

Appendix F

Floodplain Development Compliance

TECHNICAL MEMORANDUM

DATE: September 10, 2019
TO: Lewis County
FROM: Jeffrey Coop, PE
SUBJECT: Base Flood Elevation Impact Analysis
CC: Jennifer Hughes, Parametrix
PROJECT NUMBER: 267-8092-001
PROJECT NAME: Cowlitz Timber Trails Association (CTTA) Shoreline and Floodplain Permitting

INTRODUCTION

Parametrix has been supporting the Cowlitz Timber Trails Association (CTTA) with permitting associated with its Shoreline Mater Program Development. The proposed development includes the addition of an estimated number and volume of four-walled structures as well as parking pads. Lewis County, the permitting agency with jurisdiction, requires that the existing Base Flood Elevation (BFE) be reviewed to determine potential impacts associated with the proposed development. This technical memorandum summarizes the analyses performed to evaluate potential BFE impacts.

APPROACH

Lewis County Code (LCC) Section 15.35.190 contains the following requirement regarding fill or encroachments:

Any placement of fill or encroachments shall minimize the net increase in flood levels to less than or equal to the federal standard of one-foot increase in flood levels from the cumulative effect of the proposed development when combined with all other existing and anticipated development during the occurrence of the base flood discharge.

In accordance with the above code, the analyses performed for the project were performed to determine if a 1-ft rise in the BFE could be anticipated by the proposed development. The analyses for this technical memorandum estimated the BFE at the project area, estimated the volume of fill below the estimated BFE, and estimated the potential change to the BFE. The analyses were not performed to establish an existing or proposed BFE at any specific location. The analyses were performed based on general potential development patterns as well as information from available mapping. Exact locations of potential future buildings or parking pads and associated ground elevations and BFE at specific sites are not currently known.

The project vicinity is shown in Attachment 1. Project area ground elevations area shown in Attachment 2. The section and area locations referenced in the calculations are also shown in Attachment 2.

The project area is within Special Flood Hazard Area (SFHA) Zone A as shown on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) panels 5301020460B, 5301020470B, effective December 15, 1981. Based on the Zone A designation, the project area is within the area of the 100-year flood.

However, because the project area is within a Zone A designation, the BFE and flood hazard factors have not been determined. Floodplain areas and widths for the project area are shown on the FEMA FIRMs in Attachment 3.

The BFE within the project area was estimated based on gage data from the United States Geological Survey (USGS) Station 14238000 located on the Cowlitz River below the Mayfield Dam. This Station is located approximately 3.8 miles upstream of the project area. The stage data at this station was used to estimate the rise in the BFE over normal water elevation and a corresponding area associated with the 100-year flood. The stage data could not be interpolated downstream to the project area because the Cowlitz River is not included in a detailed Flood Insurance Study (FIS) in this area. The station data provided stage data rather than water surface elevations. Consequently, all stage information and calculation results were added to the stage datum, which was converted from the National Geodetic Vertical Datum of 1929 (NGVD29) to North American Vertical Datum of 1988 (NAVD88) using the vertical transformation software VDATUM developed through the National Oceanographic and Atmospheric Administration (NOAA). USGS Station 14238000 gage information is shown in Attachment 4.

Annual peak flow rate and stage data were input into a spreadsheet based on USGS Technical Bulletin 17B, *Guidelines for Determining Flood Flow Frequency*, (TB17B; USGS; 1982) to determine the 100-year flow rate and 100-year peak stage. TB17B provides methodologies to analyze peak flow frequency data at gaging stations. Although TB17B was prepared to analyze peak flow frequencies, the methodology was used for both flow rates and stages as an initial check to confirm that the calculated 100-year stage occurred similar in time with a flow rate similar to the calculated 100-year flow. As a further check, the peak annual flow and stage data was then used in the Statistical Software Package developed through the US Army Corps of Engineers Hydrologic Engineering Center (HEC-SSP). The following three scenarios were analyzed based on variations in how HEC-SSP can analyze data:

- Flow rate analysis based on flow rates;
- Duration analysis based on peak stage;
- Peak stage analysis based on using stage data as flow rates.

