Appendix J
Geomorphology and Sediment Transport Evaluation

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Southern Flow Corridor Project

Geomorphology and Sediment Transport Evaluation

DR-1733-OR

Tillamook County, Oregon

October 2015

CCPRS

Fast Response. Smart Recovery.

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Acronyms and Abbreviations

bgs	below ground surface
BMPs	best management practices
BP	before present
cm	centimeters
EIS	environmental impact statement
FEMA	Federal Emergency Management Agency
km^2	square kilometers
m	meter
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
N/s	Newtons per second
OCCRI	Oregon Climate Change Research Institute
RS	river station
SFC	Southern Flow Corridor
TBNEP	Tillamook Bay National Estuary Project
TBTF	Tillamook Bay Task Force
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service

SECTION 1 Introduction and Scope

The Federal Emergency Management Agency (FEMA), National Oceanic and Atmospheric Administration (NOAA), the United States Fish and Wildlife Service (USFWS), and state and local partners, are proposing to fund the implementation of a project to alleviate flooding while improving tidal habitat at the head of the Tillamook estuary, in northwest Oregon. The project, named the Southern Flow Corridor (SFC) Project, occupies an area of low floodplain between the Trask and Wilson rivers, where they converge and enter Tillamook Bay, Oregon. Although the purposes of the SFC project are to alleviate flooding and improve habitat, the project would also influence many aspects of sediment transport and geomorphology at the head of the Tillamook estuary. In turn, altered sediment transport and geomorphic regimes might be expected to influence flooding and habitat, through their interactive effects on the channel and floodplain topography.

In compliance with the National Environmental Policy Act (NEPA), FEMA is preparing an environmental impact statement (EIS) to disclose the benefits and impacts of the proposed project. The purpose of this report is to provide a semi-quantitative overview of the most important geomorphic and sediment transport features of the project, for the purpose of informing the development of the EIS.

Geomorphology and sediment transport, as used here, refers to the interrelated processes that control the movement of sediment in the river and consequent changes in topography. Spatial and temporal changes in sediment transport result in deposition and erosion, leading to changes to the shape of the channel and floodplain (i.e., geomorphology); these changes, in turn, directly impact hydraulics. For example, sediment deposition reduces the threshold discharge for overbank flooding, leading to more frequent flooding.

Providing a thorough literature review and summary is beyond the scope of this report. However, there are several comprehensive reviews of the scientific literature on geomorphology and sediment transport in Tillamook Bay and the Tillamook Bay rivers (Coulton et al. 1996; TBNEP 1998; USACE 2005; Pearson 2002; Jones et al. 2012). Chapter 5 of the report produced by the Tillamook Bay National Estuary Project (TBNEP) (1998) contains a particularly comprehensive and systematic summary of the technical literature on sedimentation and geomorphology in Tillamook Bay. That document describes existing conditions for many topics that are not covered in detail in this current report.

This report describes the existing geomorphological conditions of the project site, focusing on the topics and conclusions judged to be most relevant to the SFC Project:

- First, the report briefly condenses the scientific literature about the geomorphic setting, sediment transport processes, and causes of sedimentation in Tillamook Bay.
- Second, the existing sediment transport conditions are briefly evaluated using output from the 1-Dimensional (1-D) hydraulic model (HEC-RAS) available for the site.
- Following the description of the existing conditions, the report summarizes some of the anticipated geomorphic consequences of the No Action Alternative, and the three action

alternatives, SFC-Landowner Preferred Alternative (Proposed Action), Hall Slough Alternative, and the SFC – Initial Alternative, using available information. The anticipated consequences of the project alternatives are subdivided into short term[1] impacts (during and immediately following construction), transitional period impacts (1 year to ~20 years following construction), and long term impacts (> 20 years following construction).

HEC-RAS model is a one-dimensional computer program that models the hydraulics of water flow through natural rivers and other channels. The program can simulate both steady and unsteady flows. Also, the program includes several hydraulic design tools such as sediment transport capacity calculation module. For this study, unsteady-state HEC-RAS model was used, which was developed through a full network of open channels. The hydraulic structures including bridges, culverts, and levees were incorporated into the model. After running the model, the sediment transport rates at all the cross sections were calculated for the maximum flow depths using the sediment transport capacity calculation module.

[1] The definition of the short-term, transition period, and long-term are applied to geomorphology effects and may differ from other resources studied in the EIS. The transition period for geomorphology covers both the initial 1 to 5 years following construction when the vegetation on site would be expected to become established and potential site-generated erosion would decline and also the transitional period of 1 to 20 years when larger scale geomorphic changes such as channel formation and channel aggradation as a result of the project may be expected to be in greatest flux.

SECTION 2 Existing Geomorphic Conditions

The project area is hydraulically and geomorphically complex, owing to the interaction between tidal fluctuations and the convergence of three rivers (Wilson, Trask, and Tillamook). Geomorphology and sediment transport in the project area have been widely studied, in part because they are crucial factors influencing navigation, flooding, and habitat in one of the major tidal estuary systems on the Pacific Coast. The following section highlights geomorphological literature that is most relevant to the SFC project.

2.1 Geomorphic Setting

The project area is in the tidally influenced sections of the Wilson and Trask rivers, at the head of Tillamook Bay (**Figure 1**). The five rivers draining into Tillamook Bay—the Wilson and Trask rivers being the two largest—have naturally high sediment loads due to the heavily weathered volcanic and sedimentary bedrock, steep slopes, seismic activity, and heavy rainfall in their watersheds (Jones et al. 2012). This is discussed in more detail in Section 2.7 of this document.

Most of the watersheds are in the steep upland portion of the Coast Range, and the abrupt transition from mountainous terrain to the lowland containing Tillamook Bay is only 10 to 15 river km upstream of the project area at most, at head of Tillamook Bay (Jones et al. 2012).

The watersheds of the Wilson and Trask rivers, 500 square kilometers (km^2) and 450 km^2 respectively, are mostly on the steep uplands of the Oregon Coast Range. These watersheds are dominantly underlain by Eocene volcanic rocks and sediments (Walker and MacLeod 1991), which tend to be highly erodible rock types. An important geomorphic distinction between the two rock types is that, once eroded, the sedimentary rocks disaggregate more quickly, dominantly producing sand and fines, whereas the volcanic rocks tend to produce gravel-size bed material, including cobbles and boulders (Wallick et al. 2011; Mangano et al. 2011; Jones et al. 2012). Both the Trask and Wilson river basins contain large areas of volcanic and sedimentary rock types (see Section 2.6). Other reports contain tables reporting the proportions of different types of rocks underlying the watersheds (e.g., Tillamook Bay Task Force [TBTF] et al. 1978; Pearson 2002; Jones et al. 2012).

The Coast Range portions of the watersheds contain large areas of active and inactive landslides, debris flows, and earth flows. Mass movements can temporarily dam large rivers such as the Wilson and Trask rivers, possibly impacting the duration and sizes of floods (Jones et al. 2012). These background processes may be exacerbated by natural and anthropogenic disturbances, such as vegetation removal, prescribed burning and wildfires, earthquakes, tsunamis, and heavy rainfall, all of which may deliver abundant sediment to the head of Tillamook Bay, as well as recent and ongoing sea level rise (e.g., TBTF et al. 1978; Jones et al. 2012). Additional background information on the geomorphic context may be found in Attachment A to this appendix.

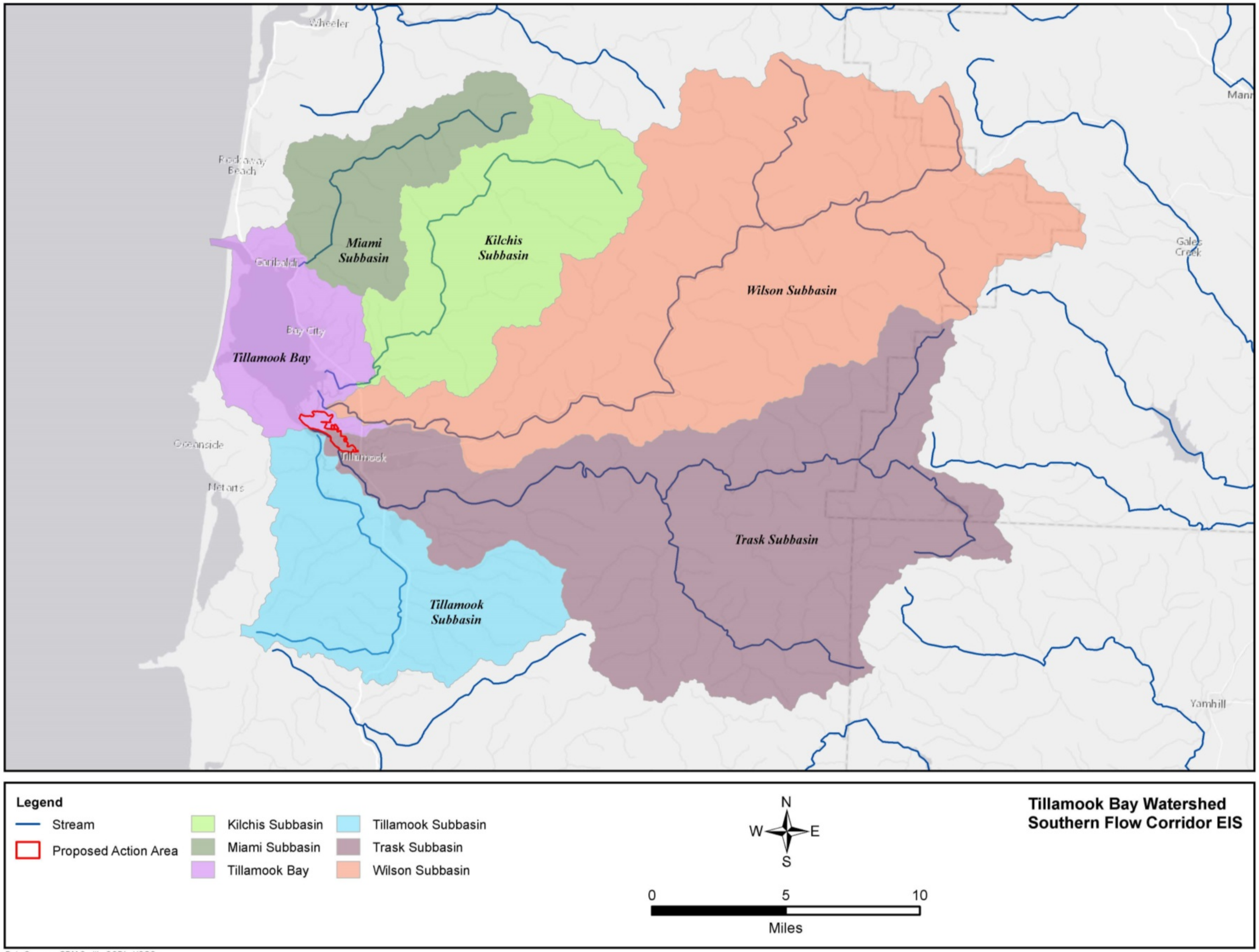


Figure 1. Tillamook Bay Watershed

Summary of Geomorphic Setting

The SFC project area, at the head of Tillamook Bay, sits at the transition between the upland watersheds and the tidal zone. The high watershed sediment supply, combined with the abrupt transition from steep uplands to tidal lowlands, naturally tends to favor rapid sediment deposition. In the tidally influenced portions of the Wilson and Trask rivers, sedimentation occurs in the river bed and in deltaic deposits, such as bars and islands. Surprisingly, Jones et al. (2012) found that exposed sand bar area decreased substantially over the past 70 years, which they attributed to vegetation colonization and floodplain modifications (levees and bank armoring). Overbank sedimentation in the tidal zone is limited, primarily owing to channelization of the Wilson and Trask rivers and the building of levees, such as those within the SFC project area.

2.2 Historical Accounts

Historical accounts describing the project area are helpful to characterize the existing geomorphological conditions. Historical accounts provide a picture of the geomorphic setting, and help interpret the impacts of human intervention. Several studies have compiled historical accounts of the geomorphology at the head of Tillamook Bay (Coulton et al. 1996; TBNEP 1998; Pearson 2002; Jones et al. 2012). Some of the most relevant descriptions drawn from these accounts and interpretations are:

- Few if any accounts are available before European-American colonization, but sediment cores from Tillamook Bay provide evidence that forest burning by Native Americans increased sediment delivery to the head of Tillamook Bay prior to European contact (McManus et al. 1998), although some question whether the practice was widespread (Nonaka and Spies 2005). This implies that **sediment loads, though high, can be measurably impacted by human activity in the watershed**.
- As late as the early 20th century, the Wilson and Trask rivers were so clogged with wood that they flooded far more frequently than they would otherwise, and contained log jams more than 200 meters (m) long. The U.S. Army Corps of Engineers (USACE) reported that "One of the most serious troubles with this bay is caused by the large number of snags and fallen trees that are carried in on floods, which eventually sink on the shoals and become buried in the same" (USACE 1897). Therefore, a **large amount of the material underlying the present river channel and floodplain may partially consist of buried wood**.
- The USACE reported that "gravel, sand and mud is annually deposited" in the rivers entering Tillamook Bay, and that in 1896, there was difficulty driving piles into the streambed due to encountering sand and gravel approximately 12 feet below the surface (USACE 1896). This implies that **gravel was being transported and deposited at that location because of the low gradients and tidal influence**.
- The USACE reported that as early as 1902 copious quantities of sediment (gravel, sand, and mud) were delivered to Tillamook Bay annually by its tributaries (Jones et al. 2012). This implies that **sediment loads were typically high prior to the era of widespread logging and wildfires**.

Summary of Historical Accounts

The geomorphology of channels at the head of Tillamook Bay has changed substantially over the past 100 to 200 years. The most important human-caused geomorphic changes are likely related to the removal of wood from channels, levee construction, bank armoring, and channel dredging (Levesque 2010). The tidal Wilson and Trask rivers have far less geomorphic complexity than they did at the turn of the 20th century.

2.3 Tillamook Bay Sedimentation History

Sedimentation in Tillamook Bay has been a practical issue pertaining to flooding and navigation for at least the 160-year duration of European American settlement, and probably was a factor in the location of Native American villages, fishing grounds, and other uses. Historical accounts clearly suggest the lower rivers were characterized by frequent flooding and sedimentation in the channels. Sedimentation in Tillamook Bay has long hindered navigation, increased flooding, and interfered with other activities, such as oyster cultivation, near the head of Tillamook Bay.

Several studies have documented sedimentation and channel changes and examined the natural and anthropogenic causes for sedimentation (TBTF 1978; Coulton et al. 1996; McManus et al. 1998; Pearson 2002; Komar et al. 2004; Jones et al. 2012, and others). This section summarizes the evidence of past and recent trends in sediment delivery based on accumulation of sediment in Tillamook Bay. Two approaches to characterizing sedimentation have been used in Tillamook Bay: repeat bathymetry and research coring and analysis.

2.3.1 Repeat Bathymetry

Because of its importance as an early navigation hub on the West Coast, bathymetric survey data for Tillamook Bay are available as far back as 1867. Bernert and Sullivan (1998) compared surveys of Tillamook Bay representing 1867, 1957, and 1995 (**Figure 2**). The red arrow in each panel in **Figure 2** points to the confluence of the Wilson and Trask rivers at the western edge of the SFC project area.

Bernert and Sullivan (1998) attributed some of the differences among the three bathymetric maps shown in **Figure 2** to poorer data density and accuracy in the 1867 survey, but made some qualitative observations of sedimentation patterns. From a comparison of the maps, they concluded:

> *"The bathymetric maps for 1957 and 1995 are generally similar, and suggest a somewhat more homogeneous bay as compared with the 1867 map, and one that is more conspicuously marked by distinct channels. We know that channel dredging occurred between 1867 and 1957, and dikes were constructed during that period as well." (p. 21)*

It would be possible but misleading to compute an average sedimentation rate for Tillamook Bay from the data shown in **Figure 2**, given the large data uncertainties, and the complex spatial patterns of sedimentation.

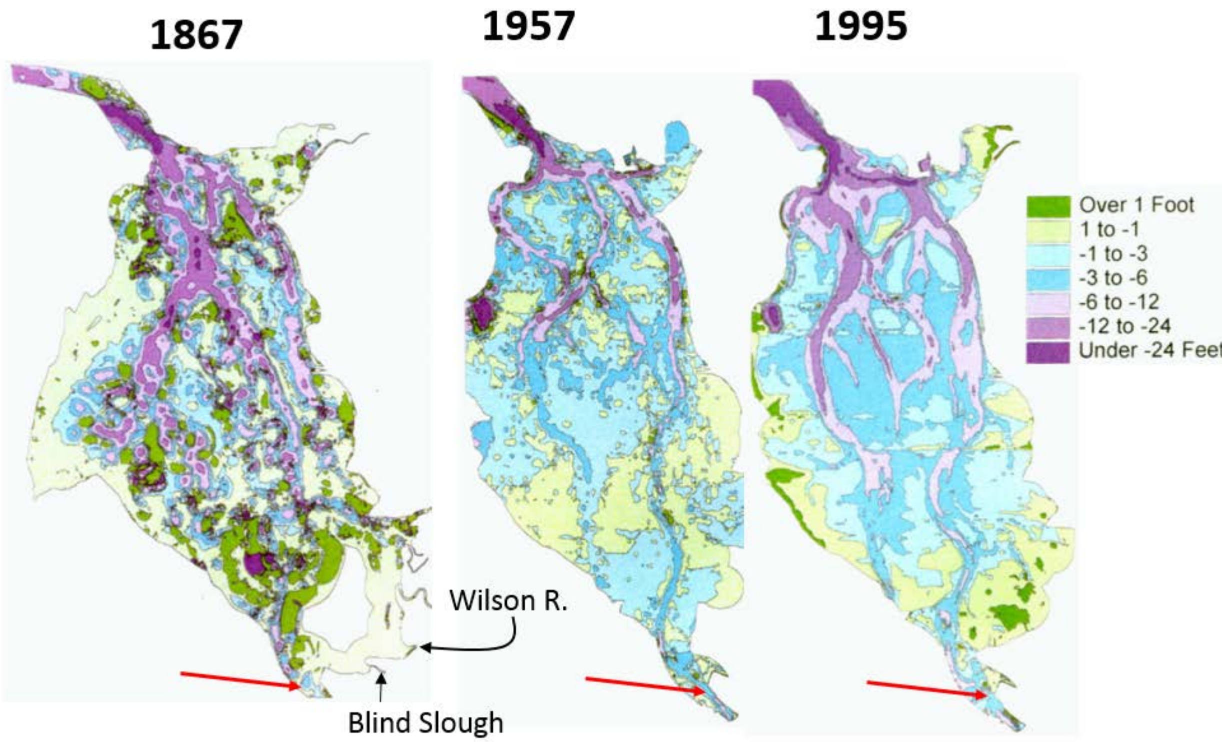


Figure 2. Historic Bathymetry for Tillamook Bay

Source: Bernert and Sullivan 1998
Note: Red arrows point to the confluence of the Trask and Wilson rivers at the downstream end of the SFC project area.

Overall, it appears from this analysis that sedimentation has been occurring over most of the Bay, possibly smoothing previously complex bathymetric surfaces, except where dredging and diking have maintained concentrated channels. Deposition has clearly occurred in the upper Tillamook Bay, in the vicinity of the SFC project area, between 1867 and 1957 (**Figure 2**). This pattern would be expected given the high sediment supply from the watershed, the low gradient, and the tidally-influenced geomorphic setting discussed in Section 2.1. In addition, sea level rise of about 0.5 foot between 1867 and 1995 almost certainly contributed to the sedimentation observed in the bathymetric data (Bernert and Sullivan 1998).

2.3.2 Tillamook Bay Surface Sediment Sampling

Extensive scientific coring has been conducted in Tillamook Bay (McManus et al. 1998; Komar et al. 2004). McManus et al. (1998) performed geochemical and mineralogical analyses of 106 surface samples around the Bay to try to establish sediment sources and to understand sediment transport pathways within the Bay. They also collected nine gravity cores for detailed analysis, dating using ^{210}Pb, ^{14}C to compute sedimentation rates, and using the down-core ratio of Aluminum to Titanium for tracking river sediment contributions over time.

McManus and others (1998) used the mineralogy and geochemistry of the surface samples to infer the present relative contributions of mud, rock fragments, and quartz/feldspar in sediment from the ocean and from rivers (**Figure 3**). Whereas beach sand, characteristic of marine sediment sources, consists of nearly all quartz and feldspar sand, sediment from the five Tillamook Bay rivers consists of comparatively angular rock fragments. Thus, the ratios of angular rock fragments and of non-quartz and feldspar minerals can be used as a proxy for the relative contributions of river and marine sediment sources.

Surface sediments are dominantly muddy sand to pure sand (**Figure 3A**), leading McManus, et al. to interpret that most of the mud coming from the rivers exits the Bay, and most of the sand is deposited. The ratio of rock fragments in surface samples clearly shows that river sources are the dominant sediment source of the southern Tillamook Bay, including the SFC project area (**Figure 3B**). This pattern is consistent with the pattern of mineral ratios (**Figure 3C**). Based on these data, McManus and others interpreted the pattern of sediment transport pathways for all of Tillamook Bay (**Figure 3D**).

Overall, marine source-dominated sediment fills the Bay near the active inlet and along the entire western half of the Bay. The eastern half of the Bay is dominated by river-derived rock fragments, principally because the combined channels of the Trask, Wilson, Tillamook and Kilchis rivers hug the eastern shore of the Bay as water flows toward the inlet (McManus et al. 1998).

2.3.3 Tillamook Bay Sediment Coring

In addition to investigating spatial patterns, McManus et al. (1998) analyzed nine cores to document changes over time in sedimentation rates and sediment sources. Using a sediment budgeting approach, they estimated that about 60 percent of the sand in the Bay is derived from marine sources and 40 percent from rivers. Including sand and silt (mud), for which the trap efficiency in Tillamook Bay is only estimated, they concluded that the total sediment contributions from river and marine sources were about equal. McManus et al. (1998) further concluded that the contributions of river sediments had increased in recent time, using the ratios of Aluminum to Titanium as a proxy for river sediment in the cores. The interpretation of that finding would be that human activity has increased the delivery of sediment to the head of Tillamook Bay.

Sediment accumulation rates in the cores, measured using radio-isotopic age markers (^{14}C and ^{210}Pb), were generally consistent with the findings from repeat bathymetry. The accumulation rates in two of the cores that contained shell fragments (dated at 1460 AD and 1720 AD) were 20 and 43 centimeters (cm) per century. Accumulation rates obtained using ^{210}Pb only provide sedimentation rates prior to European American arrival, because the upper portions of the cores were disturbed by bioturbation. Sedimentation rates for the undisturbed portions of the cores ranged from 7 to 138 cm per century, approximately consistent with the values obtained with ^{14}C. Those authors were unable to clearly show a recent increase in sedimentation rates due to human activity, but this is probably because the upper parts of the cores were disturbed due to burrowing animals. Full documentation of the coring data is provided in the original document.

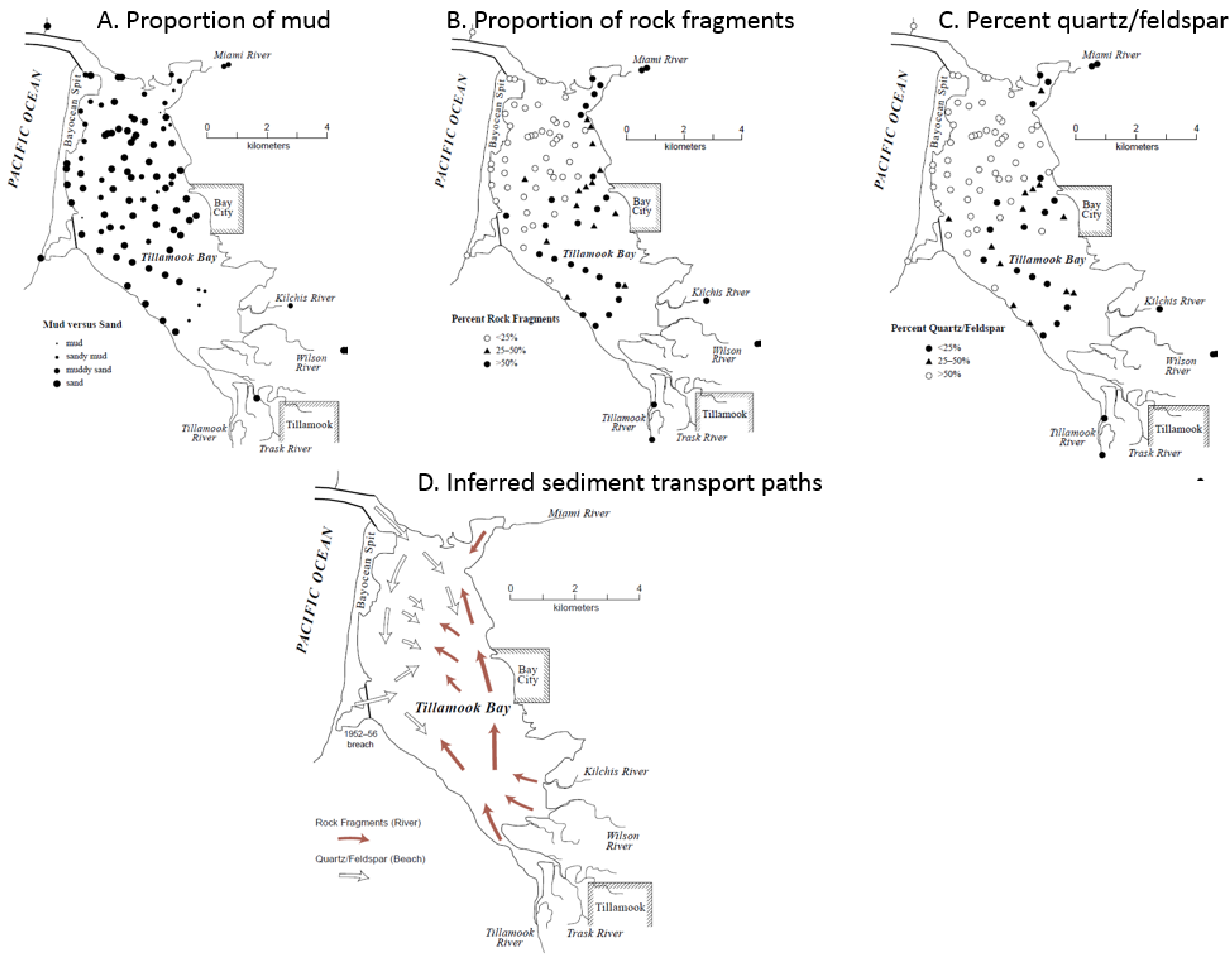


Figure 3. Results of Surface Sampling in Tillamook Bay

Source: McManus et al. 1996

2.3.4 Interpretation of Sedimentation History

Sediment accumulations and shoaling in Tillamook Bay have been related to changes in the condition of the upper watersheds (TBNEP 1978; Coulton et al. 1996; McManus et al. 1998; Pearson 2002; Komar et al. 2004; Jones et al. 2012, and others). In summary, the studies all agree that the five rivers draining into Tillamook Bay, the Wilson and Trask rivers being the two largest, have naturally high sediment loads due to the heavily weathered volcanic and sedimentary bedrock, steep slopes, seismic activity, and heavy rainfall in their watersheds. Superimposed on this naturally high background sediment supply have been human impacts such as widespread forest removal and burning by Native Americans and logging by Euro-Americans.

Two notable, high magnitude, low-frequency events in the past several centuries temporarily increased the already-high sediment loads to the rivers:

- The earthquake and tsunami of 1700. The tsunami brought significant ocean-borne sediment well into the Bay (McManus et al. 1998; Komar et al. 2004; Peterson et al. 2013), causing sediment deposition at the mouths of the bay rivers. The earthquake probably also triggered numerous landslides in the watershed.
- The series of extraordinary wildfires collectively known as the Tillamook Burns in 1933, 1945, and 1951 severely burned nearly all the steep, mountainous portions of the Wilson and Trask watersheds. As a result, sediment loads increased by a large but unquantified amount (Coulton et al. 1996). These fires were followed by a major reforestation effort, presumably reducing the watershed sediment supply back to pre-burn levels by the 1970s (Jones et al. 2012)

In addition, the construction of a jetty at the inlet to Tillamook Bay in 1917 led to the breaching of Bayocean Spit in 1952 to 1956, a period when large quantities of beach sand were swept into the Bay. In the 1952 to 1956 breach area of Bayocean Spit, the water is still locally deep within the Bay due to tidal currents having scoured a channel when the breach was open. Mud is now being trapped within the quiet water of this deep part of the Bay (McManus et al. 1998).

Komar et al. (2014) provide a simplified conceptual model of the recent history of river and ocean sediment supply to Tillamook Bay, showing both natural and anthropogenic influences and the repeated gradual reductions in sediment supply following a variety of perturbations (**Figure 4**).

Summary of Sedimentation History

Sedimentation rates near the head of Tillamook Bay are naturally high due to abundant sediment supply, rising sea levels, and low sediment transport capacities at the tidal interface. Over the past 9,000 years since sea levels began to rise, sedimentation rates have been on the order of tens of centimeters per century; rates have increased measurably over the past 150 years due to human activity. Although the sediment supply may have recovered from the most recent set of perturbations to the sediment supply in the early and mid-20th century, current sediment delivery to Tillamook Bay is high and is expected to remain so for the foreseeable long term future. During the long term, the SFC project area may receive additional sudden pulses of sediment supply due to future landscape disturbances, such as landslides, wildfires, floods, earthquakes, or tsunamis, further contributing to sedimentation near the SFC project site.

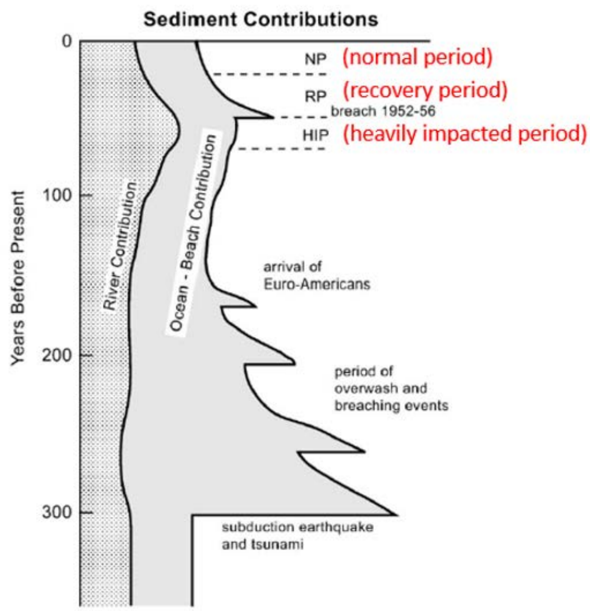


Figure 4. Model of Recent Sedimentation History of Tillamook Bay

Source: Modified from Komar et al. 2004, Figure 10.
Note: Red text added to highlight periods of Euro-American and wildfire impacts to watershed sediment supply.

2.4 Effect of Sea Level Rise

The project site and adjacent channels are near or, at some locations, below sea level; therefore, the project area will be impacted by sea level rise. This has been true in the geologic past, and the anticipated near term acceleration of sea level rise will almost certainly affect flooding in the project area in the future. While the exact amount of future sea level rise is unknown, the current Intergovernmental Panel on Climate Change (IPCC) predictions for global sea level rise by 2100 are from 1.5 to 2.7 feet (Field et al. 2014; Oregon Climate Change Research Institute [OCCRI] 2010, 2013). In a low-gradient tidal system such as Tillamook Bay, even relatively small amounts of sea level rise would have a significant effect on the water surface gradient over many miles, causing sedimentation in channels near the study area and well upstream of the tidal zone. In addition to the direct hydraulic effect of rising sea level, the rise in base level will also cause sedimentation in some areas.

A substantial amount of information is available regarding past sea level rise and sedimentation in the Tillamook Bay (Glenn 1978; Bernert and Sullivan 1998; McManus et al.1998). Overall, deep coring in Tillamook Bay showed that from 9,000 to 7,000 years before present (BP), a period of rapid sea level rise, sediment deposition rates were on the order of 200 cm per century, keeping up with rising sea level (Glenn 1978). After about 7,000 years BP, deposition rates dropped by an order of magnitude, to about 20-30 cm per century. This latter range of values is viewed by Komar et al. (2004) as the “natural” rate of sediment accumulation, prior to the arrival of Euro-Americans, presumably with a stable base level. An independent estimate of the sedimentation rate using repeat bathymetric data computed that the deposition rate averaged about 0.5 cm/year between 1867 and 1995, consistent with the longer term rate shown in the deep cores (Bernert and Sullivan 1998; McManus et al. 1998). Based on ^{14}C and ^{210}Pb dating of a large number of Tillamook Bay cores, McManus et al. (1998) estimated sedimentation rates on the order of 0.2 to 0.4 cm/year over the past 500 or so years. They inferred that a period of higher sedimentation rate, perhaps 0.7 cm/year, between 1867 and 1954 corresponded to elevated sediment supply from the watershed, due to logging and the Tillamook Burns.

A sediment transport and morphology model would be required to predict the specific changes in channel form as a result of sea level rise; however, it is likely to have a major impact on sediment transport and geomorphology, and therefore flooding, over the next 100 to 200 years.

With regard to sedimentation at the mouths of the Trask and Wilson rivers, Jones et al. (2012) interpreted that the length of the tidally influenced reaches of the Tillamook Bay may be an indication of sediment supply of the bed material in each of the watersheds. The Trask River has a comparatively long tidal reach, suggesting to them that sea level rise may be outpacing sedimentation. By contrast, the tidal reach of the Wilson River is shorter, suggesting that the bed material supply was sufficient to keep up with sea level rise over the past 10,000 years.

Summary of Sea Level Rise Impacts

Sea level rise has been a primary influence causing sedimentation in Tillamook Bay for 9,000 years. It is reasonable to expect that ongoing and future sea level rise will continue to impact the existing geomorphological conditions in this way, leading to further non-equilibrium sediment balance in the future, with or without the SFC project. It is possible that, due to differences in sediment supply, the Trask River may be more heavily impacted by sea level rise than the Wilson River.

2.5 Active Tectonics

The Tillamook Bay is located at an active subducting plate margin; therefore, it is prone to major earthquakes and resultant tsunamis, as well as more gradual changes. Abrupt burials of tidal marshes correlated with Cascadia earthquakes have been found in the geologic record (Atwater et al. 1995), showing that earthquakes can significantly impact patterns of sediment transport and geomorphology, thus impacting flooding in coastal Oregon. Land elevations in coastal bays may drop by 1 to 2 m in these coseismic subsidence events, which have a recurrence interval in Oregon of a few hundred years (Darienzo et al. 1994), the last of which was in 1700 AD. Cores in Tillamook Bay show that recurrent subduction earthquakes have a complex influence on sedimentation rates and patterns (McManus et al. 1998; Komar et al. 2004). While sudden land subsidence would tend to create additional space for sediment to accumulate, sand transport into the Bay during tsunamis may counteract the subsidence.

Aseismic (gradual, not associated with earthquakes) subsidence of Tillamook Bay is unknown, but it is reasonable to expect that such subsidence may occur and partially accounts for the basin containing Tillamook Bay. Gradual basin subsidence would be one factor counteracting sedimentation, leading to deeper bay relative to sea level.

Summary of Impacts from Tectonics

The most important tectonic impacts on the geomorphology at the head of Tillamook Bay are: (1) land subsidence during infrequent subduction zone earthquakes, which suddenly create a significant amount (>1 m) of accommodation space within the Bay; and (2) sudden influxes of marine sediment into the Bay due to tsunamis created by those earthquakes. These changes can cause shifts to deeper or shallower water habitat regimes and influence future sedimentation patterns from rivers. The impacts to any given location within Tillamook Bay will vary greatly due to the complex pattern of subsidence and tsunami sand deposition.

2.6 Subsurface Geologic Information at Project Site

2.6.1 Findings of Wells and Others (1994)

The Tillamook area crosses a broad, northeast-plunging structural arch in Tertiary volcanic and sedimentary strata that form the northern Oregon Coast Range (**Figure 5**). The core of the uplift consists of Eocene basalt and interbedded marine strata. The Eocene volcanics are divided into five units, and a distinction is made between the lower Eocene Siletz River Volcanics and the overlying Tillamook Volcanics of late middle Eocene age. Marine mudstone and sandstone are interbedded with all of the volcanic units and comprise most of the late Eocene to Miocene stratigraphic section which forms the flanks of the Coast Range uplift. Continental shelf and slope sequences predominate in the basins flanking the Coast Range uplift.

2.6.2 Findings of Golder Associates, Inc. (2011)

- The Tillamook coastline is a dynamic region with an energetic wave climate.
- Tillamook Bay has been shown to be a major sink of beach sand, having accumulated more beach sand than sand derived from the five rivers that drain into it.
- General long-term scour and channel stability is maintained inside the entrance channel from the ocean to Tillamook Bay.

2.6.3 Findings of Anderson Geological (2014)

- The regional geology consists of flood plain and terrace alluvium overlying Tertiary volcanic deposits. The area is underlain by floodplain and marine bay mud deposits with layers of sand and gravelly sand and organic matter to depths of more than 150 feet. These deposits are underlain by marine sedimentary deposits. Areas of prior development are underlain by fill material consisting of sawmill wood waste.
- Outside of existing channels, saturated soils were first encountered at depths of 1 to 3 feet below ground surface (bgs). Groundwater was encountered at 2 to 8 feet bgs. Given the lack of significant topographic features in the area, the groundwater surface is expected to be relatively flat.

- Outside of existing channels, surface water is found in marshes and wetlands that display standing water at various times of the year in response to precipitation events. Upland portions are isolated from intermittent surface water bodies by low, earthen levees.

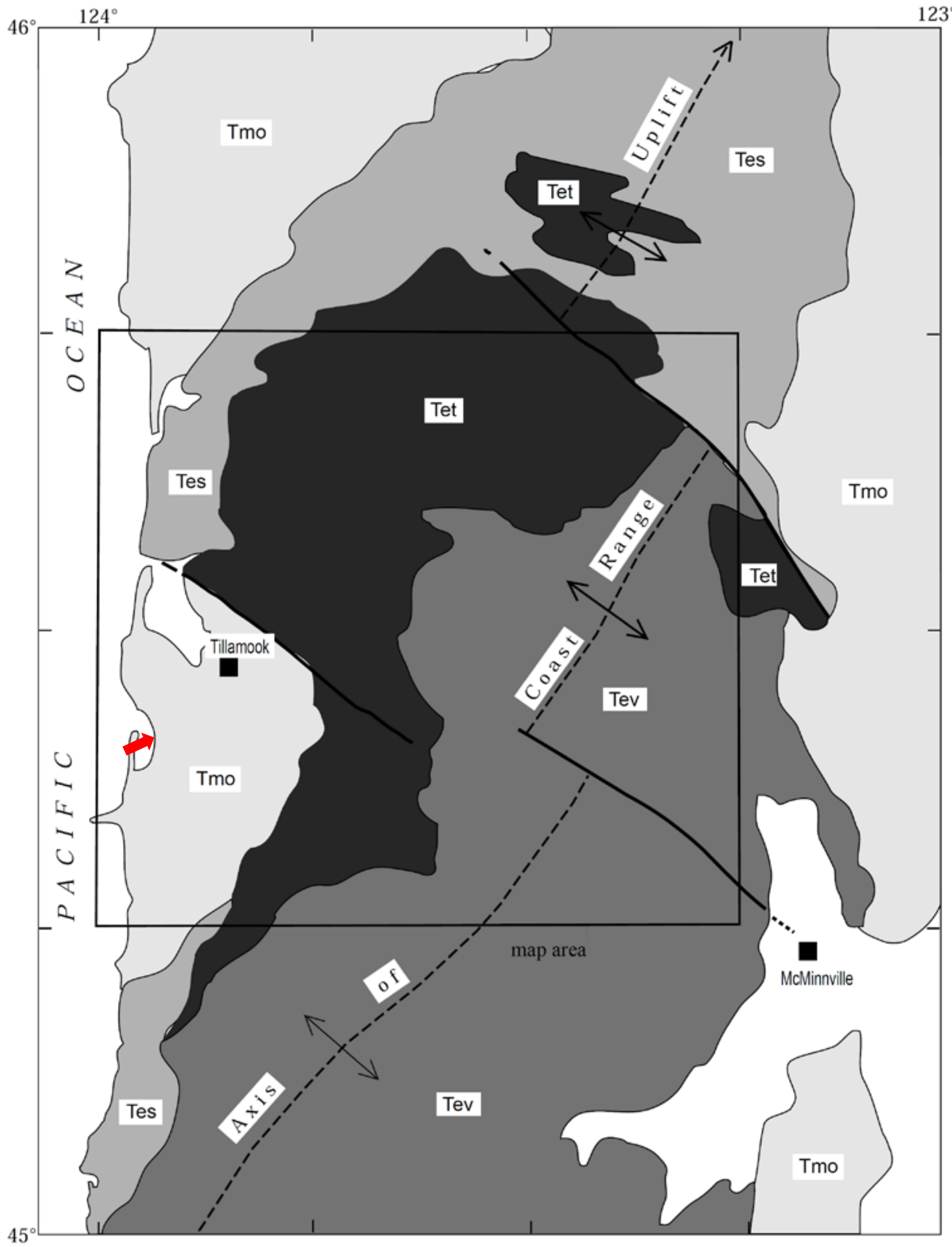


Figure 5. Geologic Setting of Tillamook Highlands Area in the Northern Oregon Coast Range

Source: Wells et al. 1994
Notes: Tmo = Miocene and Oligocene sedimentary and volcanic rocks;
Tes = Eocene sedimentary rocks
Tet = Eocene Tillamook volcanic rocks
Tev = middle and early Eocene volcanic and sedimentary rocks

2.6.4 Findings of Shannon and Wilson, Inc. (2014)

- The project watersheds lie along an active tectonic plate boundary, where the oceanic crust is being subducted beneath the North American continental crust. The Oregon Coast Range began to form more than 50 million years ago when an oceanic volcanic island chain slowly collided with the ancient Oregon coast. The present Coast Range took shape as blocks of the volcanic island chain and sedimentary rocks, which had formed in a temporary basin between the islands, compressed against the continental margin and uplifted. The project area rivers drain from a part of the Coast Range referred to as the Tillamook Highlands, which has at its core the Tillamook Volcanics (former volcanic islands).
- During the last ice age, when the sea level was on the order of 300 feet lower than at present, the rivers eroded deep canyons in the bedrock formations. At the close of the ice age, about 15,000 years ago, the sea level began rising to its present level, drowning the mouths of the rivers that drained to the sea. With the rise in sea level, the former deep river channels aggraded with sediment, matching grade with the rising sea.
- The Wilson-Trask floodplain geology is dominated by alluvial deposits, up to 120 feet or more deep. The oldest and deepest sediments are dominated by semi-consolidated basaltic gravel and cobbles with interstratified sand, silt, and clay. The older deposits are in most areas mantled by younger alluvial flood deposits consisting of fine sandy to clayey silt and silty clay soils, which may locally incorporate significant organic material.

