Overview & Concurrence Form (Form 1)

B. Overview

This request for a Letter of Map Revision (LOMR) is for a the recently constructed Smith Island Estuary Restoration Project in Snohomish County, Washington (Figure 1). The project is located in Snohomish County (County), State of Washington (State), on Snohomish County- owned land along Union Slough extending from 1,600 feet upstream of Interstate 5 to approximately 10,000 feet upstream of the Interstate. Union Slough is a distributary channel of the Snohomish River where the river flows through an estuary delta as it discharges into Possession Sound. Other sloughs in the estuary delta include Steamboat Slough, Ebey Slough, and interconnecting channels between the three sloughs. Because of project effects and updates to the hydraulic analysis of the Snohomish River System the LOMR mapping revision covers portions of the FIRM panels listed in Table 1.

Table 1. Map panels affected by the LOMR

Community No.	Community Name	State	Map No.	Panel No.	Effective Date
535534	Snohomish County	WA	53061C	0716G; 0717G; 0720G; 1035G	June 19, 2020
530164	City of Everett	WA	53061C	0720G; 1035G	June 19, 2020
530168	City of Marysville	WA	53061C	0716G; 0717G; 0720G	June 19, 2020

The restoration project included the following elements:

- Constructing a setback dike to protect adjacent agricultural properties, Interstate-5, and Everett Wastewater Treatment Plant infrastructure;
- Breaching 4,500 linear feet of existing dike located on the left (west) channel bank of Union Slough, restoring tidal inundation; and
- Creating habitat elements designed to restore estuarine natural processes, including reconnecting / creating tidal channels, filling linear ditches to prevent fish stranding, creating large wood structures, and suppressing invasive plants.

A more detailed map of the project site is included as Figure 2.

A description of the unique FIRM mapping for this region (FIS 53061CV002B, Section 10.2) explains that the lower reach of the Snohomish River is mapped and managed as Density Fringe, as opposed to a traditional floodway. This is one of only two density fringe areas currently mapped in the United States and was established in 2001 in agreement between FEMA and local communities. The agreement removed the need for a traditional floodway. The Density Fringe on the Snohomish River extends from

the mouth of the river at the Possession Sound at Section A, River Mile (RM) 0.0 upstream to Section AH at RM 15.7, which is just downstream from the confluence of the Skykomish and Snoqualmie Rivers that combine to form the Snohomish River. The Density Fringe where the project is located is governed by Snohomish County Code and managed by the Department of Planning & Development Services (PDS) of Snohomish County. The Density Fringe is managed to a 1-foot cumulative rise standard.

The requestor for this LOMR is Snohomish County that was the project sponsor for the project covered by this request. The mapping changes will affect the following communities:

- City of Everett
- City of Marysville
- Snohomish County

The project was permitted by Snohomish County and due to an isolated area of increased base flood elevations near the downstream end of the project a CLOMR was submitted prior to project construction. The base flood increase documented in the CLOMR was less than the allowable 1-foot rise; however, the CLOMR was submitted by Snohomish County for documentation purposes. The approved CLOMR is dated December 19, 2016, with Case Number 16-10-1536R. The CLOMR focused on changes to the project area and Union Slough but did not note changes in any other location. The CLOMR extent was limited to DFIRM Panel No. 1035G on Map No. 53061. The CLOMR application proposed no changes to the existing mapping as the area was fully covered by the existing Density Fringe and would continue to be so after the project. All land flooded by the reconnection to Union Slough is owned by Snohomish County and no insurable structures were impacted. As a result, the previous CLOMR made no changes to the effective mapping in this area. Because the purpose of this project was for tidal estuarine restoration and partially funded by state funds (54.6%), the CLOMR application was also fee exempt.

Upon revisiting the CLOMR model, the modeling efforts of this LOMR submittal included several required model corrections and involved review of model results across the estuarine system, leading to revisions to the effective mapping as described in the narrative for Form 2, Section B and C.

C. Review Fee

Based on the current FEMA fee schedule definitions, this project is fee-exempt per the Homeowner Flood Insurance Affordability Act of 2014 (Public Law 113-89, section 22), as the project's primary purpose was habitat restoration and because 15.6 million of the 28-million-dollar project cost was provided by the State of Washington Recreation and Conservation Office (RCO).