Table 1 summarize the BFE calculated for USGS 14238000. Calculations are included in Attachment 5.

Table 1. Summary of Base Flood Elevation for USGS 14238000

	Calculated Value	Date with values similar to Calculated Value ¹
TB17B, 100-year flow rate, cfs	77,748	11/28/95 (68,400)
TB17B, 100-year elevation, ft NAVD88	252.33	11/28/95 (252.79)
HEC-SSP, 100-year flow rate, cfs	78,491	68,400
HEC-SSP, 100-year duration, ft NAVD88	256.27	N/A
HEC-SSP, 100-year stage as flow, ft NAVD88	256.58	26.2-ft depth = 256.28 NAVD88
Average 100-year BFE using HEC-SSP, ft	$(256.27 + 256.58) / 2 = 256.43$	N/A

1 From data for USGS 14238000; Attachment 4

After the BFE for the gage station was estimated, the widths and elevations for normal flow were estimated at the gage station as well as at the three project area sections. The normal flow widths at the project area were based on shading maps produced through the Lewis County Geographic Information System site and based on USGS quadrangle maps. Elevations were approximated based on USGS quadrangle maps. A cross-sectional area was estimated at the gage station that represented the area above the normal flow elevation up to the approximated BFE and its associated width. It is assumed that the same area of flow at the USGS gage station would occur downstream at the project area. Table 2 summarizes the widths and elevations for normal flow and the BFE at the gage station and the project area.

Table 2. Summary of Water Widths and Elevations

Location	Normal flow		Base Flood		Depth above normal flow, ft	Flow Area Sq ft
	Width ¹ , ft	Elevation, NAVD88	Width ² , ft	Elevation, NAVD88		
USGS 14238000	293	240	592	256.43	16.43	7,270
Section 1	492	202	616	215.12	13.12	7,270
Section 2	417	202	626	215.94	13.94	7,270
Section 3	507	210	590	223.25	13.25	7,270

- 1 Based on calculations in Attachment 2.
- 2 Based on calculations in Attachment 3.

After the flow depths and area for Table 2 were determined, the amount of fill within the floodplain was estimated based on the potential amount of structures and building pads. This analysis supports a Shoreline Master Program (SMP) Conditional Use Permit (SCUP) application that is requesting approval for the potential maximum build out of member lots at CTTA within the SMP. The SCUP proposed maximum build out square footages based on the types and sizes of structures that CTTA has allowed on each member lot in the past. That same information was used to determine the potential for four-walled structures or improvements with volume that could affect floodplain storage. For each member lot within or partially within the FEMA mapped floodplain area, the analysis includes 392 square feet of 4 walled structures (non-habitable sheds), and 800 square feet of gravel placement up to two inches in depth. The fill volume associated with these two elements were then subtracted from the estimated floodplain volume and the potential change in the BFE recalculated to achieve the same flow area as in Table 2.

Table 3 summarizes the changes in the BFE associated with the potential fill. Table 3 reflects four areas based on the 3 sample section locations. Area A is from the upstream limit of the project area to Section 3. Area B is between Section 3 and Section 2. Area C is between Section 2 and Section 1. Area D is between Section 1 and the downstream project area limit. Existing ground elevations were approximated based the amount of area within the elevation ranges indicated in Attachments 3 and 5. The BFE for Areas B and C were averaged from the calculated BFE at Sections 2 and 3 and Section 1 and 2, respectively. Floodplain areas were calculated from the FEMA FIRMs. Area calculations for normal flow areas are included in Attachment 6. Spreadsheet calculations for Tables 2 and 3 are included in Attachment 7.