2.7 Evidence for Recent Trends

While historical accounts clearly suggest the lower rivers were characterized by frequent flooding and sedimentation in the channels, quantitative evidence of channel changes is more ambiguous. There are at least two published sources of data documenting long term changes in the tidal Trask and Wilson rivers (Pearson 2002; Jones et al. 2012). In addition, a set of repeat cross sections, informally provided by Northwest Hydraulic Consultants (NHC, personal communication 2014a), documents changes at numerous locations where repeat survey data were collected in 2002 and 2014, to support the updating of the hydraulic model for the proposed project (Attachment B).

The following points summarize some of the main findings about recent (last 100 years or less) trends in the tidally influenced reaches of the Wilson and Trask rivers.

2.7.1 Findings of Jones and Others (2012)

- Jones et al. (2012) compiled and analyzed numerous data sets relating to sediment transport and geomorphology of the Tillamook Bay tributaries, extending well up into their watersheds. They concluded that the tidal portions of the Wilson and Trask rivers are transport-limited (more sediment supplied than can be transported). Because of this, they inferred that these tidal reaches are most heavily impacted by watershed conditions that affect the supply and transport of fine-grained sediment (sand and silt), implying that the tidal portions of these rivers would be sensitive to 20^{th} century logging and wildfires.

- The authors measured changes in the area of river bars in aerial photographs collected in 1939, 1967, 2005, and 2009. They observed that the amount of exposed bar area in the tidal portions of the Wilson and Trask rivers was small, compared with other rivers and other portions of those rivers, and interpreted that this was due to the lack of gravel reaching the tidal portion of the system. Despite the small area of exposed bars, they also found that exposed sand bar area decreased substantially over the past 70 years, which they attributed to vegetation colonization and floodplain modifications (levees and bank armoring).

- In reviewing repeat aerial photographs from 1939 to 2009, the investigators stated that planform changes of tidal Wilson and Trask rivers were minor or barely detectable, and there were no changes in centerline length for these two river segments. They attributed the lack of changes in channel position to bank modifications (armoring); 77 percent of the tidal Wilson River and 71 percent of the tidal Trask River are bordered by "floodplain modifications."

- They compiled long term repeat cross section surveys of all the rivers, making use of bridge inspection reports from the Oregon Department of Transportation among other data sources. Only three cross sections were available in the tidal sections of the rivers in the vicinity of the SFC project site, including one on the Wilson River and one on the Trask River (**Figure 6**). At the Highway 9 bridge over the Wilson River, the cross sections show a barely detectable amount of change since 1930 (**Figure 7A**). For the Trask River, the cross sections are only available for 2003 and 2004; therefore, long term changes are not evident (**Figure 7B**). On the Tillamook River at the Highway 131 bridge (outside the project area), there appears to be some evidence of channel degradation since 1961; however, the shape of the cross section in **Figure 7C** suggests that this change may not be a genuine change, but the result of insufficient survey data below the water line. In conclusion, the repeat cross sections in the vicinity of the study area compiled by Jones et al. (2012) are inconclusive, and the data are insufficient to make conclusions about recent trends of aggradation or degradation in the vicinity of the project area.

2.7.2 Findings of Pearson (2002)

- Pearson (2002) also reviewed aerial photographs of all five Tillamook Bay rivers and provided detailed narratives describing observations for each mile of river, and of qualitative and quantitative changes between photo sets. In summary, Pearson concluded that channel planform remained relatively stable and that the area occupied by bars and islands declined since 1939 in the lowest portions of both rivers.

- Pearson (2002) compared longitudinal profiles of the five Tillamook Bay tributaries in 1978 and 2000. Although the profiles were not shown in that report, the author reported that the rivers were generally aggrading but that they all have both aggrading and degrading reaches.

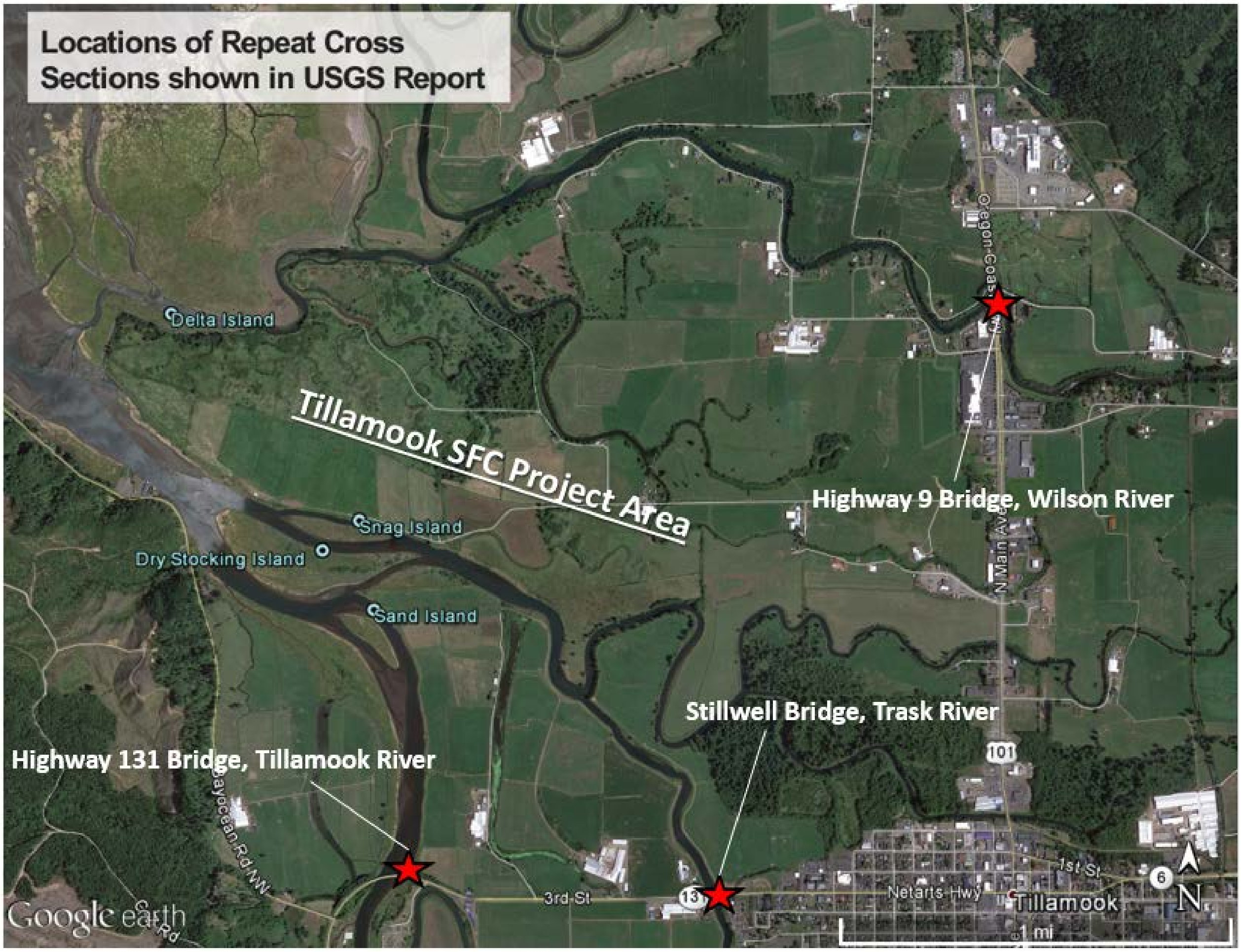


Figure 6. Long-term Repeat Cross-sections near Tillamook SFC Project Area.

Note: Cross-sections compiled by Jones et al. (2012) are shown in Figure 7.

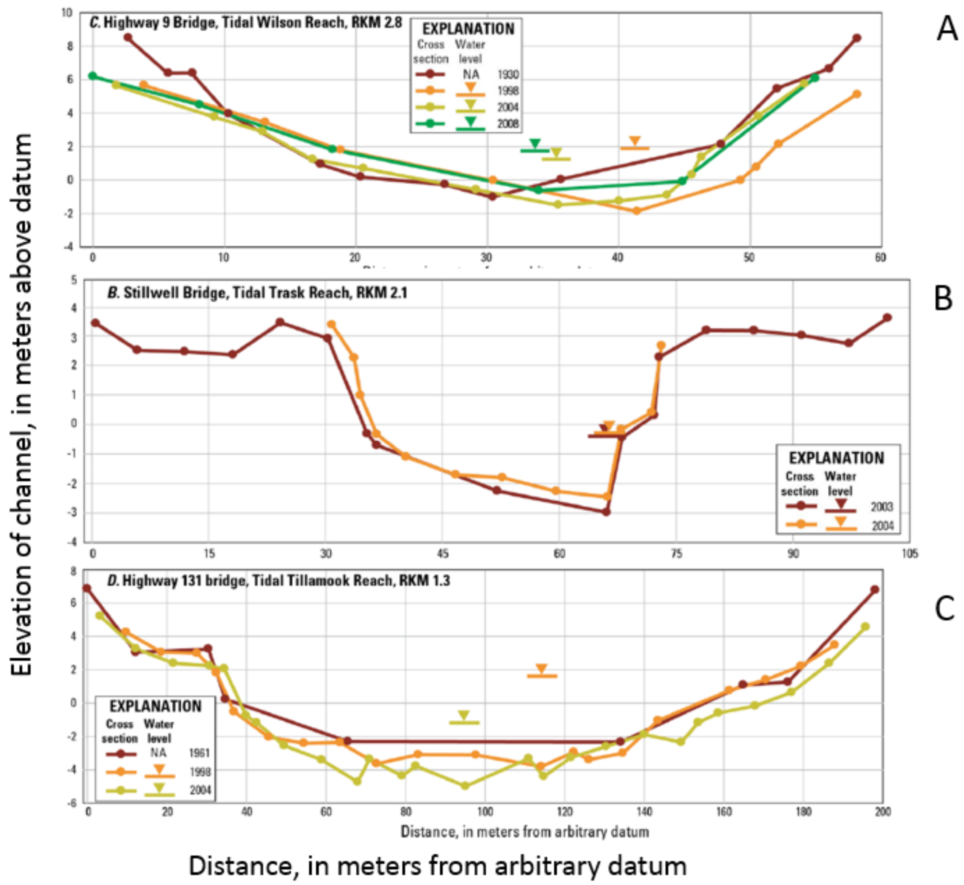


Figure 7. Repeat Cross-sections at Bridges in the Lower Tillamook, Wilson, and Trask Rivers

Source: modified from Jones et al. 2012

2.7.3 Repeat Cross Sections from 2002 and 2014

One generally reliable way of interpreting trends in aggradation or degradation of a river is to examine repeat cross section surveys separated by a substantial period of time. Northwest Hydraulic Consultants (NHC), in updating a hydraulic model for the proposed SFC project, compiled a series of cross sections surveyed in 2002 and again in 2014. The 2014 survey revisited 54 locations that had been surveyed in 2002 in the Wilson River, Tillamook River, Trask River, Hoquarten Slough, and Dougherty Slough. The entire set of cross sections was provided by NHC (2014a) as a series of screen captures from the HEC-RAS model display screen, and they are included as Attachment B of this report.

Each of the 54 cross sections was categorized as aggrading, degrading, or "no clear trend" for the recent 12-year period. Based on these categorizations, patterns of aggradation are observed in those 54 cross sections (**Figure 8**). Overall, 27 of the 54 cross sections (50 percent) showed clear aggradation, and most of the rest (23) showed no clear trend. Only 4 of the locations showed degradation between the two surveys. Overall, the cross sections summarized in **Figure 8** indicate a general trend of aggradation. However, there are some spatial differences as well, and the Wilson River shows the clearest evidence that it is aggrading (14 aggrading cross sections, compared with only 1 degrading section, and 7 cross sections with no clear trend). The cross sections in the Trask and Tillamook rivers also appear to be either aggrading or show no clear trend. The cross sections in the named sloughs are more ambiguous, but the trend in Hoquarten Slough appears to be towards sedimentation as well.

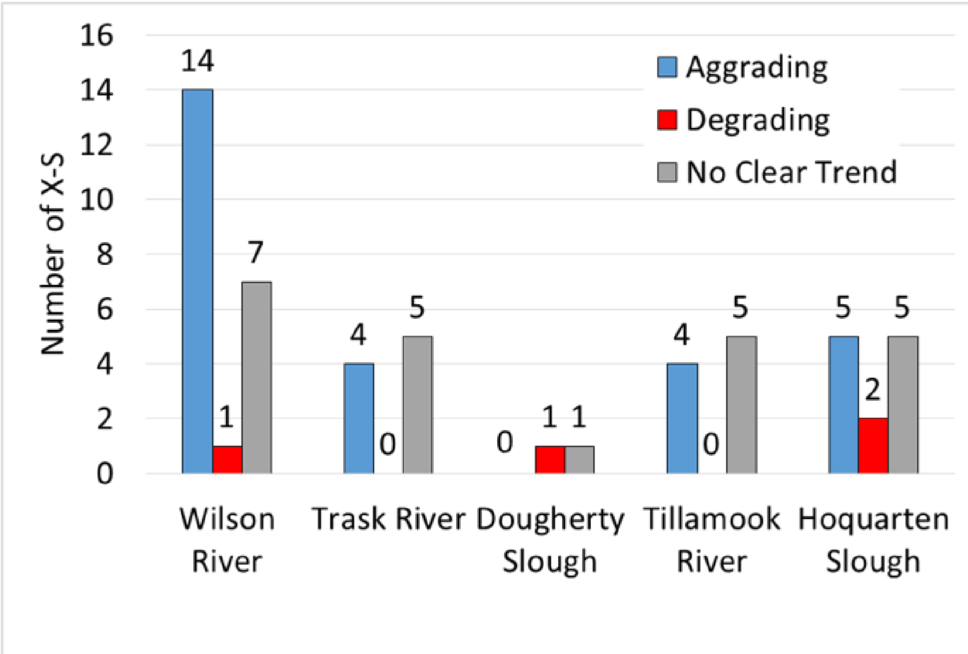


Figure 8. Channel Changes Between 2002 and 2014

Source: NHC 2014a

Notes: Data interpreted from evaluation of 54 repeat cross-sections in the SFC project area based on screen captures provided by NHC. The file containing all 54 comparisons is included in Attachment B.

While these repeat cross sections provide some strong evidence of an existing overall trend towards aggradation in the rivers at the project site, comparing repeat streambed profiles, rather than number of cross sections, might provide better integration of trends among variously spaced cross sections. Also, the integrated rates of aggradation along streambed profiles are not well defined by the repeat cross sections. In general, where they have aggraded, river cross sections have usually deposited on the order of 10 to 20 cm in the time between surveys, equivalent to about 1 to 2 cm per year, or 100 to 200 cm/century.

Summary of Recent Trends

The repeat cross sections provided by Northwest Hydraulic Consultants provide the clearest evidence that the channels have mostly aggraded over the past 12 years. The typical amount of aggradation is on the order of 10 to 20 cm between the two recent surveys. This is equivalent to an aggradation rate of 100 to200 cm per century, and this range is an order of magnitude higher than the inferred "natural" background rate of sediment accumulation, prior to the arrival of Euro-Americans, of 20 to 30 cm per century over the past 7,000 years (Komar et al. 2004). Other available data are less conclusive, but do not conflict with this interpretation from the repeat cross section data.

2.8 Summary of Existing Geomorphological Conditions

Based on the many historical accounts and recent analyses, existing geomorphological conditions of the SFC project area may be summarized as follows:

- The SFC project site lies the confluence of the Wilson and Trask rivers, which drain large portions of the western slope of the highly erodible Oregon Coast Range. The geomorphic setting of the rivers is a low-gradient, fluvial-to-deltaic transition at the head of Tillamook Bay.
- The project area encompasses a low floodplain surface between the two rivers at the tidal interface. This setting is hydraulically and geomorphically complex, influenced by the interaction between tidal cycles and flooding and sediment transport in two rivers with large, mountainous watersheds.
- The rivers in the vicinity of the project site are not in equilibrium and have not been during historical or prehistoric times. Sedimentation has occurred at the head of Tillamook Bay since at least early Holocene time (~9,000 years ago) due to high sediment supply and sea level rise. Historical geomorphic trends are ongoing and will likely continue into the long term future of the project.
- Human-induced changes, including burning, logging, and river engineering, are superimposed on this natural background trend, and have varied effects on sedimentation rates and processes. Most, but not all, of these influences have further *increased* the amount of sediment delivered to the head of Tillamook Bay, likely contributing to increased rates of aggradation.
- In addition to watershed influences, past, present, and future sea level rise have been, and will continue to be, a primary cause of continued aggradation in the project area.
- This overall aggradational trend has been partially counteracted in the past by active dredging and diking of the channels. Future dredging could continue to counteract further aggradation, depending on the amount and location of dredging. However, to prevent aggradation from occurring, dredging would need to be continued indefinitely. The amount of dredging required to counteract this natural trend would probably increase over time in the future, as sea level rise accelerates the rate of aggradation.

SECTION 3 Existing Sediment Transport Conditions

Changes in sediment transport patterns can influence flooding, habitat quality, water quality, and habitat types in the SFC project area. Developing a basic understanding of existing sediment transport conditions at the site is necessary to provide an evaluation of how sediment transport patterns may change as a result of the project. The river reaches at the project site are very clearly transport-limited (Jones et al. 2012); therefore, sediment transport is primarily influenced by the hydraulics at the site.

In such a hydraulically complex environment, sediment transport dynamics are governed by hydraulic processes in two and three dimensions. A two-dimensional hydraulic model is not available for the site. However, a 1-Dimensional (1-D) hydraulic model (HEC-RAS) of the complex site has been developed by multiple parties over more than a decade. A detailed review of the hydraulic model is provided in Appendix E of the Southern Flow Corridor Project DEIS.

This section uses select model output from the 1-D HEC-RAS model to provide a semi-quantitative characterization of existing sediment transport conditions in the lower Wilson and Trask rivers. The potential impacts of the SFC action alternatives on the sediment transport in the Wilson and Trask rivers are discussed in Section 4.

3.1 Hydraulic Model Background

Development of the hydraulic model has a long history, dating to the early 2000s when the USACE first started its work on the General Investigation and Feasibility Study (USACE 2005). The model has since changed platforms (from MIKE11 to HEC-RAS) and has been updated and modified by multiple users. FEMA identified the need to perform an independent review of the history of model development, applications, assumptions, and uncertainties, and ultimately, the overall suitability of the modeling work to date to prepare the EIS. The findings of this review are documented in the Hydraulic Peer Review Memorandum, Appendix E of the SFC Project DEIS.

Based on the project purpose and need statement, defined alternatives, public and agency comments, and discussions with FEMA and project partner staff, the Hydraulic Peer Review Memorandum (CCPRS 2015) characterized the objectives of the model as follows:

- Establish a basis for comparing risk to life and property among all alternatives during flood events due to a range of estimated flood depths, durations, and velocities.
- Establish a basis for comparing natural hydrologic and sediment transport processes among all alternatives, particularly related to flood velocities during the design life of the project.
- Characterize the spatial variability of innundation frequency within the project area to compare relative impacts of all alternatives on agricultural lands and proposed habitat areas.

- Characterize the performance of levees and the local movement of flood waters within the project area to compare alternative impacts on channels, overland flow, tide gates, sloughs, and wetlands.

The base model, also referred to as the Existing Conditions model, is intended to represent the condition of the river network as it operates currently, but the data inputs, specifically the topographic and bathymetric data, were collected at different times. Most of the bathymetry was collected in 2014, while most of the topography comes from earlier LiDAR.

The stationing shown on **Figure 9** approximately links points on the ground to points in model space. However, the accuracy of this mapping is limited—the accuracy is +/-500 feet relative to the model space. Determining the precise stationing on the ground is challenging because it is difficult to recreate the model alignment in a different software platform like GIS without introducing some discrepancies. Such detailed and laborious work with the HEC-RAS model is beyond the scope of the current review. Thus, the following discussion considers that the accuracy of matching points on the ground to points in the HEC-RAS model space is poor, about +/-500 feet, and the interpretations are made in consideration of that limitation.

Figure 9. Approximate Stationing Along the Wilson and Trask Rivers in HEC-RAS Model.

Notes: Profiles are graphed in Figures 11 through 15. Distances and stationing were measured manually and do not correspond well to distances in the HEC-RAS model output. Location accuracy for interpreting model results is considered to be plus or minus about 500 feet.

3.2 Existing Sediment Transport Conditions in the Lower Wilson and Trask Rivers

This section interprets sediment transport conditions in the vicinity of the project site based on an output selection from the 1-Dimensional hydraulic model.

Because the tidal portions of the Wilson and Trask rivers in the vicinity of the SFC project area are transport-limited (Jones et al. 2012) and the bed is composed of erodible alluvium, sediment transport conditions are primarily controlled by hydraulics, not sediment supply. Modeled hydrographs for the Wilson and Trask rivers are shown with the tidal stage for the 1999 flood event, which was approximately a 5-year recurrence interval flood peak (**Figure 10**). The graphs in **Figure 11** through **Figure 14** show longitudinal profiles of river bed elevation, water surface elevation (WSE), energy gradient, in-channel discharge, and stream power, for both high and low tides. Stream power is used here as a proxy for the relative sediment transport rate (e.g., Bagnold 1966, Julien 1995). **Figure 11** and **Figure 12** show the Wilson River and **Figure 13** and **Figure 14** show the Trask River. The profiles are shown relative to the "River Station" (RS) in the model space, which, as explained above, is difficult to map onto points and landmarks on the ground. Therefore, all the interpretations refer to approximate locations on the ground.

The text boxes in **Figure 11** through **Figure 14** are used to annotate some of the interpretations directly on the profiles, and the following points summarize the interpreted existing sediment transport conditions in the tidal Trask and Wilson rivers.

3.2.1 Wilson River

- The water surface profile for the Wilson River shows a notable step near RS ~12,500, in the vicinity of Highway 101 (**Figure 11**). The cause of this is believed to be related to a constriction in the channel width, very dense vegetation, and a sharp bend in the river near the highway crossing, or it may be due to the steep streambed slope.

- It should be noted that the model includes extremely high roughness values in this short segment. These roughness values are believed to be physically justified (CCPRS 2015); however, it is possible that this modeling assumption is actually the cause of this "step," so that feature may not occur during real floods. However, if it does occur, this step feature could have a local influence on geomorphology and sediment transport because it corresponds with a localized peak in stream power (**Figure 12B** and **12C**). It could indicate a higher likelihood of downward erosion of the streambed (incision) at that location; however, the existing bathymetry shows no sign of localized erosion or a head-cut, which would be evident if this was an important sediment transport feature. The model results would imply that that the bed of the Wilson River may be coarser in the reach affected by the "step" in the water profile. The streambed elevation will change if there is an imbalance between the sediment transport capacity and sediment supply. Therefore, even though the sediment transport capacity at a location is much higher than that upstream and downstream of it, the streambed can be stable if the sediment supply is balanced with it.

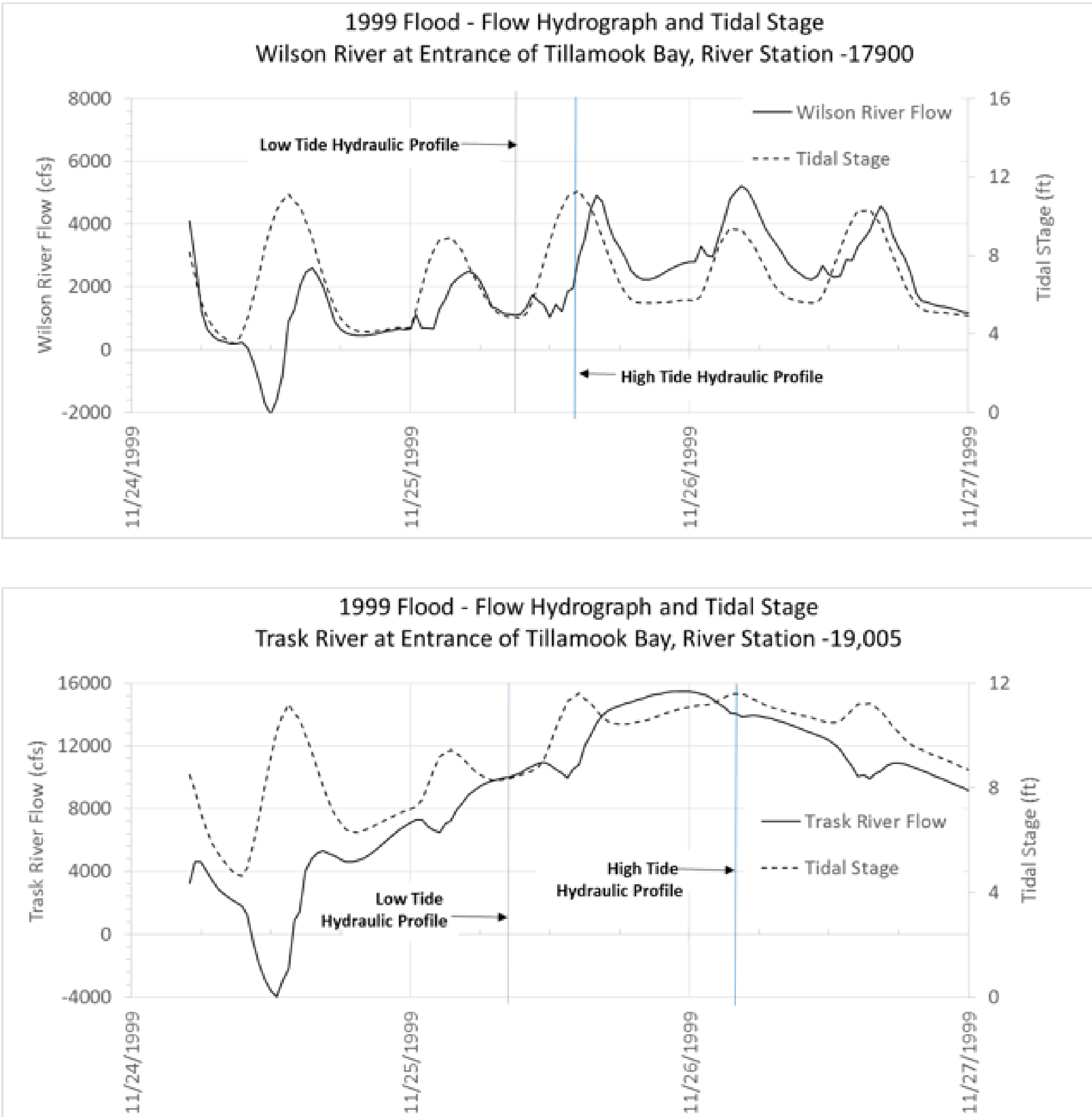


Figure 10. Modeled Hydrographs and Tidal Stage for 1999 Flood Event

Notes: Modeled hydrograph and tidal stage is for near the peak of the 1999 flood event, which was an approximately 5-year return interval peak flow. Vertical lines mark the times at which the high tide and low tide profiles were extracted from the hydraulic model. Top graph is for the Wilson River and the bottom graph is for the Trask River.

- The lowest ~500 feet of the Wilson River, adjacent to the SFC project area, appears to be impacted by a tidal “drawdown” effect, as can be seen by the steep drop in WSE at ~RS ~17,500. The combination of high water elevation from upstream, due to the flood, and dropping base level downstream, as a result of the tide, appears to create a steepening in the water surface slope adjacent to the project site (**Figure 11**). This local steepening is accompanied by a peak in stream power (**Figure 12C**) during low tide and conversely a flattening of the stream power during high tide. This cyclical behavior may produce a pattern of local erosion and deposition that is in sync with the tidal cycle, and counter-intuitively create an erosional zone in a normally backwatered, aggradational setting. Similar geomorphic environments – erosional areas in and just upstream of tidal backwater – have been recognized in other rivers, notably the lower Mississippi River, where the tidal drawdown section covers a reach several hundred river miles long (Nittrouer 2010; Lamb et al. 2012).

- The gradual downstream decrease in discharge between ~RS 2,000 to ~RS 15,000 (shown with a red arrow in **Figure 12A**) shows that water flows out of the Wilson River channel into the floodplain. This occurs at both high and low tides, but during high tide the floodplain flow is even greater, especially in the upstream portion of the model space (RS 0 to RS 5,000). During flow into the floodplain of the Lower Wilson River during floods such as that in 1999, fine sediment is delivered from the Wilson River into the floodplain along the lower several miles via overbank flow, and more sediment enters the floodplain when flood flows coincide with high tides.

- Abrupt drops in discharge between RS ~16,000 and RS ~18,000, near the west end of the SFC project area, are more likely related to split flow paths because significant portions of the flow in the channel enter secondary channels at those locations.

- Although substantial flow exits the lower Wilson River due to this overbank flow pattern during flood flow, in-channel stream power does not noticeably decrease over the same reach. Thus, under existing conditions, while flow does enter the floodplain, there does not appear to be any additional sedimentation caused by the loss of flow into the floodplain, although this pattern may differ under lower flows and this condition may be impacted by the proposed project. As discussed in section 4.2.2 (below), sending additional flow into the floodplain would cause a drop in stream power, thereby, possibly instigating sediment deposition in this reach.

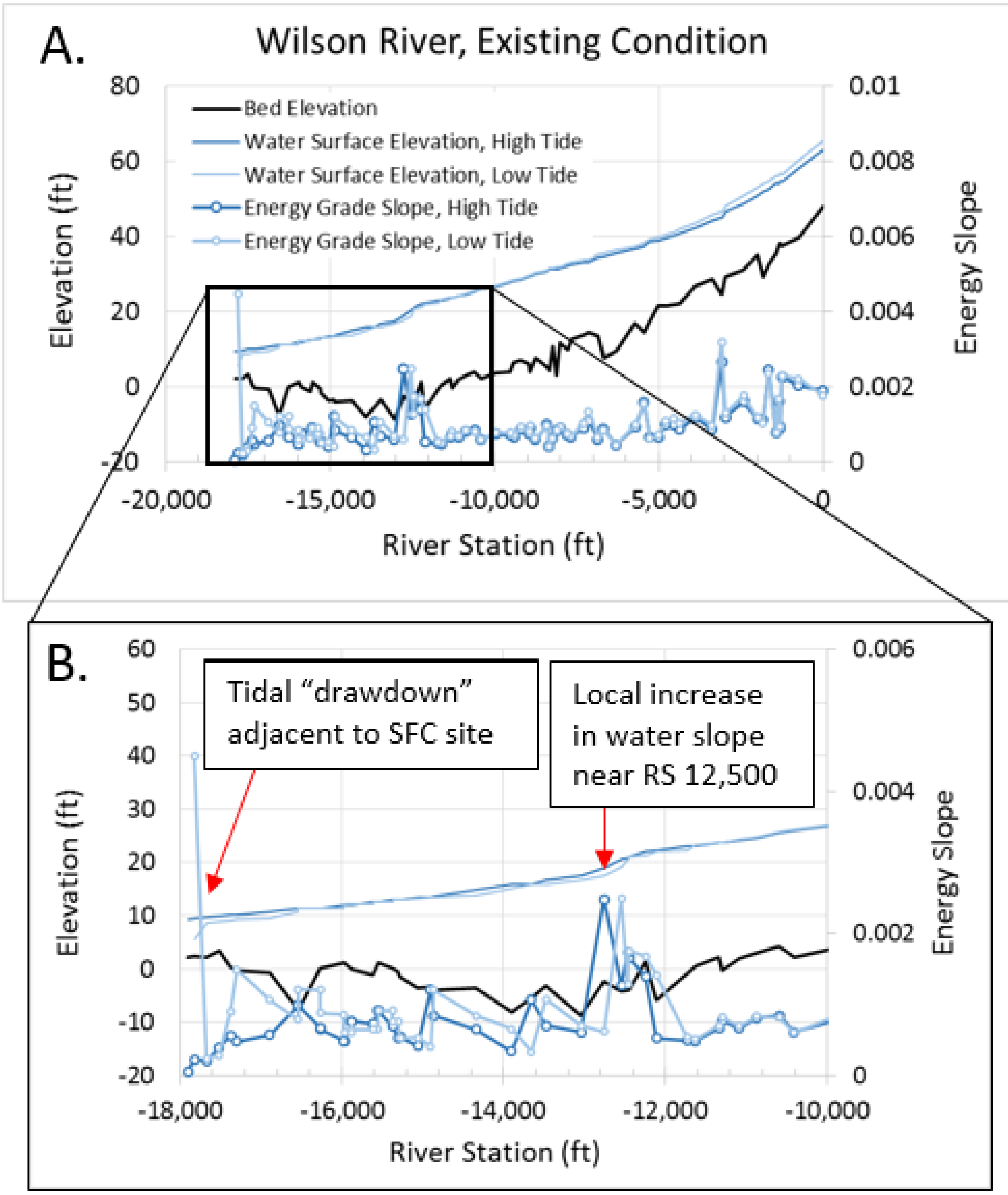


Figure 11. Water Surface Profiles and Energy Slope for Wilson River During 1999 Flood Event

Notes: Water surface profiles and energy slope modeled at high and low tides during the 1999 flood event. Text boxes contain interpretations of model results.

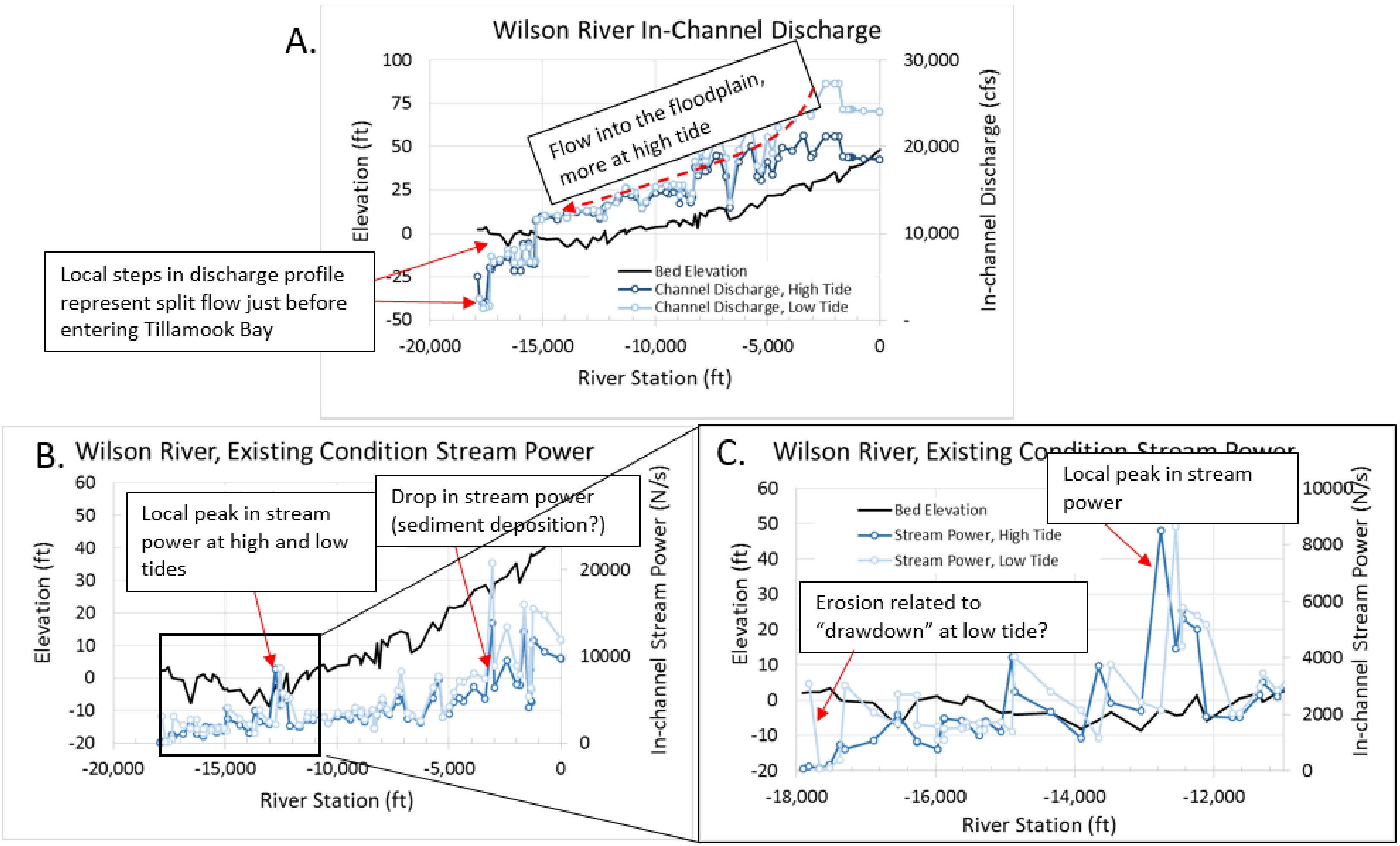


Figure 12. In-channel Profiles of Flow and Stream Power for the Lower Wilson River During the 1999 Flood

Notes: Graph A represents the in-channel profile of flow in the lower Wilson River at high and low tides during the 1999 flood event.
Graph B represents the in-channel profile of stream power in the lower Wilson River at high and low tides during the 1999 flood event.
Graph C highlights the stream power profile focusing on the SFC project area between station ~15,000 and 18,000.
Text boxes contain interpretations of the model results.

3.2.2 Trask River

- The tidal Trask River has a much subtler tidal “drawdown” effect (discussed above) than the Wilson River, because its confluence is farther upstream from the bay. The model shows only a barely noticeable tidal drawdown at RS 19,000 on the Trask River (**Figure 13**). A stronger drawdown effect is observed on the Tillamook River just downstream of its confluence with the Trask River.