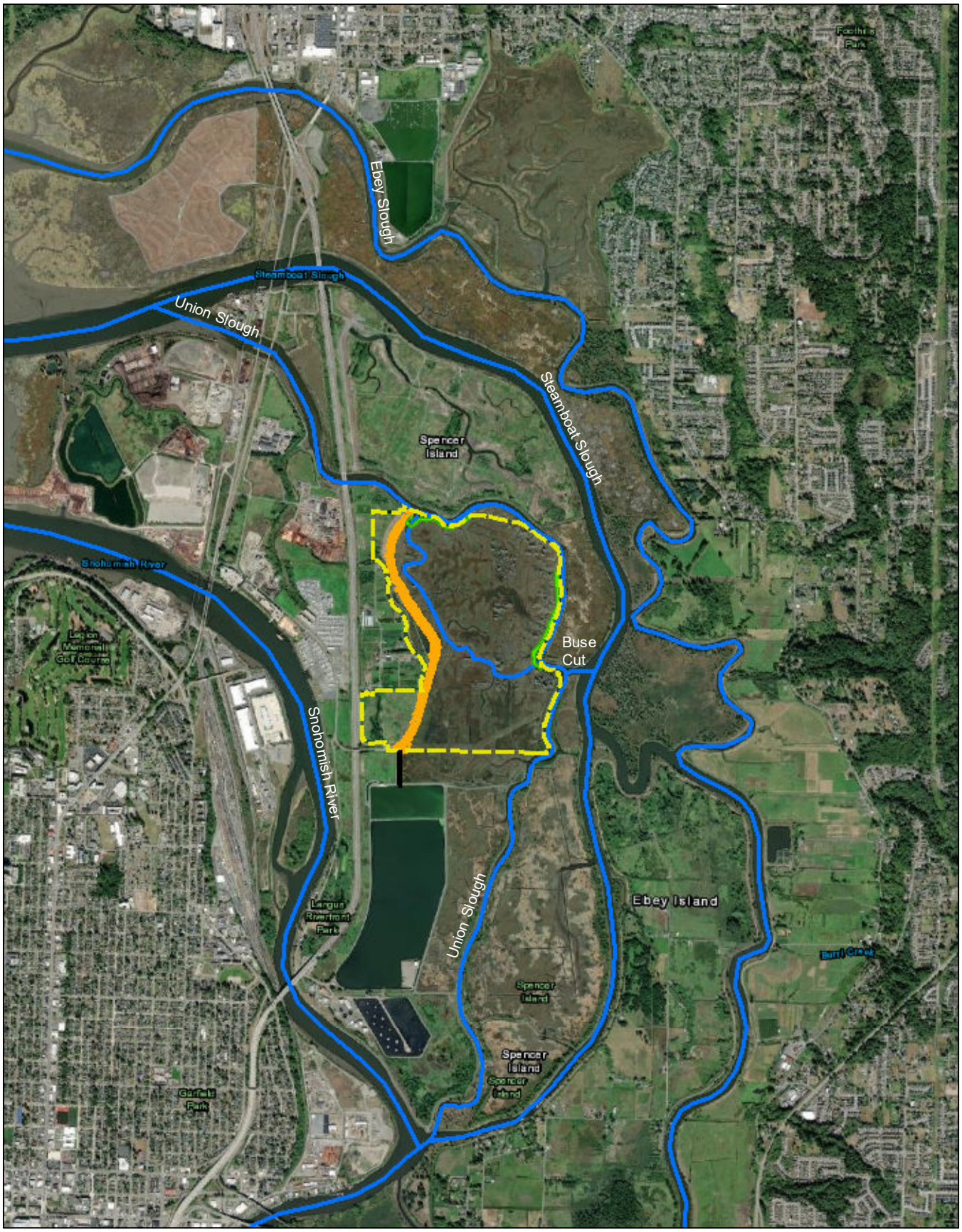

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Figure 1:
Project Location Map

Legend

- Project Site
- Setback Dike
- Dike Breach
- River Reaches
- City of Everett Dike

