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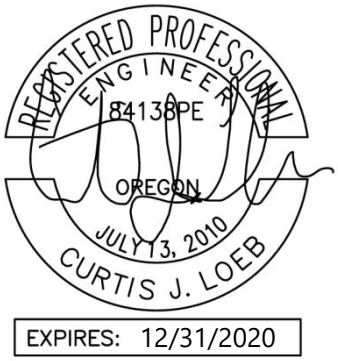

Technical Memorandum

Date:	REVISED 9/22/2019
To:	Dick Vander Schaaf, Project Manager Associate Coast and Marine Conservation Director The Nature Conservancy of Oregon
From:	Curtis Loeb, PE, Principal Engineer Wolf Water Resources Portland, OR
Project:	Porter Tract Restoration - Kilchis Estuary Preserve
Subject:	Flood Analysis Memo

Introduction

The Nature Conservancy of Oregon (TNC) seeks to continue restoration of tidal wetland habitats along the margins of Tillamook Bay with restoration of the Porter Tract, an approximately 60-acre parcel in the floodplain of the Kilchis River in Tillamook County west of Highway 101 and north of the town of Tillamook. The Porter Tract is located in the lower Kilchis River watershed, one of the five large river tributaries to Tillamook Bay. The restoration site is situated approximately one mile from the mouth of the Kilchis River and is influenced by both river flow and ocean tides. The Porter Tract is north of and adjacent to the recently restored Kilchis Estuary Preserve (former Dooher Property) that was constructed in 2015 by the TNC. The cumulative area of these restoration efforts would result in 127 acres of high functioning estuarine habitat.

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The overall goal of the Kilchis Estuary Preserve project is to restore freshwater and tidal hydrologic connections to the Porter Tract wetlands, providing off-channel rearing habitat for salmonids and re-establishing spruce swamp habitat. Specific objectives and constraints of the project are described in the Basis of Design Report (W2r 2019).

Restoration measures proposed for the Porter Tract Restoration include:

- Tidal channel creation,
- Restoration / expansion of the connector channel between the Hathaway Slough tributary channel and Stasek Slough,
- Filling linear drainage ditches,
- Removing man-made dikes and berms along sloughs,
- Removal of water control structures (tidegates, culverts, and berms),
- Two new pedestrian bridges for vegetation maintenance,
- Wood habitat structures in the tidal channels as cover habitat and organic substrate for rearing habitat for juvenile salmonids,
- Site revegetation with native grasses, shrubs, and woody plants

The scope and purpose of this memo is to summarize any potential changes in flood conditions under proposed restoration actions using a 2-dimensional hydrodynamic model of the Kilchis River and its broader fluvial and tidally-influenced floodplain including the Porter Tract. Evaluation of flood conditions compares existing conditions to those under the above proposed restoration actions at key locations around the site to determine the timing and magnitude of any changes.

Hydrodynamic Model Development

A two-dimensional hydrodynamic model was originally developed for the Dooher Property (Kilchis River Estuary Restoration Phase1; ESA 2014). Model geometry or topographic extents along the Kilchis River and Tillamook Bay tidelands are described in the Phase 1 report. This report also describes model calibration to observed water levels, and hydrologic (tidal water level and riverine flow) boundary condition scenario development to examine typical tidal conditions as well as extreme storm events.

The Phase 1 model was updated to reflect Porter Tract Concept Restoration Designs (W2r 2017), and then it was updated for minor revisions associated with the final engineering designs (W2r 2019). The most recent changes to the model to reflect final restoration design are described in the letter report by Northwest Hydraulic Consultants (NHC 2019), which is included in Attachment A. The final restoration design overview and associated changes to the hydrodynamic model geometry are included in Figure 1 and Figure 2, respectively.

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Figure 1 Porter Tract restoration site overview indicating restored channels, filled ditches, dike removals, new bridges, and low mounds.