- There is a sudden drop in the magnitude of fluctuations in stream power due to an abrupt transition in the river bed longitudinal profile of the Trask River near RS ~6,000, upstream of the SFC Project area (**Figure 14B**). Above this point, stream power approaches 30,000 Newton/sec (1 Newton = 0.22481 pounds force) at several locations, but below this point, it never exceeds 10,000 N/s. This suggests there may be a significant geomorphic transition where the valley widens and the gradient shallows, and could be the upstream limit of the influence of rising sea level. It is possible, but not certain, that much of the gravel bedload of the Trask River would deposit in gravel bars in this area.

- For the 1999 flood (and presumably similar sized floods), there is little minimal flow out of the Trask River into the floodplain at low tide, but when high flow coincides with high tide, about 20 percent of the flow enters the floodplain upstream of RS ~11,000 (**Figure 14A**). The difference between low and high tide mainstem flows is associated with different inflows from upstream (i.e., there is more inflow during high tide and the tidal effect does not extend far upstream).

- Nearly half the flow exits the channel at around RS 15,000 where it flows into the Old Trask River. Flows remain reduced in the Trask River until flows from Hoquarten Slough join with the Trask River at RS 17,000 (**Figure 14B** and **14C**). There is a significant drop in the in-channel stream power in the reach affected by the reduced in-channel flows (**Figure 13C**). This drop suggests that this location, downstream of the point where nearly half the flow exits the Trask River, could be a locus of sediment deposition near the project area. It would be expected that there is an elevated rate of sediment deposition, and possibly a decrease in sediment grain size, in the Trask River downstream of ~RS 15,000.

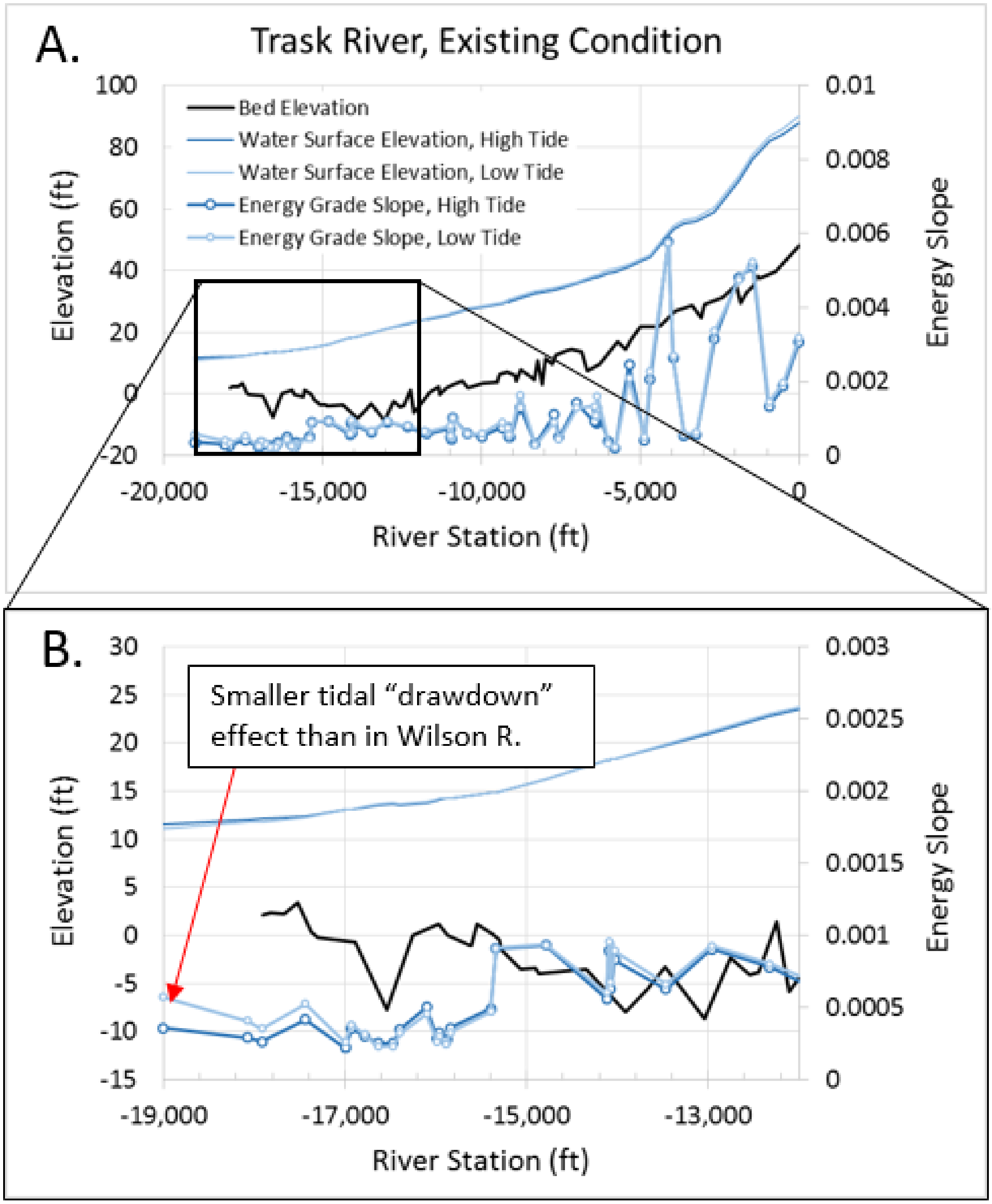


Figure 13. Water Surface Profiles and Energy Slope for the Trask River During 1999 Flood Event

Notes: Water surface profiles and energy slope are modeled at high and low tides for the 1999 flood event. Text boxes contain interpretations of model results.

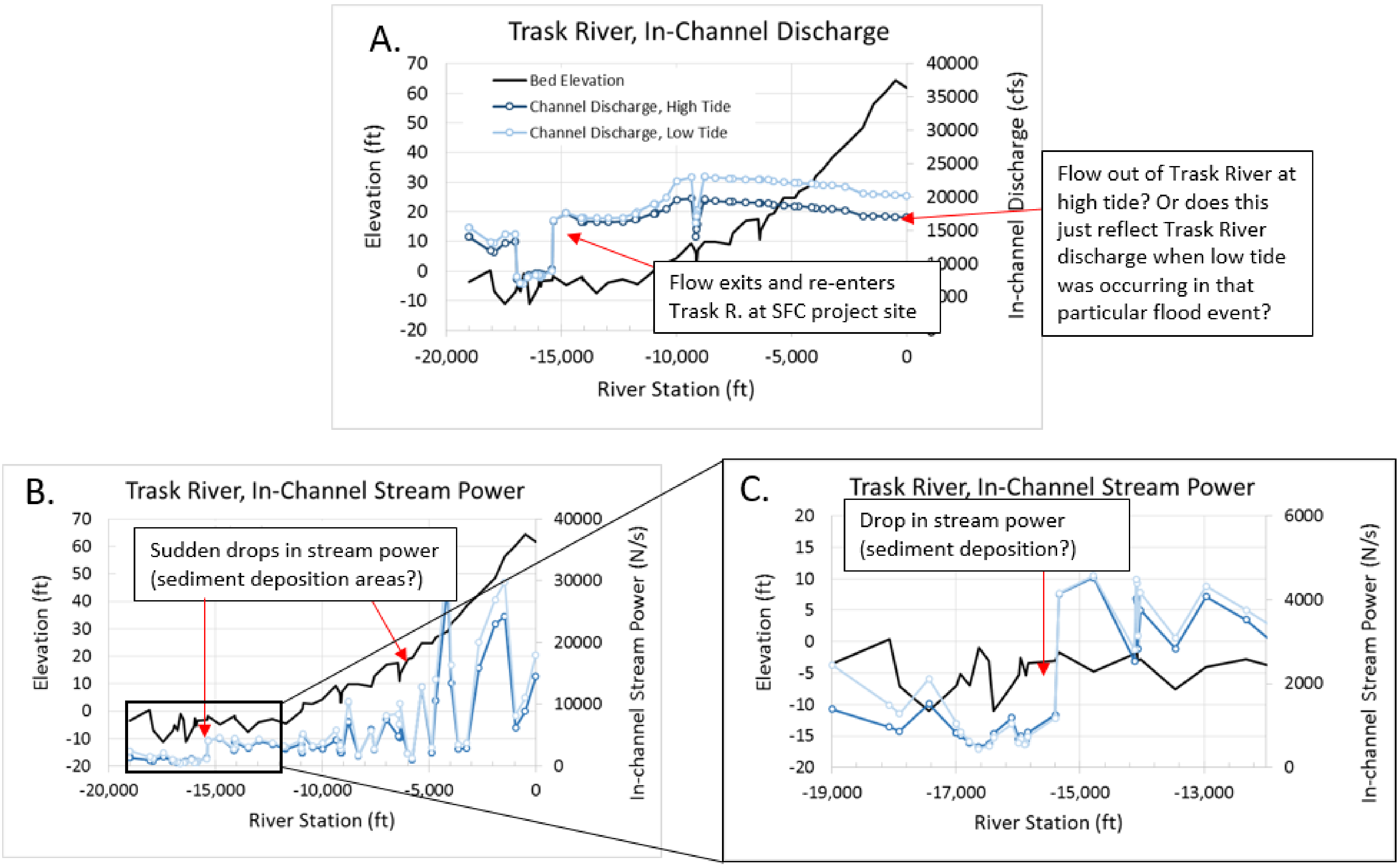


Figure 14. In-channel Profiles of Flow and Stream Power for Lower Trask River During 1999 Flood Event

Notes: Graph A represents the in-channel profile of flow in the lower Trask River at high and low tides during the 1999 flood event.
Graph B represents the in-channel profile of stream power in the lower Trask River at high and low tides during the 1999 flood event.
Graph C highlights the stream power profile focusing on the SFC project area between station ~15,000 and 18,000.
Text boxes contain interpretations of the model results.

SECTION 4 Geomorphic and Sediment Transport Effects

In this evaluation, the potential geomorphic and sediment transport impacts of the proposed project are considered at three distinct time scales: short term (referring to the construction and initial post-construction adjustment period); transitional period (1 to ~20 years following construction); and long term (the next one to two centuries).

Short Term (During Construction and First Year Post-Construction). The short term impacts generally revolve around issues of erosion and water quality. Reducing project-related erosion and sediment transport during construction, and in the first year after construction, is an important design consideration for the project. Tables 1 and 2 in Attachment C provide detailed descriptions of sediment-related impacts associated with construction of the action alternatives. Those tables review the possible impacts, the plans for mitigating these impacts, and guidelines for construction BMPs related to each sediment impact. These impacts are summarized along with agency guidelines and additional suggestions for reducing erosion during construction.

Transitional Period (1 Year to ~20 Years Following Construction). Over the medium term (1 to ~20 years), the project area will be impacted by multiple flood events, so many of the sediment transport impacts of the action alternatives would occur at that time scale. Medium term impacts are primarily evaluated using the hydraulic model results comparing the initial and proposed conditions. The hydraulic model has only been run for the Landowner Preferred Alternative; therefore, medium term impacts of the other action alternatives are qualitative and speculative.

Long Term (>20 Years Following Construction). Long term impacts involve changes in channel and floodplain morphology of the drainage system that occur over decades and longer, especially related to sea level rise. Long term impacts are discussed in relation to how the SFC project area would evolve in conjunction with sea level rise along the Oregon Coast, projected to be on the order of 1.5 to 2.7 feet by 2100 (Field et al. 2014; OCCRI 2010, 2013).

4.1 No Action Alternative

Under the No Action Alternative, no construction would occur, and the project area would continue to be characterized as described under existing conditions of geomorphology (Section 2) and sediment transport (Section 3) above.

4.1.1 Short Term Impacts

- No short term sediment impacts would be expected.

4.1.2 Transitional Period Impacts

- The project area is not in sediment equilibrium. It is a locus of sediment deposition, and has been for at least the last 9,000 years, due to its geomorphic setting, high watershed sediment supply, and rising sea level. Ongoing sediment trends, discussed in Section 2.7, would continue under the No Action Alternative.

- The current trend of channel aggradation at a rate on the order of 20 to 40 cm per century would continue, and probably would increase with sea level rise.
- Continued channel aggradation would increase flood frequency and magnitude, and those floods would probably contribute to increased rates of sedimentation across the floodplain.
- The rate of floodplain sedimentation under the No Action Alternative is not known, but would probably be on the order of several cm per year (Komar et al. 2004). Floodplain sediment would probably consist of silt, clay, and possibly very fine sand.
- Over the transitional period, the project area may be subject to perturbations that could cause minor or major changes to geomorphology and sediment transport conditions at the SFC project area. The most important perturbations that could impact rates of sedimentation at the site are wildfire, flood, landslide, earthquake, and tsunami. Most, but not all, of the impacts that could occur from such perturbations would tend to increase the rate of channel aggradation at the confluence of the Wilson and Trask rivers.

4.1.3 Long Term Impacts

- Beyond the next two decades under the No Action Alternative, the geomorphic and sediment transport conditions at project site would continue to evolve in disequilibrium, as discussed in Sections 2 and 3 above.
- Sea level rise would be the primary factor causing long term geomorphic impacts. Sea level rise of 1 to 2 feet is forecast for the Oregon Coast over the next century. Sea level rise of more than two feet would affect the hydraulics of the project site, causing more overbank flooding, and subsequent floodplain sedimentation, over time.
- Over time, the geomorphic evolution would depend on the balance between sediment supply and sea level rise. The Wilson River has a shorter tidal reach than the Trask River because the greater sediment load from the Wilson River allows it to keep pace with sea level rise (Jones et al. 2012). The Trask River, on the other hand, has a long tidal reach due to a lower sediment supply. Projecting present conditions into the long term future, under the No Action Alternative, the Wilson River could continue to keep up with sea level rise but the Trask River may not.

4.2 Alternative 1: Proposed Action (Southern Flow Corridor - Landowner Preferred Alternative)

Alternative 1, the Southern Flow Corridor - Landowner Preferred Alternative, would construct a project to reduce life safety risk from floods, reduce flood damages to property and other economic losses from floods, while also contributing to the recovery of federally listed Oregon Coast coho and restoring habitat for other native fish and wildlife species. Construction includes levee removal, modification, and setback; tidal channel reconnection; and reconfiguration of tidal gates and floodgates. The proposed action would introduce water and sediment into the floodplain through tidal channels and over banks and, by design, would have significant geomorphic impacts on the project area. Inundation would occur immediately after construction, even during small river flows, and many of the design features would become active during normal tides.

4.2.1 Short Term Impacts

- Short term geomorphic impacts around construction would occur during first several tidal cycles once flows are introduced, and include erosion of destabilized soil surfaces and consequent water quality effects from suspended sediment and increased turbidity.
- Short term construction-related impacts and proposed mitigation measures (construction BMPs) are discussed in detail in Attachment C, Table 1.

4.2.2 Transitional Period Impacts

- According to the model, the Proposed Action would have substantial impacts on the sediment transport regime in the Wilson River near the project area, increasing stream power in some areas while reducing it in other areas (**Figure 15**).
- At low tide (**Figure 15A**), the model predicts an increased stream power at two locations as a result of the Proposed Action (at around RS ~14,800 and ~ 15,400). Downstream of ~RS 15,500, the proposed project would reduce in-channel stream power over about a 2,000-foot-long reach. The reduction in stream power between about RS 16,000 and RS 17,000 is present but less pronounced at low tide (**Figure 15B**). Presumably this reduction in in-channel stream power reflects more flow leaving the channel into the floodplain as a result of the project. It is possible, but not certain, that the change in stream power during flood flows could contribute to additional aggradation of the Wilson River in the vicinity of the project, as well as possible fining of bed sediment in that area as a result of the project.
- In the Trask River (**Figures 16A** and **16B**), the model suggests that the impacts of the Proposed Action on sediment transport rates would be negligible (see dashed lines in both panels). Newly connected tidal channels are expected to evolve quickly over first 20 years of the project. Lengthening of the channel network and widening of individual channels would occur relatively rapidly, within the first few years (NHC 2014a). However, the rate of evolution of newly connected tidal channel network is not presently known. The extent of tidal channel network depends on the hydraulics and sediment properties (i.e. the resisting and eroding forces).
- Of the new tidal channel network, the new tidal channel inlet/connection points would evolve the most and most quickly. The initial inlet configuration would determine the amount of water entering the tidal channels, and control much about the final tidal channel forms. However, the specific impacts to the geomorphology and sediment transport in the new tidal channels would become better known after further details about initial inlet configuration are included in the plans.

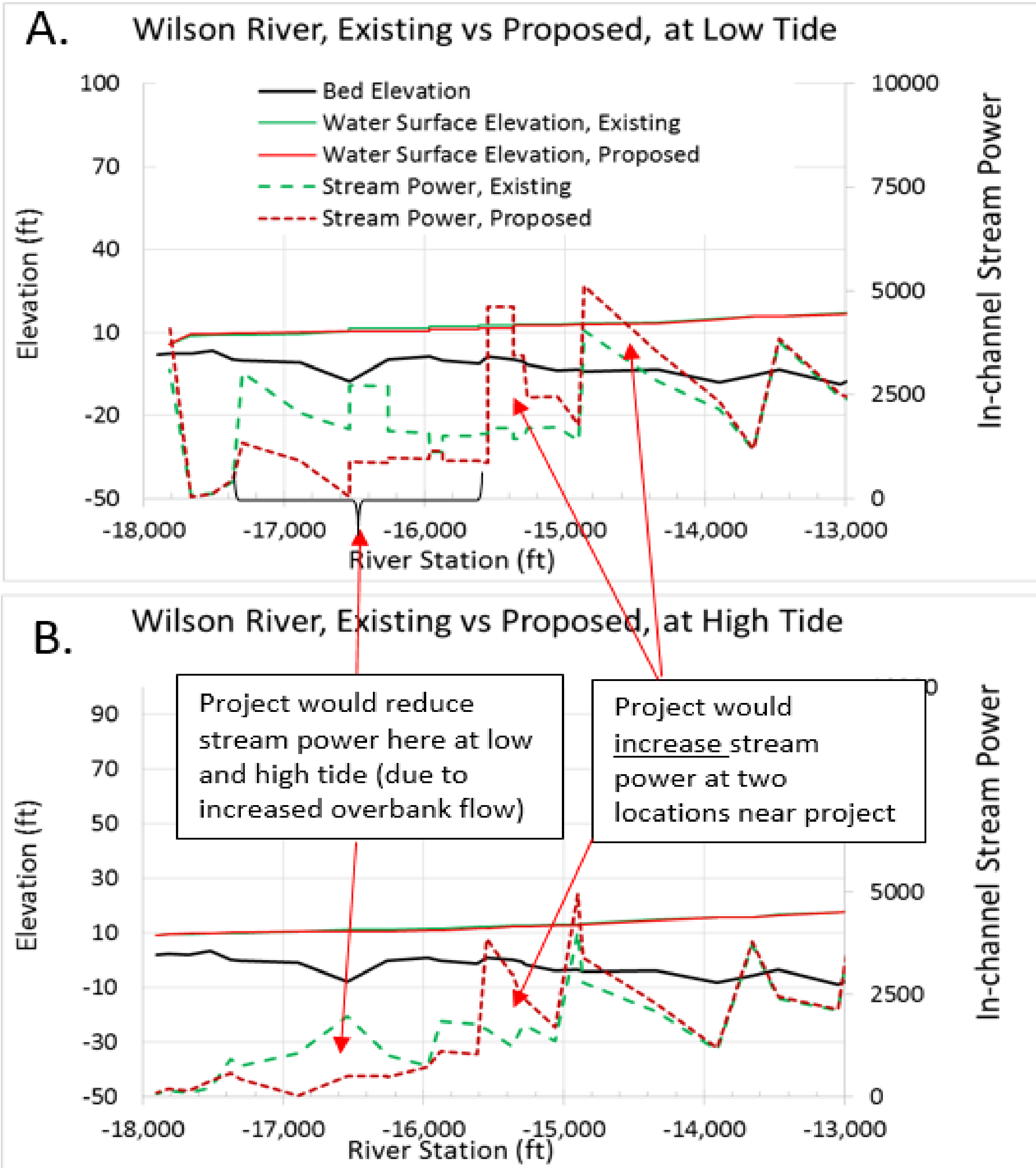


Figure 15. Stream Power Profiles for Wilson River for No Action Alternative and Proposed Action

Notes: Graph A shows the modeled stream power profile for low tide. Graph B shows the modeled stream power profile for high tide. Both graphs represent conditions during the 1999 flood event.

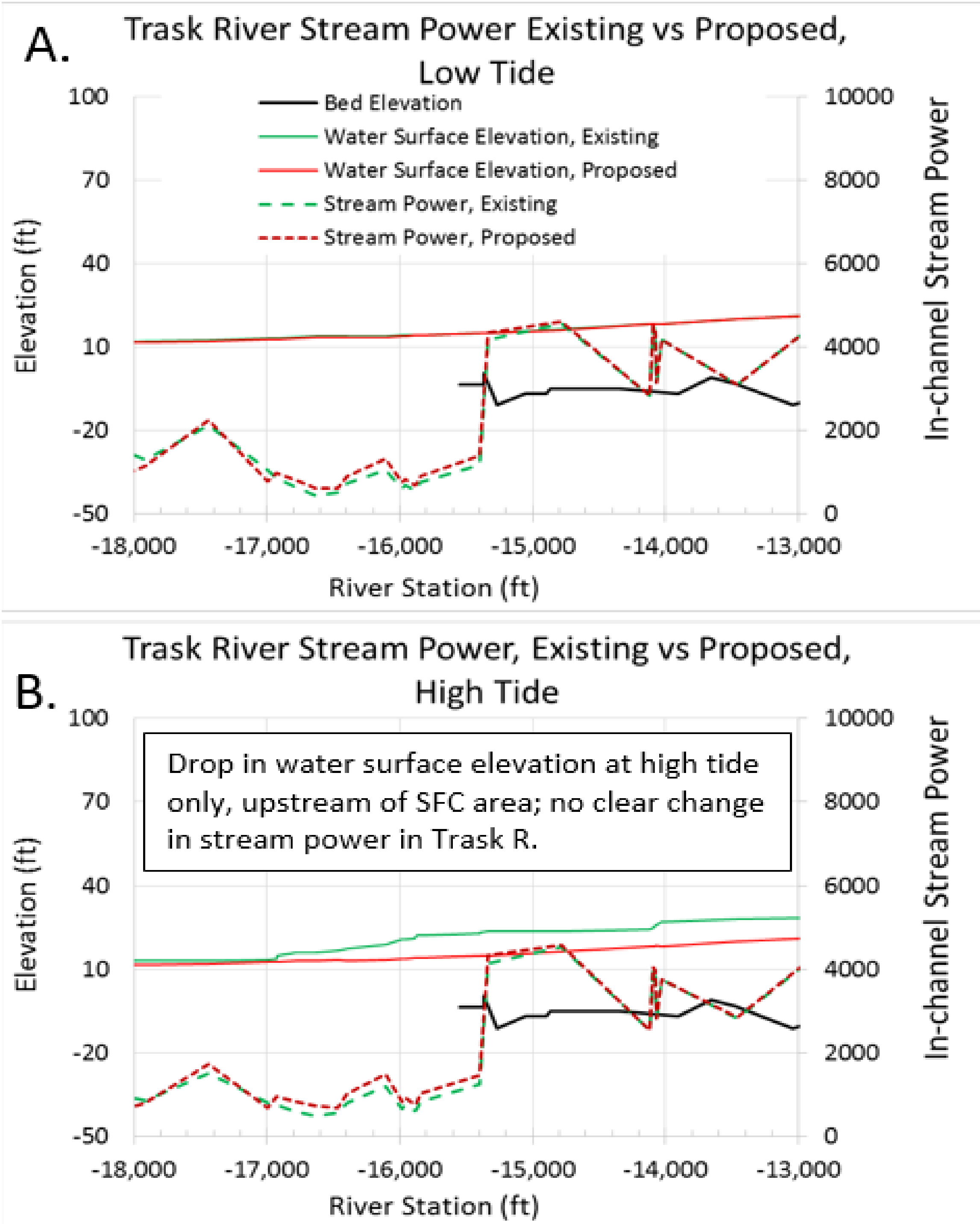


Figure 16. Stream Power Profiles for Trask River for No Action Alternative and Proposed Action

Notes: Graph A shows the modeled stream power profile for low tide. Graph B shows the modeled stream power profile for high tide. Both graphs represent conditions during the 1999 flood event.

- The newly connected tidal channels on the northern side of the project area, where existing channels would be reconnected, should become functional tidal channels quickly, exchanging water and sediment in a manner similar to other tidal channels in Tillamook Bay. The Proposed Action includes excavation of reconnection points through the river banks to connect the Trask River with the approximate locations of historic channels. It is expected that new tidal channels would form from these locations, although they may not reform in exactly the same places as the historic channels because the original channel shapes have been mostly obliterated by cultivation.

- Increased sedimentation on the floodplain surface would result from the Proposed Action. The greatest amount of sedimentation in the floodplain would occur as splays at new levee breach locations. Sands would deposit close to main channels, especially in splays. Very fine sand and silt would deposit farther away from the breaches. Clay generally would settle only where standing water occurs following floods over the newly connected floodplain.

- Transitional period rates of distal floodplain accretion are unknown, but would probably be less than about 1 cm/year; the actual rate and pattern of floodplain sedimentation would depend on future floods, sediment concentrations, and 2-Dimensional floodplain hydraulics not captured by the 1-Dimensional HEC-RAS model. Generally, diffuse sedimentation rates in the floodplain would be greatest where flow enters the floodplain, and would decrease with distance from the channel.

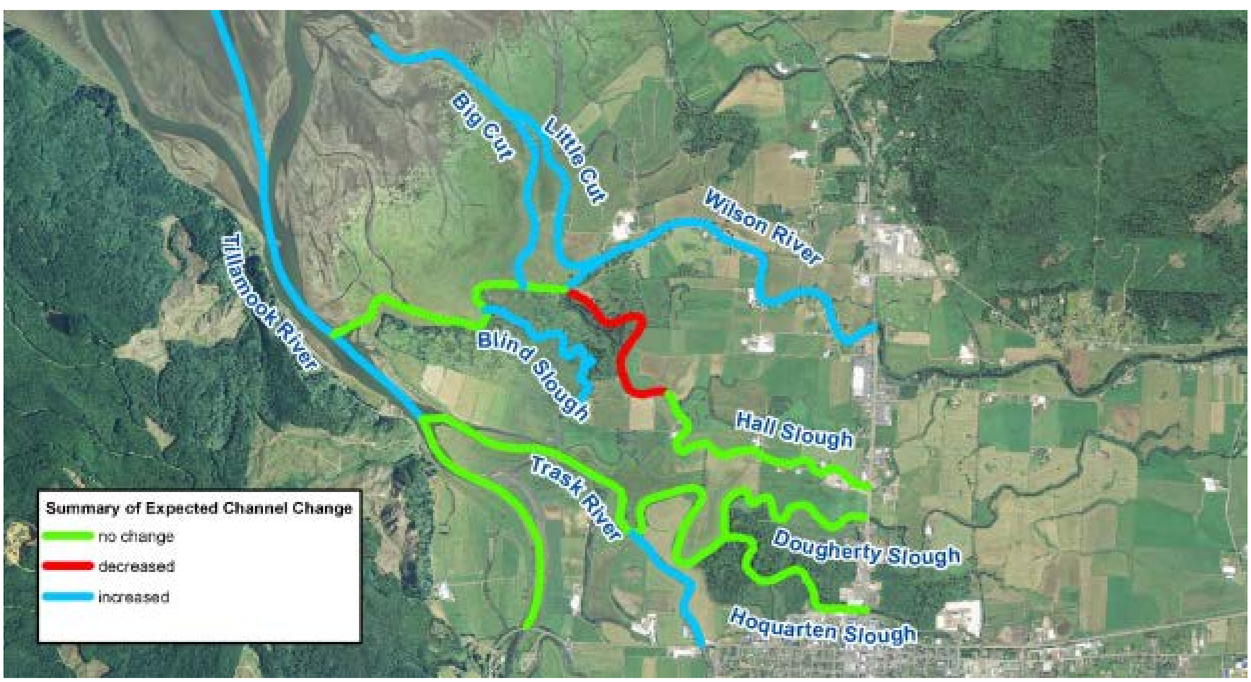
4.2.3 Impacts on Sediment Transport

- NHC (2015) performed a study of potential impacts on the current sediment transport regime (Attachment A) under the Proposed Action for the lower Tillamook, Trask, and Wilson rivers. The analysis area extends from Highway 101 in the east and Highway 131 to the south, and then downstream to the Bay (Attachment A, Figure 1).

- The channel reaches in the study area are formed through a combination of riverine and tidal processes. Closer to the Bay, tidal forces will be dominant in shaping the channel form, while further from the Bay, riverine processes are more likely to dominate. Therefore, in the NHC analysis, both processes were examined and their relative influence examined across each reach.

- For the riverine process, two methods were used. The first method calculated the excess shear stress at each cross section. In the second method, the sediment transport capacity was estimated along each reach using the sediment transport capacity calculation module of the HEC-RAS model. NHC selected the Engelund-Hansen equation of the sediment transport equations included in the model. Then, the relative changes in excess shear stress and sediment transport capacity were compared to evaluate how the project would impact riverine flood flows and processes in each reach. Figures 9 and 10 of Attachment A summarize the predicted changes on sediment transport rates downstream of Highway 101 and Highway 131 during 6-year and 100-year floods. In these figures, the sediment transport capacities of the reaches are classified as no change (green), decreased (red), and increased blue).

- For the tidal process, changes in the tidal prism were examined as an indication of expected channel morphology changes between pre- and post-project conditions due to tides under low river flow conditions. Figure 11 of Attachment A presents the expected change in tidal prism as a result of the project for low-flow conditions.
- The results of the riverine flood and tidal analyses were combined and each reach categorized according to its dominant channel forming process and predicted change under with-project conditions. Based primarily on this sediment transport analysis, but also considering prior reports, field visits, and anecdotal evidence from long-time residents, each reach has been classified as to whether riverine flooding or tides are the dominant process. The results are summarized in Table 3 and Figure 12 of Attachment A (**Figure 17** of this appendix).
- Overall, most reaches are predicted to have neutral or increasing sediment transport capacity (see **Figure 17**). This is attributed to two factors. In the upper reaches, the project generally results in increased in-stream velocities and hence shear stresses by the removal of impediments to flows. In the lower reaches, shear stresses during floods can be lower, but the channels are mostly tide dominated, so this reduction does not affect long-term channel form. Under low-flow conditions, the project generally has small effects, with the notable exception of Blind Slough, which is expected to undergo significant expansion. The only reach that shows a risk of aggradation is lower Hall Slough. Removal of levees along the left bank of Hall Slough will allow both flood waters and high tides to spill into Blind Slough rather than flow through the lower end of Hall Slough reducing water volume and velocity and thus sediment transport capacity.



Source: NHC 2015

Figure 17. Summary of Expected Changes to Channels with Proposed Action

4.2.4 Long Term Impacts

- In the long term under the Proposed Action, the project site would continue to evolve as described for the transitional period.
- Sea level rise is a primary factor contributing to long term impacts. Sea level rise of 1.5 to 2.7 feet (Field et al. 2014; OCCRI 2010, 2013) is forecast for the Oregon Coast by 2100. Sea level rise of more than 2 feet would affect the hydraulics of the project site, causing more overbank flooding, and subsequent floodplain sedimentation, over time.
- Over time, the sedimentation effects would depend on the balance between sediment supply and sea level rise. The tidal reach of the Wilson River is shorter than that of the Trask River because the greater sediment load from the Wilson River allows it to keep pace with sea level rise; the longer tidal reach of the Trask is due to a lower sediment supply (Jones et al. 2012). Projecting this to the long term, the Wilson River could continue to keep up with sea level rise but the Trask River may not.

4.3 Alternative 2: Hall Slough Alternative

Hall Slough is a former flow thread of the Wilson River, at least 6 miles long, that was disconnected from the main channel in 1950. Under the Hall Slough Alternative, Hall Slough would be reconnected on the upstream end to the Wilson River to reduce some localized flooding (**Figure 18**). The alternative would include setting back or modifying more than six miles of levees, and dredging and excavating nearly two miles of the slough to increase the capacity of Hall Slough to carry flood water. Although the Hall Slough Alternative focuses on flood conveyance, it would have significant ancillary impacts on geomorphology and sediment transport, over the short term, transitional period, and the long term.

The hydraulic impacts of the Hall Slough Alternative were reviewed by USACE (USACE 2005); however, the alternative's design features were not fully developed for modeling.

4.3.1 Short Term Impacts

- Geomorphic impacts would result from levee reconstruction, dredging, excavating, and related earthwork; and the effects would occur immediately following the introduction of the first several tidal cycles.
- Short term construction-related impacts and proposed mitigation measures (construction BMPs) are discussed in detail in Attachment C, Table 2.

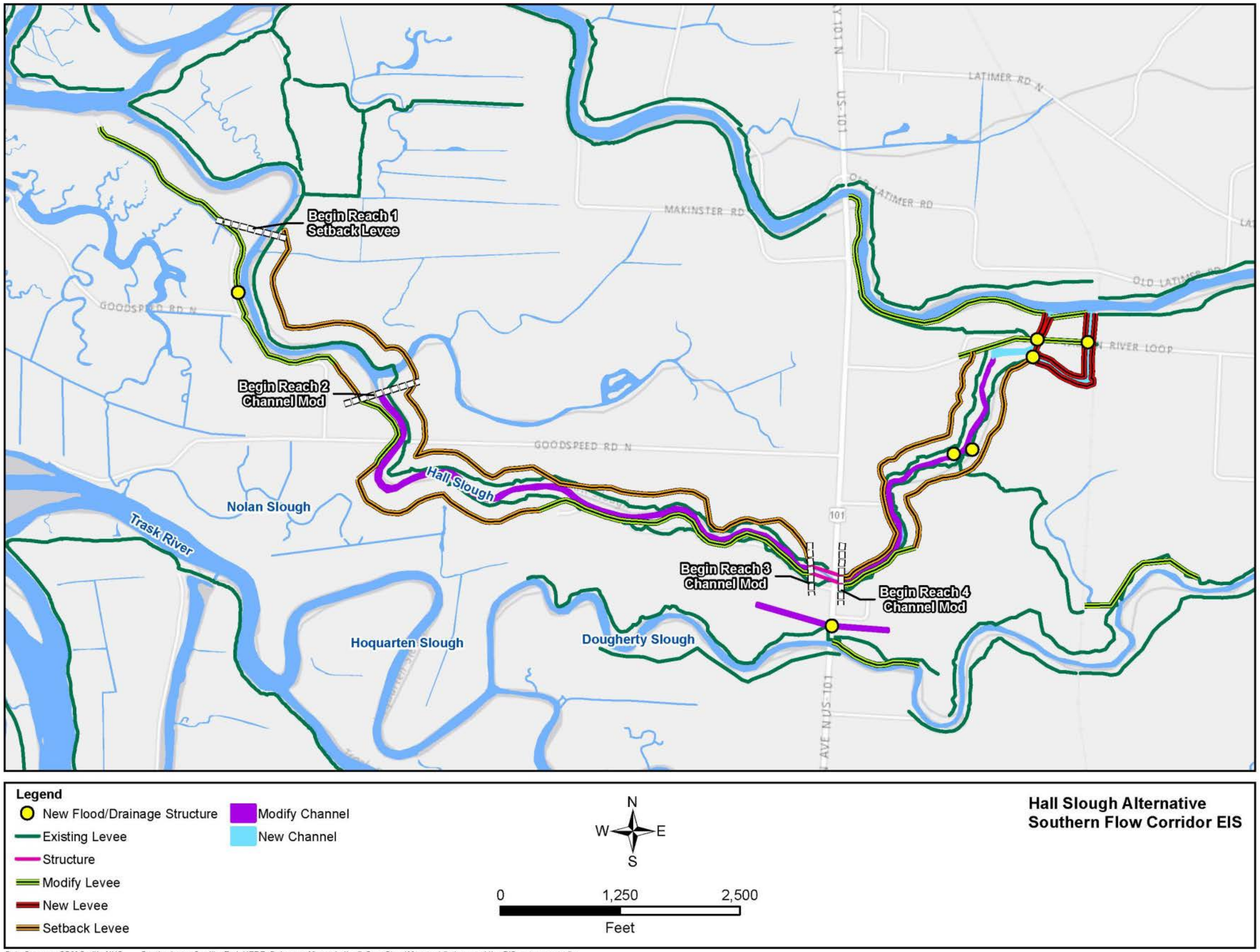


Figure 18. Hall Slough Alternative

4.3.2 Transitional Period Impacts

- In of the absence of hydraulic modelling, transitional period effects of the Hall Slough Alternative would be speculative.
- The volume of sediment delivered to the study area would be the same as under the other project alternatives; however, the patterns of transport and deposition of sediment within the project area would be different. Under this alternative, a relatively large percentage of flow would leave from the Wilson River main stem and flow through Hall Slough, a side channel, before returning into the Wilson River main stem just upstream of the confluence with the Trask River. Hall Slough would carry approximately 1,000 cubic feet per second (cfs) of floodwater that would relieve the flooding of Highway 101.
- USACE performed limited modeling of the effects of the Hall Slough alternative (USACE 2005). They found that the stream power of Hall Slough would increase, which probably would reduce sedimentation within the slough and upstream of Highway 101. However, a kickback of increased water surface elevation would occur downstream of the levee and channel improvements, at the confluence of Hall Slough with the Wilson River, where there might be increased sedimentation.
- Potential transitional period effects of this alternative are confounded by the fluctuating tidal base level, which is expected to rise over time.

4.3.3 Long Term Impacts

- Over the long term, the sedimentation effects would depend on the balance between sediment supply and sea level rise, as under the Proposed Action. Rising sea level would affect sedimentation at the constructed inlet to Hall Slough from the Wilson River, as would changes in sediment supply due to watershed management over the long term. If flow conveyance through Hall Slough becomes increasingly constrained by sedimentation over time, the transport and sediment patterns would trend toward the present patterns. Therefore, the proposed maintenance dredging would be planned based on the predicted sedimentation along Hall Slough.

4.4 Alternative 3: Southern Flow Corridor – Initial Alternative

The short-term, transition period, and long-term effects of the Southern Flow Corridor – Initial Alternative on geomorphology and sediment are assumed to be similar as those for Alternative 1. Short term construction-related impacts and proposed mitigation measures (construction BMPs) are discussed in detail in Attachment C, Table 1. Over the transition period and long term, there would be shifts in the patterns of erosion, sediment transport, and sediment deposition (relative to Alternative 1) because the configuration of levee improvements and drainage restoration would be different. However, the complexity of the hydraulic system and uncertainties of system performance in the absence of more detailed hydraulic modeling preclude differentiation of effects between the Initial Alternative and the Proposed Action.

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Attachment A

Draft Southern Flow Corridor Project Impacts on Sediment Transport

Source: NHC 2015

DRAFT SOUTHERN FLOW CORRIDOR
PROJECT IMPACTS ON SEDIMENT TRANSPORT

Prepared for:

Port of Tillamook Bay
Tillamook, Oregon

Prepared by:

Northwest Hydraulic Consultants Inc.
Seattle, Washington

02 April 2015

NHC Ref No. 200184

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Principal

DISCLAIMER

EXECUTIVE SUMMARY

The impact of the Southern Flow Corridor project on the current sediment transport regime for the lower Tillamook, Trask, and Wilson Rivers has been analyzed. Levee removal will alter the total transport rates by diverting some flows and suspended sediments out of the channels and into the newly reconnected floodplain areas. The potential for aggradation in the main river channels and sloughs due to the project was identified as the primary process that required detailed evaluation. Changes to channel form due to the project were evaluated for a range of riverine flood conditions and a low-flow, tidally influenced condition.

The Tillamook Bay reaches are formed through a combination of riverine and tidal processes. Closer to the Bay, the tidal forces will be dominant in shaping the channel form while further from the Bay, riverine processes are more likely to dominate. Both processes were examined and their relative influence examined across each reach. For the flood evaluation two methods were used. Both methods evaluated 1 mm sand as the most representative size of sediment in the lower rivers. Outputs from the HEC-RAS model at the peak water level for the 2001 (1.5-yr), 1999 (5-yr), 2007 (22-yr), and 100-yr floods were used in both methods. The first method calculated the excess shear stress for 1 mm sand at each cross section. In the second method, the sediment transport capacity was estimated along each reach using the Engelund-Hansen equation. The relative changes in excess shear stress and sediment transport capacity were compared to evaluate how the project will impact riverine flood flows and processes in each reach. Changes in the tidal prism were examined as an indication of expected channel morphology changes between pre- and post-project conditions due to tides under low river flow conditions.