Snohomish County

Otak

N

0 3,000 6,000 Feet

Source: Smith Island Estuary Restoration Zero Rise Modeling Report

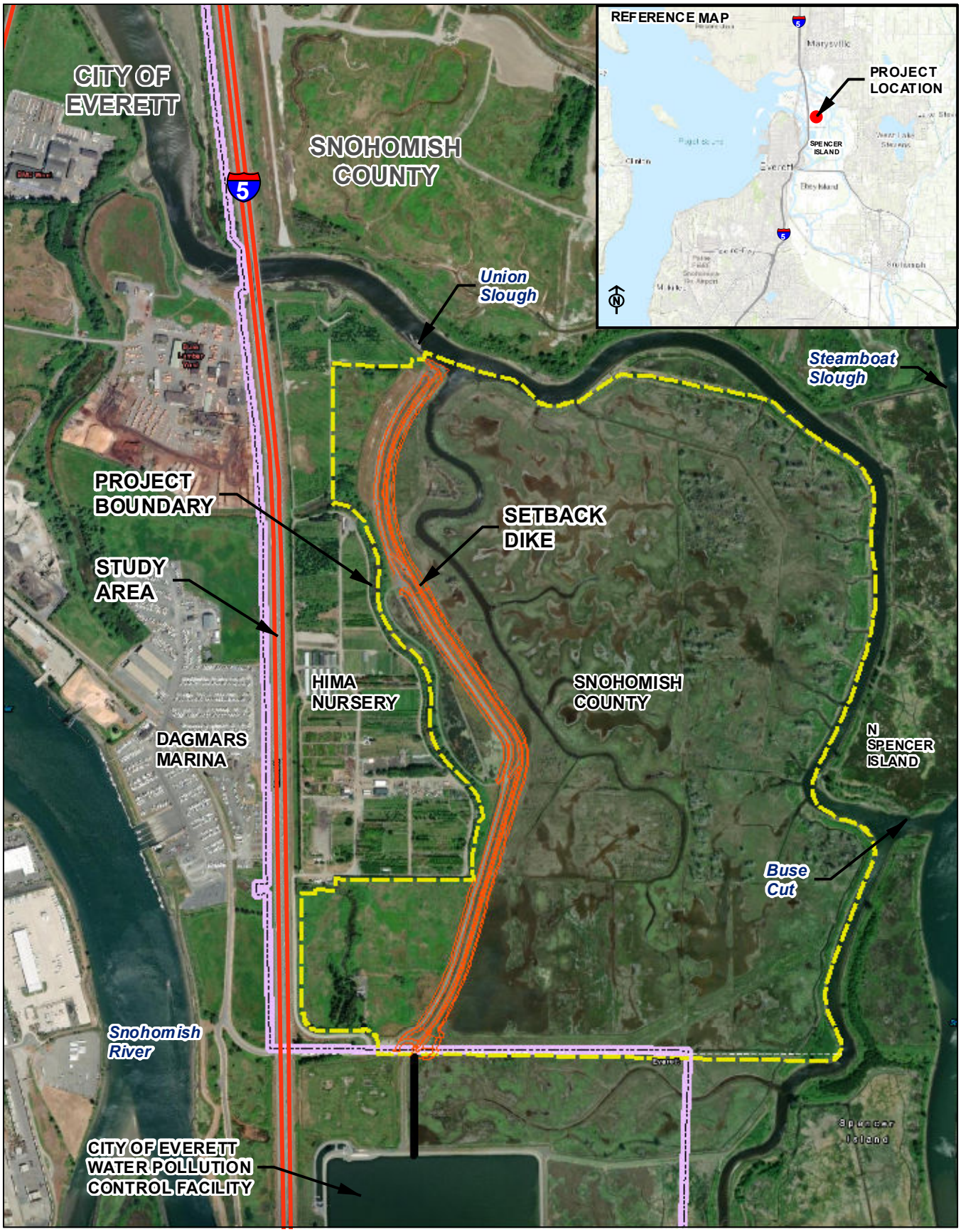

Figure 2:
Project Site

Interstate
Levee Outline
City of Everett Dike
Everett City Limits
Smith Island Project Boundary

Snohomish County
Otak

0 500 1,000
Feet

Source: Smith Island Estuary Restoration Zero Rise Modeling Report

Date: 11/16/2022

Riverine Hydrology & Hydraulics Form (Form 2)

A. Hydrology

No changes in hydrology from that used in the effective FIS are proposed for this LOMR. Model flows were taken from the original input files used for the Effective model.

B. Hydraulics

The lower reach of the Snohomish River consists of a network of distributary channels where the Snohomish River crosses a delta (Union, Steamboat, and Ebey sloughs) before discharging into Possession Sound. Much of the overbank areas are disconnected from the channels through dikes and levees that overtop at various flow frequencies. Because of this the Effective and subsequent models are unsteady flow one-dimensional (1-D) models that consist of a network of channels connected to overbank storage areas through lateral structures. Figure 3 is a map showing the network of channels in this area with the project site located on Union Slough.