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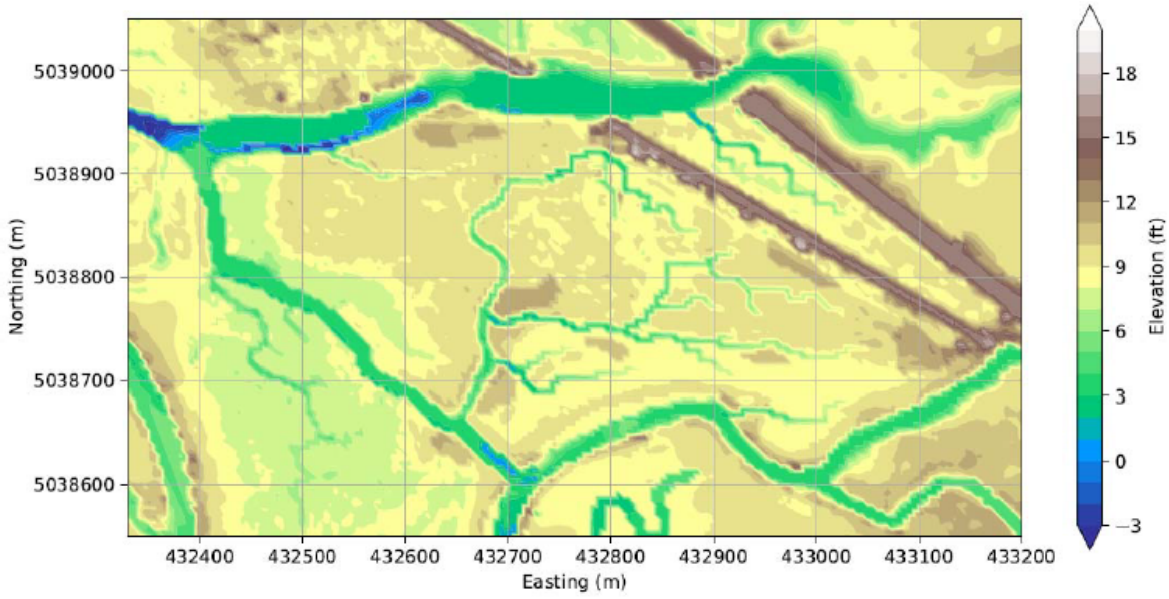
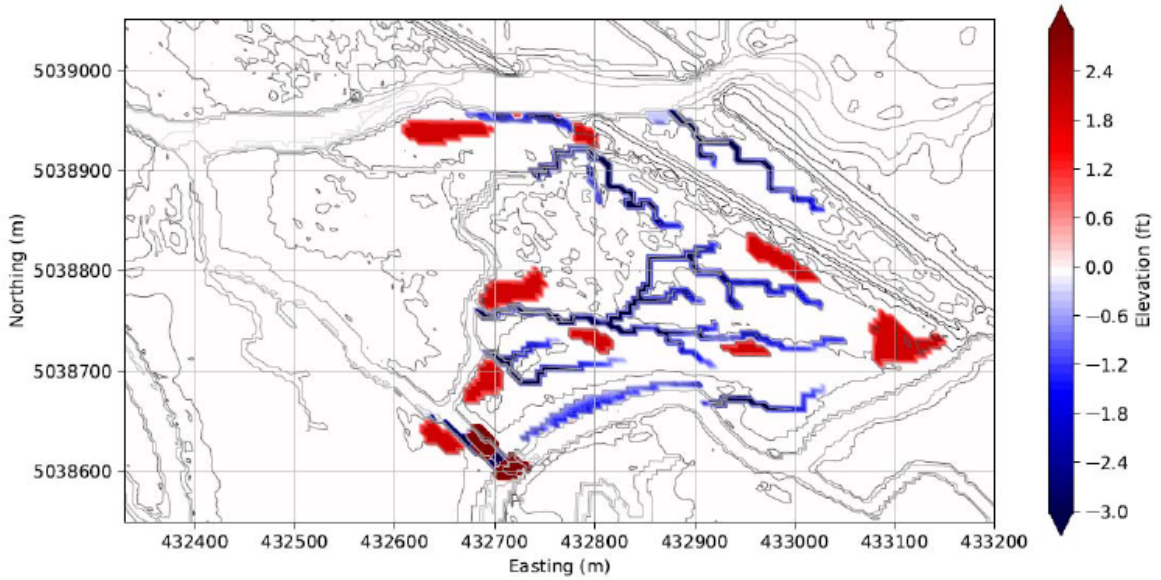


Topography with proposed restoration measures.



Differences between existing topography and proposed topography.

Figure 2 Hydrodynamic model geometry (top) and changes in topography (bottom) reflecting the restoration design (NHC 2019).

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Model results

Results of the hydrodynamic model simulations are presented in the NHC memo (2019). Model simulations examined two hydrologic scenarios: representative base flood conditions which included the December 2015 storm with peak water levels of 12 feet NAVD88 approximating the base flood condition (1% annual chance occurrence event); and, typical winter /tidally-dominant conditions represented by the January 2017 storm which experienced a low-level storm followed by typical tidal fluctuations. The combined flow/tidal boundary conditions are shown in the NHC report in Attachment A, and results of the **representative base flood scenario** are summarized and interpreted below.