The results of the riverine flood and tidal analyses were combined and each reach categorized according to its dominant channel forming process and predicted change under with-project conditions. Lower Hall Slough is predicted to have less sediment transport capacity in the long term, mainly due to the spilling of flows into Blind Slough under with-project conditions.

The rest of the reaches are predicted to have neutral or increasing sediment transport capacity. This is attributed to two factors. In the upper reaches, the project generally results in increased in-stream velocities and hence shear stresses by the removal of impediments to flows. In the lower reaches, shear stresses during floods can be lower, but the channels are mostly tidal dominated, so this reduction does not affect long-term channel form. Under low-flow conditions, the project generally has small effects, with the notable exception of Blind Slough, which is expected to undergo significant expansion.

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1 INTRODUCTION

The Southern Flow Corridor project proposes to remove 7 miles of levee and reconnect over 400 acres of floodplain to the adjacent river channels and sloughs. The removal of the levees will provide flood level reductions across most of the lower Wilson, Trask, and Tillamook river floodplains. The project will change the distribution of flood flows between the rivers, sloughs and floodplain, which may lead to changes in the morphology of the channel network. In addition, floodplain reconnection will increase tidal exchange during low river flows, which can also lead to changes in channel form. Deposition of sediment on the beds of the rivers and sloughs is the primary concern, as this could lead to less flood level reduction benefits from the project. Northwest Hydraulic Consultants (NHC) evaluated sediment transport regimes in the rivers and sloughs draining into the south end of Tillamook Bay to address this issue. The evaluation considered both flood and low flow, tidally dominated conditions.

1.1 Sediment Sources and Size

While there is little direct sediment data from the rivers in the project area, studies on sediments in Tillamook Bay provided information used in this analysis. The major sediment sources contributing to the Bay have been identified through sediment core analysis (McManus et al., 1998). Marine derived sands comprise 60% of the sediment, and the remaining 40% is sand and finer sized material from the rivers (Komar et al., 2004). Sediment samples were dominated by fine sands (0.125 to 0.250 mm in diameter) and finer sized sediments (McManus et al., 1998). A few larger sediment sizes between 1 to 3 inches were found in samples from the upper areas of the Wilson River and Hall Slough, but were limited to less than 10% of the measured sediment samples and not found elsewhere in the system (Pearson, 2002).

2 SEDIMENT TRANSPORT DURING FLOODS

The Southern Flow Corridor project proposes removing extensive lengths of levees. Upon removal of these levees, water and sediment will be able to flow out of the river and into the reconnected floodplain area. The floodplain is expected to accrete as fine sediments settle out of the water column and deposit. Larger sediment sizes will remain within the river channel area to deposit on and scour from the river bed with varying flow rates. This analysis determines the ability of channel flows to mobilize and transport these sediments based on the shear stresses acting on the bed material.

2.1 Methods

The analysis applied two different methods to evaluate project impacts on in-channel sediment transport characteristics during floods: The Excess Shear Stress Approach and the Engelund-Hansen Sediment Transport Capacity model. In both cases, the relative change in calculated values is the parameter of interest. There is greater certainty about the computed relative change than the values of sediment transport under the pre- and post-project conditions.

2.1.1 Excess Shear Stress Approach

The ability of a sediment particle to move is dependent on the shear stresses acting on that particle being greater than the minimum shear stress required to initiate movement. When the shear stress exerted by the flow is in excess of the critical shear stress, those grains may be mobilized. The amount of shear stress in excess of critical provides an indication of the amount of sediment that may be moved and a method for evaluating the potential project impacts with respect to sediment transport rate. Excess shear stress values were calculated for the channel network using before and after project hydraulic modeling results. The change in excess shear stress due to the project provides an indication of the expected change in sediment transport capacity.

2.1.2 Engelund-Hansen Sediment Transport Capacity Method

The Engelund-Hansen model (1967) predicts the maximum amount of sediment transport possible for a given flow condition. It was developed for rivers with predominantly sand bed and substantial amounts of suspended sediment. An assumption within the model is that there is an unlimited supply of sediment available in the channel. Therefore, it is possible for the actual transport to be less than the model prediction where the supply is limited. The original model was developed from physical modeling of sediments in the range of 0.58-1.41 mm, and has since been extensively tested against a large range of grain sizes and field data (e.g. Andrews, 1986; Lanzoni and Seminara, 2002; Struiksma et al., 1985; Van Leeuwen et al., 2003; Wu, 2004). As with the excess shear stress approach, pre- and post-project sediment transport capacities were calculated and the difference between the two used to evaluate potential changes to the channel system.

2.1.3 Sediment size evaluated

Sediment transport was evaluated for 1 mm (0.04 inch) size particles. While larger than the typical 0.125 to 0.25mm sands found in the Bay, this size particle accounts for the upstream coarsening of sediment that is common in rivers, and is somewhat conservative, as larger particles have higher critical shear stresses.

2.1.4 Floods evaluated and use of the HEC-RAS model

The analysis used simulation results from the four floods that were used to determine flood reduction benefits of the Southern Flow Corridor project. Table 1 shows the four floods, with their approximate return interval, that were simulated to address the range of flows. Three of these are based on hydraulic model simulations of actual floods that occurred in 1999, 2001, and 2007. The 100-year flood uses a synthetic hydrograph based on statistical analysis of peak flows on the Wilson and Trask Rivers. All simulations were conducted in unsteady flow mode, with flow hydrographs input for rivers and tributaries, and tides at Garibaldi used for the lower boundary condition. Simulating this unsteady flow condition, versus steady state where only a single constant flow is evaluated, is important in a sediment transport analysis as it provides a better representation of the natural system and the gradients in water depth and friction slope that are responsible for generating sediment movement.

Table 1: Floods simulated

Recurrence Interval	Flood Year
1.5-yr flow	2001
6-yr flow	1999
22-yr flow	2007
100-year flow	Synthetic

Simulation results of the main river channels and sloughs were extracted from the hydraulic model for pre- and post-project conditions during the four floods. The analysis area extends from Highway 101 in the east, and Highway 131 to the south, downstream to the Bay (Figure 1). Upstream of the two highways changes to hydraulic conditions due to the project, and hence sediment transport changes, are minimal and were not analyzed.

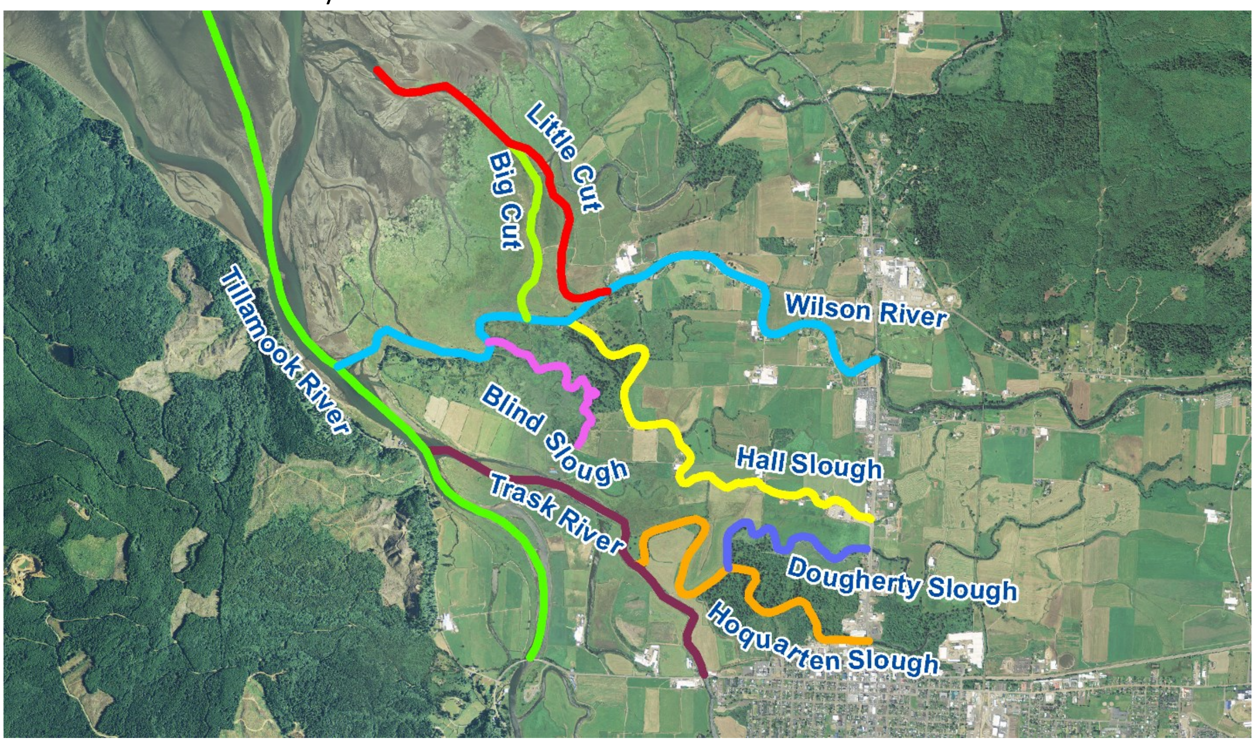


Figure 1: Rivers and sloughs analyzed for riverine flooding

For each reach and flow scenario, required hydraulic variables were extracted from the HEC-RAS model at the time of maximum flow depth (i.e. maximum flood level). However, due to the complex riverine-tidal interactions that occur during floods, the maximum shear stress may not occur during the maximum flow depth. The closer to the Bay the more likely this is the case, as is exemplified by the computed sediment transport rate over a single ebb tide near the downstream end of Wilson River (Figure 2). Transport has a looped hysteresis curve, with the transport rate increasing quickly on the rising limb of the flow and then decreasing slowly. The peak transport rate occurs on the falling limb, just after the peak flow rate. The consequence of underestimating the maximum shear stress is that the calculated sediment transport capacities are lower than the maximum possible for a given flood. However, a review of the hydraulic modeling results showed that the relative change in shear stress between existing and with-project conditions remained the same whether the time of maximum depth or maximum shear stress was used. Therefore, results from maximum flow depths were deemed appropriate for use.

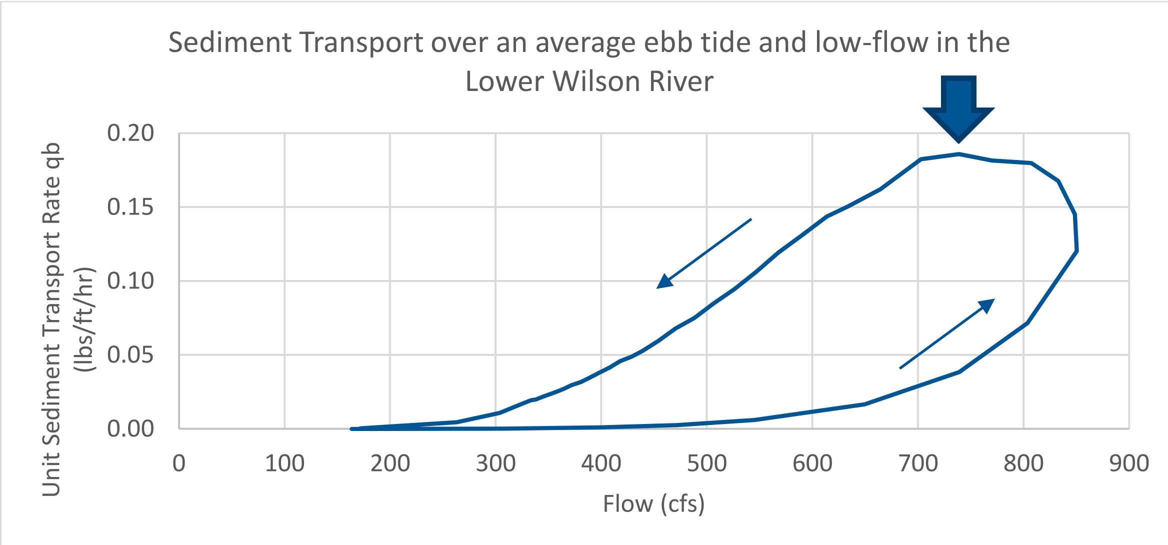


Figure 2: Example of hysteresis in sediment transport rate (large arrow indicates approximate point of maximum transport rate)

2.2 Results

This section first presents results graphically, by reach, of the computed excess shear stress difference and maximum transport rates for pre- and post-project conditions. A narrative summary by reach is given following the figures. For the excess shear approach, the change in shear stress for all four floods are shown. This is the difference in excess shear stress between pre- and post-project conditions. Negative numbers indicate areas where shear stress, and therefore sediment transport capacity, has decreased due to the project. Using the Engelund-Hansen method, sediment transport capacity results are shown for both the pre- and post-project condition. Degradation may occur when the simulated post-project rate is greater than the pre-project rate, and aggradation when the post-project is less. Analysis showed that sediment transport rates modeled for the 2007 (22-year) flow were similar to those for the 100-year flood, and the results for the 2001 (1.5-year) flow were similar to those for the 1999 (6-year) flow, thus for clarity results are shown for only two events.

Note that in some figures, the downstream-connected reaches are also shown. For instance, the Wilson River figures shown the entire reach from Highway 101 downstream to the Bay; however, the Hall Slough figures show the slough and then also the Wilson River downstream of the confluence. This allows visualization of reach wide changes that are anticipated to occur.

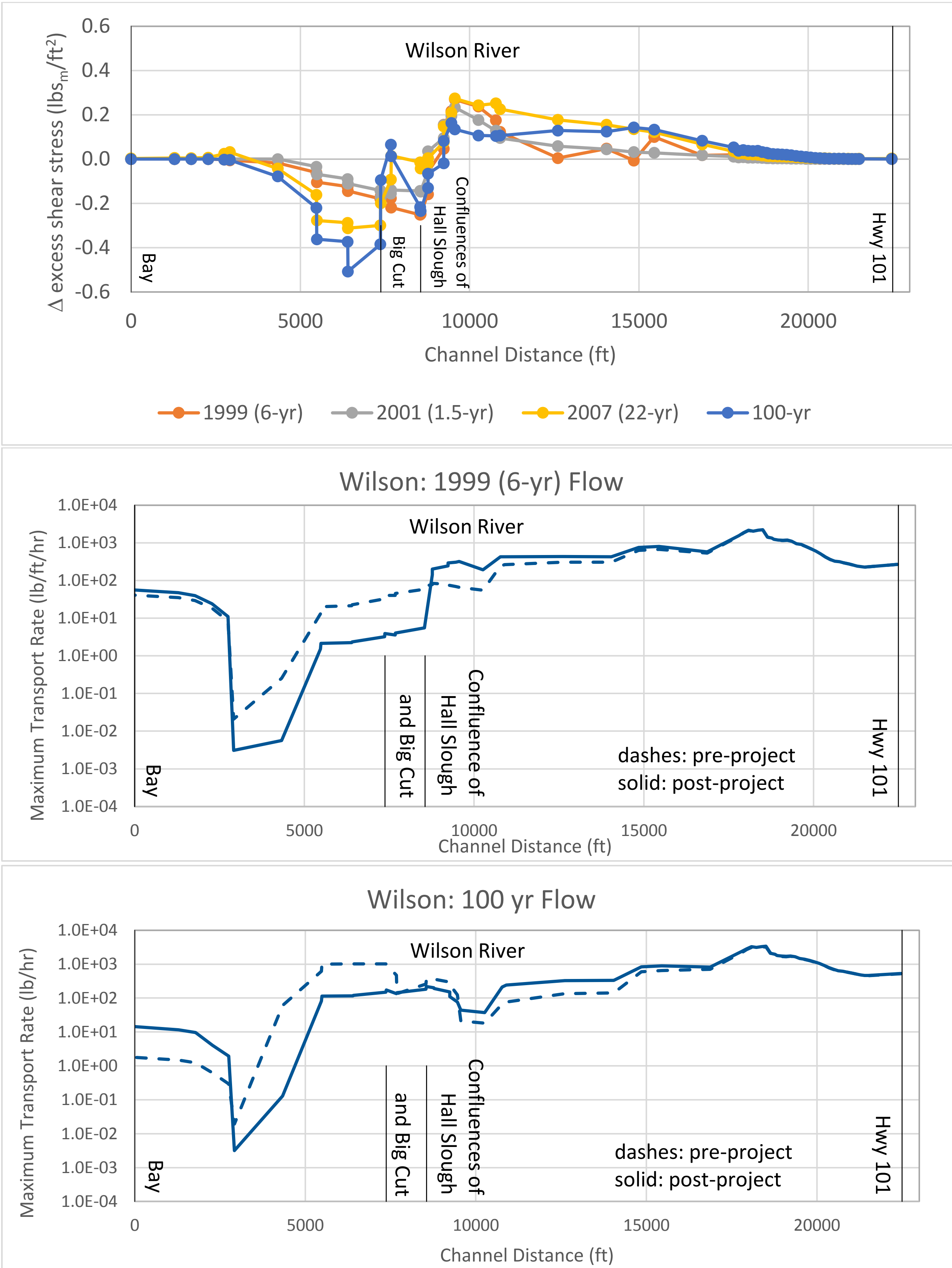


Figure 3: Wilson River excess shear and sediment transport capacity

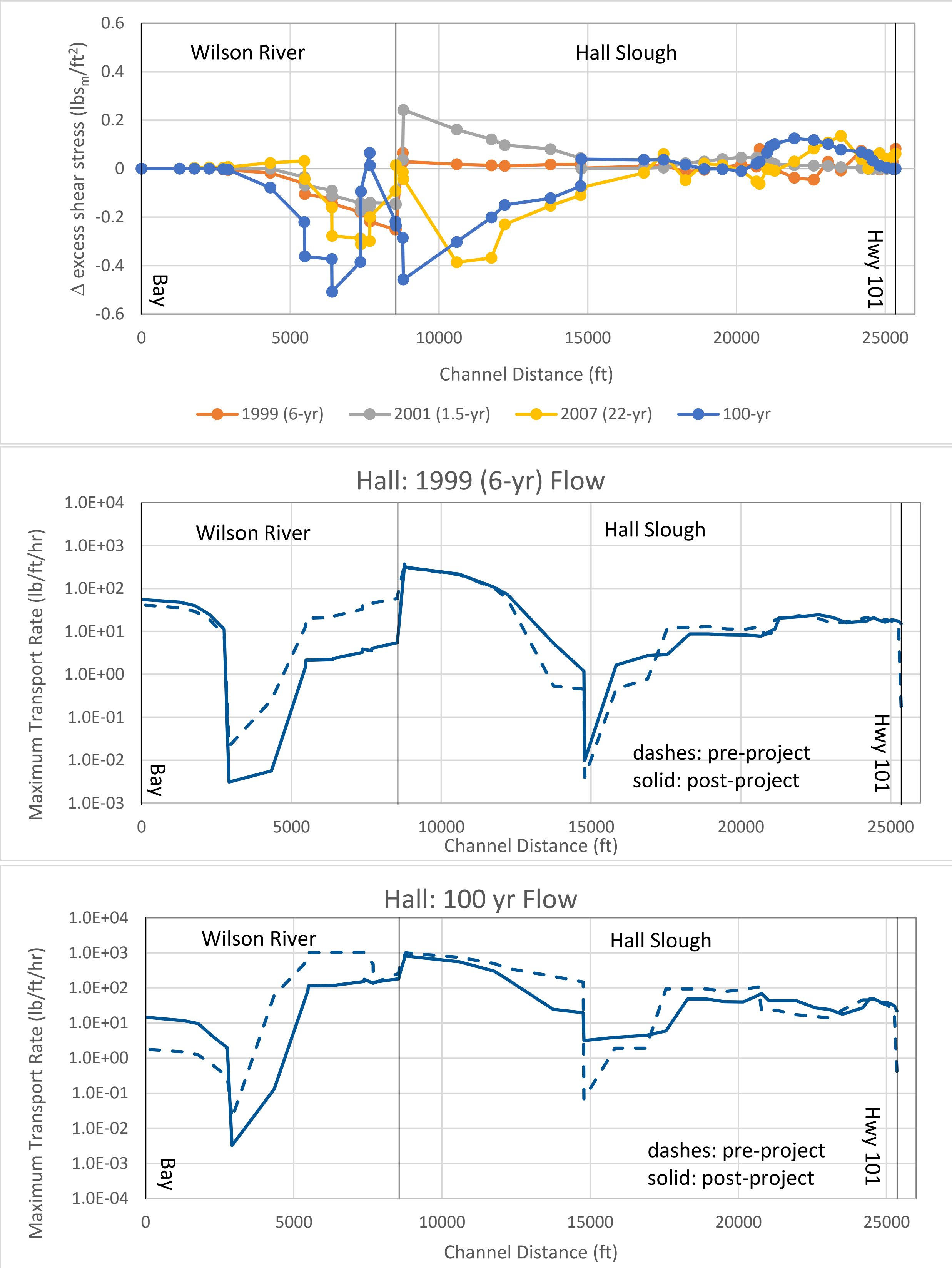


Figure 4: Hall Slough excess shear and sediment transport capacity

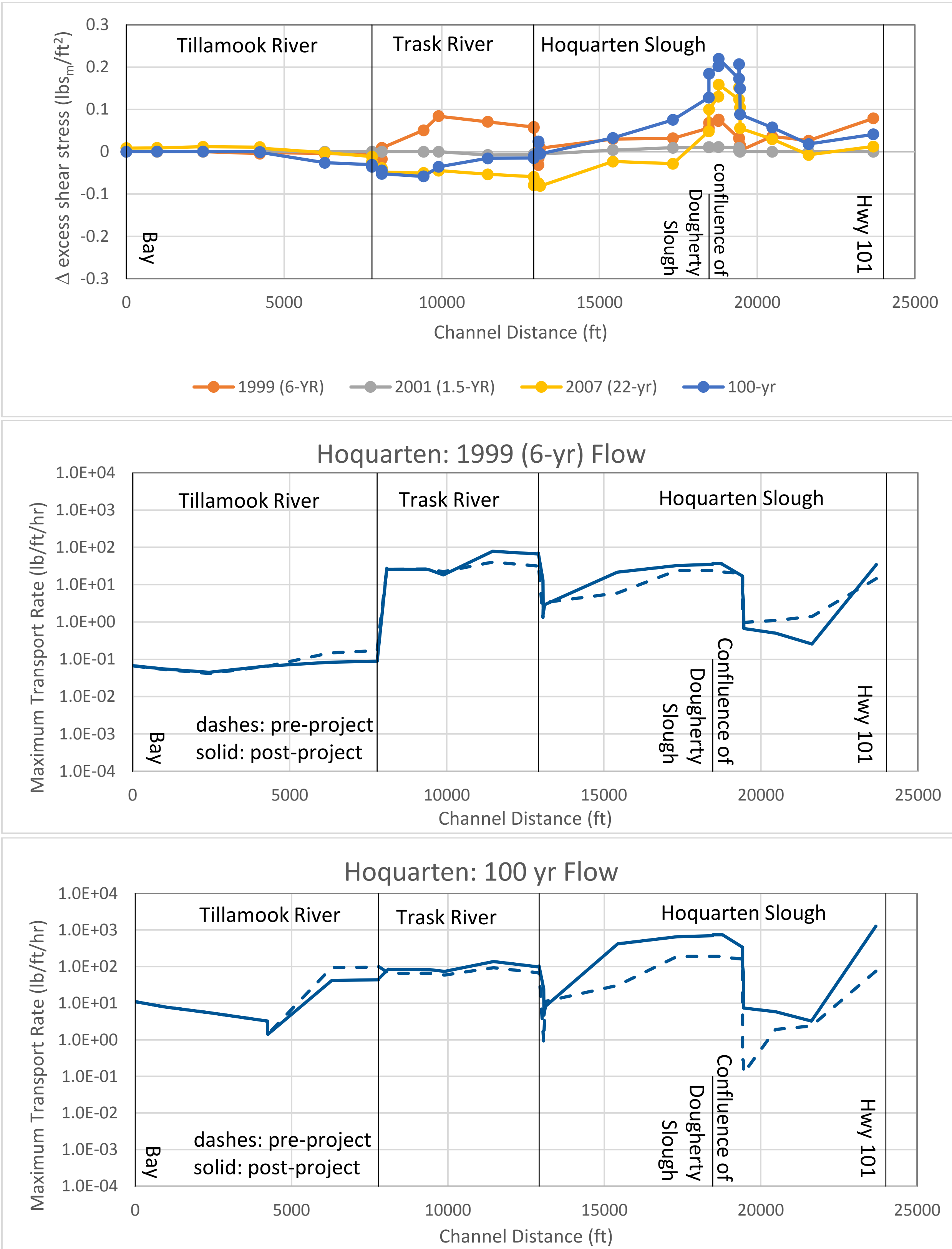


Figure 5: Hoquarten Slough excess shear and sediment transport capacity

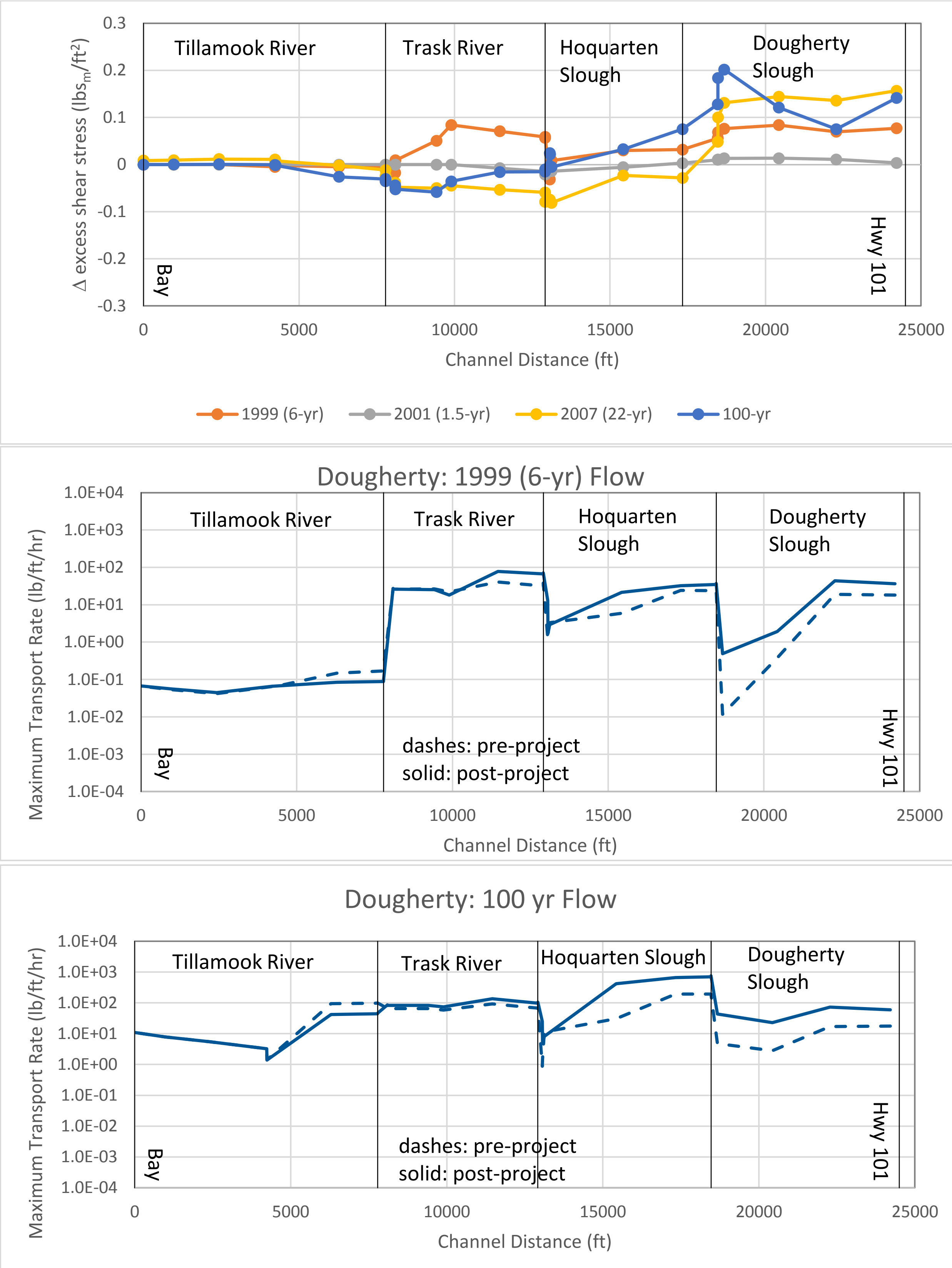
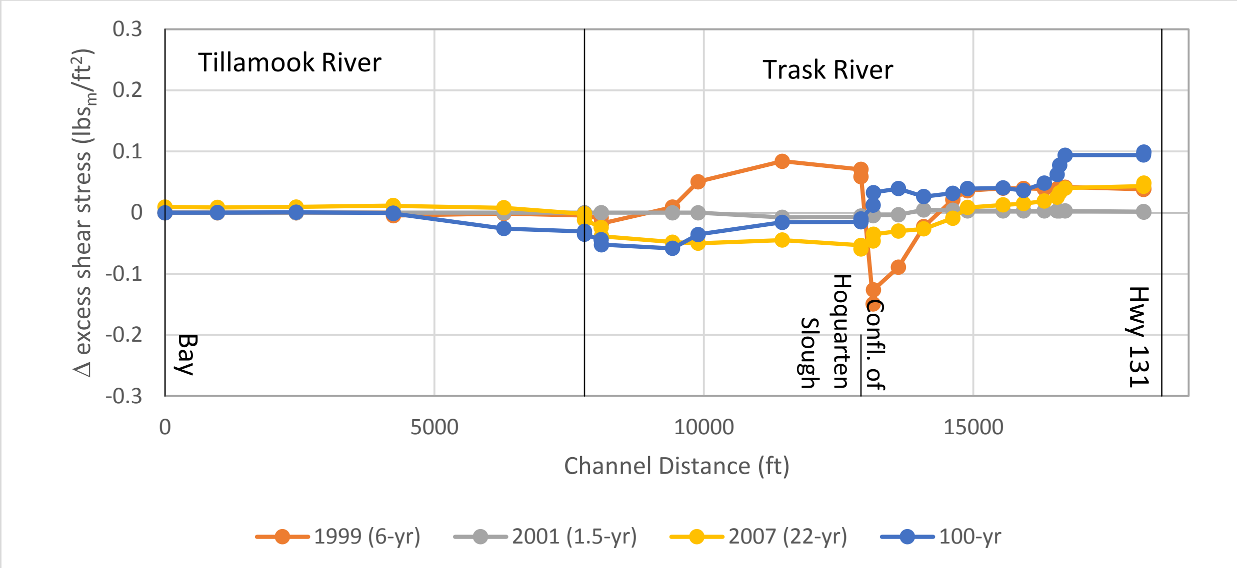
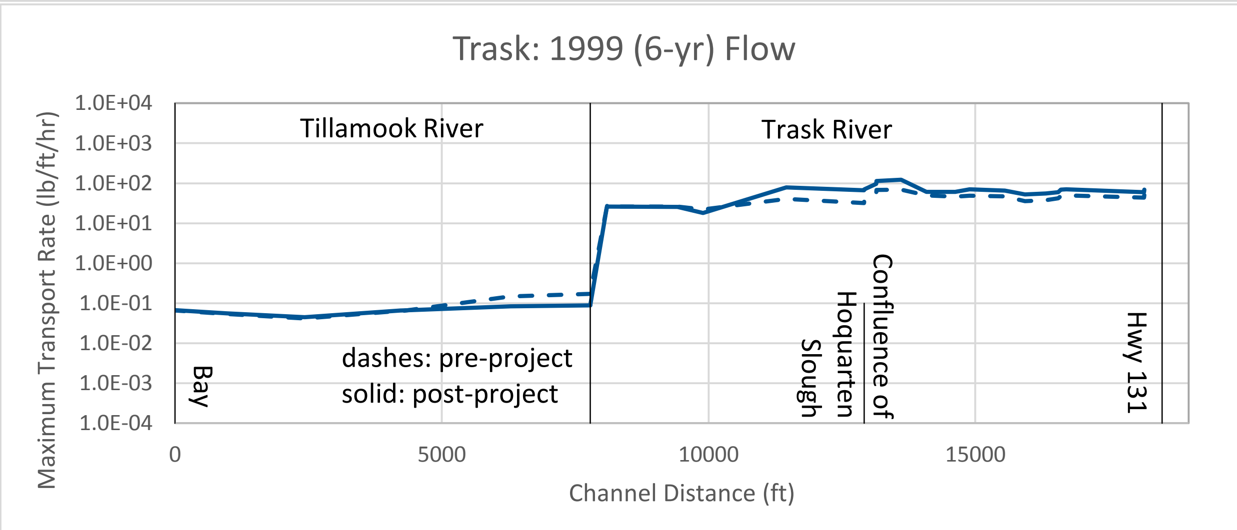


Figure 6: Dougherty Slough excess shear and sediment transport capacity





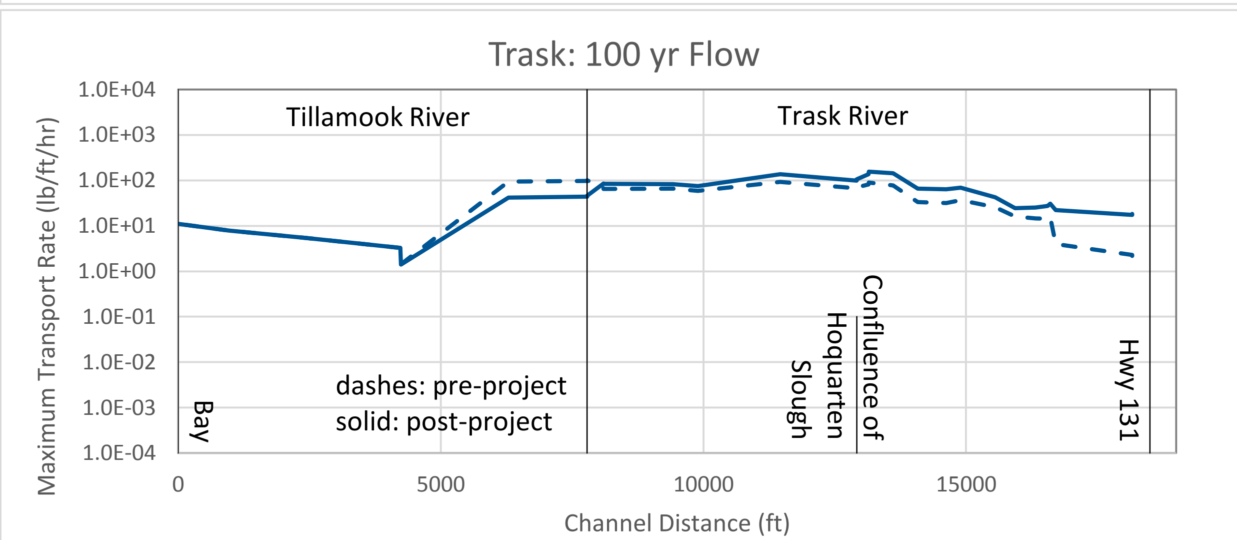


Figure 7: Trask River excess shear and sediment transport capacity

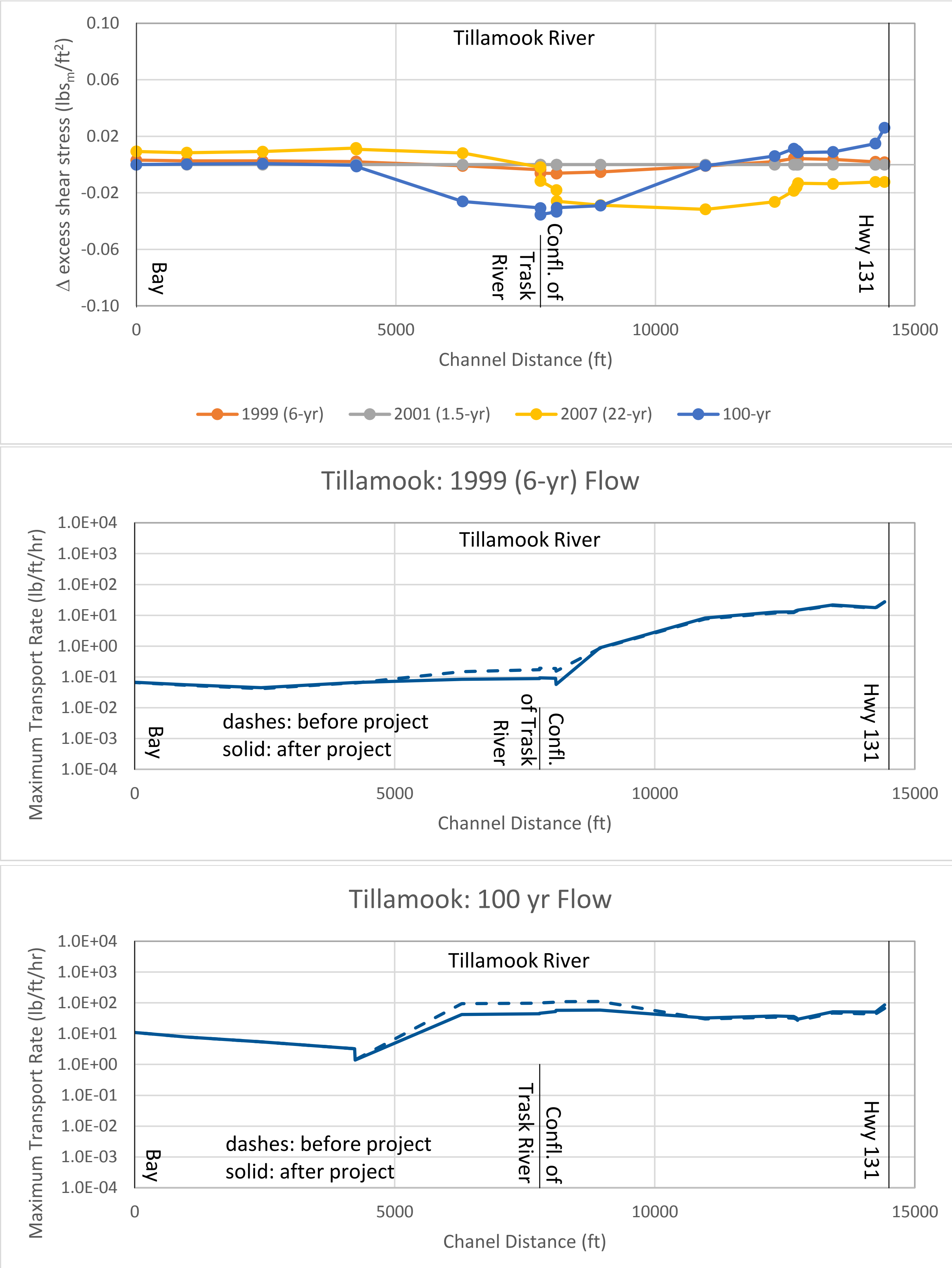


Figure 8: Tillamook River excess shear and sediment transport capacity

2.2.1 Flood Related Sediment Transport Capacity Summary

In general, sediment transport capacity will increase in the rivers, sloughs, and reaches upstream of the northern project area (the Wetlands Acquisition Area). By increasing overbank conveyance here, the project reduces water levels that in turn create steeper water surface slopes, velocities, and shear stresses in upstream channels. This is most consistently seen in the upper Wilson and Trask Rivers, and in Dougherty Slough/lower Hoquarten Slough, which behave similar to the main channels due to Dougherty Sloughs connection to the Wilson River. Upper Hoquarten Slough results are mixed, which is due to the lack of upstream river connection, very rough forested overbanks, and high sinuosity. Hall Slough is unique in spilling flow to Blind Slough mid-reach, which may lead to decreased channel capacity in the lower end. River reaches adjacent to the northern project area (the lower Wilson River and lower Tillamook reaches) show reduced sediment transport capacity due to the large increase in overbank conveyance available. Figure 9 and Figure 10 summarize the predicted changes of the project on sediment transport rates downstream of Highway 101 and Highway 131 during the 100-year and 6-year floods. More detailed reach by reach summaries are given in the following sections.

2.2.2 Wilson River

Sediment transport capacity is predicted to increase in the upper portion of the reach and decrease downstream (Figure 3). The transition occurs around the confluences of Hall Slough, Little Cut, and Big Cut. Under post-project conditions, this is where the levees that confine flows in the Wilson River end and the flows can spread out over the project area. In addition, the multiple channels (Wilson River, Big Cut, and Little Cut) and low tidal marsh offer multiple paths to flow into the Bay. By removing levees, the project lowers water levels close to the Bay tide levels in the project area. This water level reduction propagates up the Wilson River. As a result, water surface slope, velocities and shear stress all increase in the Wilson River above Hall Slough, leading to the increased sediment transport capacity.