Due to changes resulting from the project and the revised hydraulic modeling (see below) the area of map revision will affect water-surface elevations and mapping on several branches of the network. Table 2 summarizes the tie-in locations on each branch. Mapping changes are limited to the network of sloughs and associated floodplain areas in the Snohomish River delta; no mapping changes are proposed on the Snohomish River. Upstream tie-in locations on all three sloughs meet the required +-0.50-foot tie-in requirement for all flood events, except for the 100-year flood on Steamboat Slough. This condition is consistent between Corrected Effective and As-Built models, which both use the same downstream boundary condition as the Effective UNET model. On the downstream end of the revision area, all tie-ins fall within the coastal zone, therefore model elevations are superseded by the coastal elevation of 13.0 feet NAVD88 and thus match exactly in the mapping.

Table 2. Upstream and downstream tie-ins to Effective water surface elevations

River	Upstream			Downstream		
	Effective XS	Model XS	As-Built (Effective) 100-Year WSE (ft, NAVD88)	Effective XS	Model XS	As-Built (Effective) 100-Year WSE (ft, NAVD88)
Ebey Slough	L	41488.96	15.9 (16.2)	B	11437	11.12 (11.7)
Steamboat Slough	M	30347.64	15.97 (16.7)	D	11989.24	11.88 (12.0)
Union Slough	J	25237.33	15.63 (15.67)	D	6704.057	12.64 (13.80)

Models submitted for this LOMR are summarized in Table 3. Provided here is a brief description of each model. As noted in the MT-1 narrative, the previous CLOMR effort did not undertake any remapping of this area. As the LOMR intends to do so, model geometry edits were necessary to comply with FEMA standards for modeling and to allow feasibly mappable results. Further details of the previous modeling history of this area are available in the CLOMR and associated reports.

Effective Model

The effective model for the project area is a UNET model, a one-dimensional (1-D) unsteady flow hydraulic model that pre-dates the existence of HEC-RAS. No model files are available for this model, input files and documentation provided by FEMA are included with the submittal.

Duplicate Effective Model

The Duplicate Effective model for this reach of the Snohomish River is based on the UNET model. The input and geometry data for the UNET model were translated into a HEC-RAS model by others prior to the CLOMR application; the model was then submitted with the CLOMR application as the Corrected Effective Model. This model was not re-run for the LOMR and is included with this LOMR application for reference only. Several updates to this model were required to generate the Corrected Effective Model described below.

Table 3. Models submitted

Model	Software	File Name	Plan Name	Vertical Datum
Effective	UNET	UNET files*	N/A	NGVD 29
Duplicate Effective	HEC-RAS (v 4.1)	SmithIsland.prj	Smith Island Existing Conditions	NAVD 88
Corrected Effective	HEC-RAS (v 4.1)	SmithIs_CLOMR.prj	Corrected Effective – 10-Year Event – 50-Year Event – 100-Year Event – 500-Year Event	NAVD 88
As-Built Conditions	HEC-RAS (v 4.1)	SmithIs_CLOMR.prj	As-Built Conditions – 10-Year Event – 50-Year Event – 100-Year Event – 500-Year Event	NAVD 88

*No single project file available for UNET model

Corrected Effective Model

The Corrected Effective model submitted for the CLOMR (HEC-RAS, 1-D unsteady flow) is included with this LOMR application with corrections. This version of the model used the Duplicate Effective model as a starting point. Next, several model corrections were made to the model in order to meet FEMA modeling standards, for consistency with the UNET model, and to yield a reasonably mappable result:

- The lateral input hydrograph at River Station 13.6 on the Snohomish River (Reach Main1) that represents inflow for the Pilchuck River was updated to match that in the original UNET model files. The input hydrograph used at this location in the CLOMR was based on previous modeling and was assumed to equal 10 percent of the main Snohomish River hydrograph.

