761.41		761.50	0.003433	2.47	25.08	23.13	0.33
Centralia	619	10-Year	63.00	759.20	761.51		761.62	0.003883	2.73	27.65	27.10	0.35
Centralia	619	25-Year	73.00	759.20	761.61		761.74	0.004325	2.98	30.43	36.62	0.38
Centralia	619	100-Year	86.00	759.20	761.72		761.87	0.004760	3.25	34.72	42.88	0.40
Centralia	600	2-Year	36.00	759.29	761.11	760.43	761.17	0.006005	2.05	17.81	23.64	0.39
Centralia	600	5-Year	53.00	759.29	761.33	760.82	761.41	0.006000	2.38	24.20	35.64	0.40
Centralia	600	10-Year	63.00	759.29	761.43	760.91	761.53	0.006004	2.53	28.11	38.21	0.41
Centralia	600	25-Year	73.00	759.29	761.53	760.97	761.63	0.006011	2.67	32.13	44.75	0.41
Centralia	600	100-Year	86.00	759.29	761.64	761.06	761.76	0.006011	2.82	37.67	51.02	0.42

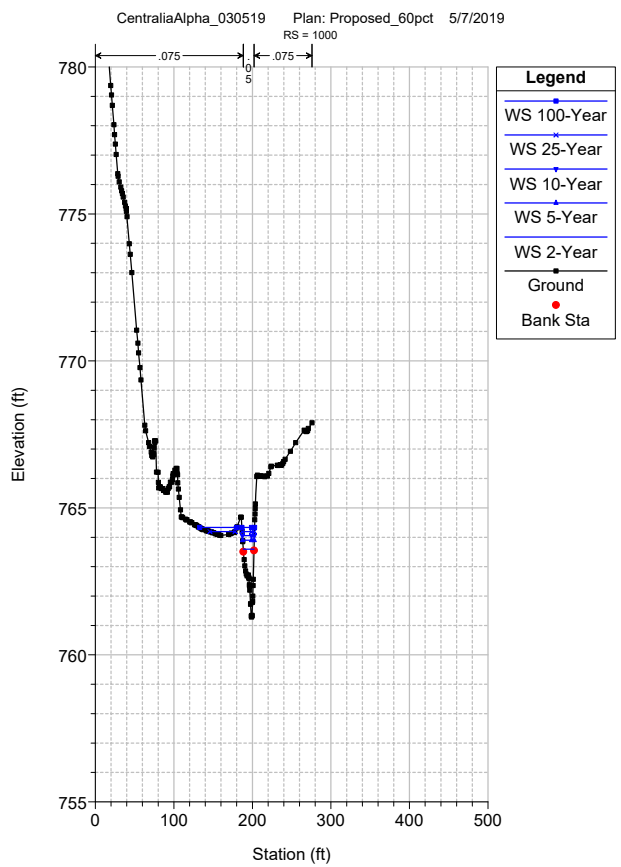
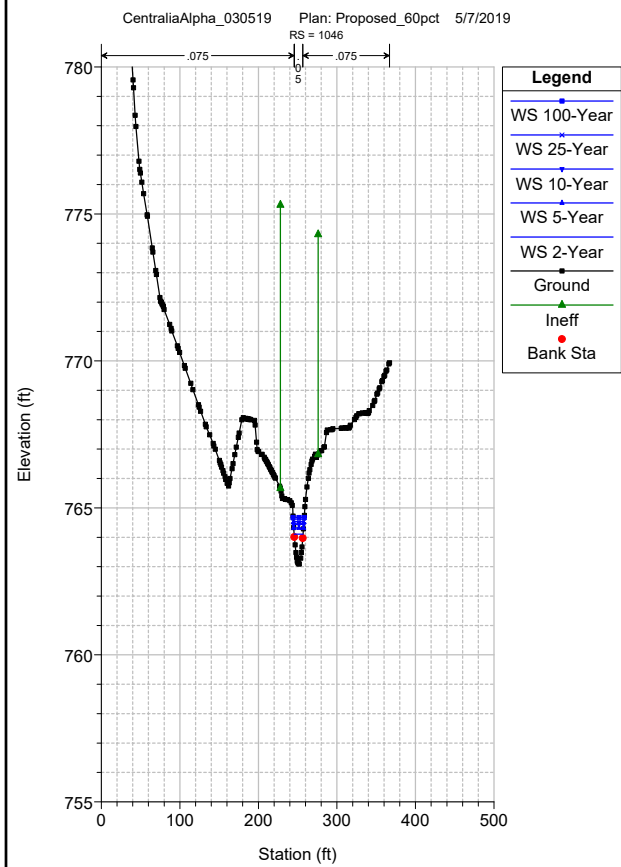
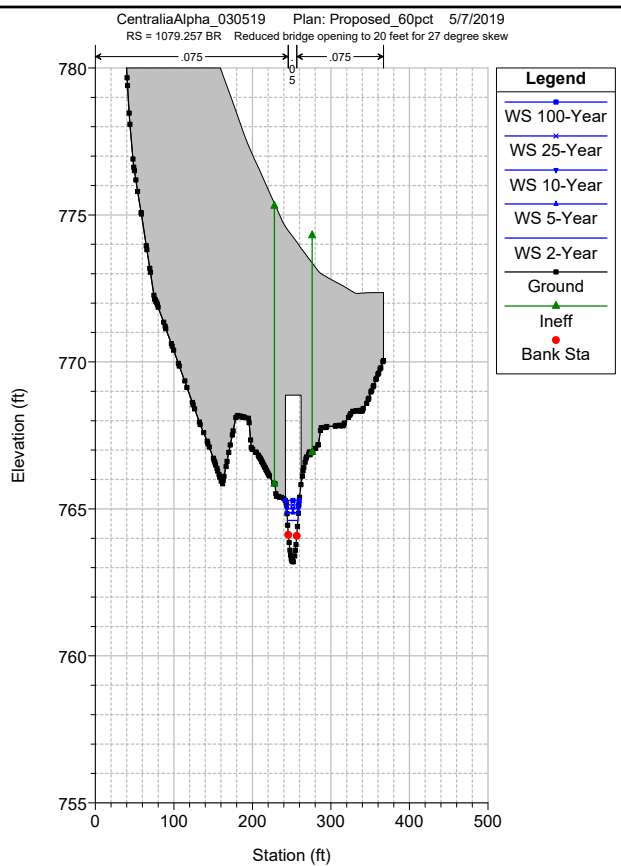