2.2.3 Hall Slough

Even under existing conditions Hall Slough floods in a unique manner. Flow in the lower end of Hall Slough reverses during larger floods. This reverse flow combines with flows arriving from the upstream reaches of Hall Slough and spills over the left bank berm into the Blind Slough area downstream of Goodspeed Road. This results in low velocities and shear stress in the Slough, and a “sag” in the water surface where spill to Blind Slough occurs.

The project will remove the left bank berms that impede this process and increase the spill into Blind Slough. Sediment transport capacity increases in the area of spill into Blind Slough (around station 15,000). Overall water surface slopes, velocities, and sediment transport capacities are low in Hall Slough. Hall Slough does not have a direct connection to the Wilson River upstream , so there is very little sediment introduced to the system during floods. The most likely area where some reduction in capacity may occur is in the downstream end, where reverse flows could pull some sediment into Hall Slough from the Wilson River.

2.2.4 Hoquarten Slough

Changes to sediment transport capacity in Hoquarten Slough between Highway 101 and the confluence with Dougherty Slough are mixed (Figure 3). Unlike the other reaches, there are no consistent trends in changes to velocities, despite the reduction in peak flood levels. Sediment transport capacity is predicted to decrease in the 6-year event and increased in the 100-year event. Because the reach has no upstream main channel connection to provide sand size sediment, and overall channel sediment transport rates are low, the chance of channel aggradation occurring due to reduced sediment transport capacity is less than elsewhere.

Downstream of the confluence with Dougherty Slough a more consistent pattern is seen, with increased flow, velocities and sediment transport capacity occurring, and positive excess shear differences for three of the four floods. In this regard, the segment is behaving in a similar manner to the upper Wilson River, and is more similar to Dougherty Slough (discussed next), than upper Hoquarten Slough.

2.2.5 Dougherty Slough

Dougherty Slough shows consistent increases in sediment transport capacity that continues downstream through the lower end of Hoquarten Slough. Dougherty is the only slough with an upstream connection to the Wilson River, and behaves in a similar manner to it, with the project causing decreased water levels, increased velocities and increased shear stress in the channel (Figure 6).

2.2.6 Trask River

Similar to the Wilson River, the project is expected to increase sediment transport capacity in the upstream part of the reach and decrease it in the lower reach (Figure 7). The reduction in water surface elevation results in higher velocities and shear stresses in the channel upstream of Hoquarten Slough. Downstream of Hoquarten Slough the project greatly increases the overbank conveyance area on the right bank. This is a transition zone where the differences in sediment transport capacity decrease and then becomes negative near the confluence with the Tillamook River.

2.2.7 Tillamook River

Sediment transport capacity is predicted to increase slightly in the upper end of the analyzed reach, where the river is confined between levees (Figure 8). Similar to the Wilson and Trask Rivers, the lower flood levels downstream results in increased velocities and shear stresses in the confined channel. As the river approaches the confluence with the Trask, excess shear stress and sediment transport capacity are reduced. This is related to the large overbank flow area now available due to the levee removal along the right bank of the Trask and Tillamook Rivers. This reduction in capacity persists through the end of the project area where the Wilson River joins. Downstream of this, in the Bay, changes are negligible.

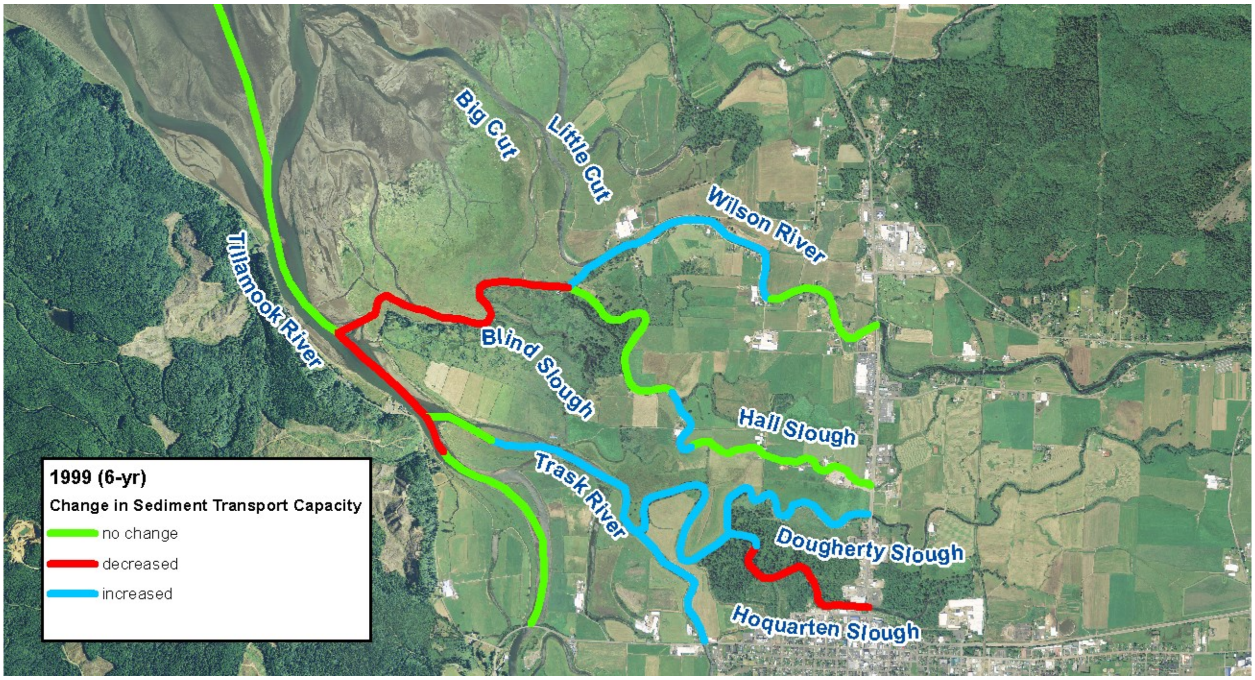


Figure 9: Expected change in sediment transport rate post-project for the 6-year flow

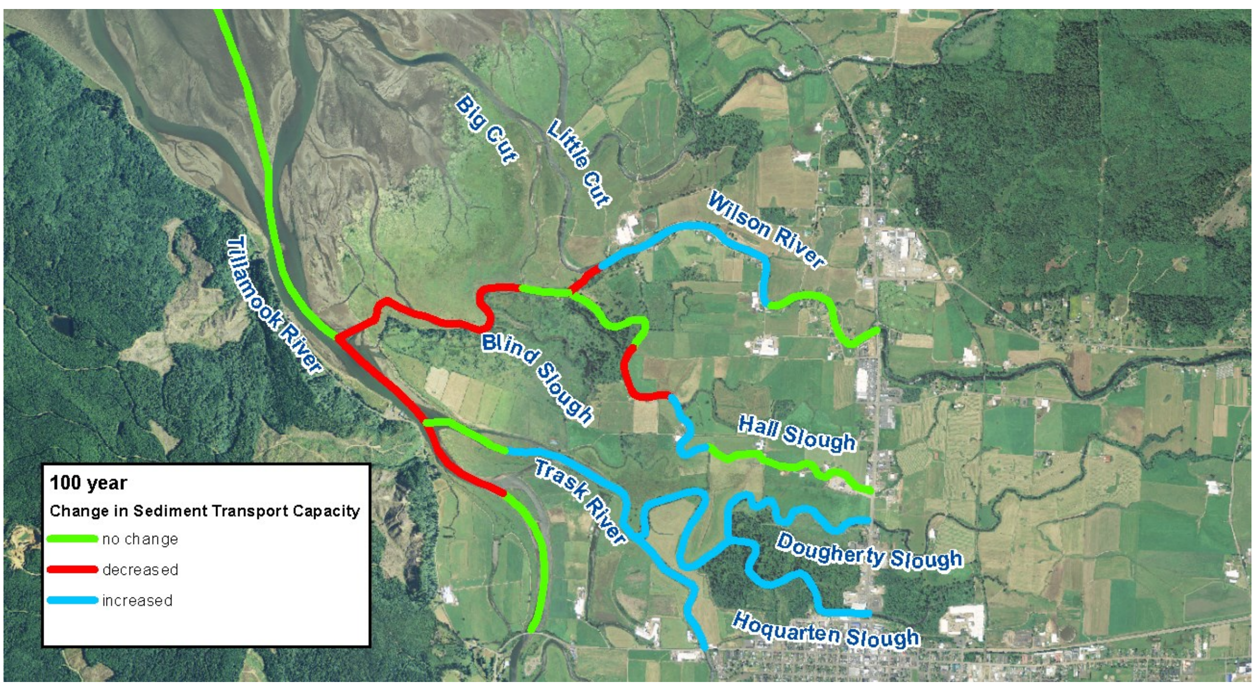


Figure 10: Expected change in sediment transport rate post-project for the 100-year flow

3 TIDAL CHANNEL MORPHOLOGY

The tides in Tillamook Bay have a strong influence on flow and sediment transport in the area's rivers and sloughs, especially under low river flow. O'Brien (1966) developed simple regime equations that predict the cross sectional area of inlets to bays and lagoons as a function of the tidal prism of the waterbody. The tidal prism is typically defined as the volume of water between mean lower low water (MLLW) and mean higher high water (MHHW) that drains through a specific location The approach has been extended to predict changes in the channel geometry in tidal marshes, including evaluation of expected change to channel form with tidal marsh restoration through the removal of levees (Williams and Orr, 2002), as is happening in the Southern Flow Corridor.

Tidal prism volume can be calculated in a channel by summing outflow over one ebb tide. For the analysis, the HEC-RAS model was used to simulate a typical two-month period with observed Garibaldi tides and average June river inflows. From this simulation, a tidal cycle that closely matched both MHHW and MLLW was selected as being representative of the tidal prism.

Outflow during the ebb tide at river and slough confluences, the upper extents of project area of influence, and a few other key locations were extracted from the model results and summed for both pre- and post-project conditions. The resulting tidal prisms are shown in Table 2 and Figure 11. Numerous studies have found that channel area scales approximately linearly with tidal prism, so the ratio of post- to pre-project tidal prism volumes is a direct measure of the expected change in cross sectional area due to the project (e.g. Byrne et al., 1980; D'Alpaos et al., 2010; Kraus, 1998; Langbein, 1963).

The majority of the river reaches will experience minimal impact during tidally driven conditions, as defined by less than a 5% change in the tidal prism ratio. This includes most of the Wilson River, Dougherty and Hoquarten Sloughs. Significant reductions in sediment transport are expected in downstream portions of Hall Slough based on the tidal prism volume dropping by 14%. The decrease in Hall Slough tidal prism is related in part to the diversion of a portion of high tides to Blind Slough under with-project conditions. The sediment transport in Big and Little Cuts is predicted to increase based on the change in flow volume. The largest increase in tidal prism is expected for Blind Slough, for which the prism volume more than doubles. This is expected, as almost the entire northern restoration area will drain through Blind Slough once the levees are removed. Though this is a large impact on Blind Slough, the increase of the Blind Slough flow volume is around 10% of the lower Wilson River volume, so major changes are not expected to propagate into the Wilson River. Tidal prism in the Trask River above Hoquarten Slough is expected to decrease by 5% to 9%, while it increases in the lower Tillamook River by up to 10%.

Table 2: Tidal prisms at select locations

Location	Pre-Project Volume (acre-ft)	Post-Project Volume (acre-ft)	Ratio of Post- to Pre-Project
Wilson River – at Hwy 101	2571.63	2560.83	1.00
Wilson River – u/s of Hall Slough	1881.11	1841.20	0.98
Mid Hall Slough	67.50	66.00	0.98
Hall Slough at mouth	294.10	253.23	0.86
Blind Slough at mouth	77.26	181.33	2.35
Wilson River – d/s of Blind Slough	1936.67	1855.74	0.96
Big Cut at mouth	128.52	161.40	1.26
Little Cut at Bay	330.10	359.60	1.09
Dougherty Slough – at Hwy 101	436.96	430.58	0.99
Dougherty Slough – at mouth	664.40	651.77	0.98
Hoquarten Slough – at Hwy 101	196.59	192.48	0.98
Hoquarten Slough – d/s of Dougherty Slough	625.83	640.12	1.02
Hoquarten Slough – at mouth	1641.51	1630.05	0.99
Trask River – at Hwy 131	1475.19	1339.29	0.91
Trask River – at Hoquarten Slough	3318.41	3156.17	0.95
Tillamook River – at Hwy 131	3362.94	3461.43	1.03
Tillamook River – below Trask	8384.14	9232.16	1.10

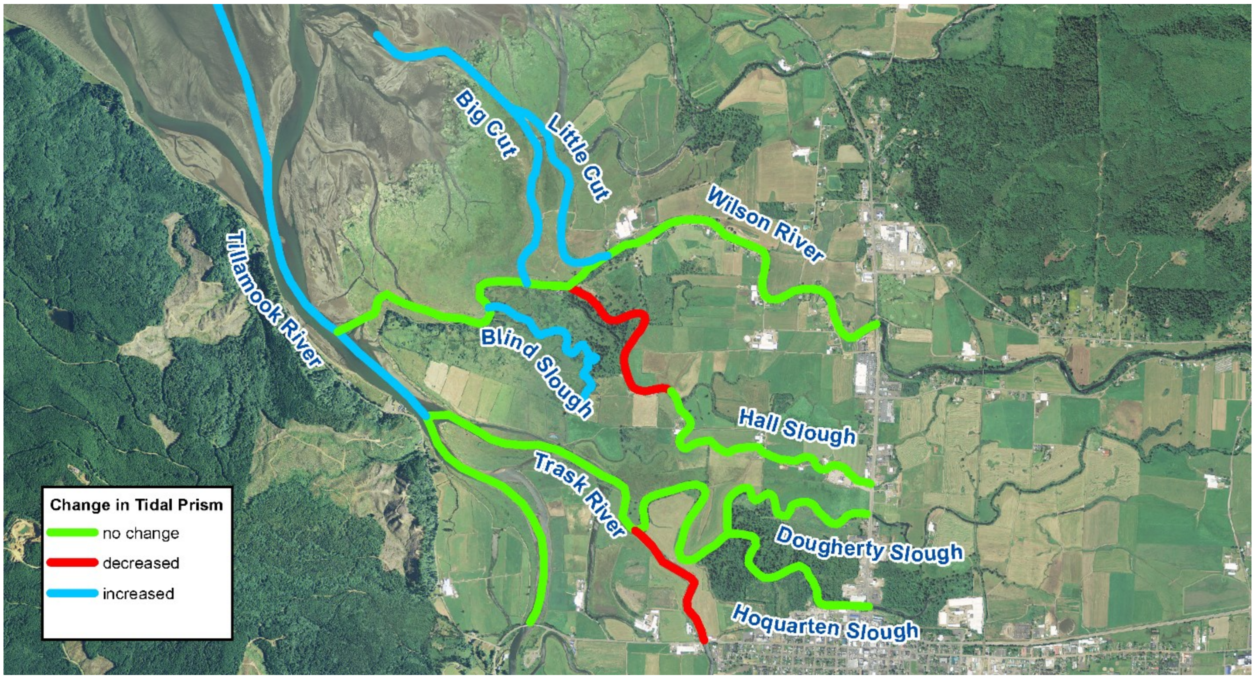


Figure 11: Expected change in tidal prism as a result of with the project for low-flow conditions

4 SYNTHESIS OF RESULTS

The river and slough reaches analyzed in this report occupy the complex transition area between fully river flood dominated and fully tidal dominated channel forming processes. The relative importance of the two varies, not only over the reaches, but also seasonally. During periods of reduced flow in the system, sediments may deposit in some of the reach areas. These sediments will transport downstream with the next increased flow. The net result is one of continued transport through the system. Overall, the area analyzed is already in a net aggradational state, which is consistent with its position at the head of the Bay and rising sea level.

Based primarily on this sediment transport analysis, but also considering prior reports, field visits, and anecdotal evidence from long-time residents, each reach has been classified as to whether riverine flooding or tides are the dominant process. The results are summarized in Table 3 and Figure 12.

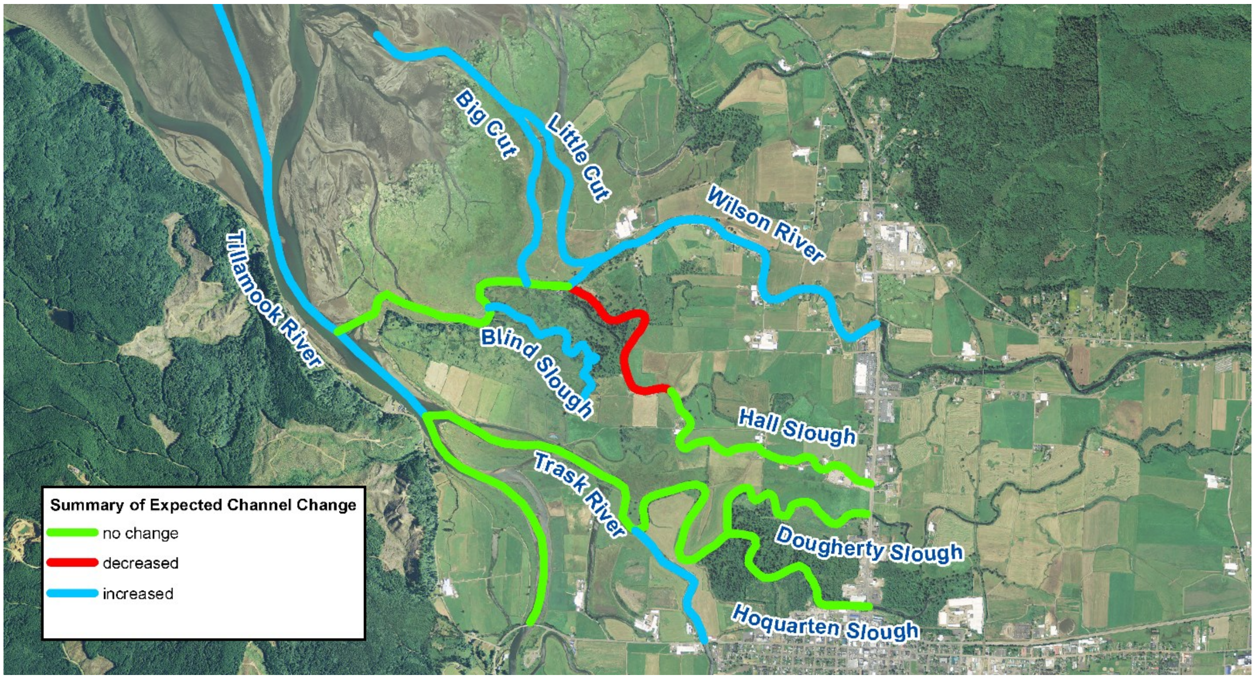


Figure 12: Summary of expected changes to channels with project

Table 3: Summary of expected changes to channels with project

	Predicted Change			(Red=Decrease, Green=Minimal Change, Blue=Increase)	
Reach	**6-yr Flood**	**100-yr**	**Tidal**	**Dominant Influence**	**With-Project Change in either Channel Area or Sediment Transport Capacity**
Wilson River – u/s of Hall Slough				Riverine	**Increased**
Wilson River – d/s of Hall Slough				Tidal	**Minimal Change**
Upper Hall Slough				Tidal	**Minimal Change**
Lower Hall Slough				Tidal	**Decreased**
Blind Slough	--	--		Tidal	**Increased**
Dougherty Slough				Mixed	**Minimal Change**
Hoquarten Slough – above Dougherty				Tidal	**Minimal Change**
Hoquarten Slough – below Dougherty				Mixed	**Minimal Change**
Trask River – above Hoquarten Slough				Riverine	**Increased**
Trask River – below Hoquarten Slough				Mixed	**Minimal Change**
Tillamook River above Trask River				Tidal	**Minimal Change**
Tillamook River – below Trask River				Tidal	**Increased**
Big Cut/Little Cut	--	--		Tidal	**Increased**

The upper Wilson and Trask River reaches are flood dominated due to their steeper slopes and confinement by levees. The other reaches were all categorized as either tidally formed or mixed. Tidally dominated reaches includes reaches close to the Bay, and Hall and upper Hoquarten Sloughs, which do not have upstream connections to main river channels and hence have less frequent river flooding.

Dougherty Slough is listed as a mixed reach. The reach is unique in having both tidal slough characteristics similar to Hall and Hoquarten Sloughs, but also having a direct upstream connection to the Wilson River. While there is less certainty about the dominant influence in the reach, the analyses indicates the slough will either not change significantly, or possibly enlarge to a small degree if riverine floods processes are of more importance.

The other mixed reach is the Trask River between Hoquarten Slough and the Tillamook River confluence. Under existing conditions this reach riverine flood processes are clearly important, as the reach is confined between high levees for some distance, resulting in increased water levels. The greatest changes to flood conveyance width are created by the project in this area. Removal of the levees will also facilitate much greater tidal exchange to the north than currently occurs. These changes will tend to increase the importance of tidal processes in channel formation, but it is not clear to what degree. Regardless, it is most likely that the net channel change will be minimal, based on results from the riverine and tidal analysis.

The greatest change in channel area will occur in Blind Slough. Removal of the levees and plug across the slough will allow most of the daily tides that inundate the northern restoration area to drain through the slough unimpeded.

The only reach that shows a risk of aggradation is lower Hall Slough. Removal of levees along the left bank of Hall Slough will allow both flood waters and high tides to spill into Blind Slough rather than flow through the lower end of Hall Slough.

Overall, most reaches are predicted to have neutral or increasing sediment transport capacity. This is attributed to two factors. In the upper reaches, the project generally results in increased in-stream velocities and hence shear stresses by the removal of impediments to flows. In the lower reaches, shear stresses during floods can be lower, but the channels are mostly tidal dominated, so this reduction does not affect long-term channel form. Under low-flow conditions, the project generally has small effects, with the notable exception of Blind Slough, which is expected to undergo significant expansion.

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Attachment B

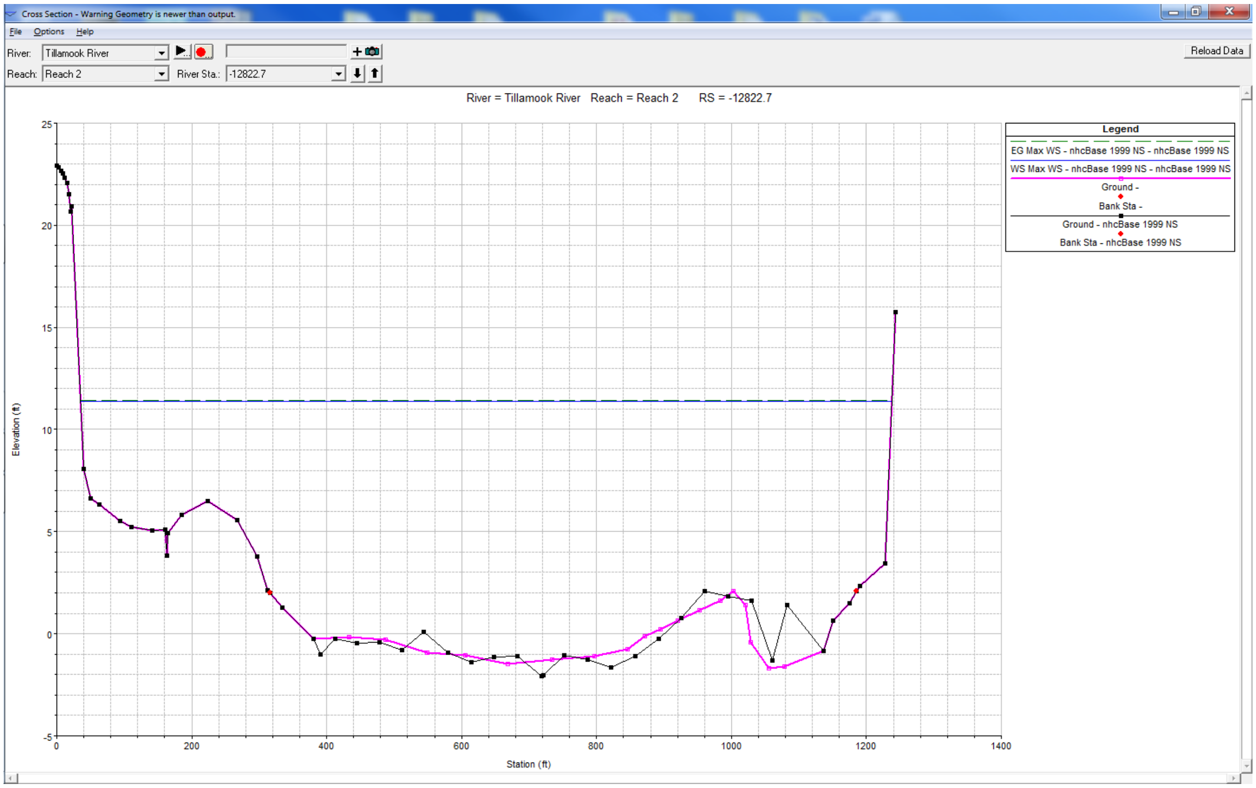
Repeat Cross-Sections of the Wilson and Trask Rivers

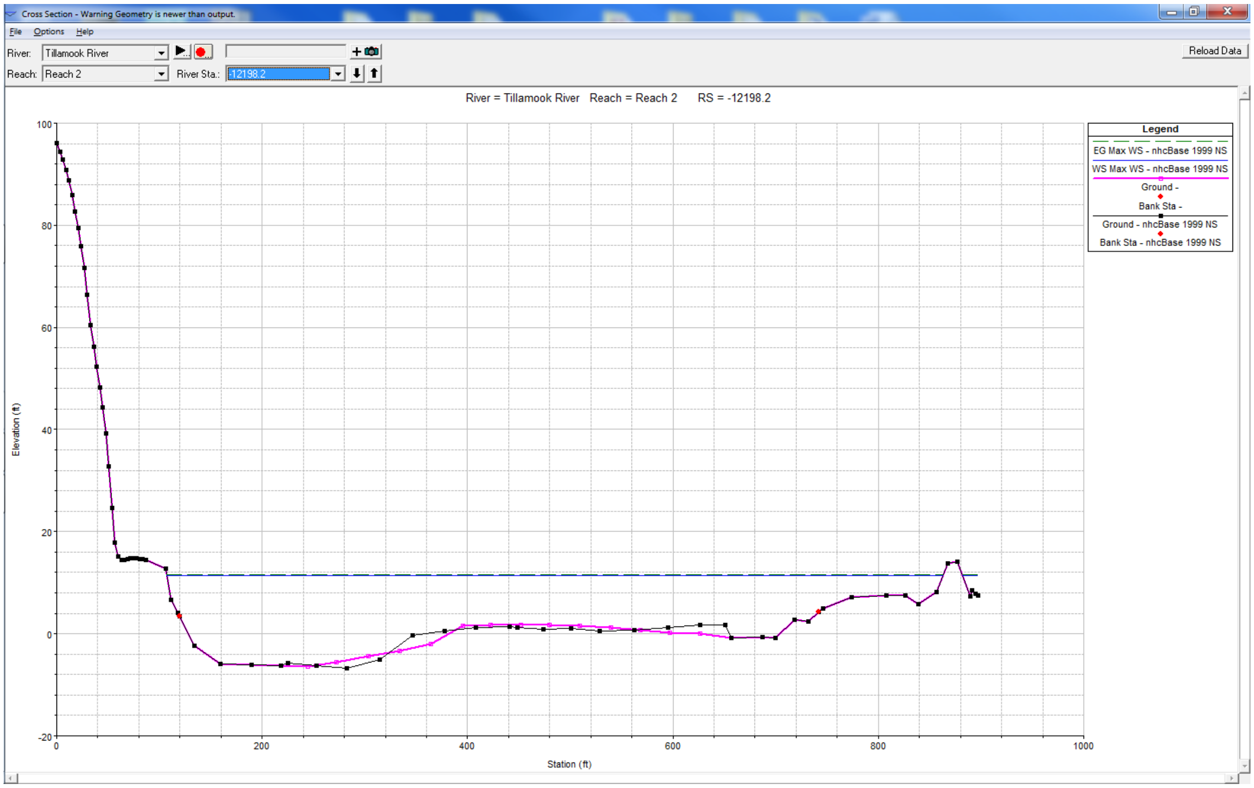
Cross sections document changes at numerous locations where repeat survey data were collected in 2002 and 2014, to support the updating of the hydraulic model for the proposed project.

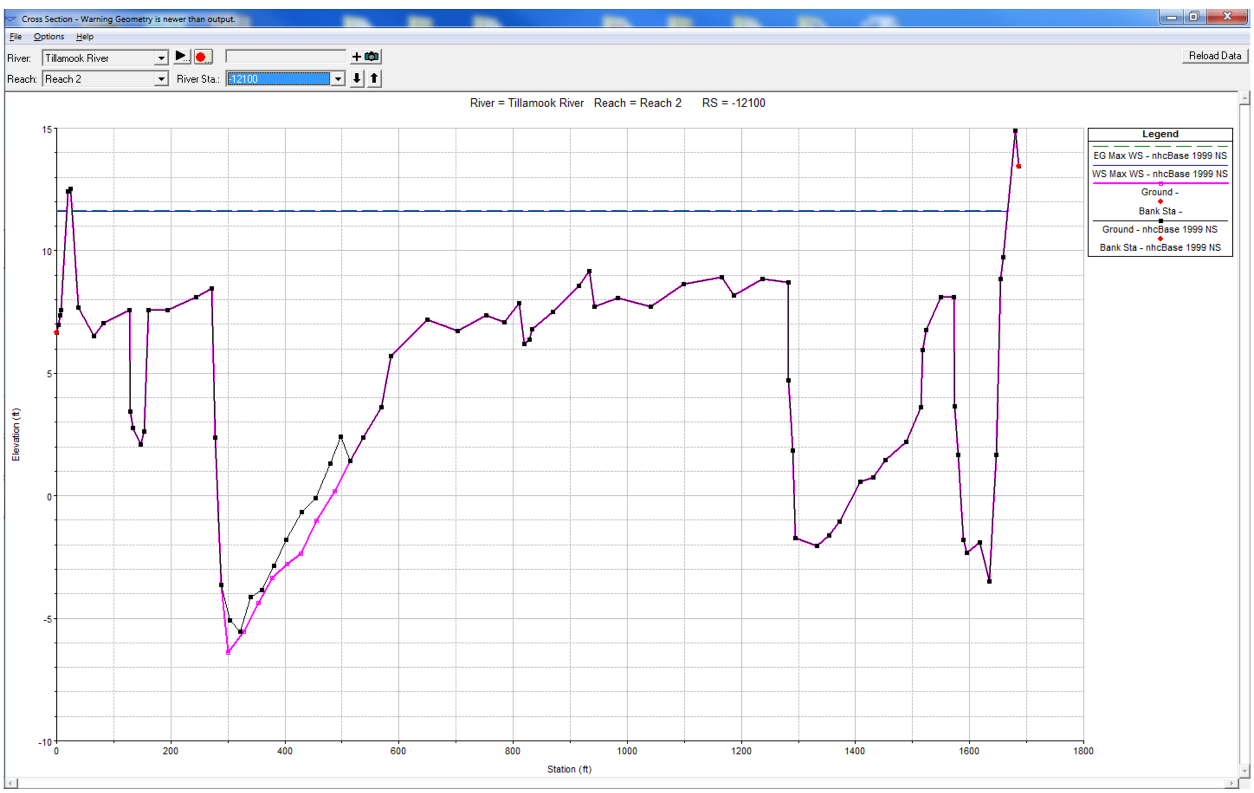
Source: NHC 2014b

Note: Updated geometry is Black.