- Model files were set up to run the 10-yr, 50-yr and 500-yr floods that were not included in the CLOMR.
- Cross sections that did not extend appropriately to terrain were lengthened to eliminate effects to water surface elevations
- Cross sections adjacent to but disconnected from storage areas were connected using new lateral structures or by lengthening lateral structures present in the duplicate effective model
- Where sloughs could connect overland in the absence of levees, lateral structures were added to allow this hydraulic connectivity between sloughs
- In cases where cross section geometry in the duplicate effective model suggested no levee was present in the terrain, levee stations were removed and helped inform the addition of new lateral structures
- Where new lateral structures occurred at the beginning of reaches, additional cross sections were necessary for the model to run in version 4.1.0
- For cross sections and lateral structures, duplicate effective terrain data were preserved; additional terrain data was appended or generated using topobathy from the United States Geological Survey (USGS) Coastal National Elevation Database (CoNED) collected in 2020

As-Built Conditions Model

The As-Built Conditions model submitted for this LOMR represents the as-built condition for the project and was developed by updating the Post-Project conditions model used for the CLOMR. Similar to the Corrected Effective, the model was run using HEC-RAS version 4.1. As-built drawings of the estuary restoration and setback dike project are included as part of Form 3. It should be noted that since the time of the Smith Island Restoration project, other levee removal and estuary restoration projects have been completed by others in the Snohomish River estuary; these projects are not reflected in this LOMR submittal. The following changes were made for the LOMR:

- The base model for as-built conditions was the CLOMR-submitted Post-Project Conditions model, with geometry changes from the LOMR Corrected Effective model added, so all applicable changes from above were included in the as-built model
- Cross sections for Reach “Smith Island – Breach” that models the flow path through the restored area of Smith Island were cut from the as-built terrain surface for this area
- Terrain representing the as-built setback dike was modeled at the as-built elevations of approximately +16.0 feet NAVD88 rather than the post-settling target elevation of +15.0 feet NAVD88.
- Ineffective flow areas used in the CLOMR model for Reach “Smith Island – Breach” were modified to reflect the as-built project in this area
- The lateral structure connecting the reach “Smith Island – Breach” to Storage Area 8 was modified to represent the as-built setback dike constructed on the west edge of the project area
- Lateral structures along Union Slough that connected to Storage Area 8 were reviewed versus as-built conditions; these structures connect to the appropriate cross sections of the reach “Smith Island – Breach” to represent the breached levee along Union Slough