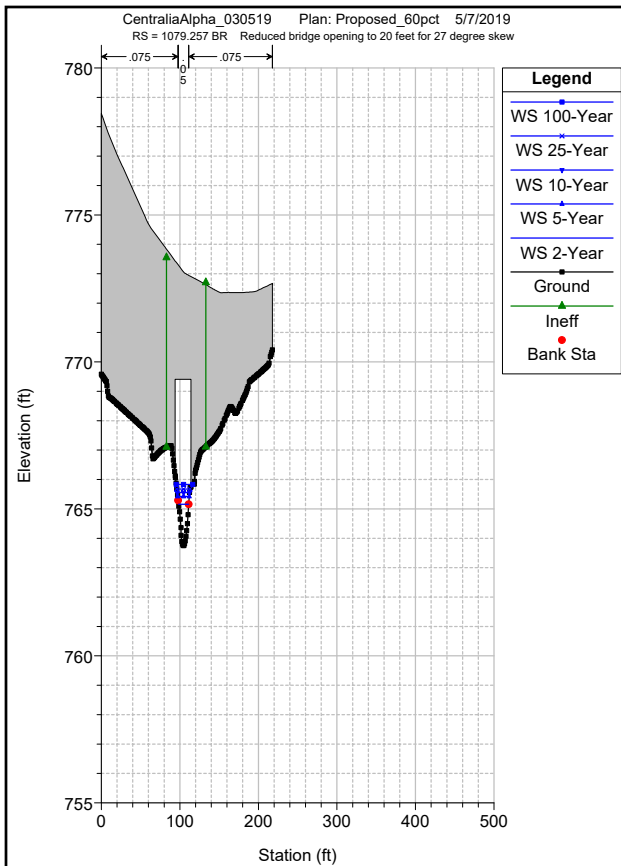


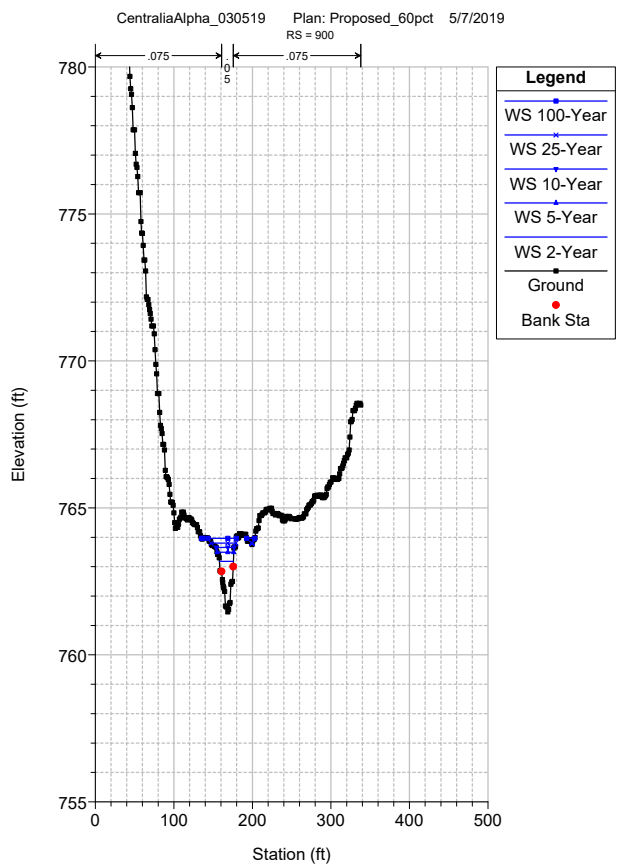
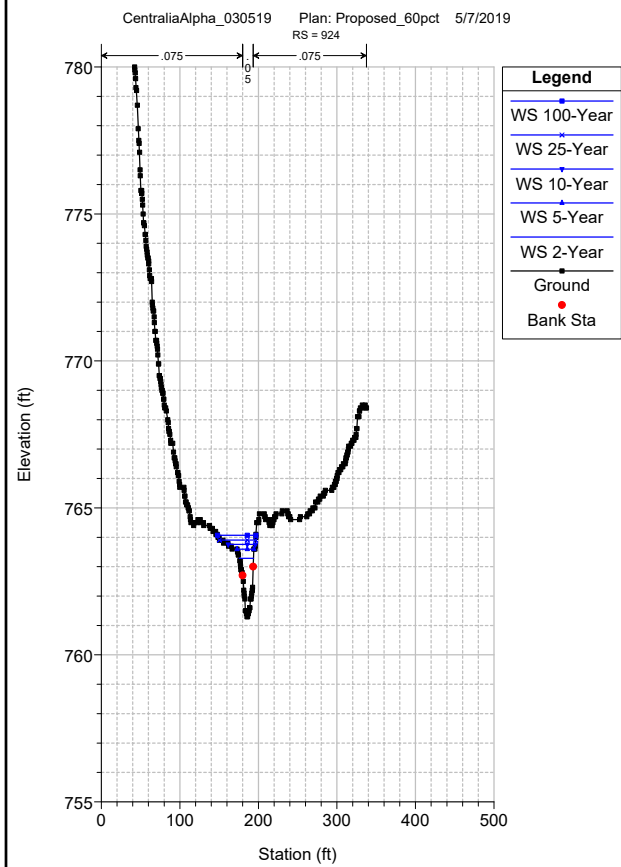
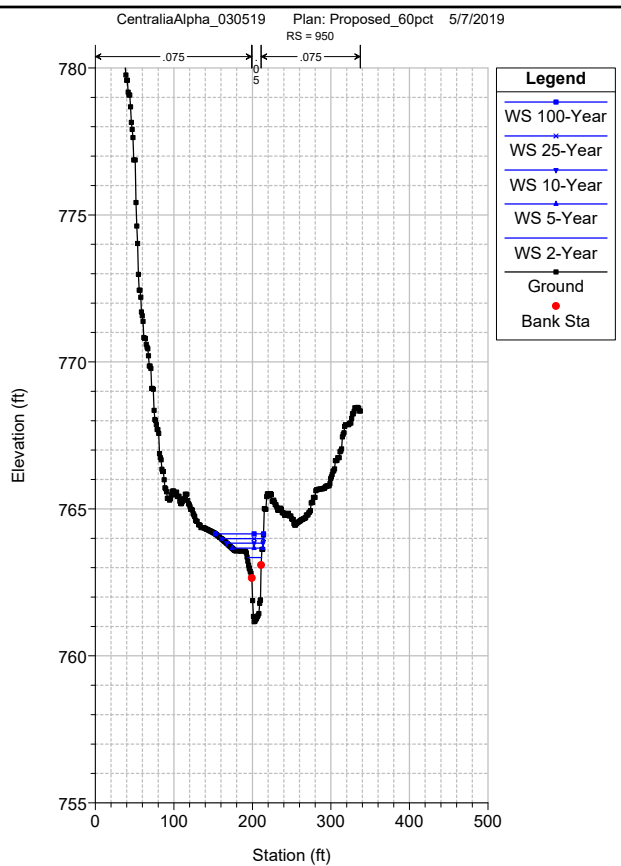
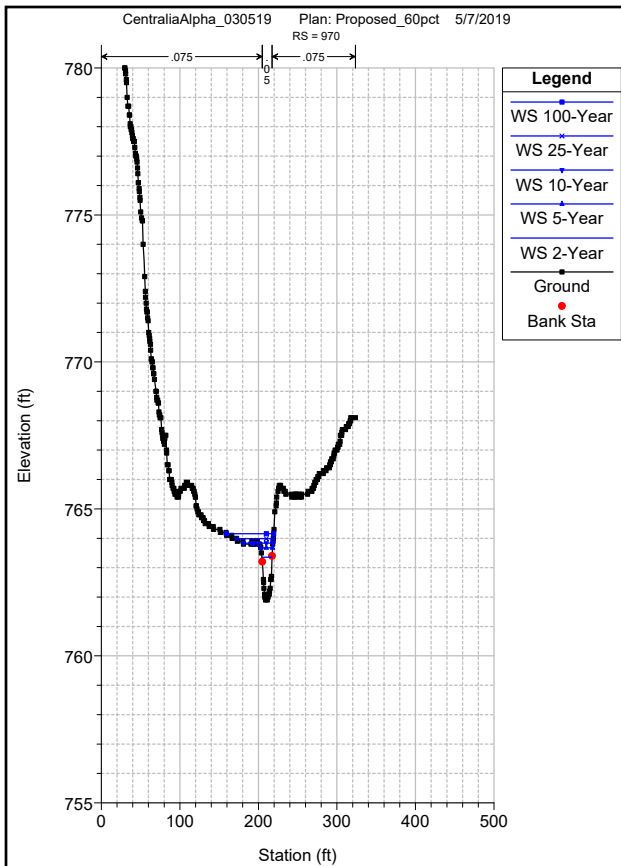