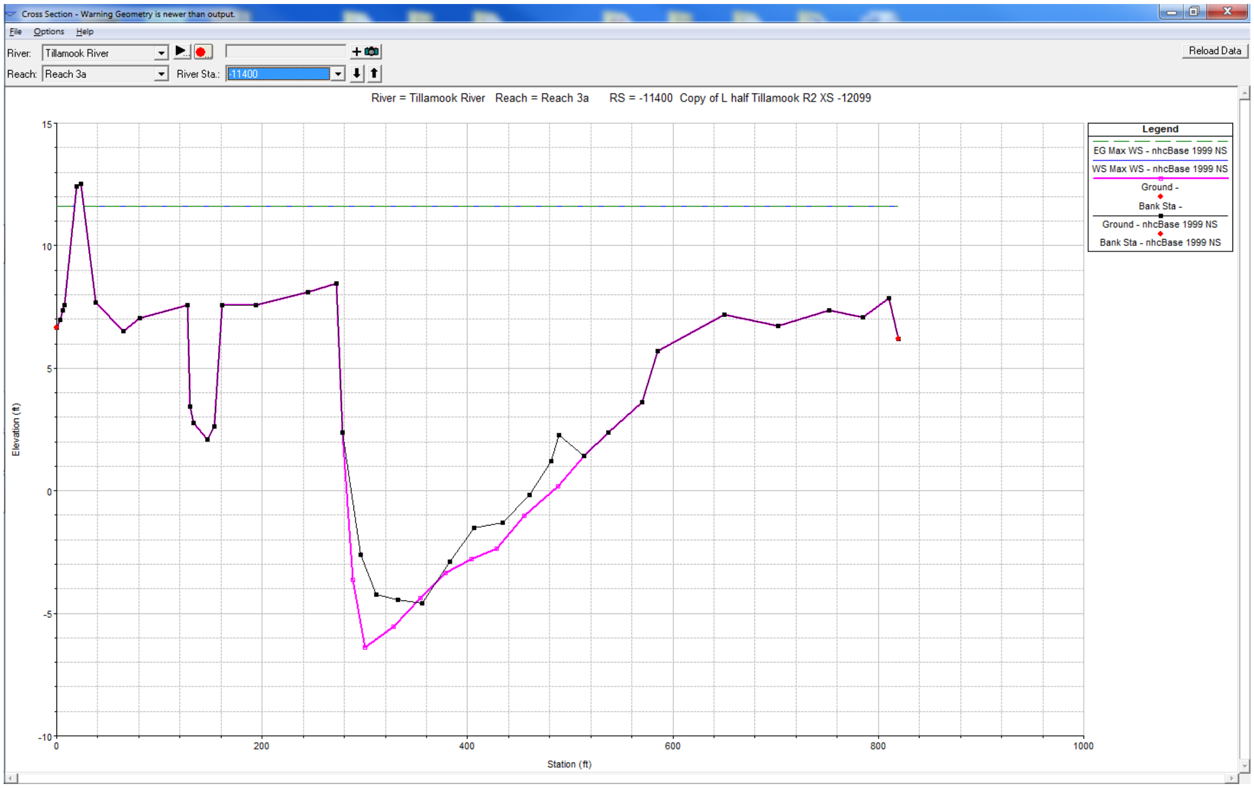
Tillamook Reach 2







Tillamook Reach 3A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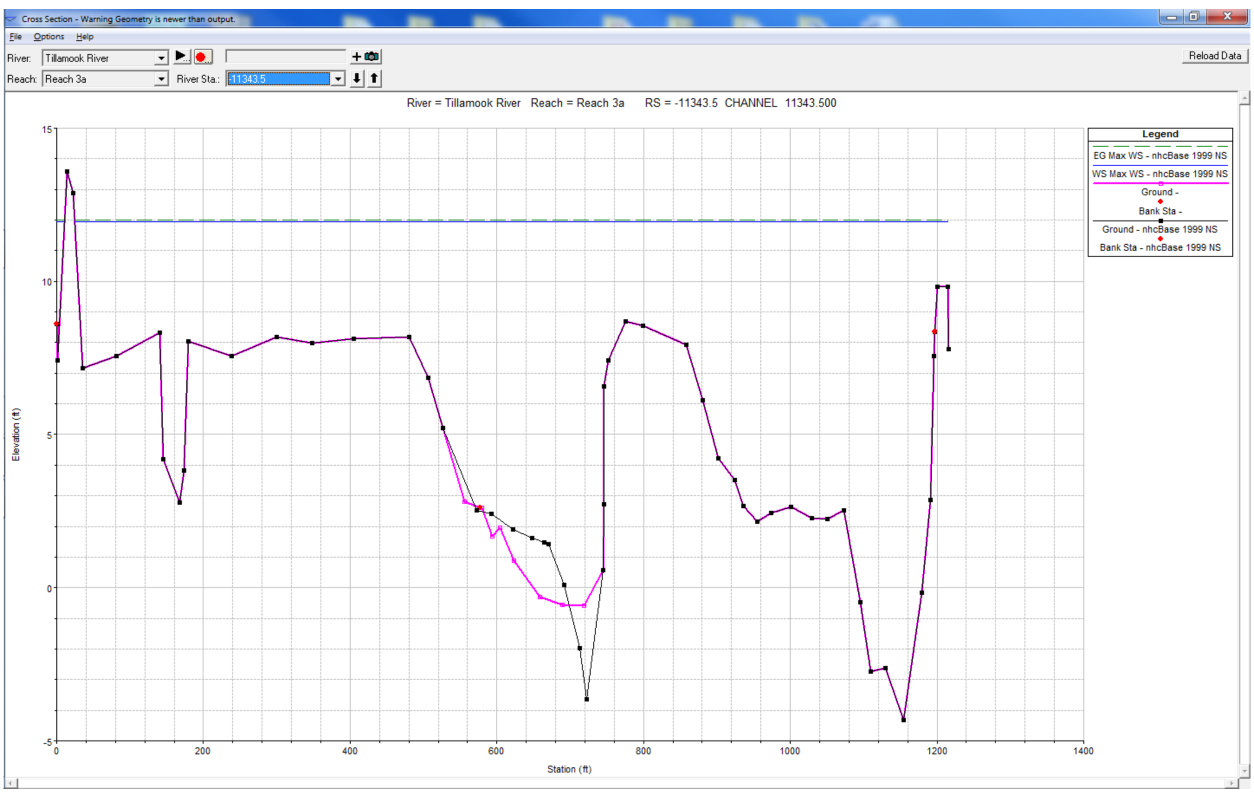
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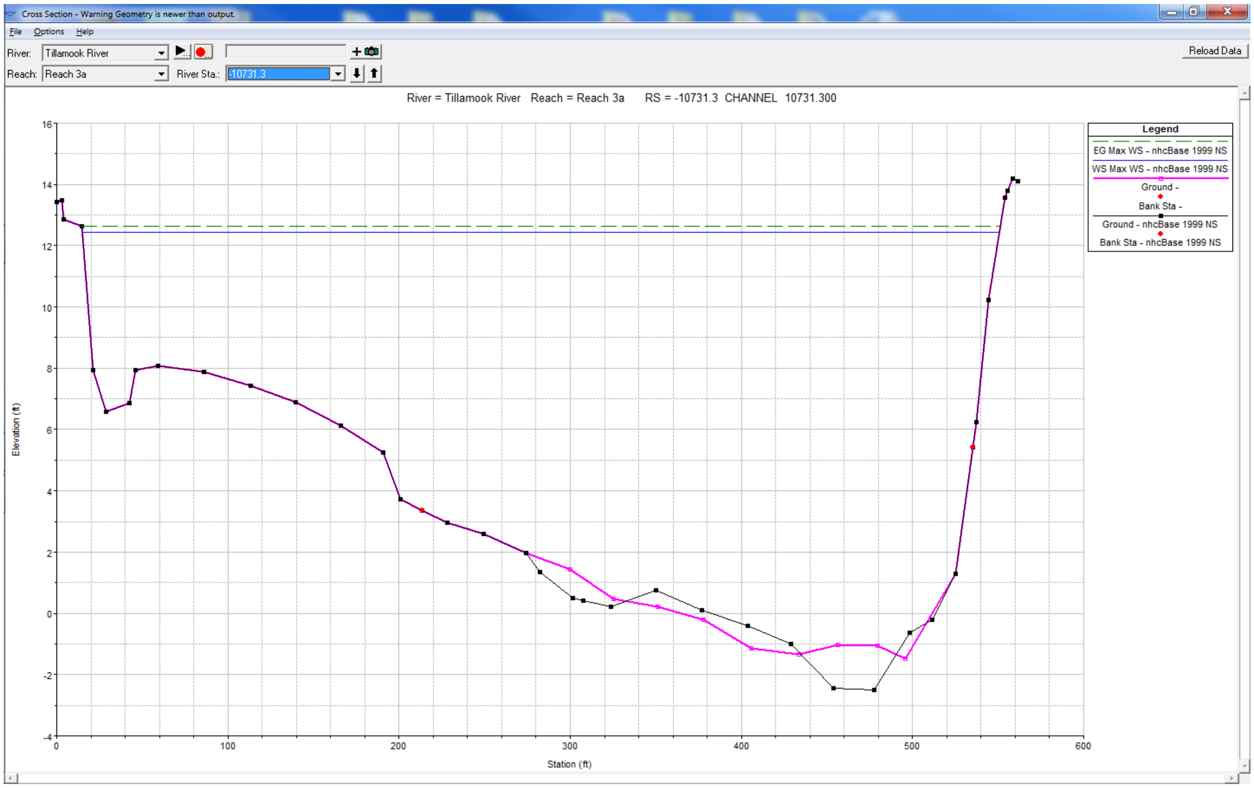
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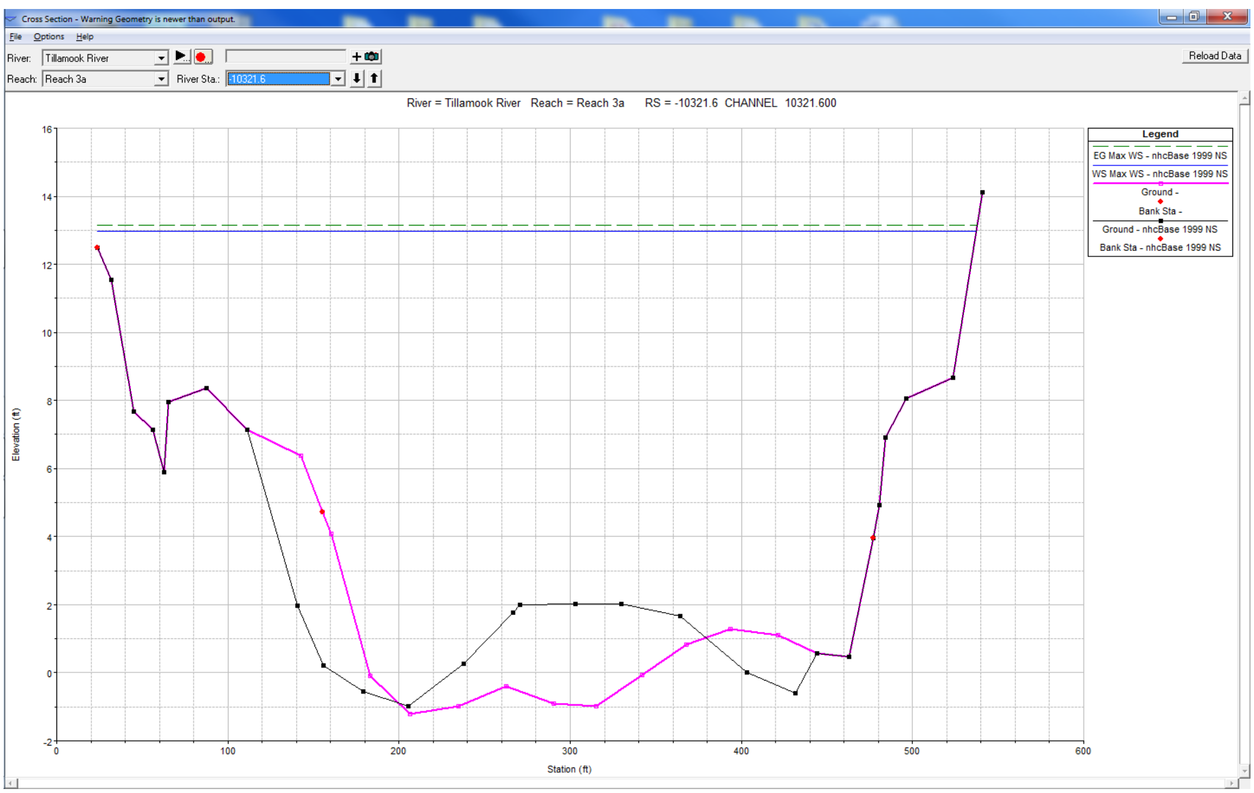
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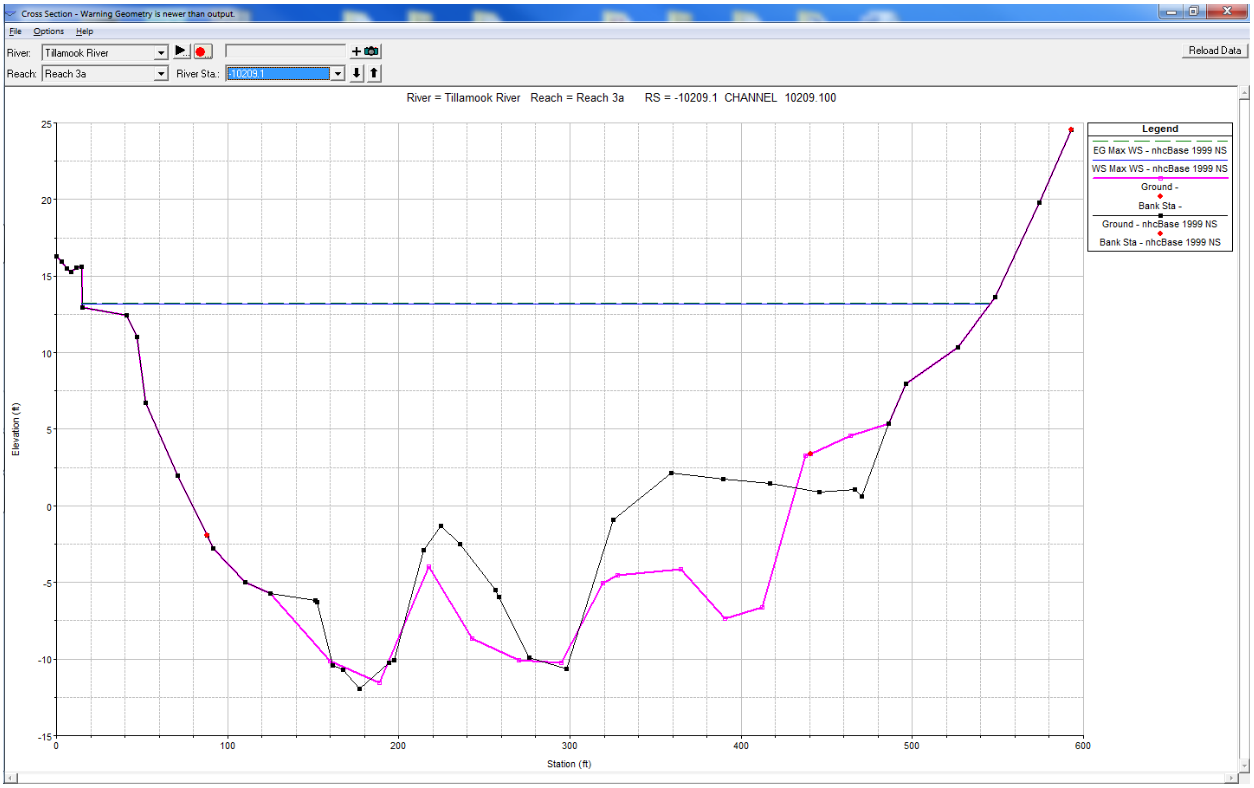
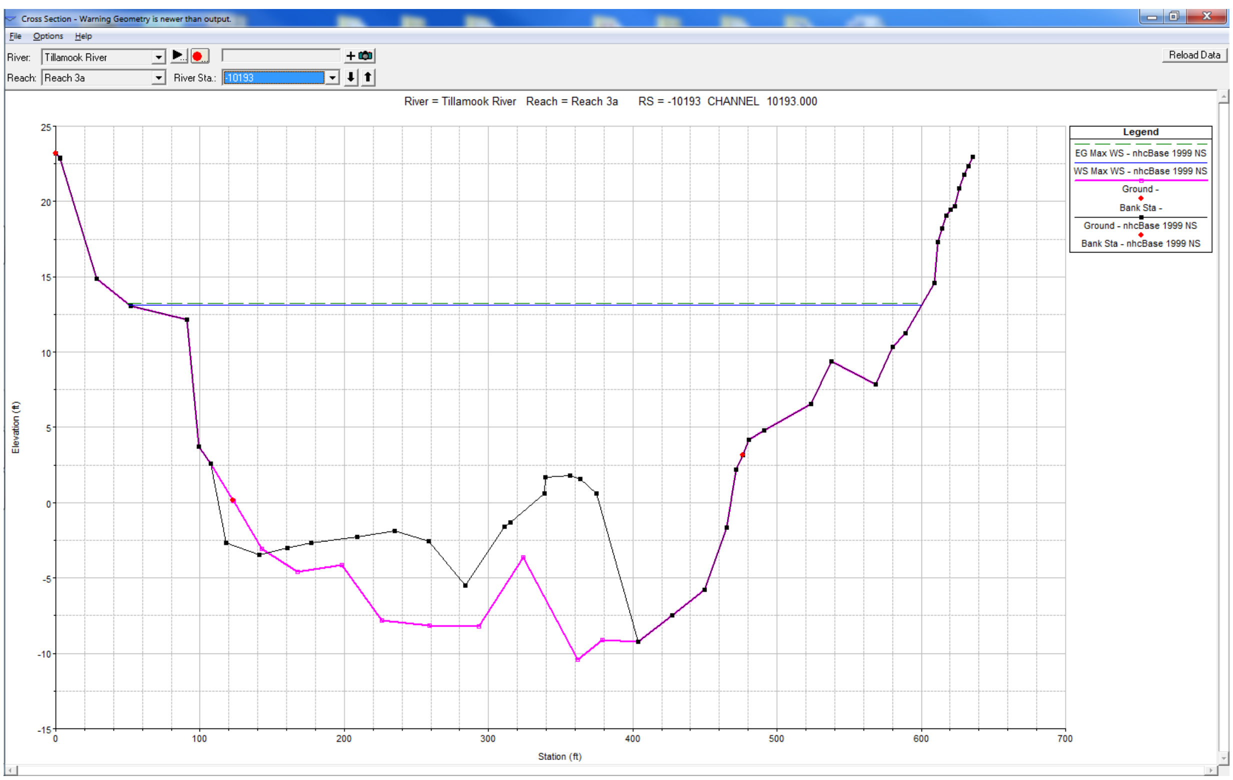
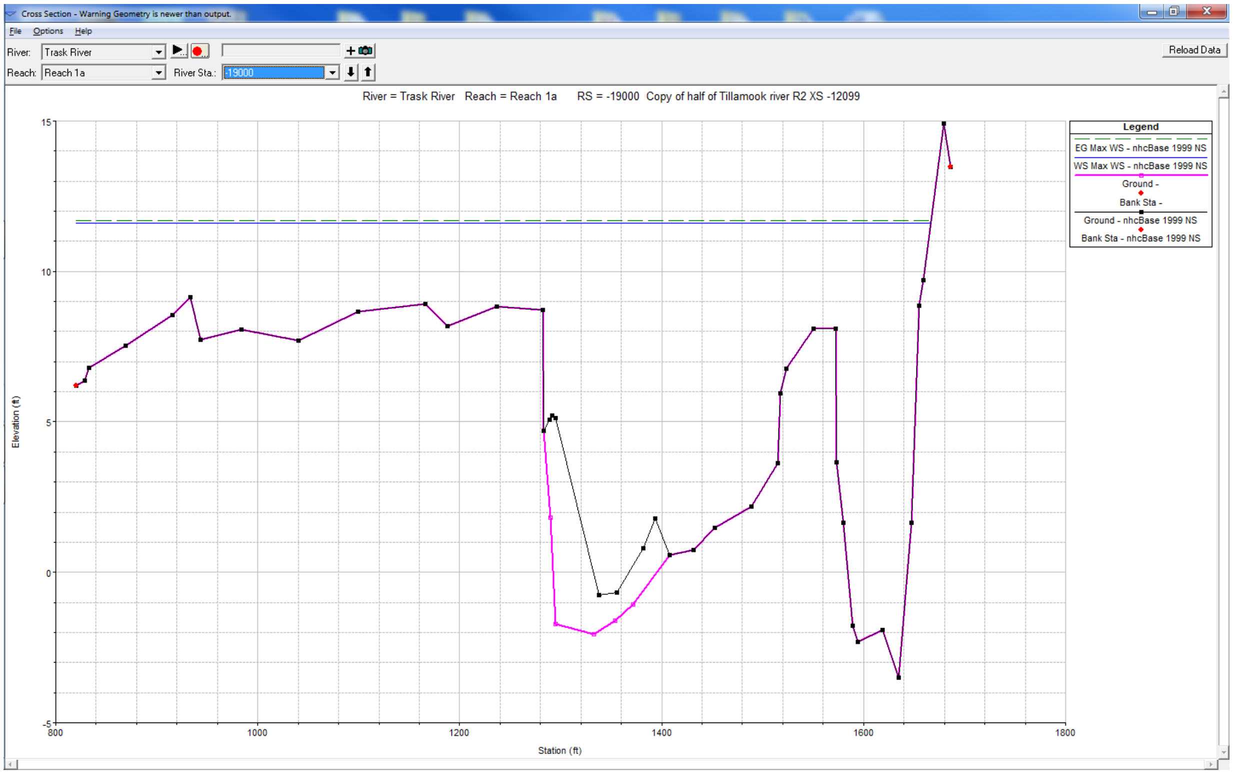




Trask River Reach 1a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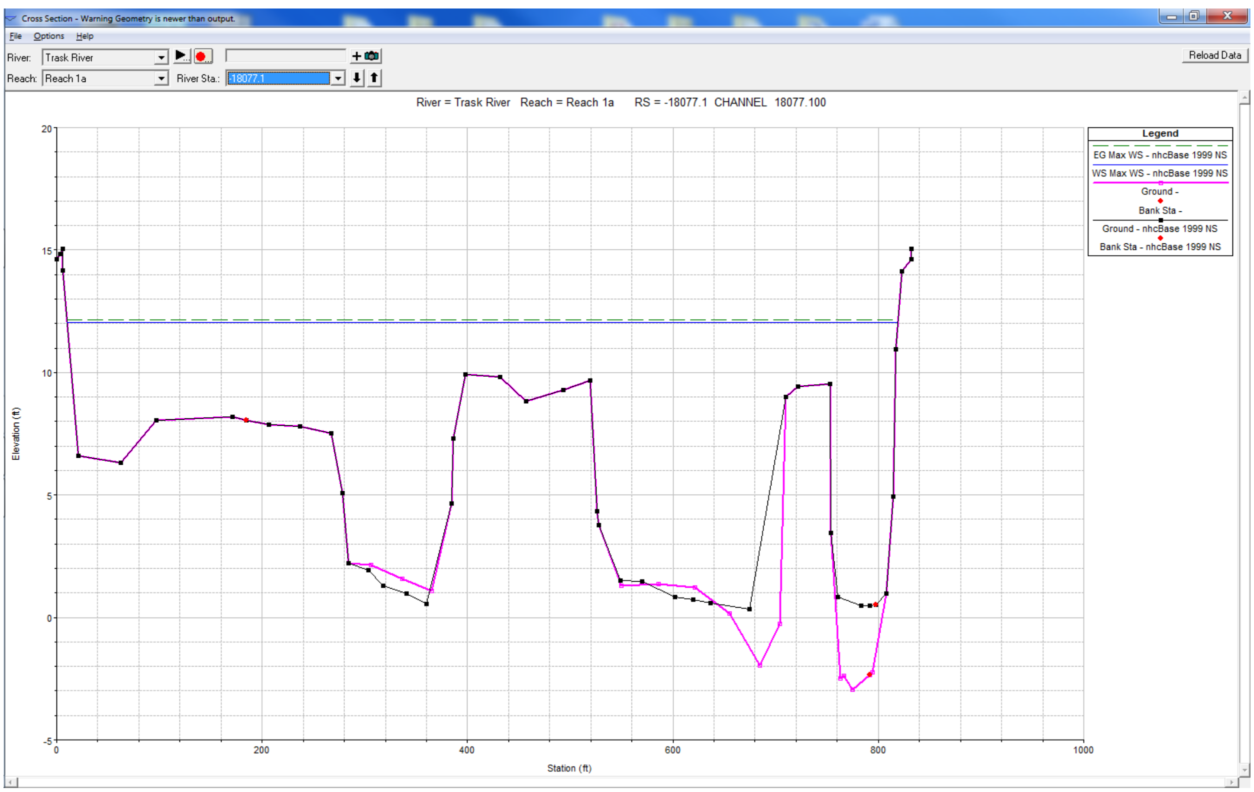
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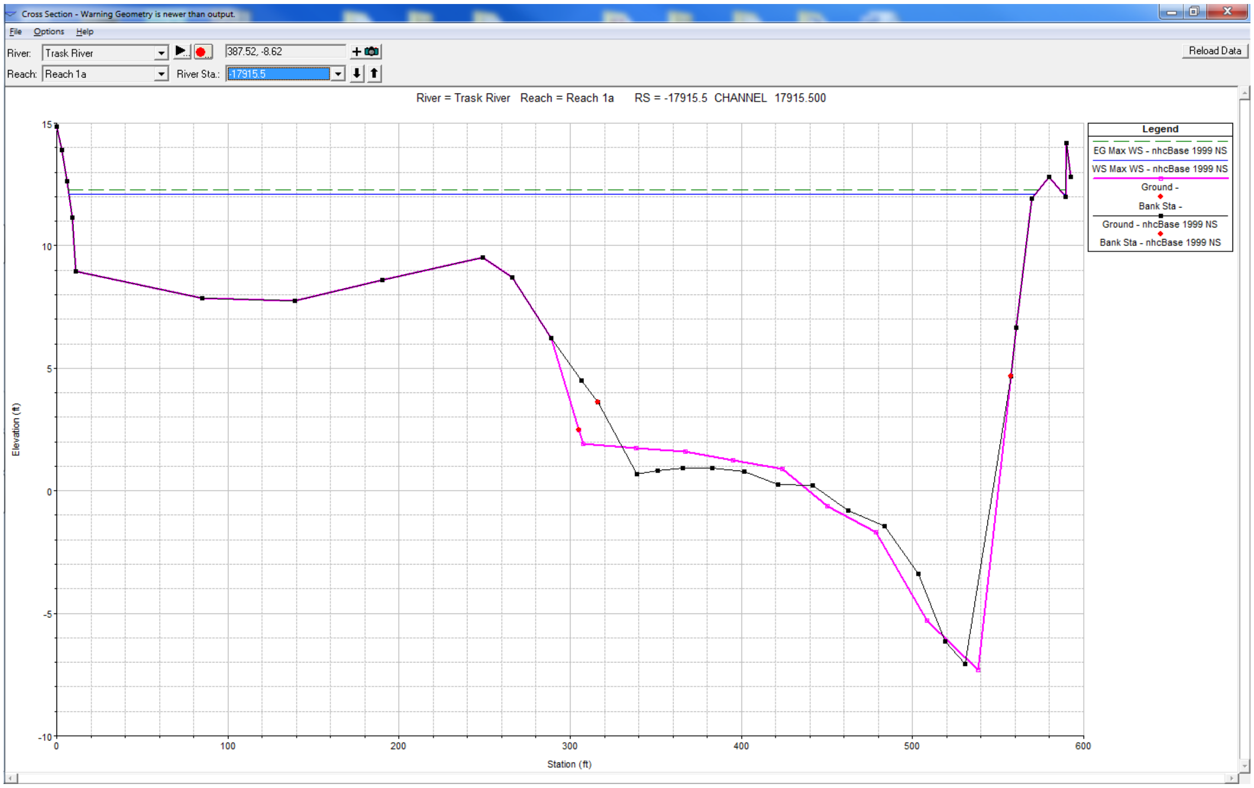
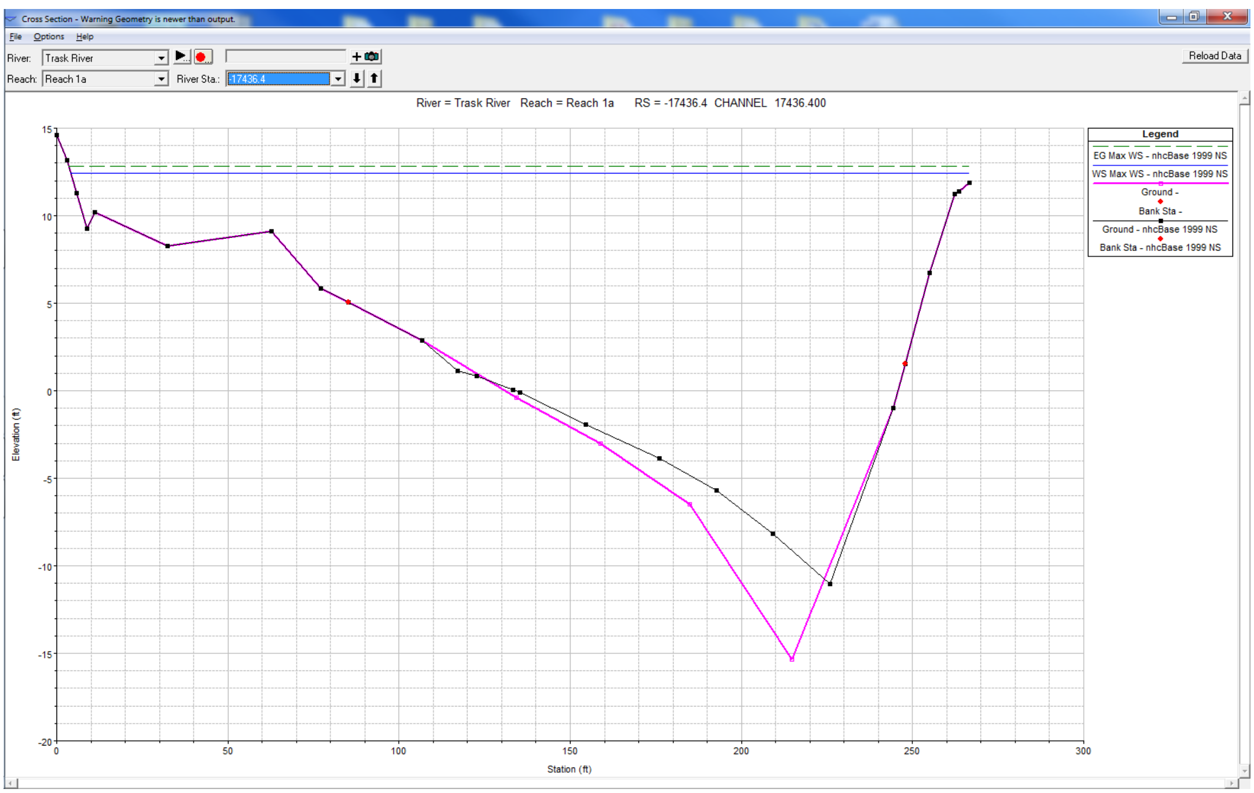
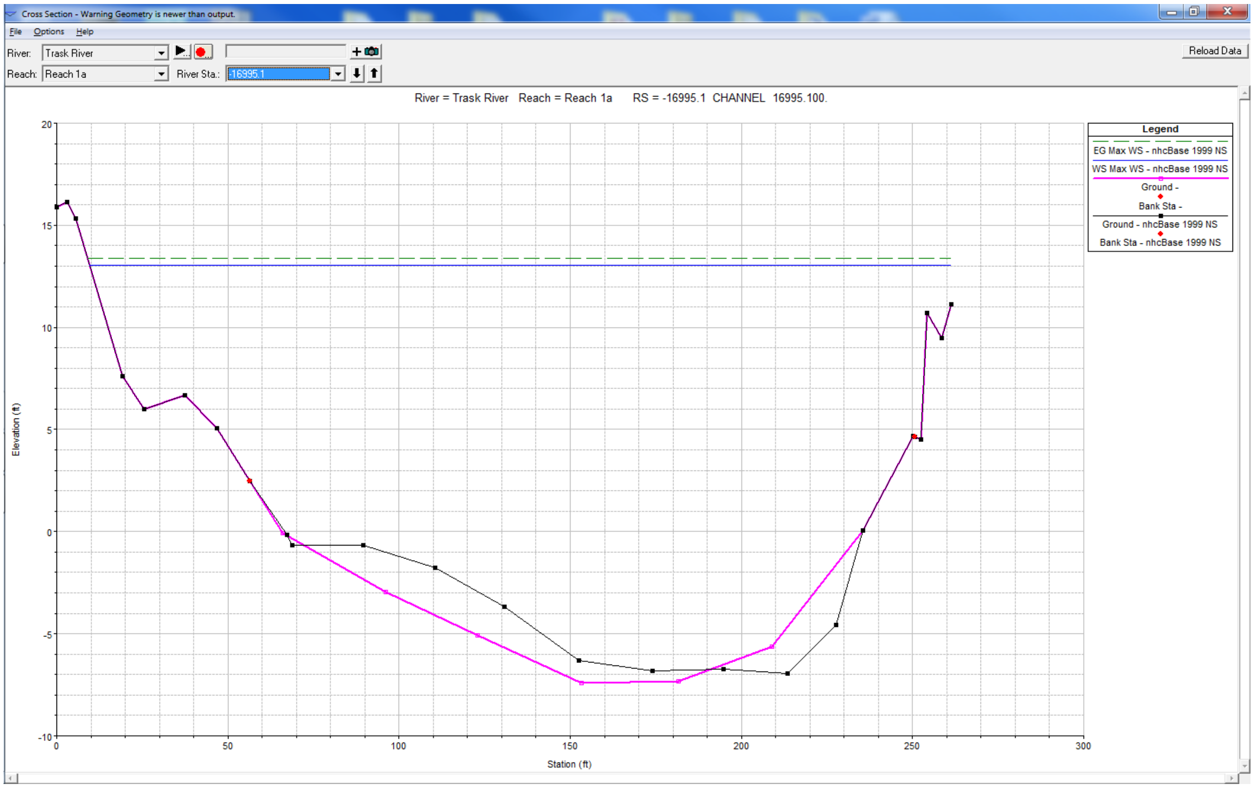
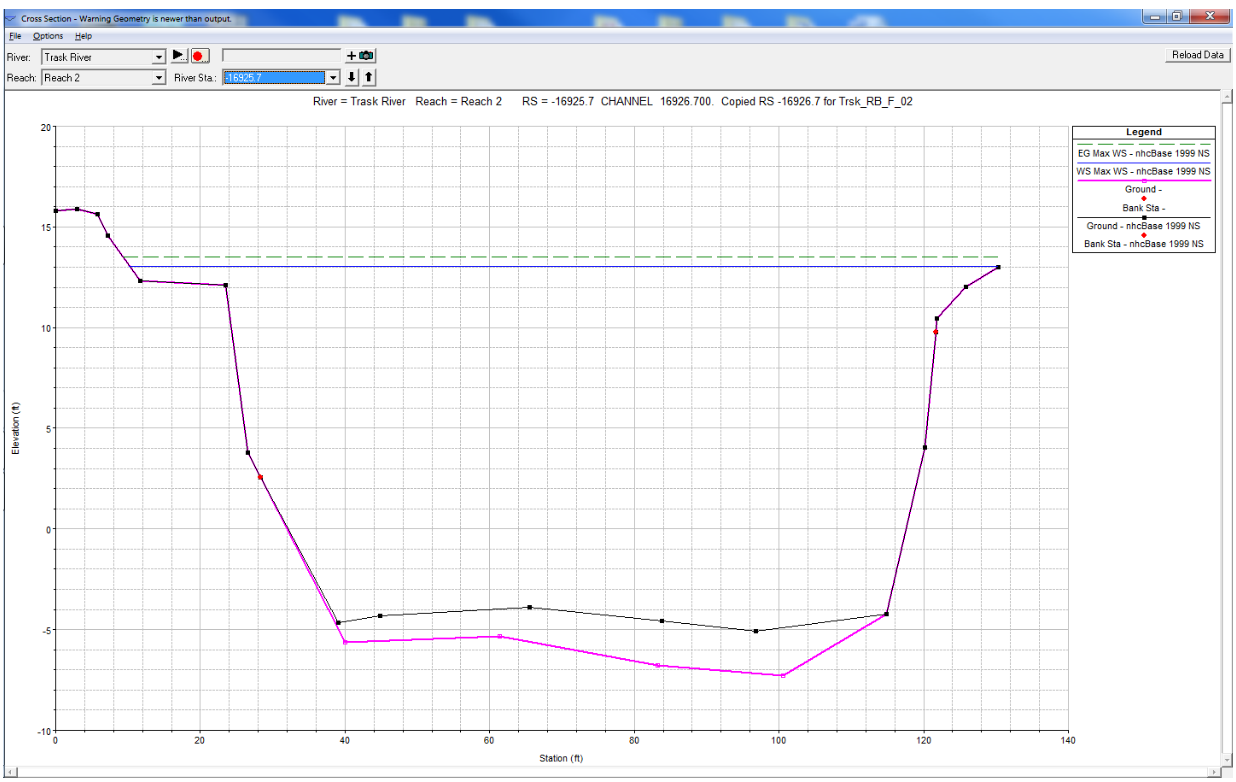
Reload Data
River = Trask River Reach = Reach 1a RS = -18077.1 CHANNEL 18077.100
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

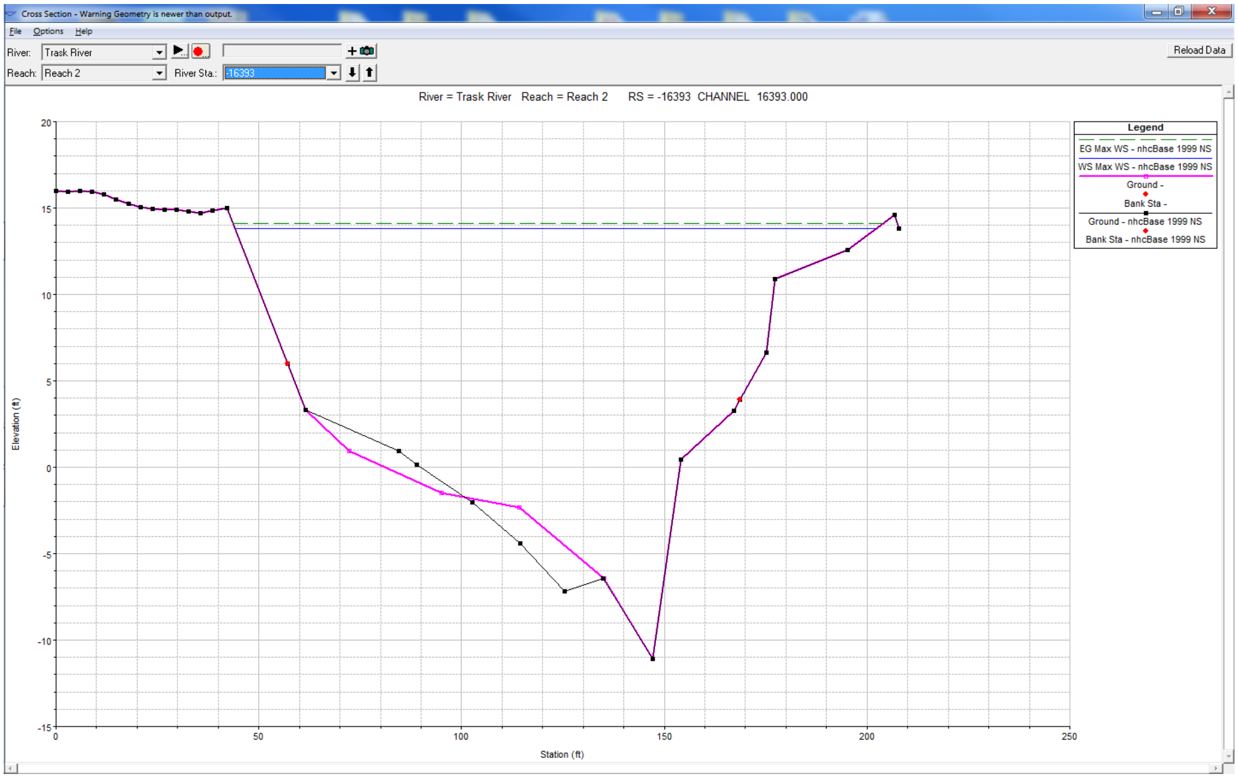

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Trask River
Reach: Reach 1a
River Sta.: 17915.5
387.52, -8.62
Reload Data
River = Trask River Reach = Reach 1a RS = -17915.5 CHANNEL 17915.500
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

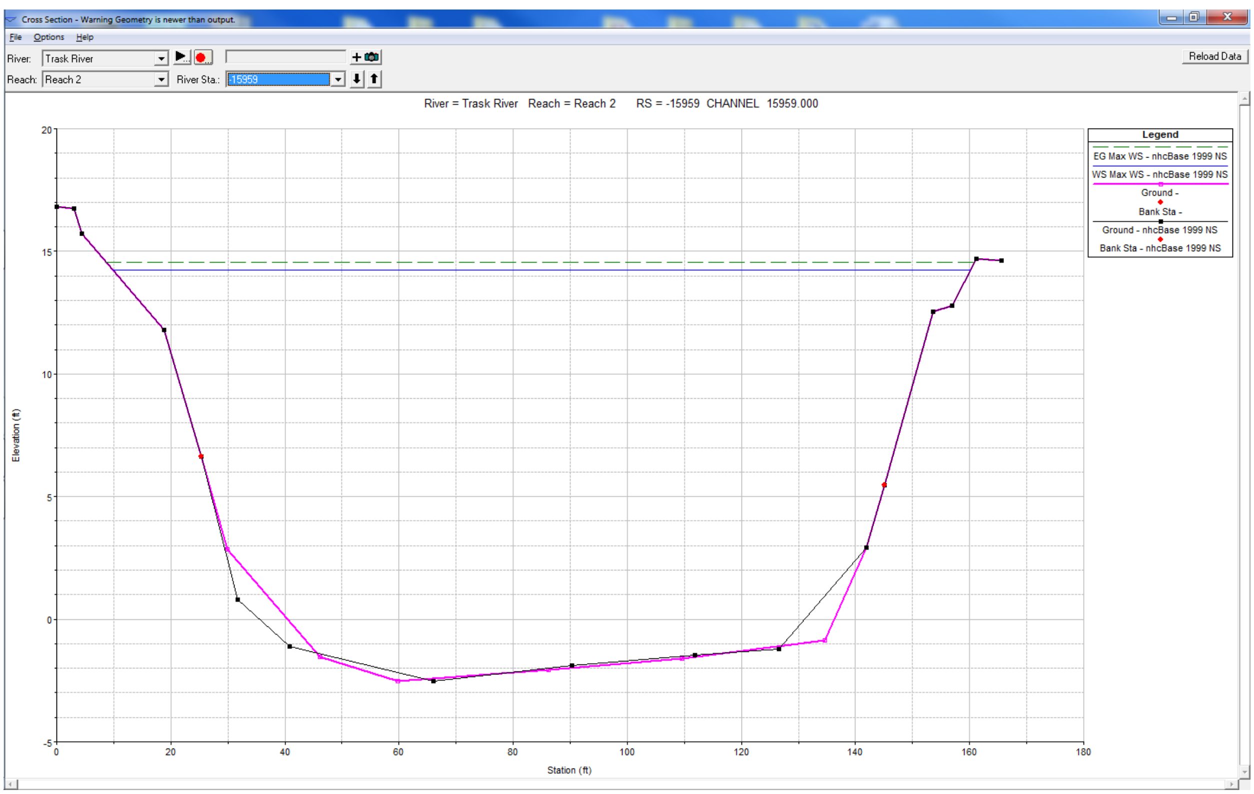

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Trask River
Reach: Reach 1a
River Sta.: 17436.4
Reload Data
River = Trask River Reach = Reach 1a RS = -17436.4 CHANNEL 17436.400
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

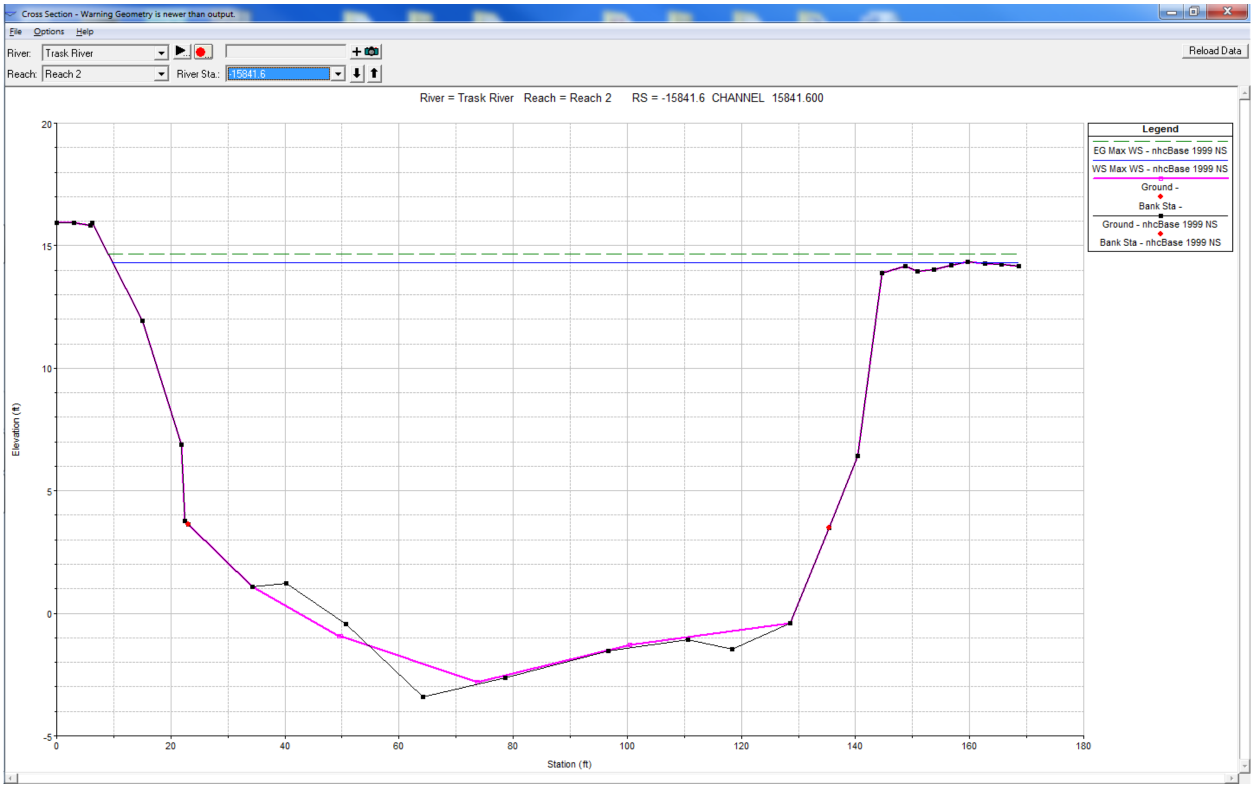


Trask River Reach 2

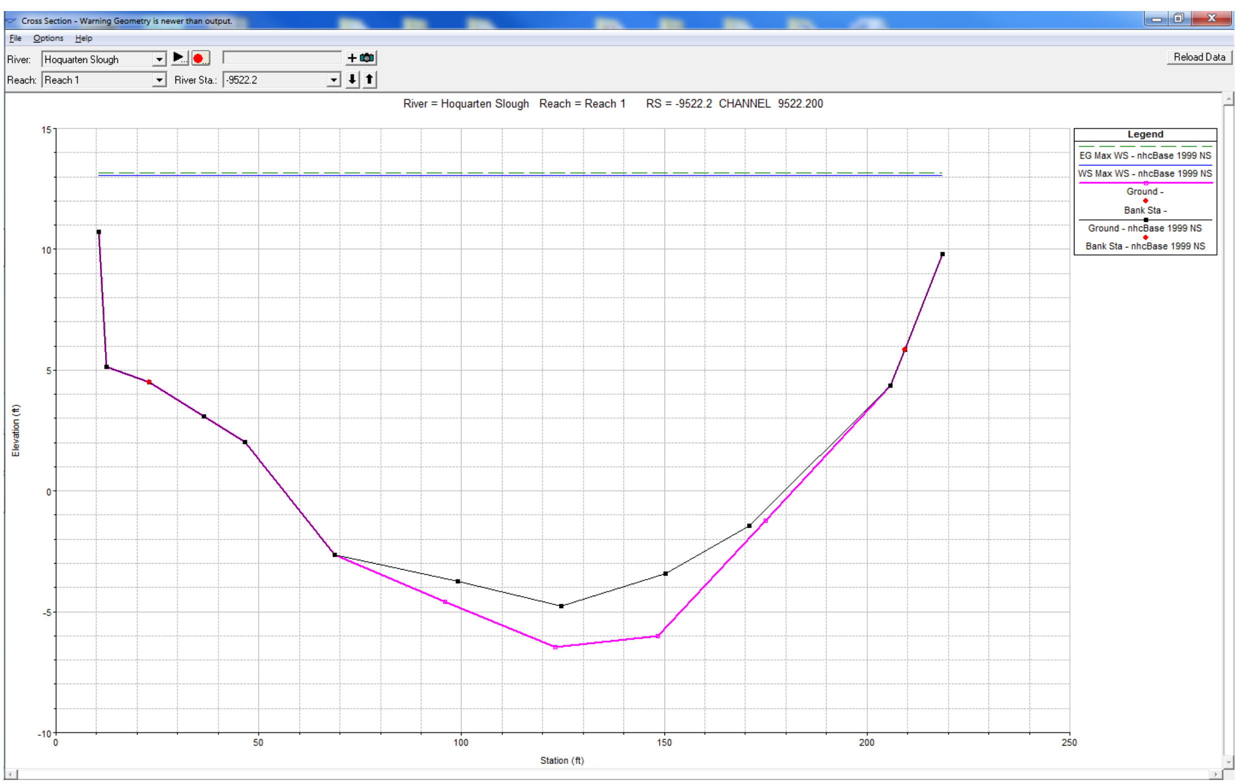


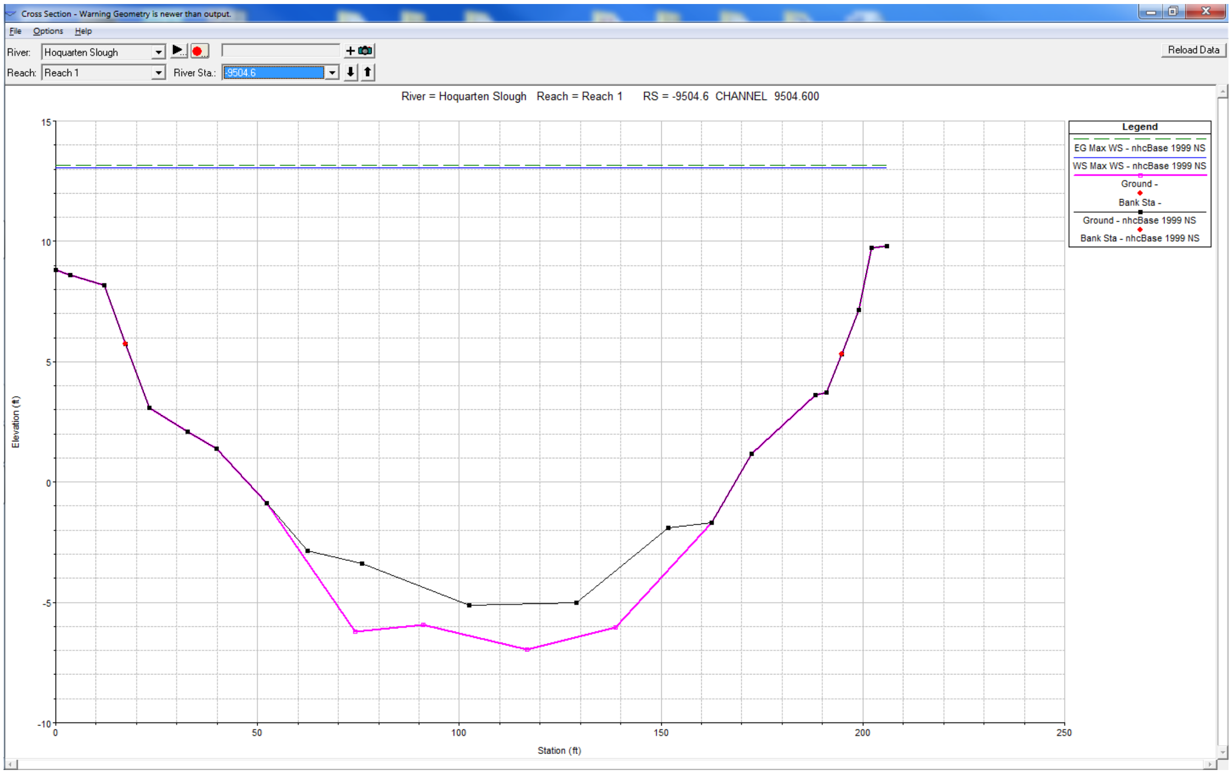

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Trask River
Reach: Reach 2
River Sta.: -16393
Reload Data
River = Trask River Reach = Reach 2 RS = -16393 CHANNEL 16393.000
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