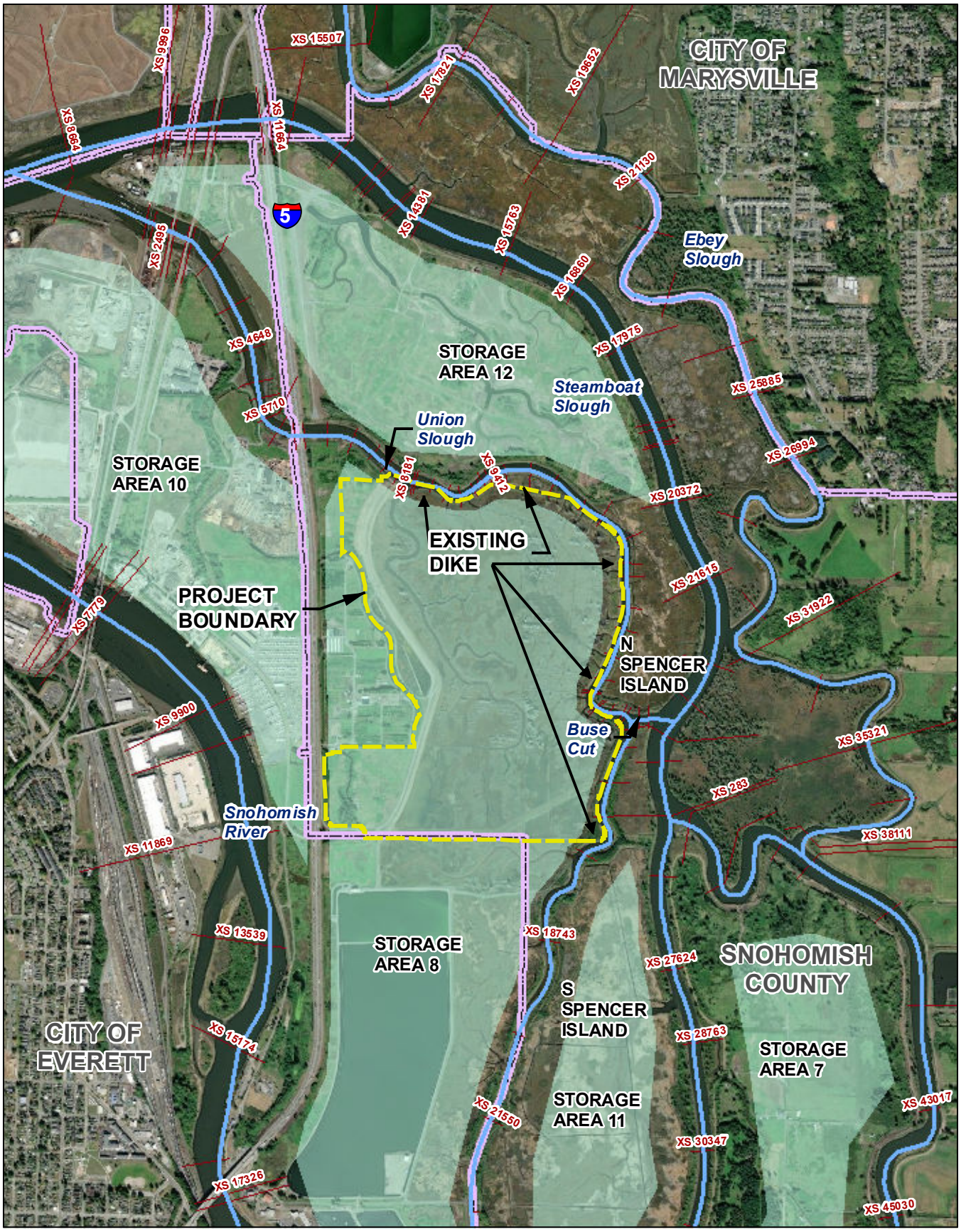

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Figure 3:
Duplicate Effective

Reach
CityLimits
Georeferenced HEC-RAS Cross-section
Storage Area
Smith Island Project Boundary

Otak
Snohomish County

0 500 1,000
Feet

Date: 11/16/2022

Model Results

In the CLOMR application, Post-Project model results indicated rises of less than the allowable 1 foot at cross sections in the vicinity of section D (0.02 to 0.05 feet) and E (0.10 to 0.71 feet) of Union Slough when comparing Post-Project conditions to corrected effective modeling. These sections are in the vicinity of where flows from the reach "Smith Island – Breach" recombine with Union Slough. Table 4 summarizes the modeling results for the corrected effective and as-built conditions modeling versus the effective mapping data for all reaches on Union Slough, Steamboat Slough, Ebey Slough, and the Ebey-Steamboat Slough Connection. Similar to the CLOMR application, BFE comparisons show that rises only occur in the vicinity of sections D and E. In the LOMR modeling effort, the parallel comparison lies between as-built and corrected effective conditions and shows rises of 0.25 and 1.04 feet at D and E, respectively. In all other areas of the estuary, BFEs decrease. When compared to the Effective BFEs, the as-built results show BFEs matching or decreasing in all reaches and sections in the estuary.

Table 4. Summary of model results

FIS Lettered Cross Section	Nearest Model Cross Section	Base Flood Elevation (ft, NAVD)			Difference (ft)		
		Effective FIS (Eff)*	Corrected Effective (CE)	As-Built Conditions (AB)	CE-Eff	AB-CE	AB-Eff
Union Slough							
C	5710.818	12.47	11.28	11.25	-1.19	-0.03	-1.22
D	6704.057	13.77	12.39	12.64	-1.38	0.25	-1.13
E	8221.455	14.37	13.12	14.16	-1.25	1.04	-0.21
F	14584.44	15.20	14.83	14.41	-0.37	-0.42	-0.79
G	17226.15	15.54	14.84	14.45	-0.70	-0.39	-1.09
H	18743.24	15.54	14.84	14.65	-0.70	-0.19	-0.89
I	21550.46	15.54	14.83	14.76	-0.71	-0.07	-0.78
J	25237.33	15.67	15.70	15.63	0.03	-0.07	-0.04
Steamboat Slough							
C	9996.48	11.61	11.63	11.61	0.02	-0.02	0.00
D	11989.24	12.02	11.91	11.88	-0.11	-0.03	-0.14
E	12840.2	12.09	11.99	11.95	-0.10	-0.04	-0.14
F	13350.41	12.35	12.14	12.10	-0.21	-0.04	-0.25
G	15763.14	13.06	12.76	12.70	-0.30	-0.06	-0.36
H	17975.77	13.76	13.32	13.24	-0.44	-0.08	-0.52
I	21615.51	14.97	14.45	14.28	-0.52	-0.17	-0.69
J	24130.24	15.33	14.90	14.64	-0.43	-0.26	-0.69
K	25338.37	15.54	15.18	14.96	-0.36	-0.22	-0.58
L	26247.62	16.03	15.18	14.96	-0.85	-0.22	-1.07
M	30347.64	16.65	16.09	15.97	-0.56	-0.12	-0.68
N	33865	16.65	16.13	16.00	-0.52	-0.13	-0.65
O	36775.99	16.65	15.69	15.63	-0.96	-0.06	-1.02
Ebey Slough							
B	11437	11.71	11.14	11.12	-0.57	-0.02	-0.59
C	12388.9	11.81	11.32	11.29	-0.49	-0.03	-0.52
D	15507.44	12.28	11.92	11.88	-0.36	-0.04	-0.40
E	17821.97	12.46	12.23	12.19	-0.23	-0.04	-0.27
F	19652.18	12.68	12.73	12.68	0.05	-0.05	0.00
G	25122.9	14.03	13.69	13.57	-0.34	-0.12	-0.46
H	31922.58	15.29	14.77	14.58	-0.52	-0.19	-0.71
I	35321.3	15.67	15.15	14.97	-0.52	-0.18	-0.70
J	38111.02	16.06	15.56	15.38	-0.50	-0.18	-0.68
K	38596.42	16.10	15.56	15.38	-0.54	-0.18	-0.72
L	41488.96	16.21	16.02	15.90	-0.19	-0.12	-0.31
M	48818.33	16.73	16.14	16.03	-0.59	-0.11	-0.70
N	50557.6	16.86	16.25	16.17	-0.61	-0.08	-0.69