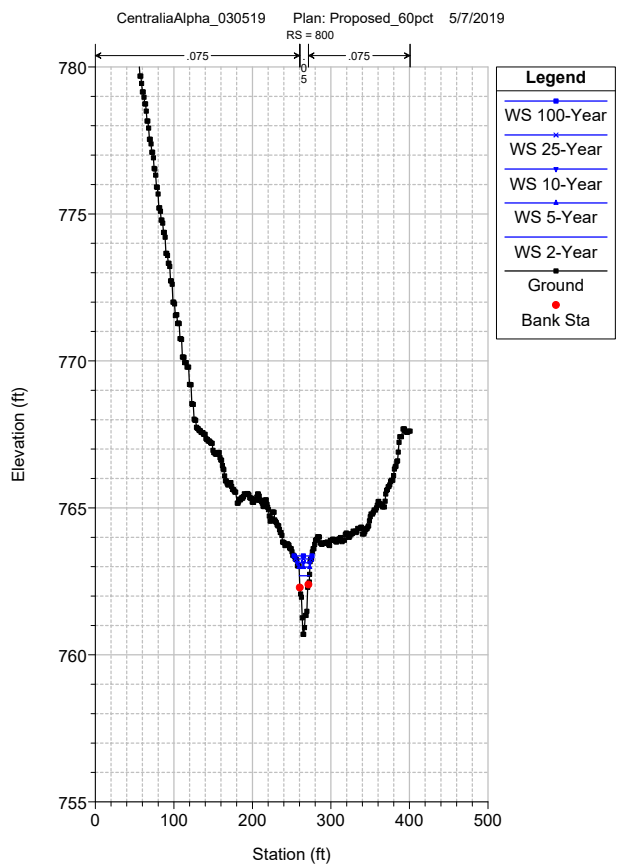
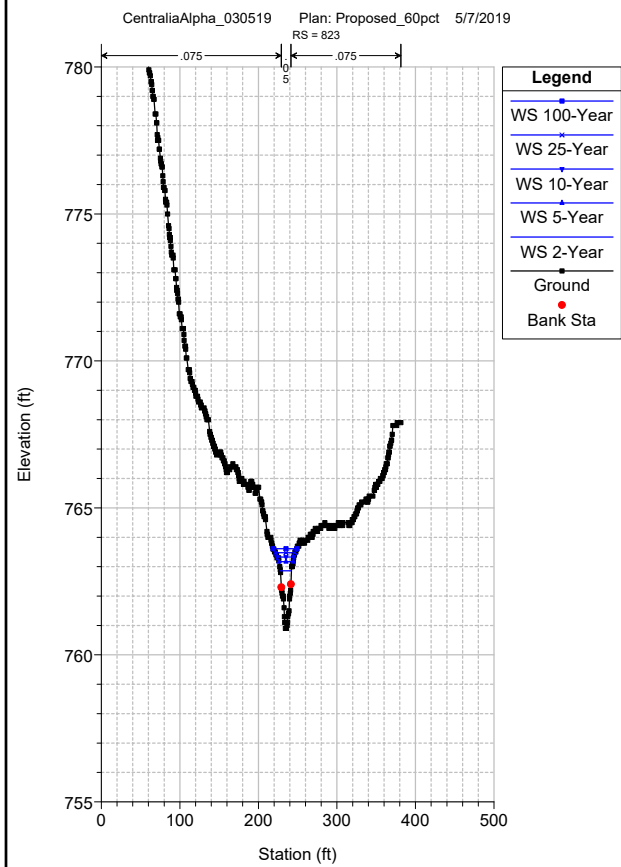
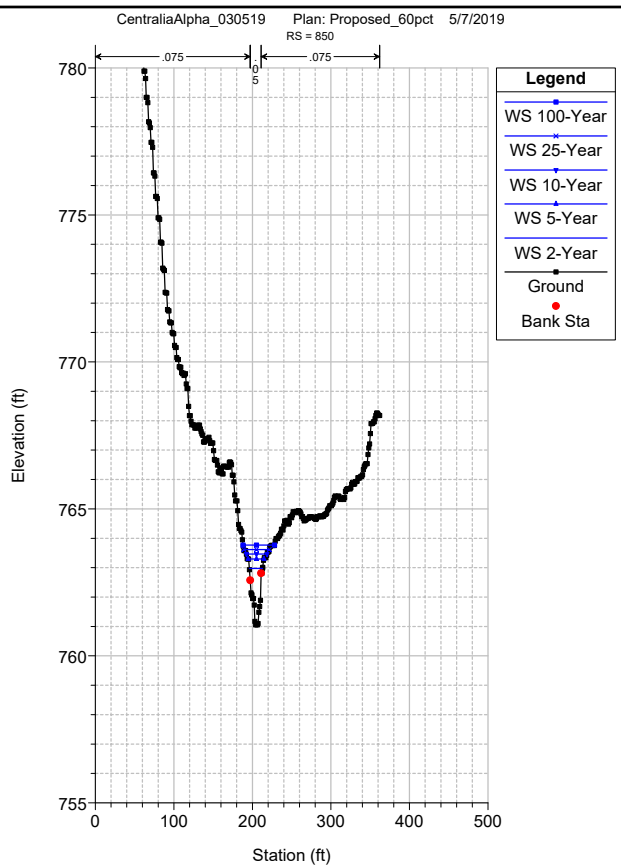
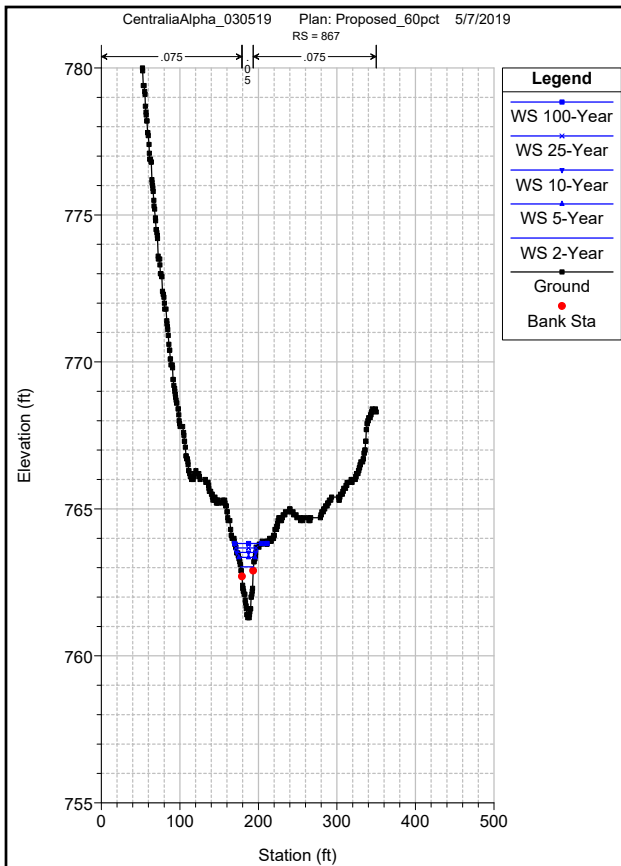


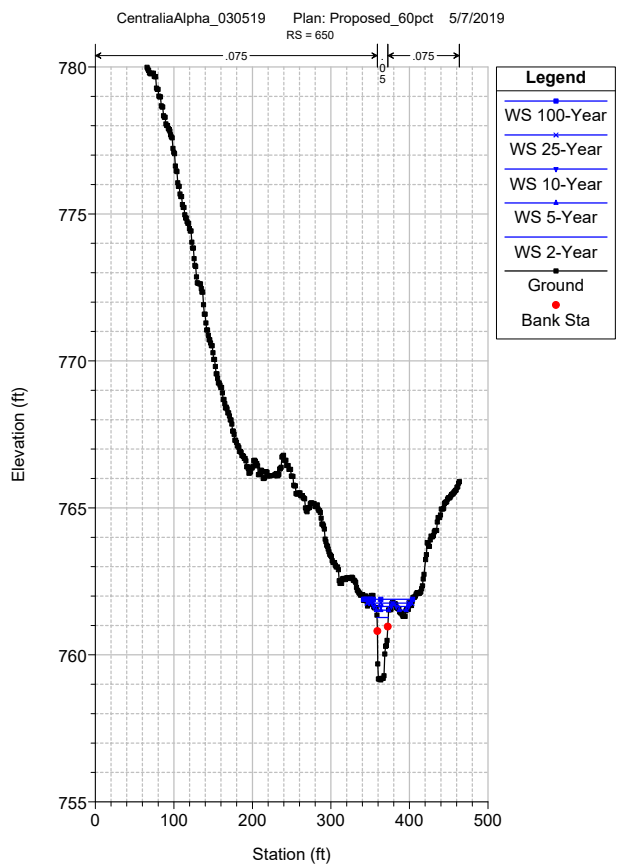