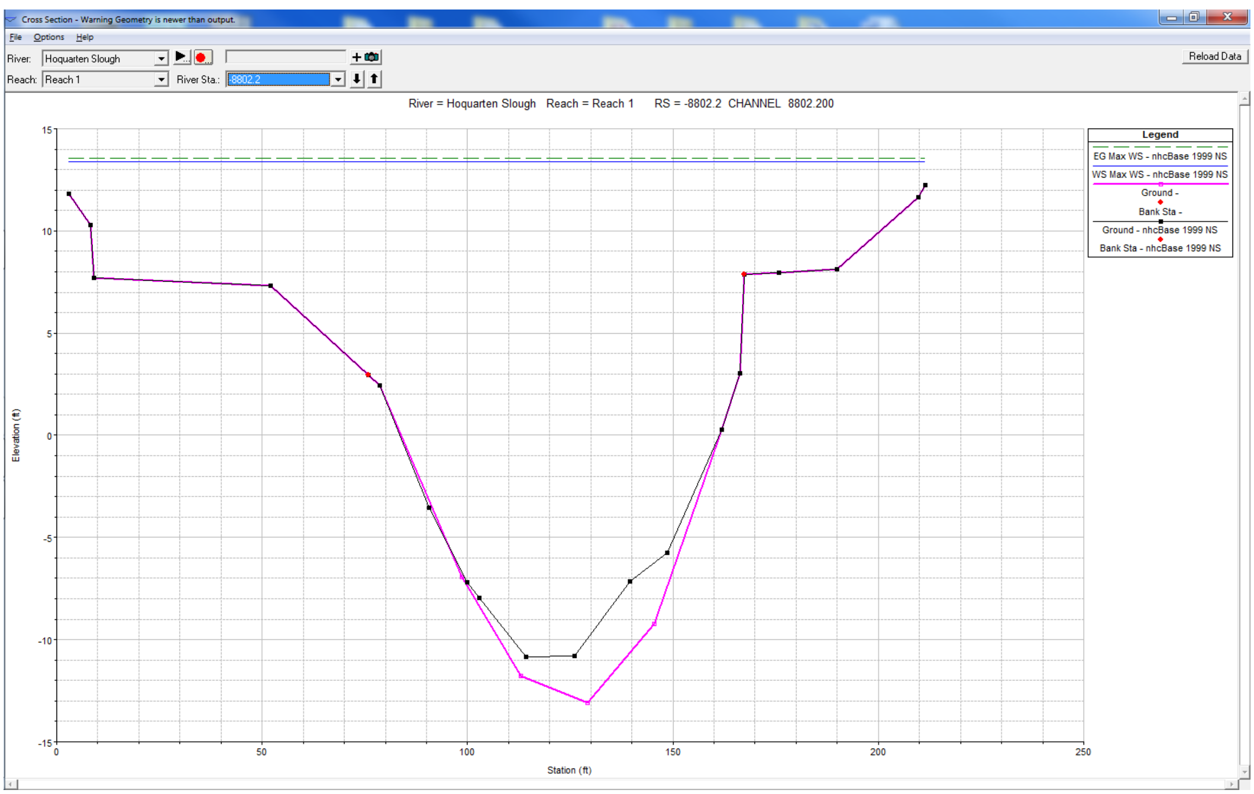

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Trask River
Reach: Reach 2
River Sta.: -15959
Reload Data
River = Trask River Reach = Reach 2 RS = -15959 CHANNEL 15959.000
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

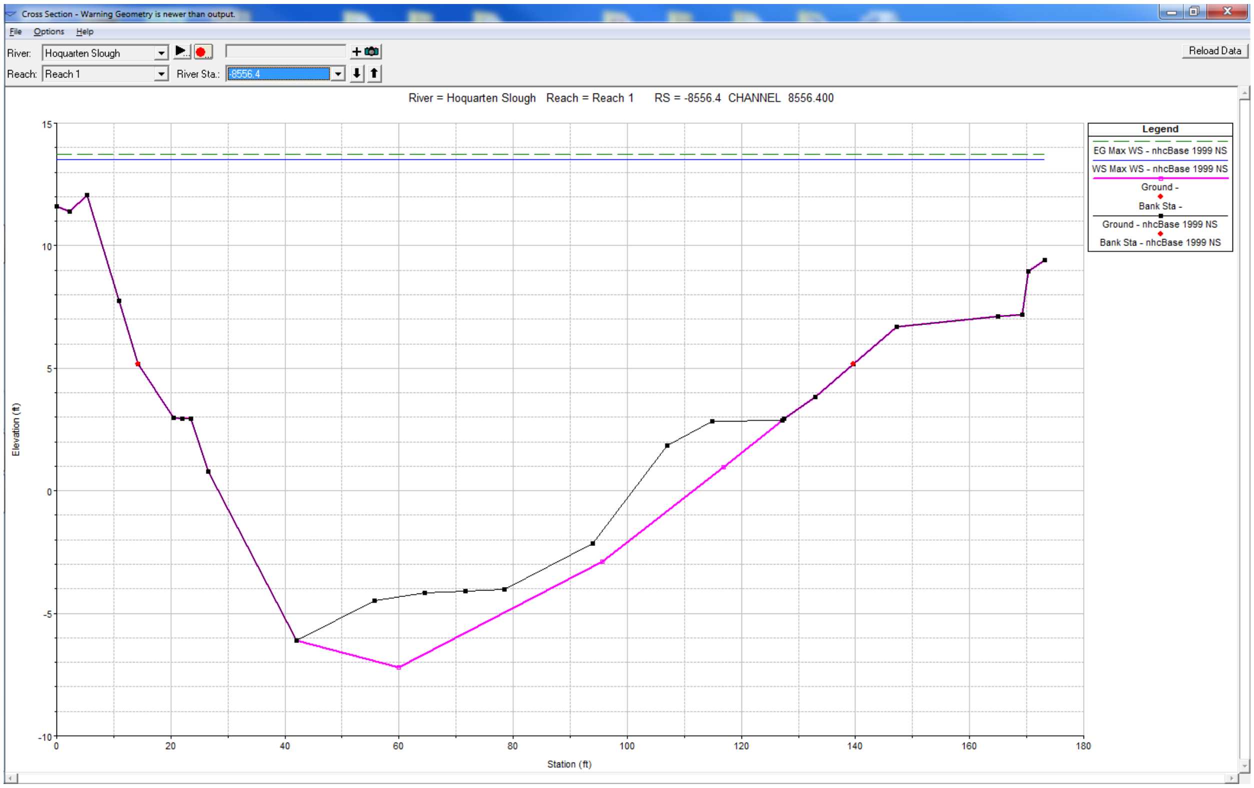


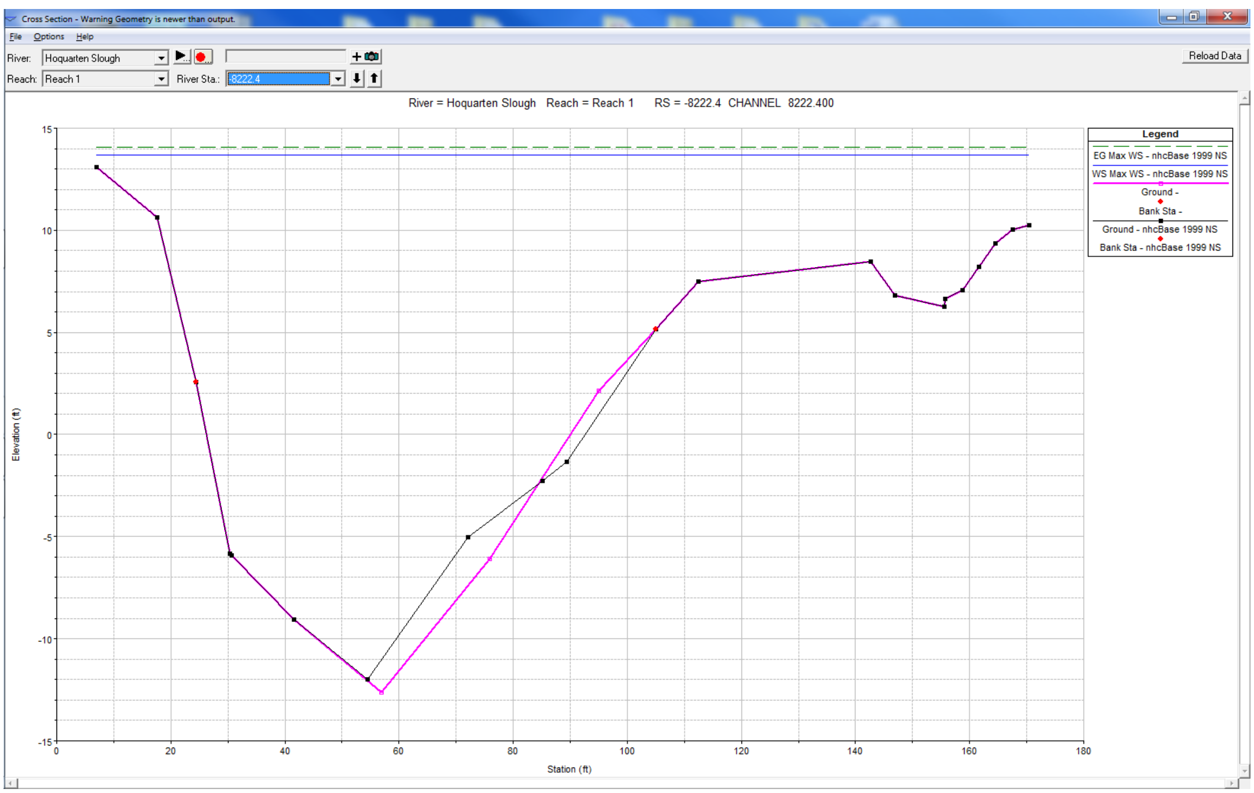
Hoquarten Reach 1

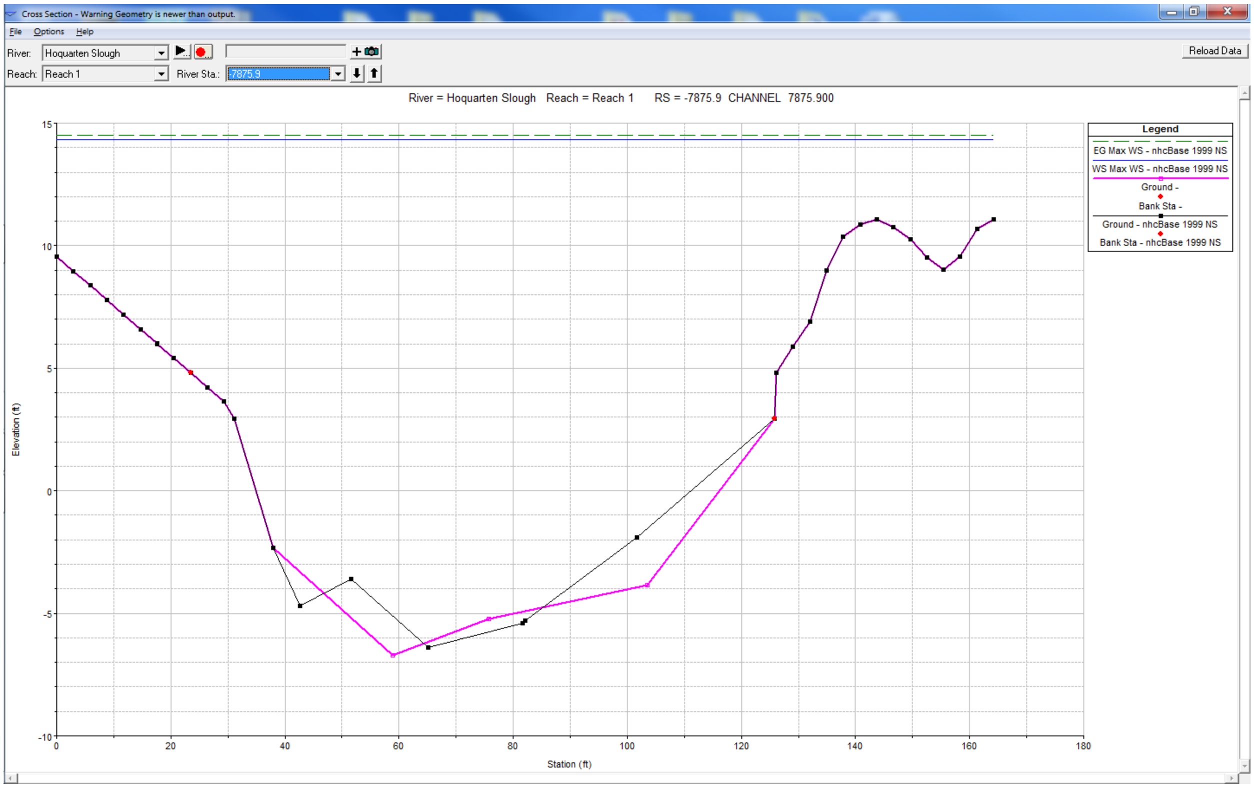



Cross Section - Warning Geometry is newer than output.
File Options Help
River: Hoquarten Slough
Reach: Reach 1
River Sta.: 9504.6
Reload Data
River = Hoquarten Slough Reach = Reach 1 RS = -9504.6 CHANNEL 9504.600
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

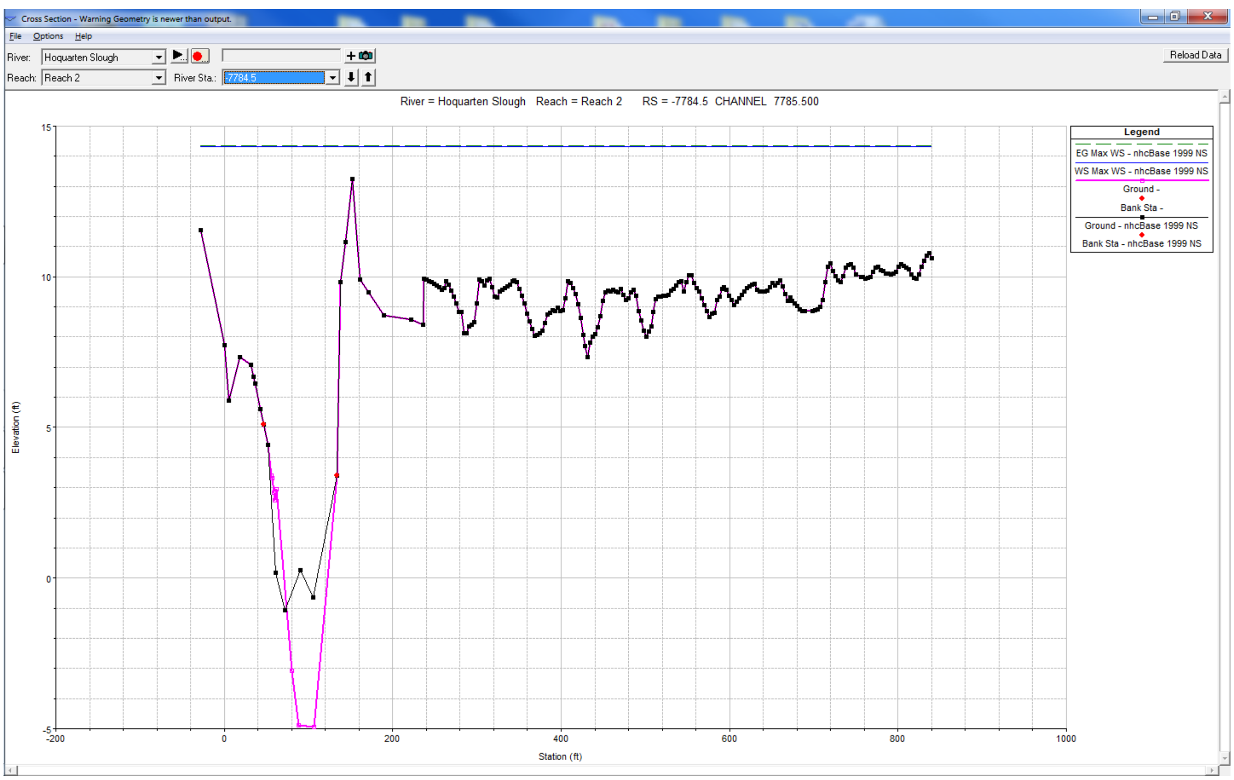

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Hoquarten Slough
Reach: Reach 1
River Sta.: 8802.2
Reload Data
River = Hoquarten Slough Reach = Reach 1 RS = -8802.2 CHANNEL 8802.200
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

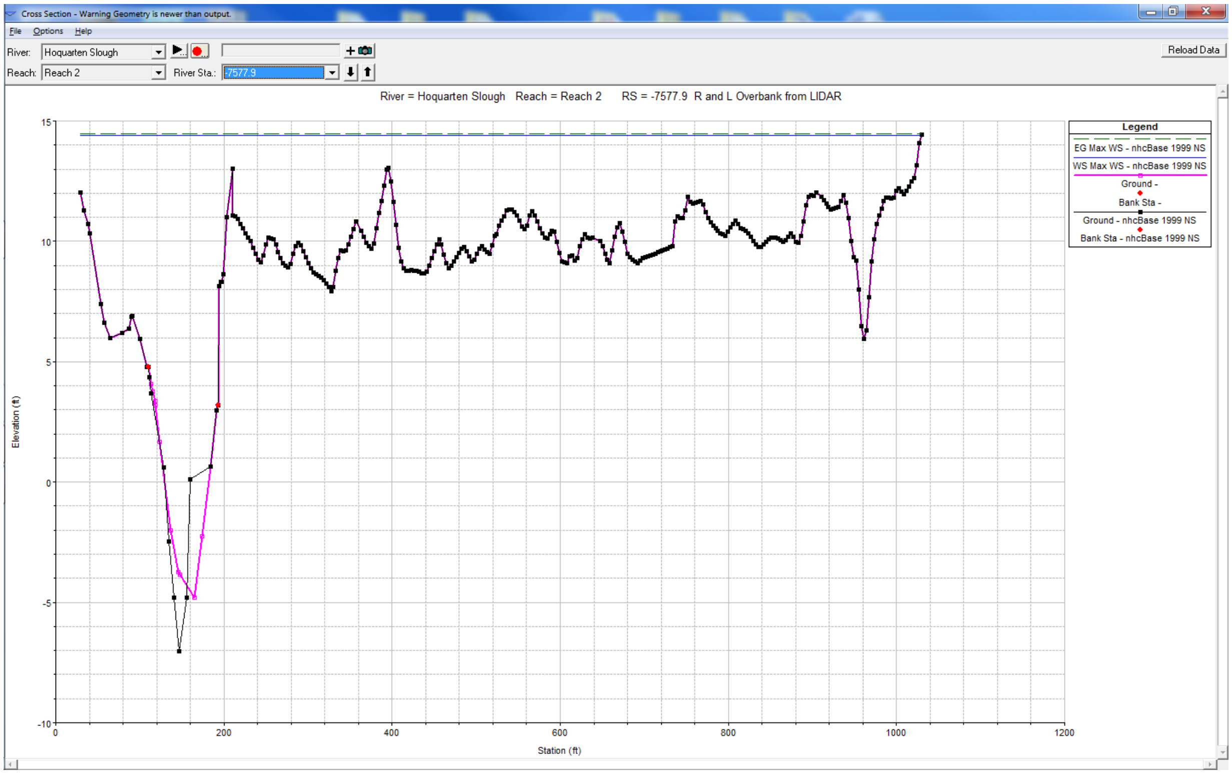

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Hoquarten Slough
Reach: Reach 1
River Sta.: -8556.4
Reload Data
River = Hoquarten Slough Reach = Reach 1 RS = -8556.4 CHANNEL 8556.400
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Hoquarten Slough
Reach: Reach 1
River Sta.: -8222.4
Reload Data
River = Hoquarten Slough Reach = Reach 1 RS = -8222.4 CHANNEL 8222.400
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

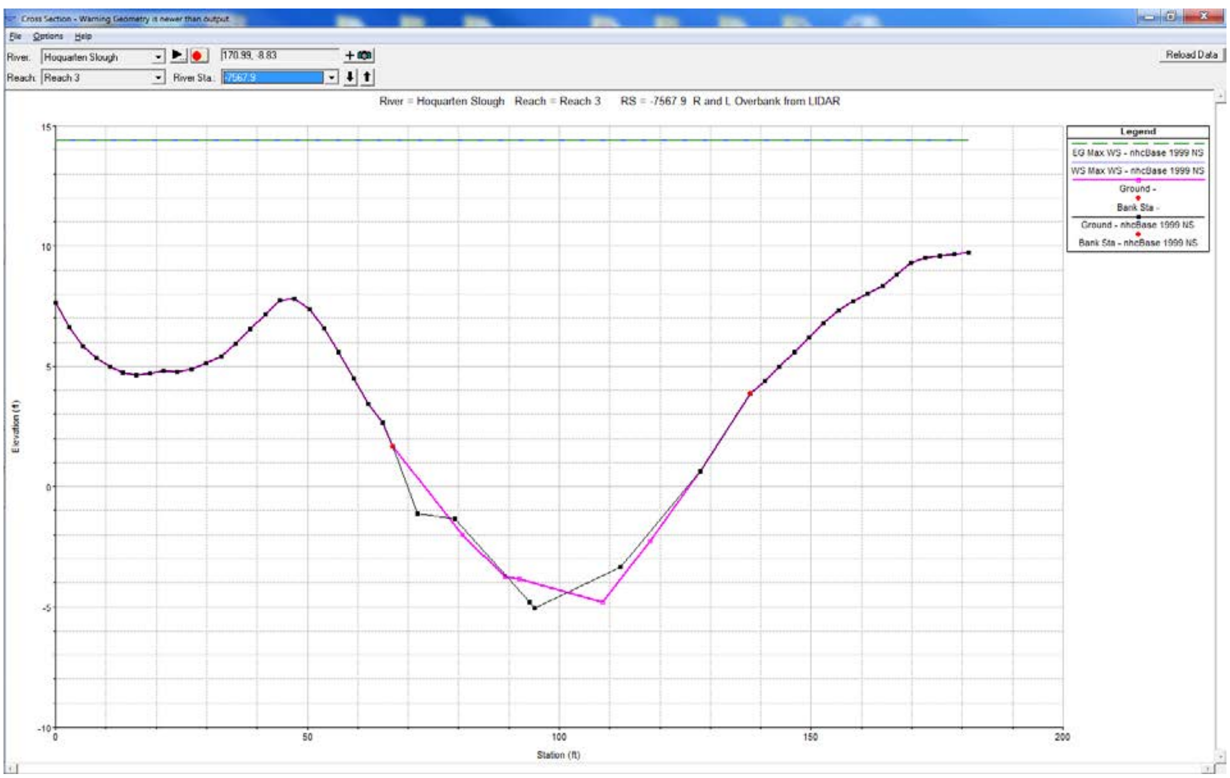


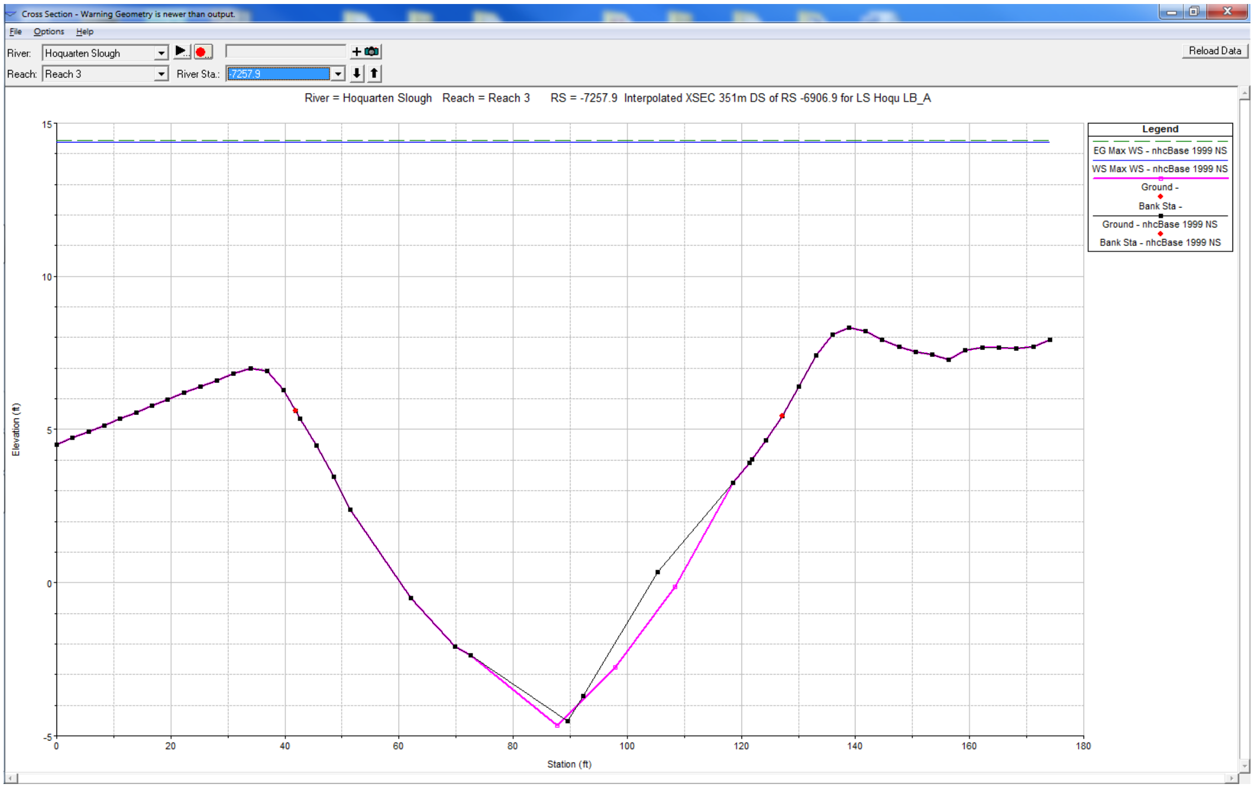
Hoquarten Reach 2

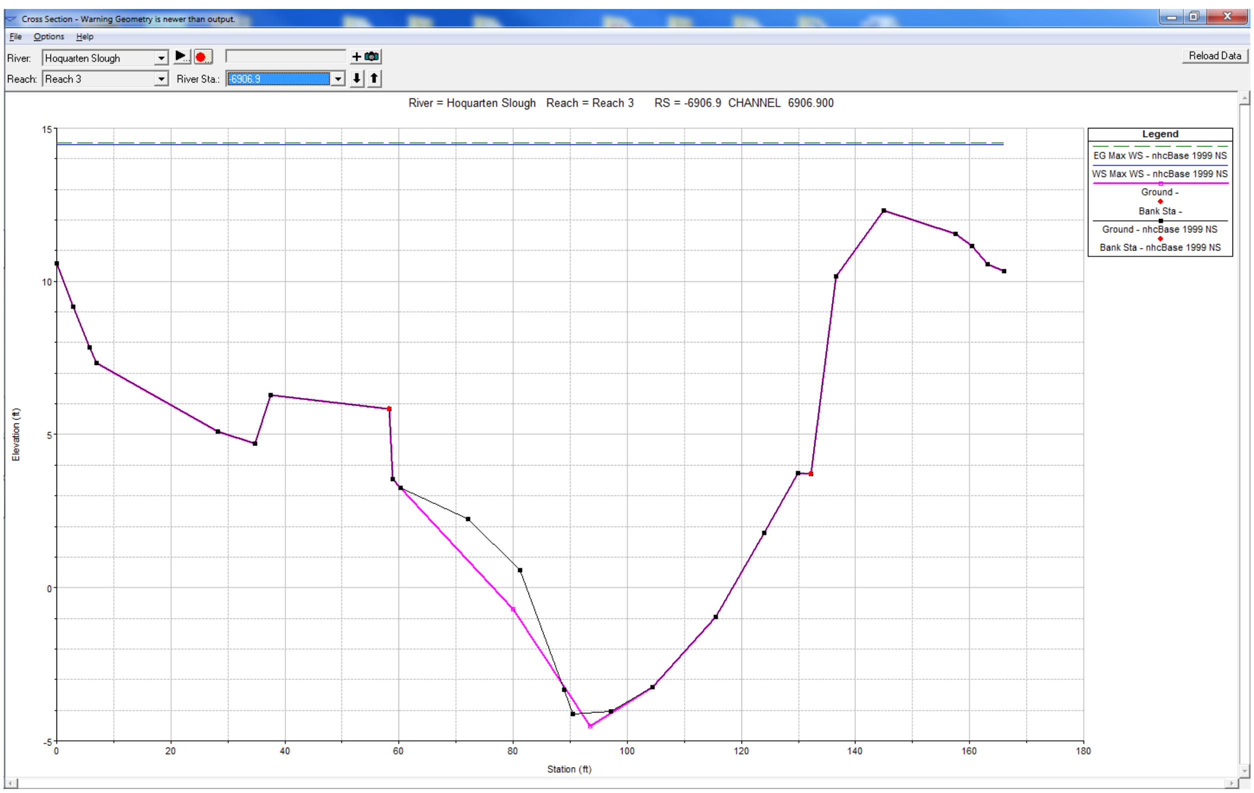




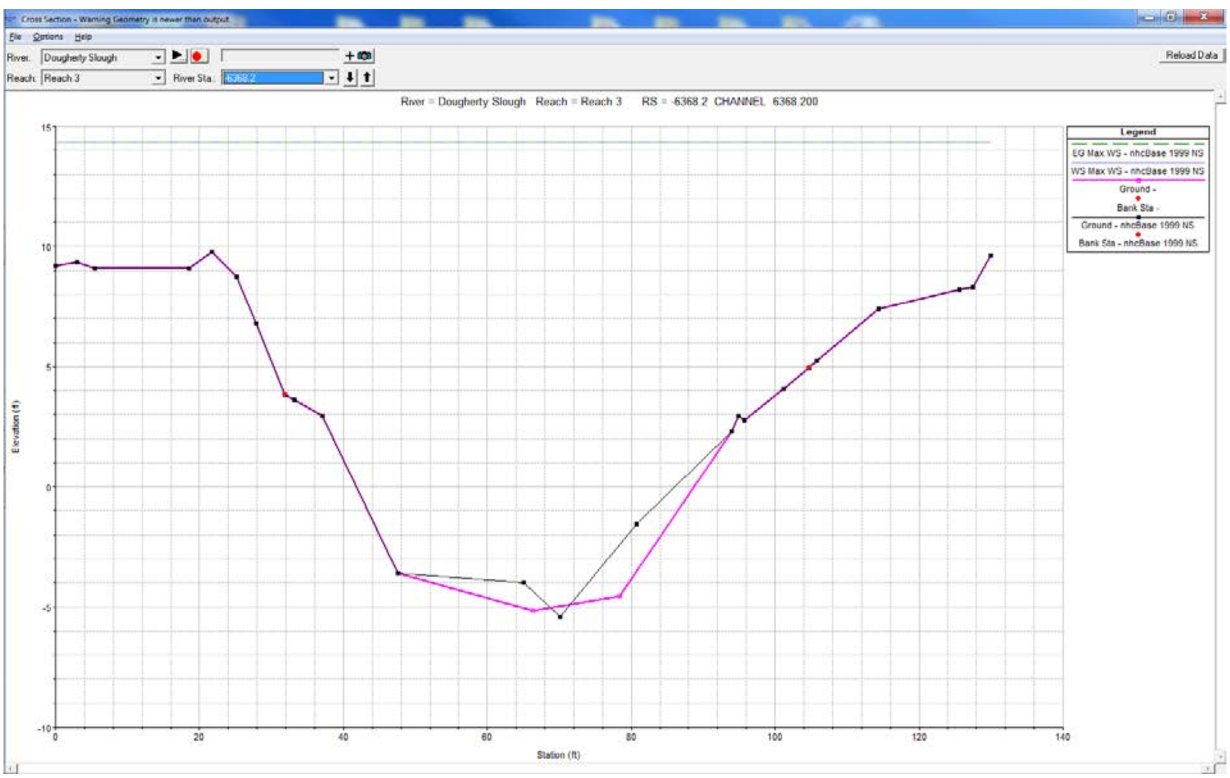
Hoquarten Reach 3

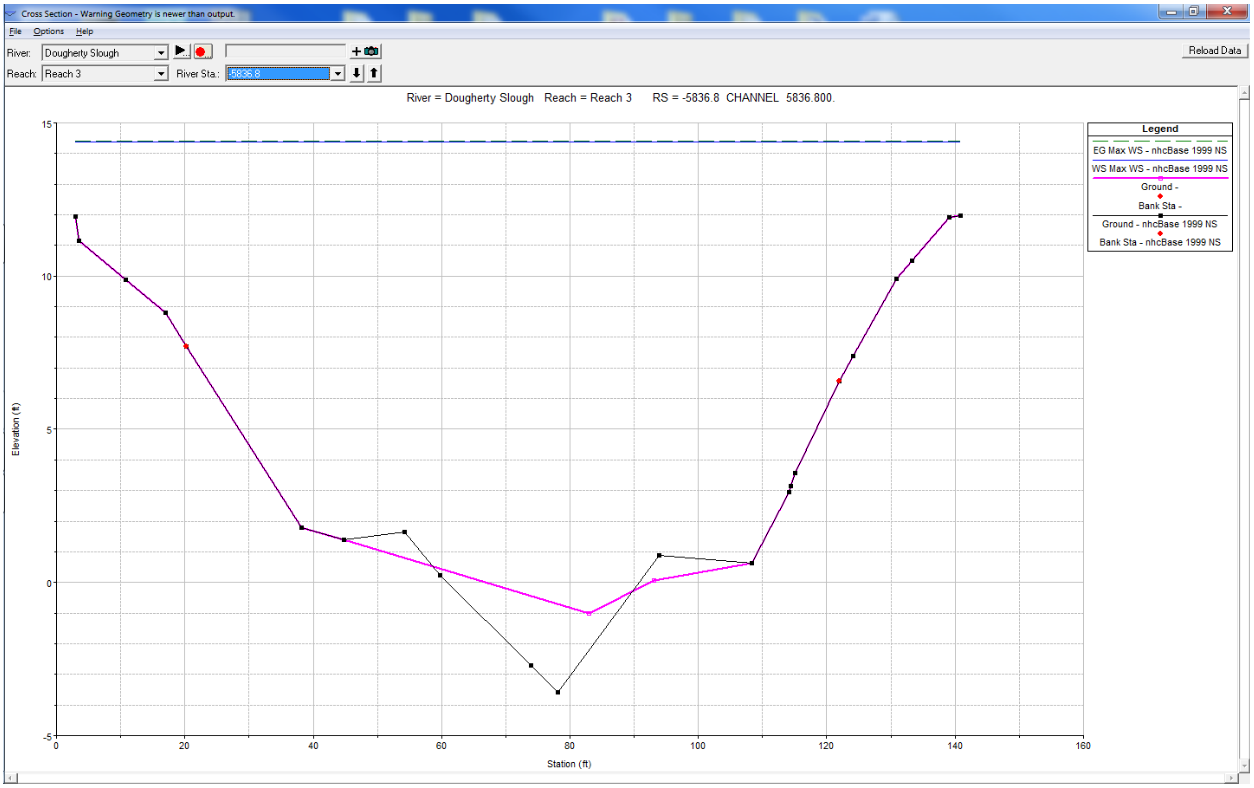



Cross Section - Warning Geometry is newer than output.
File Options Help
River: Hoquarten Slough
Reach: Reach 3 River Sta.: -7257.9
Reload Data
River = Hoquarten Slough Reach = Reach 3 RS = -7257.9 Interpolated XSEC 351m DS of RS -6906.9 for LS Hoqu LB_A
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