Representative base flood conditions

Time series comparison of water levels under existing and proposed (detailed design) conditions at Stasek Slough and Hathaway Slough are shown in Figure 3 and Figure 4, respectively.

Comparison of water levels under existing and proposed (restoration) conditions indicate that there is **no increase in base flood water levels** during the coincident peaks of tidal and riverine water levels overall (site-wide) and also at the two key locations examined (Stasek and Hathaway Sloughs below their respective Highway 101 crossings).

The reasons for no increase in base flood levels are that (1) base flood water levels are very high (approximately elevation 12 feet NAVD88) relative to general land and former berms elevations which range from approximately 7 to 10 feet NAVD88, and (2) accordingly, there is no existing or current barrier to either riverine- or tidally-based water levels of this magnitude. Water depths during the base flood are approximately 2 to 5 feet across the floodplain. For any flood events more extreme than those simulated in the model (i.e., those with combined water levels higher than elevation 12 feet NAVD88 especially events driven by tidal/ocean conditions including storm surge and wind setup), water level comparisons would be similar (no increase) due to even greater relative depths across the floodplain within and adjacent to the project limits.

Non-peak riverine flow / high tide conditions

At **Stasek Slough** during non-peak / high tide conditions (i.e. tidal water levels at or above MHHW), water levels under proposed conditions show a minor decrease that appear to be due to improved drainage as a result of the expanded connector channel between Stasek Slough and the tributary to Hathaway Slough. The general decrease is small, on the order of 0 to 0.5 feet, and is most pronounced during the falling limb of the tide, when waters are draining from Stasek Slough.

At **Hathaway Slough** during non-peak / high tide conditions, there is a corresponding minor increase in water levels (0 to 0.5 feet) on the same order of magnitude as the decreases in Stasek Slough. The short term increases also occur during the falling limb of the tide. The minor increase appears to be due to additional / faster drainage from Stasek Slough into the Hathaway Slough tributary.

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During non-peak but elevated Kilchis River conditions, there is a very minor (maximum of between 0.1 to 0.2 feet, or approximately 1 to 2 inches) increase in water levels in Hathaway Slough when water levels are between 10 and 11 feet NAVD88. The increase is very small and is close to the level of precision of the hydrodynamic model. This small increase appears to be due to slightly more Kilchis River overflows reaching Hathaway Slough through the expanded connector channel. However, during the instance (few hours) when tides peak in concert with elevated Kilchis River flows and water surface elevations reach 12 feet NAVD88, any difference in water levels goes to 0, as flood waters once again overwhelm the general vicinity of the Porter Tract (see 12/10/2015 approximately 1300 hours).