Table 4 continued							
Ebey-Steamboat Connection							
A	283.407	15.54	15.18	14.97	-0.36	-0.21	-0.57
B	1341.273	15.84	15.34	15.15	-0.50	-0.19	-0.69
C	2973.456	16.09	15.56	15.40	-0.53	-0.16	-0.69

C. Mapping Requirements

The following maps are provided in PDF form with this LOMR application:

- Maps 1-3: Certified topographic work maps for Corrected Effective Conditions
- Maps 4-6: Certified topographic work maps for As-Built Conditions
- Maps 7-9: Annotated FIRMS

In addition to being provided in PDF format, the accompanying geospatial data necessary to replicate the contents of the maps are provided in a geodatabase file (GDB).

The topographic data for the Corrected Effective modeling and mapping is comprised entirely of topobathy generated by the USGS as a part of the CoNED project and was collected in 2020 (vertical accuracy of 0.22 meters or 0.7 feet). For the As-Built Conditions modeling, the project area was updated with as-built survey of the setback dike and other areas of project grading within the boundary shown on Figure 2. Areas outside of the as-built limits utilized the USGS topobathy terrain. All data and mapping utilized the Washington State Plane North horizontal coordinate system (2011 update, WKID: 6597), with the North American Vertical Datum of 1988 (NAVD88) as the vertical datum. The State of Washington uses the U.S. Survey Foot for units of length in this system.

Several mapping assumptions and approaches were necessary to complete the data shown on the workmaps and annotated FIRM maps:

- Downstream tie-in – a coastal study of the area set the controlling tidal elevation for 100-year SFHA mapping at 13 feet NAVD88; this value was used to set the “Limit of Coastal Study” location for Corrected Effective and As-built conditions. Mapping from this point downstream is held at a static 13-foot elevation (coastal influence) rather than the lower elevations in the model results (riverine influence).
- In areas where off-channel storage areas are inundated due to universally overtopped levee boundaries, the BFE is drawn continuously per guidance for overtopping of non-accredited levees mapping (all levees in the revision zone are non-accredited).
- In areas where off-channel storage areas are inundated and flooding is held at a higher elevation inside the levee area versus the riverside BFE, the area is mapped at a ponded elevation reported by the hydraulic modeling. Riverside BFEs stop at levee boundaries in this case.
- No changes were made to the Density Fringe boundary except where the 100-Year SFHA boundary moved inside the Density Fringe boundary; the Density Fringe was edited to match at those locations.

- Effective mapping shows floodway for the sloughs between the levees. No such analysis has been performed for afloodway in this estuary, so floodway was remapped as Density Fringe in Corrected Effective and As-Built conditions.