Table 3. Summary of BFE Impacts

Location	Type of Fill	Approximate Existing Average Ground Elevation ¹ , ft	BFE for Structures; 2-in for Gravel Pads ²	Potential Fill Area ³ , sq ft	Potential Fill Volume ⁴ , cu ft	Approximate Floodplain Area ⁵ , sq ft	Approximate Bank-to-bank Area ⁶ , sq ft	Approximate Floodplain Depth ⁷ , ft	Approximate Current Floodplain Volume ⁸ , cu ft	Approximate Revised Floodplain Volume ⁹ , cu ft	Depth to Obtain Approximate Current Floodplain Volume ¹⁰ , ft	Revised Floodplain Volume, cu ft	Approximate Rise ¹¹ , ft	Rise < 1.0-ft?
Area A	Structure	219.41	223.25	8,232	31,651	872,224	686,718	13.25	10,331,761	10,297,313	13.33	10,331,761	0.07	Yes
	Gravel Pad	N/A	0.17	16,800	2,800									
Area B	Structure	213.21	219.60	19,992	127,708	1,382,560	1,061,340	13.60	16,616,035	16,481,527	13.71	16,616,035	0.11	Yes
	Gravel Pad	N/A	0.17	40,800	6,800									
Area C	Structure	212.42	215.53	25,480	79,298	1,135,520	974,852	13.53	14,278,957	14,190,993	13.70	14,278,957	0.17	Yes
	Gravel Pad	N/A	0.17	52,000	8,667									
Area D	Structure	212.45	215.12	10,584	28,294	519,312	373,076	13.12	5,855,515	5,823,621	13.28	5,855,515	0.16	Yes
	Gravel Pad	N/A	0.17	21,600	3,600									

1 Existing ground elevation estimated in GIS as shown in Attachment 2. If a project sub-area includes more than one mean elevation, the approximate existing average ground elevation was estimated based on the approximate area percentages of each mean ground elevation within the project sub-area.

2 To estimate the fill volume, the estimated BFE was used for structures because it is anticipated that proposed structures will extend above the BFE. For gravel pads, the fill volume was estimated based on a 2-inch gravel thickness layer above the approximate existing average ground elevation. 3 Estimated in GIS.

4 For structures, the fill volume is the difference between the BFE and the approximate existing average ground elevation times the area. For gravel pads, the fill volume is the thickness of the gravel layer times the area. The values listed are rounded for display purposes but do not reflect computational rounding of the approximate existing average ground elevations or BFEs.

5 Based on SFHA area calculations on FEMA FIRMS in Attachment 3.

6 Based on approximate normal channel area calculations in Attachment 2.

7 From Table 2. For Area B, the value is averaged for Section 2 and 3. For Area C, the value is averaged for Sections 1 and 2.

8 The average of the approximate floodplain area and approximate bank-to-bank area times the approximate floodplain depth.

9 The approximate current floodplain volume less the potential fill volume.

10 Calculated depth to achieve the approximate current floodplain volume.

11 The depth to obtain the approximate current floodplain volume after the fill less the approximate current floodplain depth for current conditions.

CONCLUSION

Based on the analyses performed to support the Shoreline Master Program Development and the results summarized in Table 3, the BFE rise for the proposed development is anticipated to be less than 1-ft and is therefore anticipated to comply with LCC Section 15.35.190. Design of future buildings within the SFHA will need to comply with the applicable mechanical, structural and floodproofing requirements of the LCC. Elevations to be used in future elevation certificates will need to be determined as required based on site-specific development proposals.

ATTACHMENTS

Attachment 1 – Vicinity Map

Attachment 2 – Project Area Sections, Area Locations, and Ground Elevations

Attachment 3 – FEMA FIRMs

Attachment 4 – USGS Station 14238000 Information

Attachment 5 – BFE Analyses

Attachment 6 – Water Surface Areas and Elevations

Attachment 7 – Spreadsheet Calculations