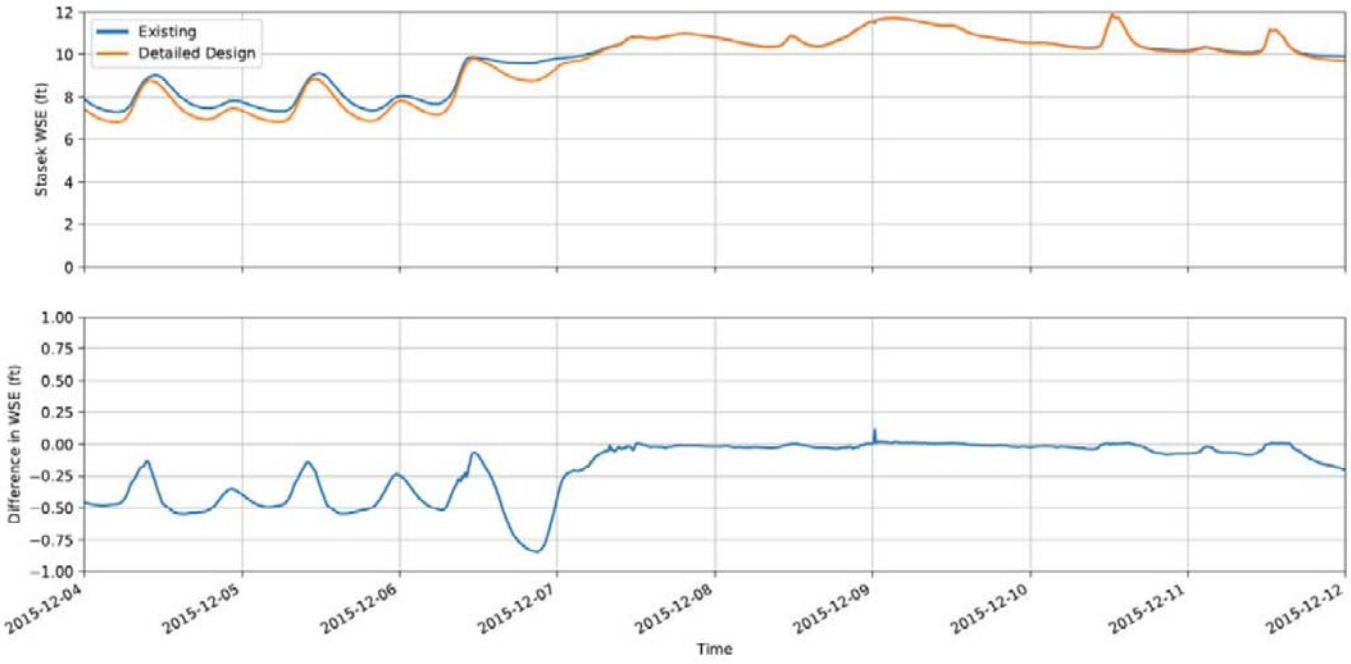

Figure 3 Comparison of water levels in Stasek Slough under existing and proposed conditions for the December 2015 peak flood event.

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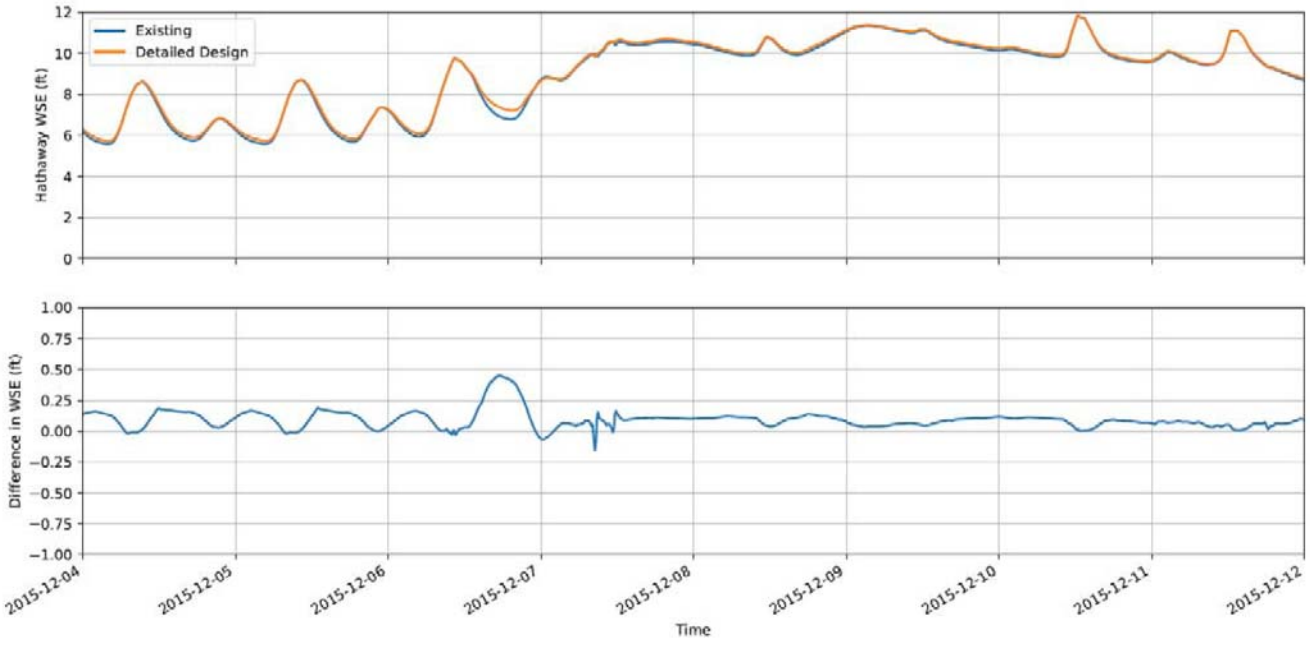

Figure 4 Comparison of water levels in Hathaway Slough under existing and proposed conditions for the December 2015 peak flood event.

FEMA Flood Map

The Tillamook County Flood Insurance Rate Map and Flood Insurance Study was updated in 2018 (FEMA 2018). The updated map is shown below in Figure 5.