D. Common Regulatory Requirements

The results of the As-Built Condition hydraulic model show small increases in the predicted water surface elevation relative to the Corrected Effective conditions model results at the downstream end of the project site where the northern-most breach of the existing dike is made. In the vicinity of Section D (RM 1.08) downstream of the breach, model cross-sections show an increase of between 0.09 and 0.35 ft. In the vicinity of Section E (RM 1.35) immediately upstream of the breach, model cross-sections show an increase of between 0.16 and 1.04 ft. When comparing as-built BFEs to Effective BFEs, all elevations are at or below those on the Effective map of the area. Notifications to all affected property owners will be sent upon the completion of mapping and technical review of this submittal by FEMA.

The as-built project was completed almost entirely within the mapped Density Fringe in this area. SCC Chapter 30.65 (Section 30.65.240 through 30.65.285) is the ordinance governing development in the Density Fringe:

SCC 30.65.240 Density Fringe Area - specifies "The development Criteria contained in SCC 30.65.250 and 30.65.255 shall be utilized to prevent a cumulative increase in the base flood elevation of more than one foot." SCC 30.65.250 specifies maximum allowable density; SCC 30.65.255 specifies maximum allowable obstruction.

SCC 30.65.260 Density Fringe Area: Exceptions to Maximum Allowable Density and Obstruction Limitations – 30.65.260(2) Dikes.

Snohomish County PDS is the County agency responsible for managing and permitting development in the Density Fringe areas of the County. PDS has provided written confirmation (see CLOMR application) in support of this application that PDS is requesting as part of their flood hazard permitting process, stating:

- Appropriate County development permits including flood hazard permits have been issued for this project
- The issuance of flood hazard permits found that the project meets the development criteria for the Density Fringe Special Flood Hazard Area
- Documentation was provided during the permit process to demonstrate that the project does not contribute to a cumulative increase in the base flood elevation of more than one foot; and
- The County "is not requesting a re-delineation of the floodway/density fringe area boundary." (Snohomish County, June 24, 2016)

Conditions of 44CFR65.12 were addressed:

Alternatives for setback dike alignment and breaching locations of the existing dike were evaluated. None produced results more protective of flood hazard than the current design, which was developed to keep any rise in the 100-year flood level as close to zero as possible. The only grading in the Density Fringe was the removal of existing levee to create breaches, and to create or restore tidal channels.

Material excavated from the existing levee and tidal channels was graded along an 1,100-foot section of the setback dike and the remaining portions of the existing dike. No fill was placed to remove any structures from any regulatory special flood hazard areas.

Snohomish County and the City of Everett are joint stakeholders in this County permitted, State and Federally (NOAA) funded project. All of the area between the new setback dike and the river was intended to be flooded as part of the reconnection of the tidal estuary to the river network. The County owns or controls all of the land affected, and there are no structures existing in the area between the new setback levee and the existing dikes (located along the channel banks). As a result, no insurable structures are affected by rises documented in this LOMR application.

Riverine Structures Form (Form 3)

A. General

This project was a new setback dike (setback levee) constructed in the Density Fringe of the tidally influenced lower Snohomish River. It contained only "levee" elements, and did not contain channelization, bridge/culvert, or dam elements. Sediment transport was considered in the design, but a detailed sediment transport analysis was not conducted. The Smith Island Setback Dike is a levee structure. Detailed Form 3 responses can be reviewed in the CLOMR application; this response only details any deviations from the proposed setback dike plans.

E. Levee/Floodwall

Item 1 – System Elements
This system consists of a single, 5,800-foot-long earthen embankment built to USACE geotechnical standards and was designed to provide 10-yr plus 2-feet freeboard flood protection. There are no Floodwall / Structural (concrete) elements in the design. It is not intended to provide 100-year protection from the Base Flood; Certification was not sought from the USACE, and Accreditation was not sought from FEMA. The completed Smith Island Setback Dike qualifies for the USACE PL84-99 Maintenance Program. The operations and maintenance plan for the Smith Island setback dike is included with this submission as are the as-built plans (Smith Island Phase 1 As Built.pdf).

Only one major change to the levee design was made during the construction phase of the project:

- Levee top elevation was built to +16.0 feet NAVD88 rather than +15.0 feet to allow for some settling of the levee for an end target of no less than +15.0 feet NAVD88.

All other entries for Form 3 have been replicated from the CLOMR application as no other deviations or further studies related to the construction of the Smith Island setback dike occurred.

Section F – Sediment Transport
Sediment transport was considered during the design process for the setback levee. A hydraulic modeling study of Union Slough completed by Tetra-Tech identified areas of potential scour and deposition in the project reach. This report can be reviewed as submitted with the CLOMR application.