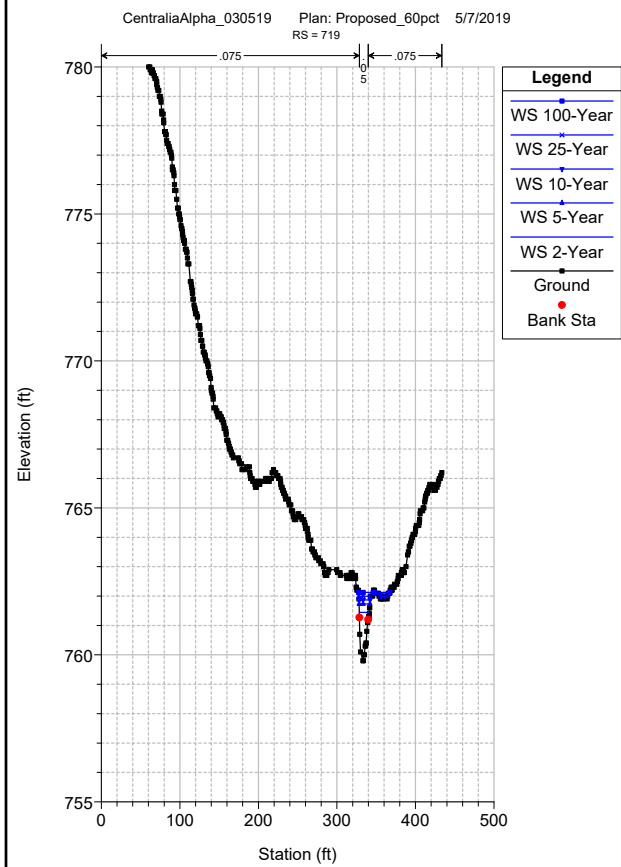
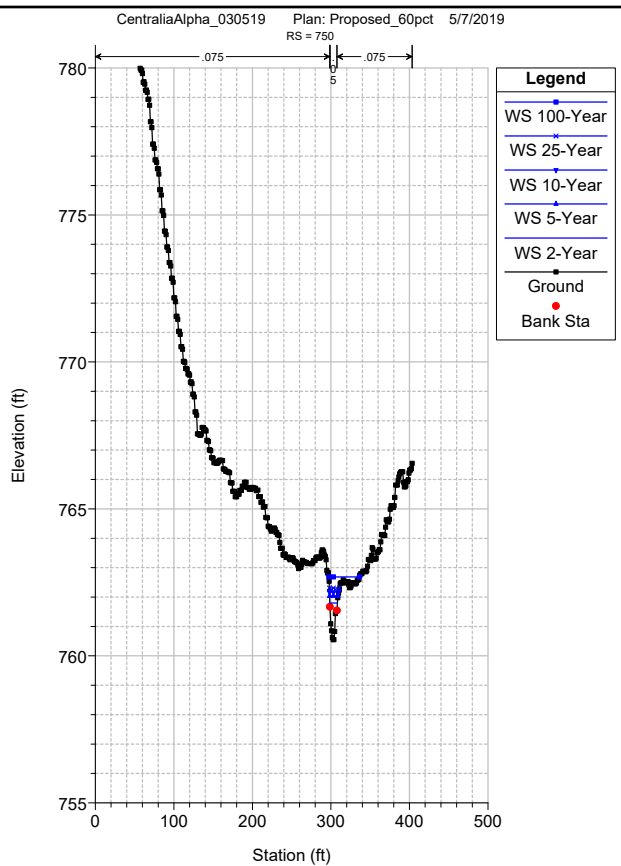
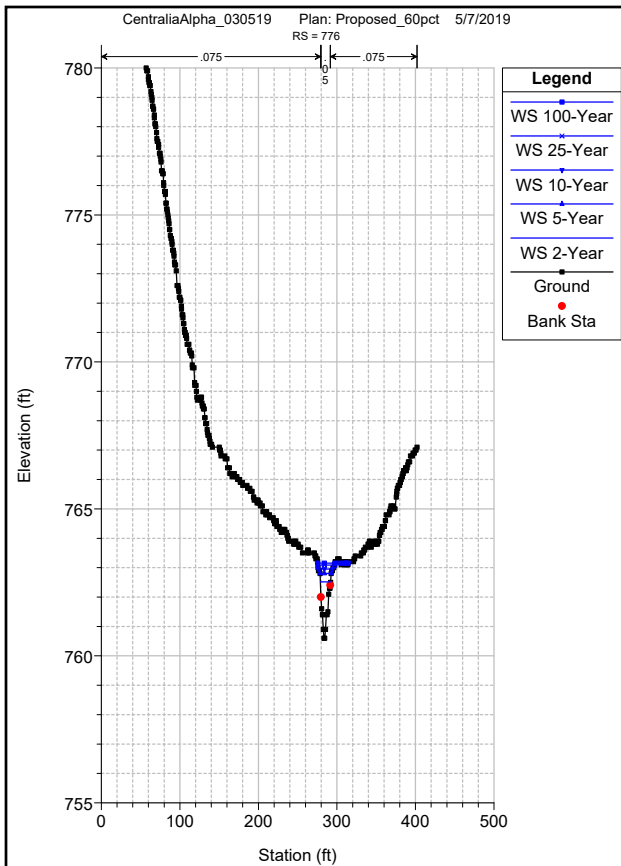












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RS = 619