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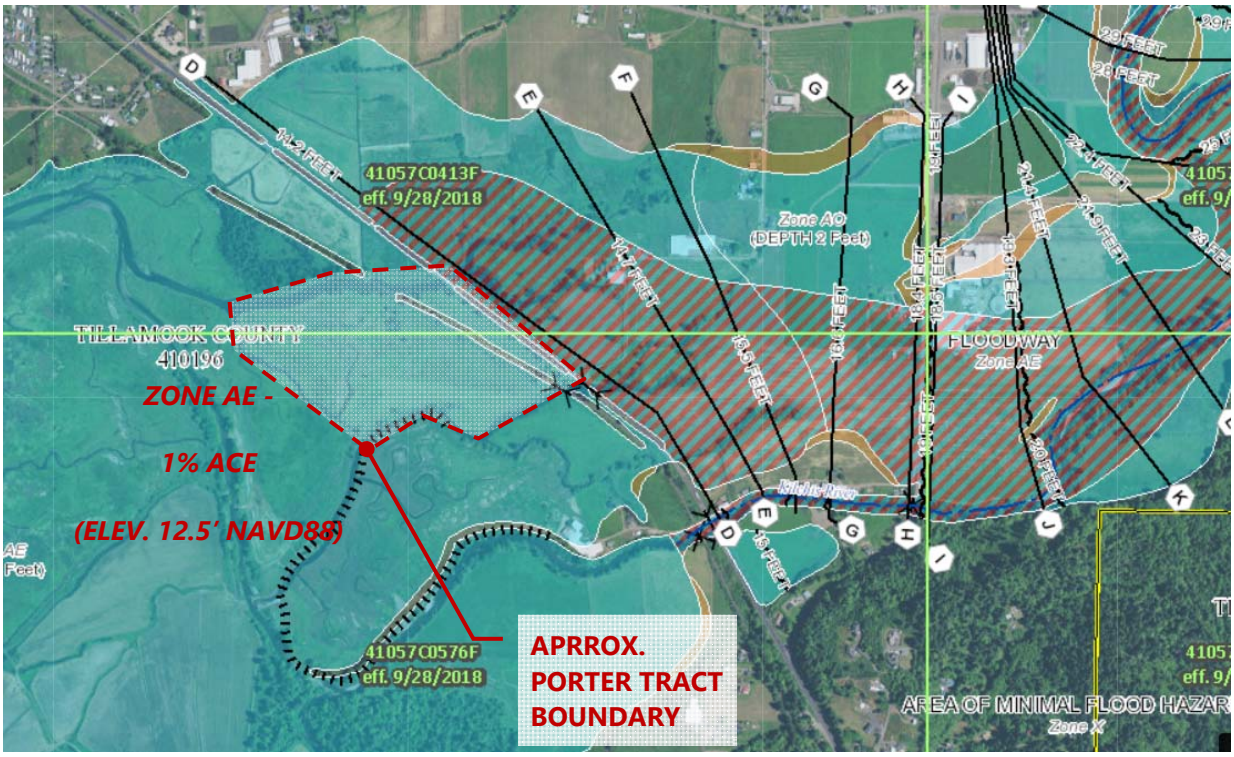

Figure 5 2018 FEMA flood insurance rate map shown with approximate Porter Tract Project limits and adjacent region marked as floodplain (light blue/green shading).

Tillamook County Land Use

The Tillamook County Department of Community Development (County) enforces land development restrictions through the Land Use Ordinance (LUO) to promote appropriate uses of land and to protect and promote health and safety of the public (Tillamook County LUO 2015). LUOs were updated in 2015 to conform to current statutes and administrative rules, and to update requirements to achieve desired outcomes and generally to improve the structure and content of the LUOs.

The Porter Tract is zoned partially in the Estuary Natural (EN) and Farm (F-1) zones (see Figure 6).

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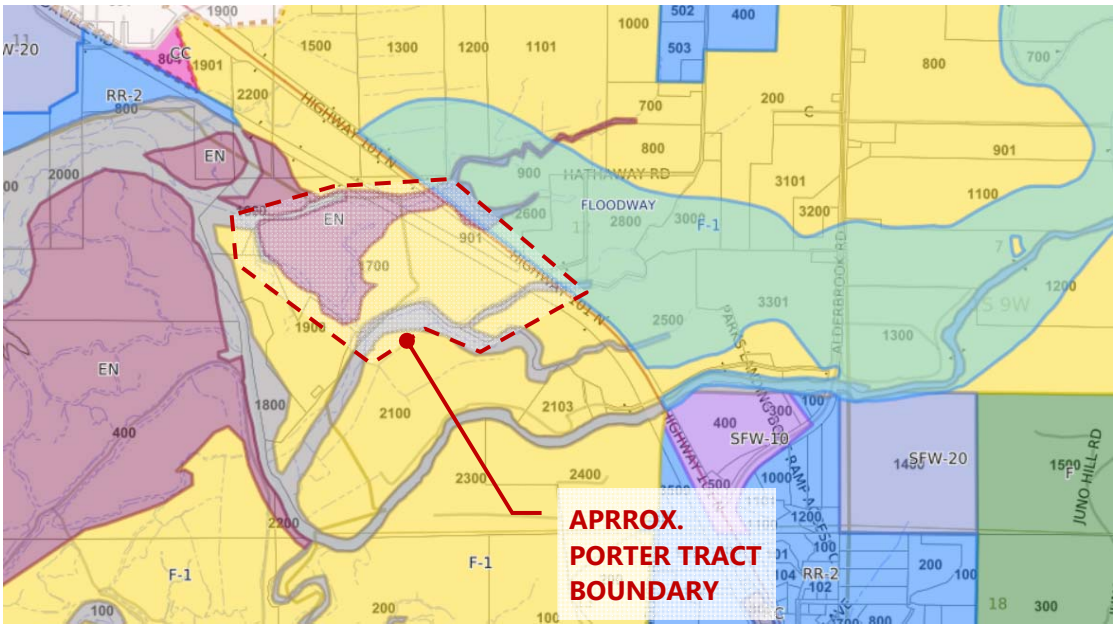

Figure 6 Tillamook County land use zones overlain on the Porter Tract (Tillamook Co. 2019).

Developments in the Floodway and Floodplain

Section 3.510 (8) of the Tillamook County Land Use Ordinances (LUO) states that that encroachments (e.g., fill, new construction, substantial improvements, and other development) within the demarcated floodway of a watercourse such as the Kilchis River must provide for conveyance of the base flood (one percent annual chance of occurrence) event without resulting in any increase in flood levels. The floodway is the portion of a river that actively conveys flows and frequently has high velocities along with debris.

In contrast, the floodplain is the general area beyond the floodway and active conveyance zone that is inundated by the base flood event. The Porter Tract project is wholly within the FEMA-designated floodplain (Zone AE, 1% annual chance occurrence demarcated), as the floodway ends on the upstream side of Highway 101. For agricultural-zoned lands within the floodplain such as those surrounding and including the Kilchis project site, the LUO does not generally restrict increases in water levels. Thus, the LUO does not preclude the anticipated minor, short-term and non-peak rise in water levels of approximately 0.1 feet within and adjacent to the project site that occurs during flood levels below the base flood. And to reiterate the prior section of this memo describing model results, flood levels during the base flood are not anticipated to change under proposed conditions.

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References

ESA 2014. Kilchis River Tidal Wetland Restoration Design, Supplemental Hydrodynamic Modeling Assessment of Flooding and Evolved Bed Conditions. Memo prepared by Environmental Science Associates (ESA), Portland, OR, prepared for The Nature Conservancy of Oregon, July 2014

FEMA 2018. Federal Emergency Management Agency Flood Insurance Study, Tillamook and Incorporated Areas, Volumes 1 and 2, effective Sep. 28, 2018.

NHC 2019. Kilchis River Estuary Porter Tract Restoration – Detailed Design, Hydrodynamic Model Results. Letter Report prepared by Northwest Hydraulic Consultants (NHC); prepared for Wolf Water Resources, Portland, Oregon, revised 7/8/2019.

Tillamook Co. 2019. Tillamook County GIS Portal. URL: http://tillamookcountymaps.co.tillamook.or.us/geomoose2

W2r 2019. Porter Tract Restoration, Kilchis Estuary Preserve - Basis of Design Report (Final Design). Report prepared by Wolf Water Resources, Portland, OR; prepared for The Nature Conservancy of Oregon, February 2019.

W2r 2017. Porter Tract Restoration, Feasibility Analysis and Conceptual Design. Report prepared by Wolf Water Resources, Portland, OR; prepared for The Nature Conservancy of Oregon, November 2017.

Attachment A

Kilchis River Estuary Porter Tract Restoration – Detailed Design, Hydrodynamic Model Results, Northwest Hydraulic Consultants, revised 7/8/2019.