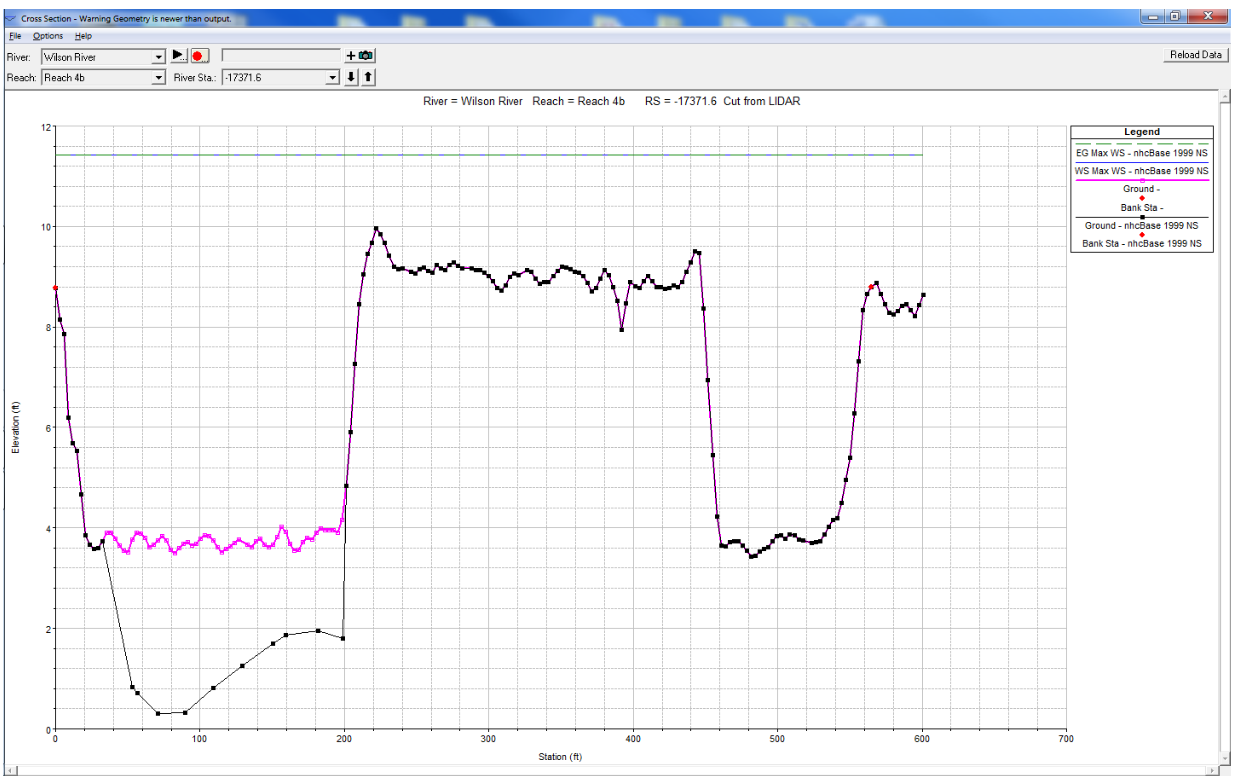

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Hoquarten Slough
Reach: Reach 3 River Sta.: -6906.9
Reload Data
River = Hoquarten Slough Reach = Reach 3 RS = -6906.9 CHANNEL 6906.900
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

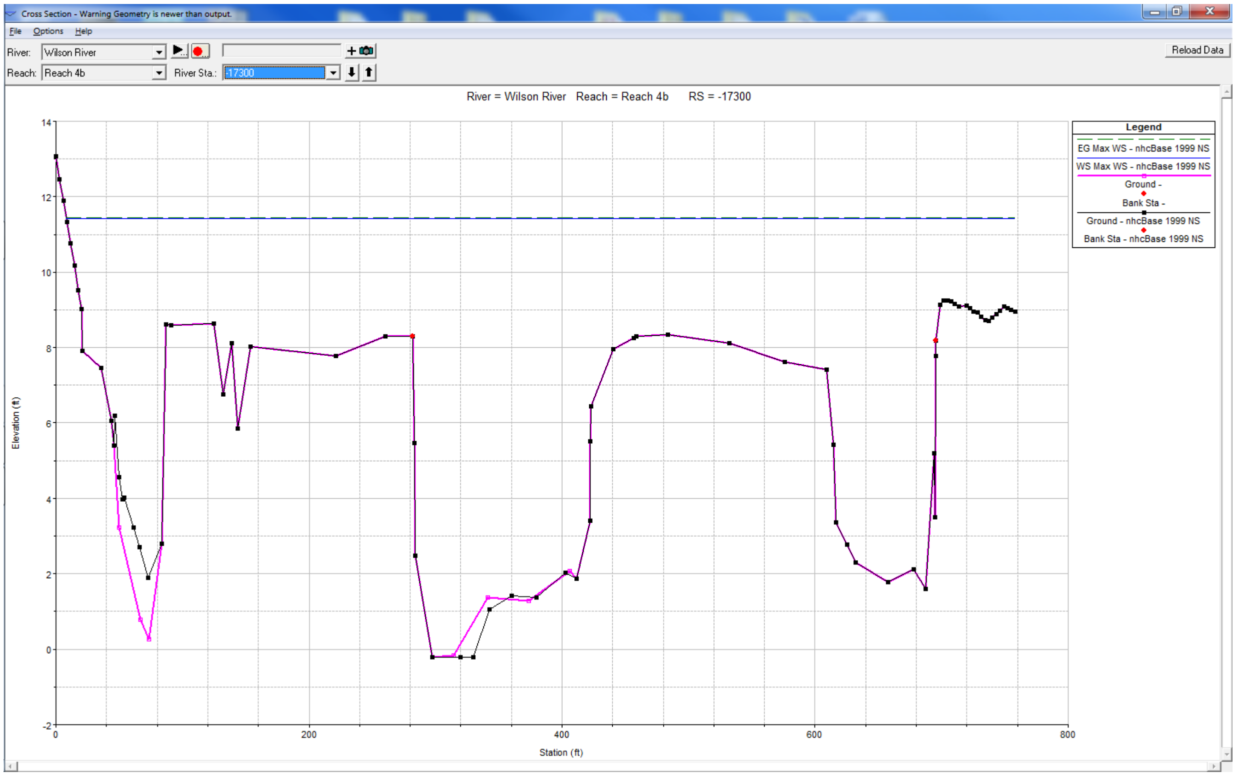
Dougherty Slough Reach 3

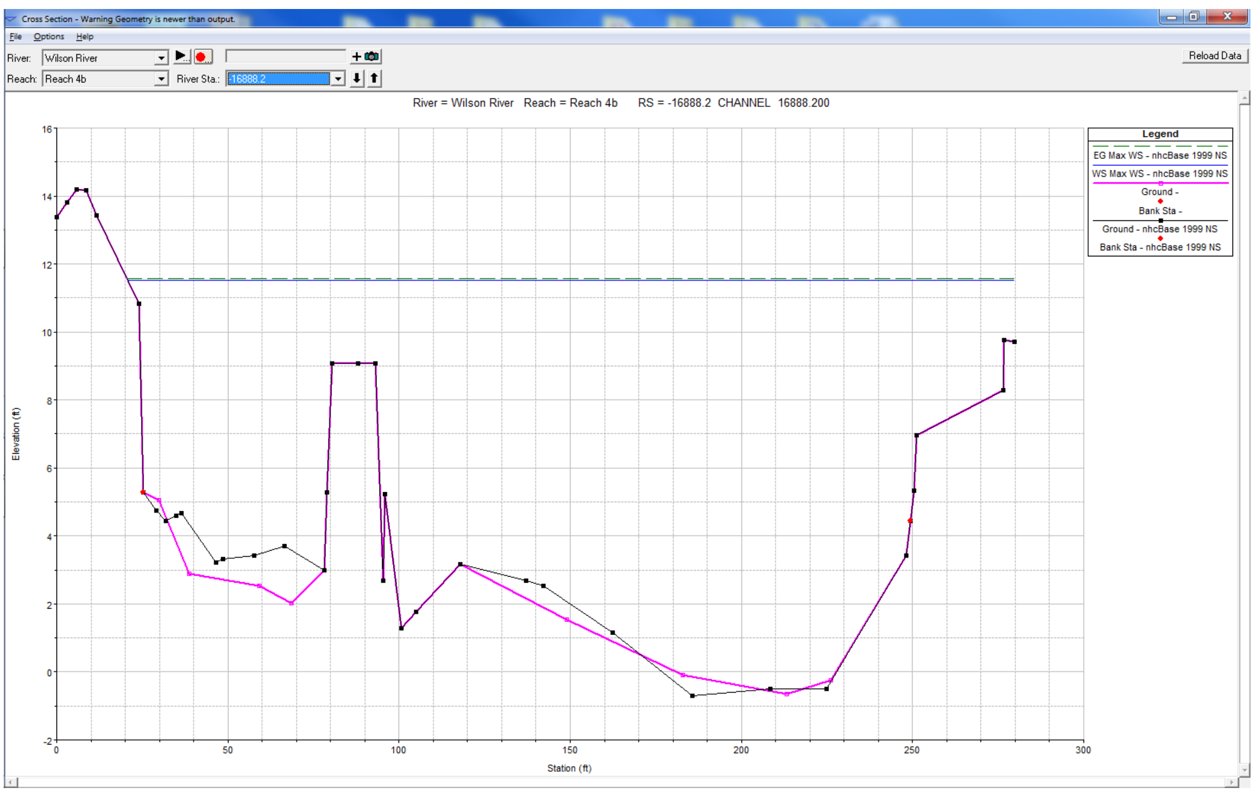


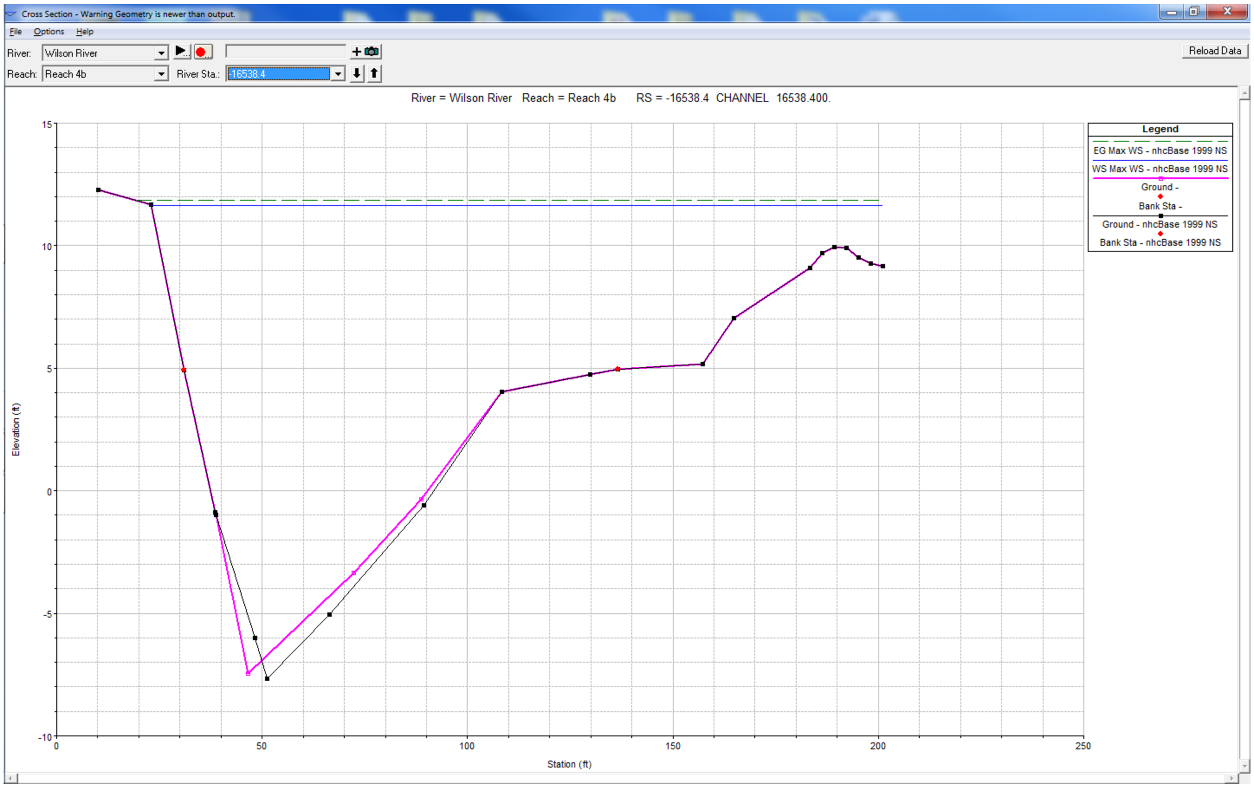


Wilson River Reach 4b

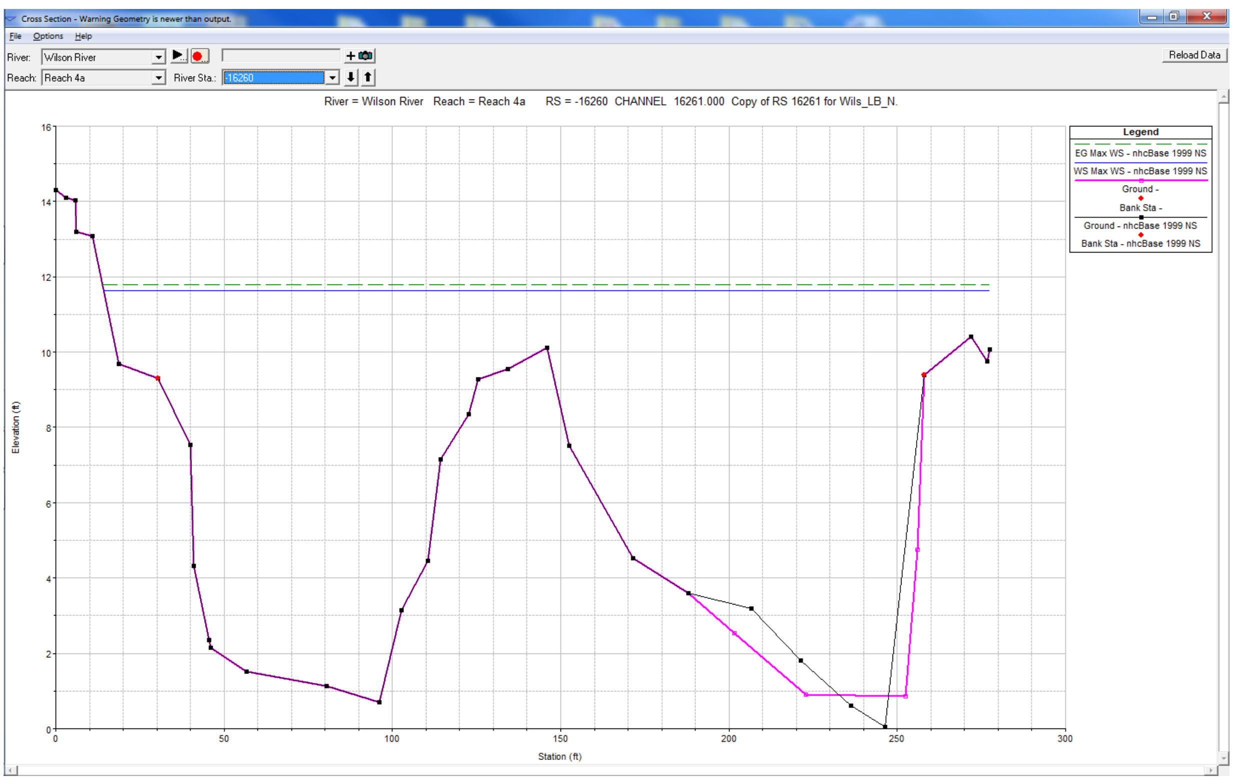


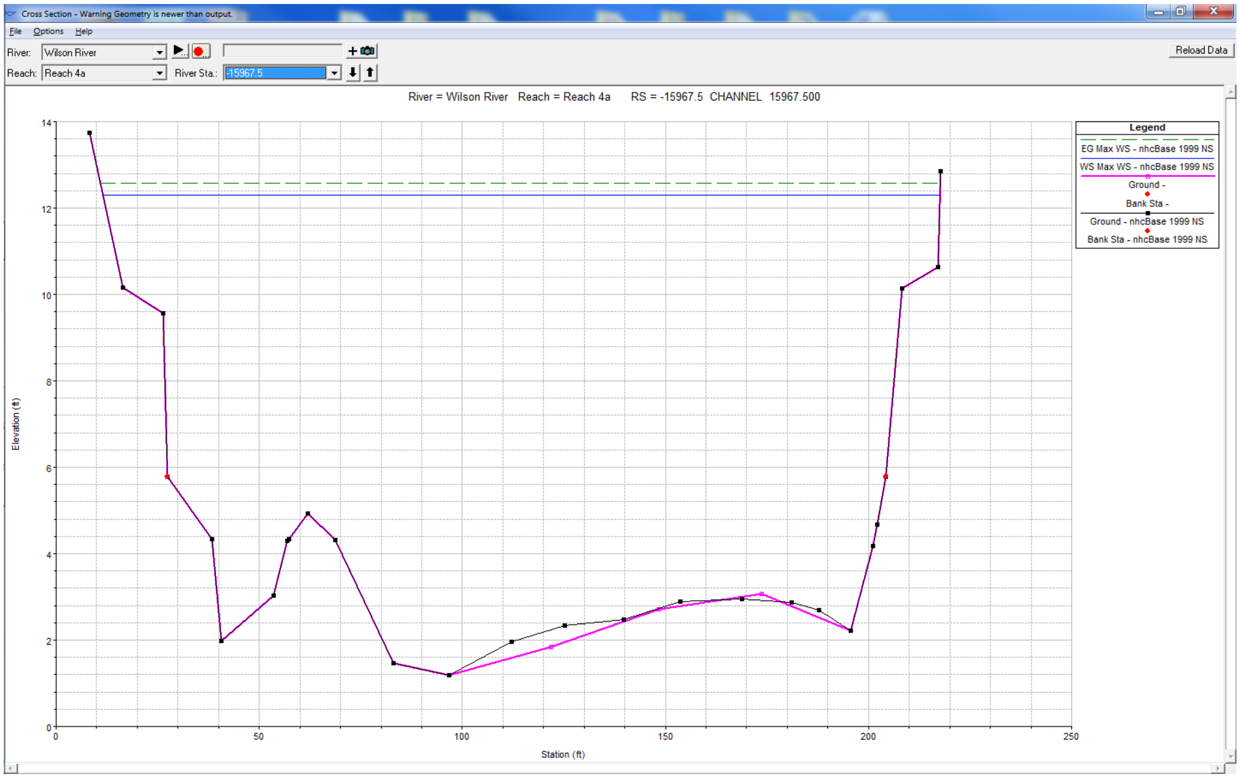

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 4b
River Sta.: -17300
Reload Data
River = Wilson River Reach = Reach 4b RS = -17300
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 4b
River Sta.: -16888.2
Reload Data
River = Wilson River Reach = Reach 4b RS = -16888.2 CHANNEL 16888.200
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

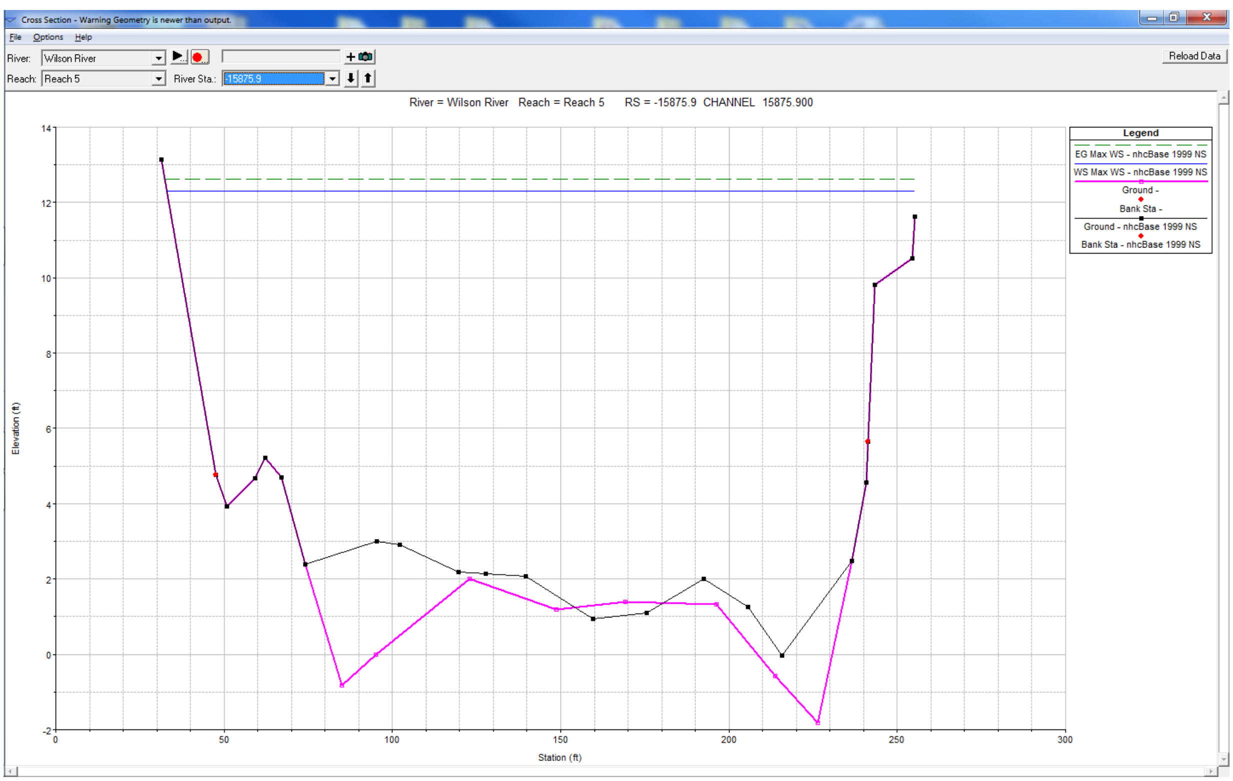


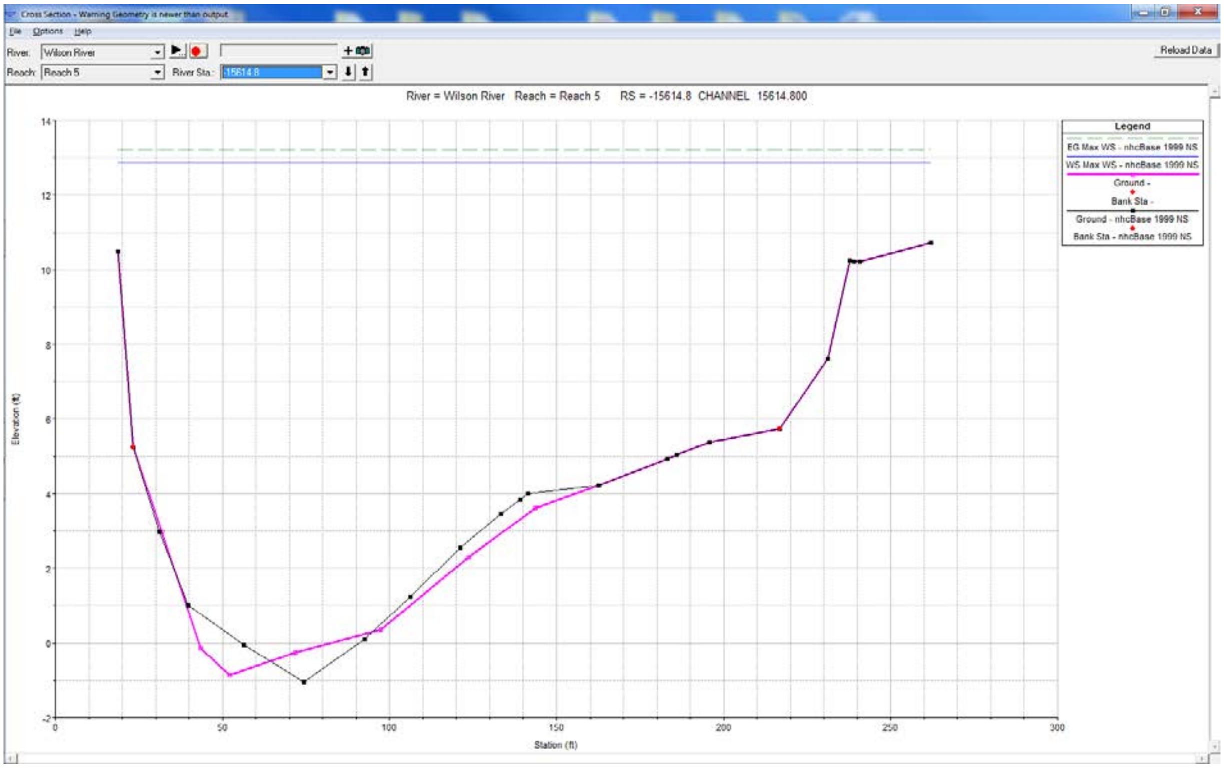
Wilson River 4a



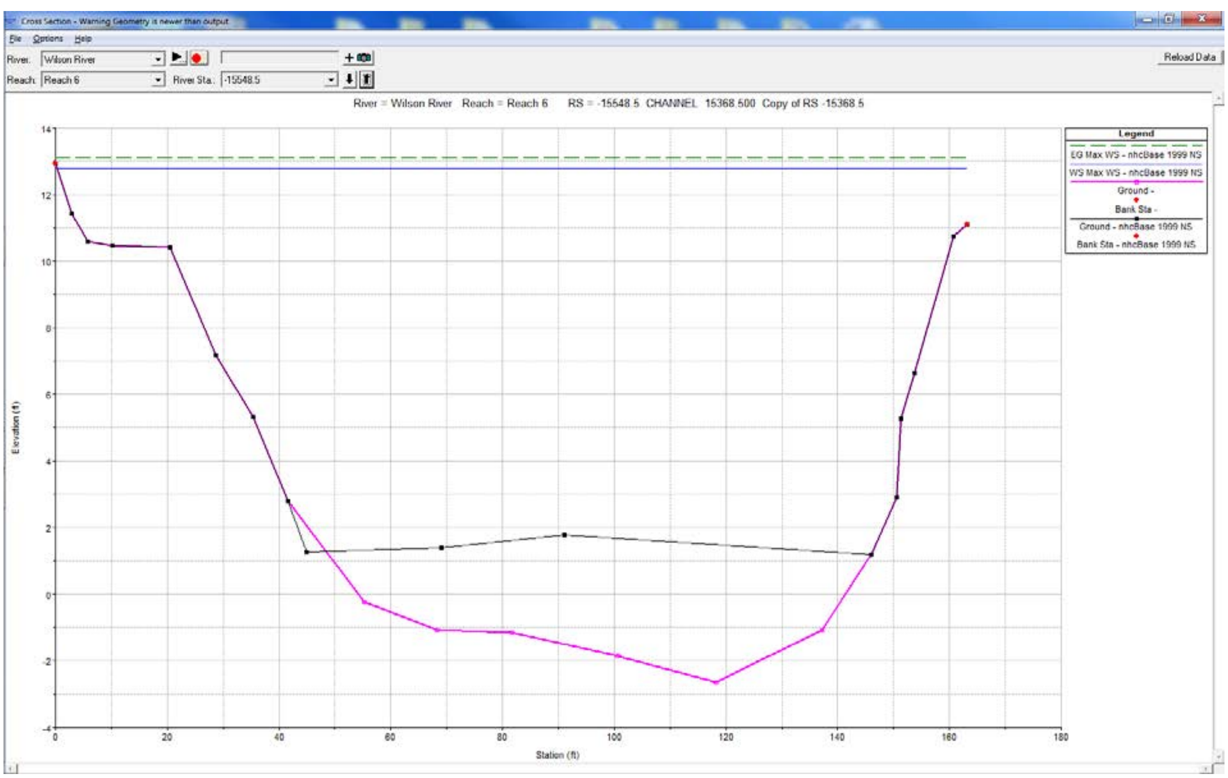


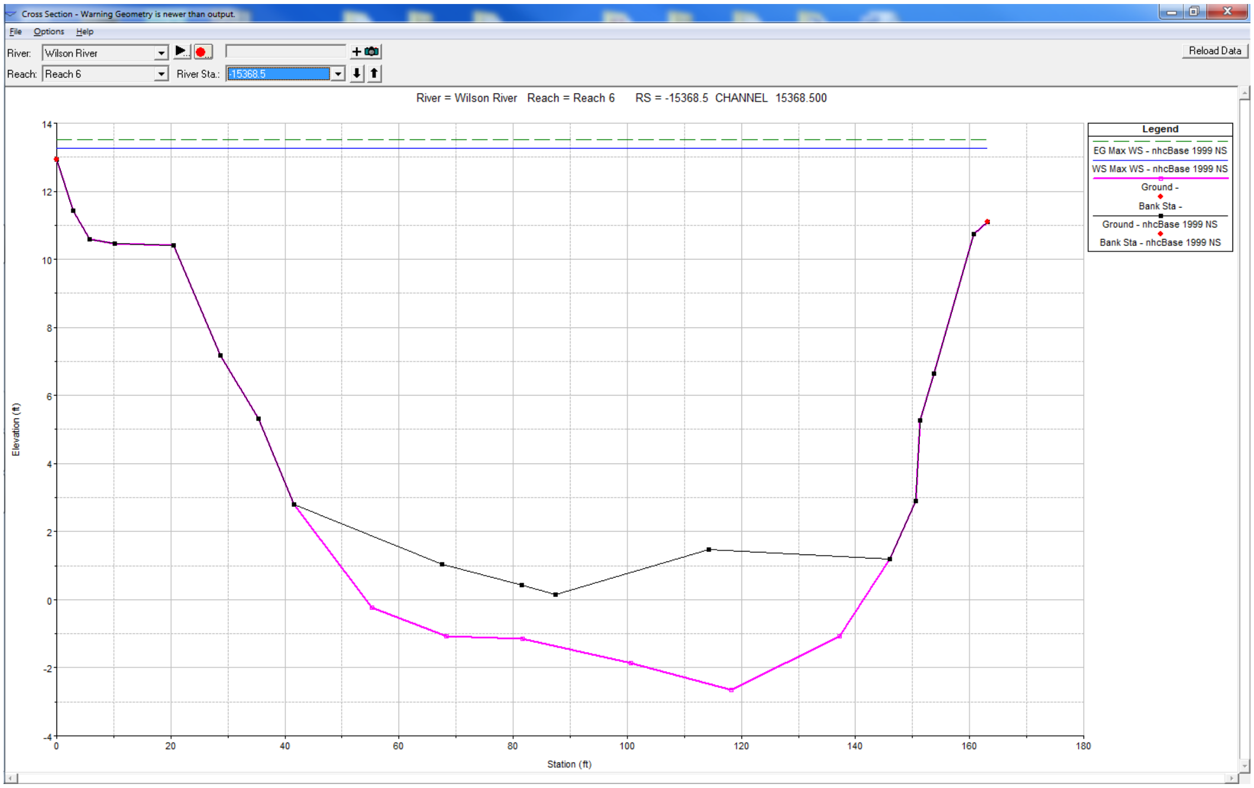
Wilson River 5



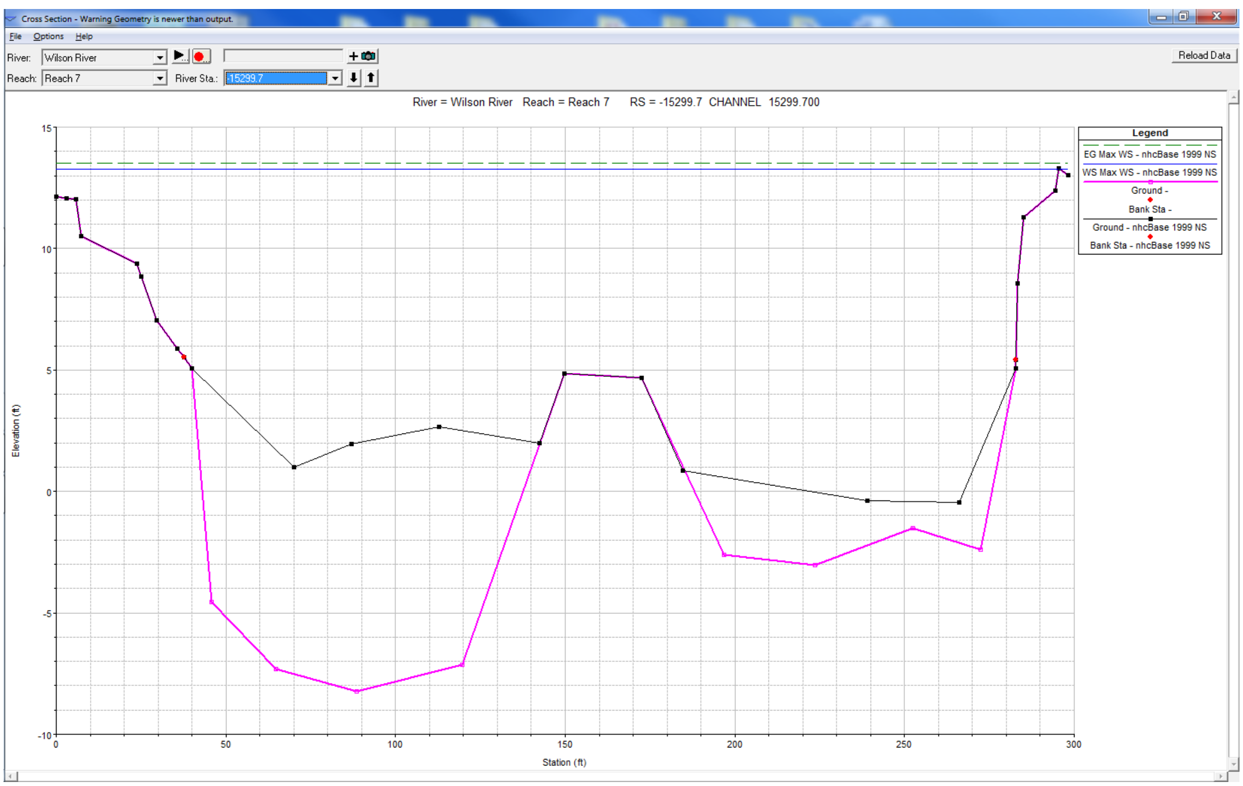


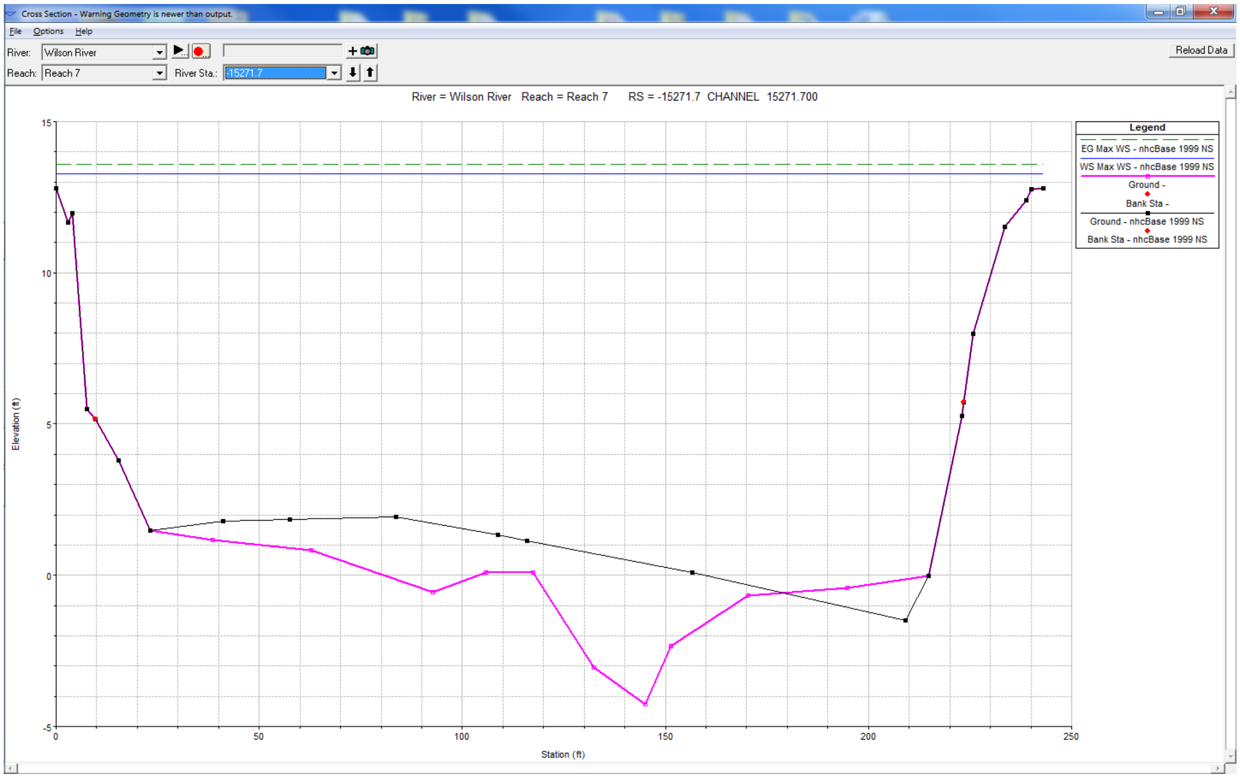
Wilson River 6

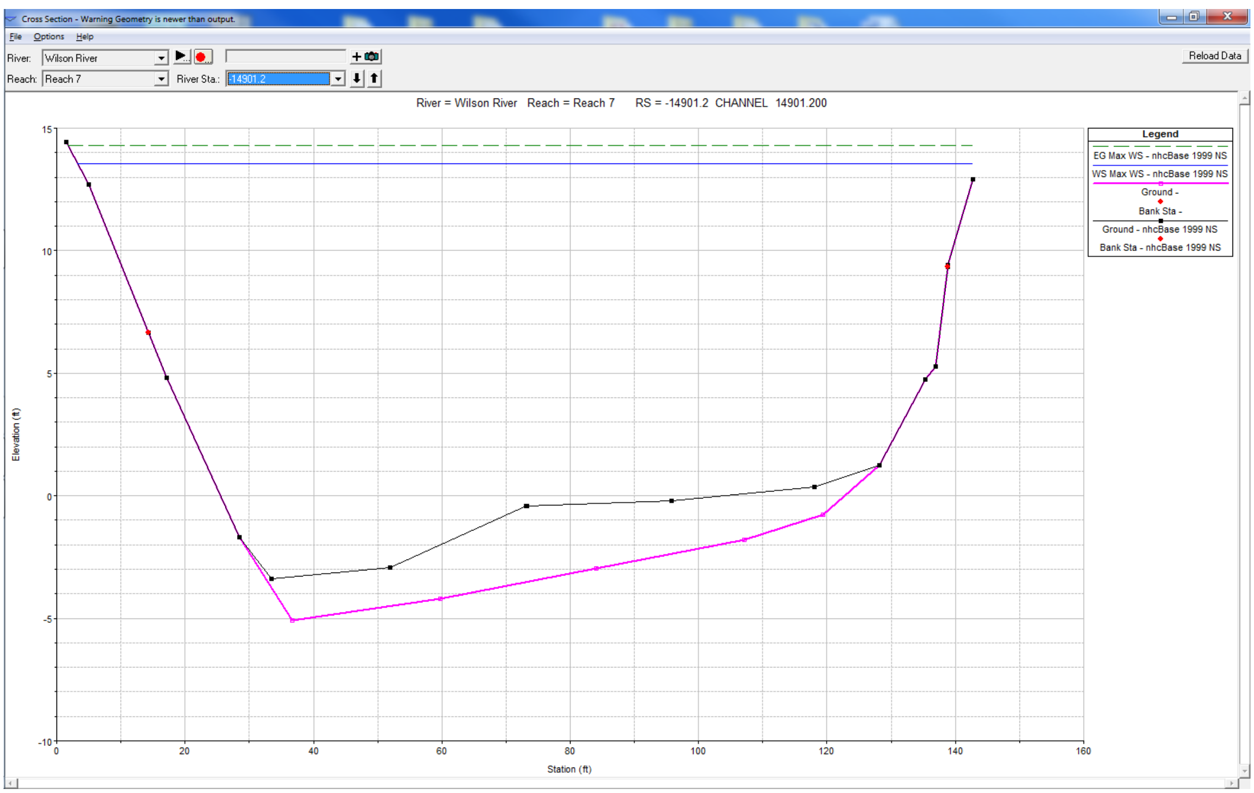


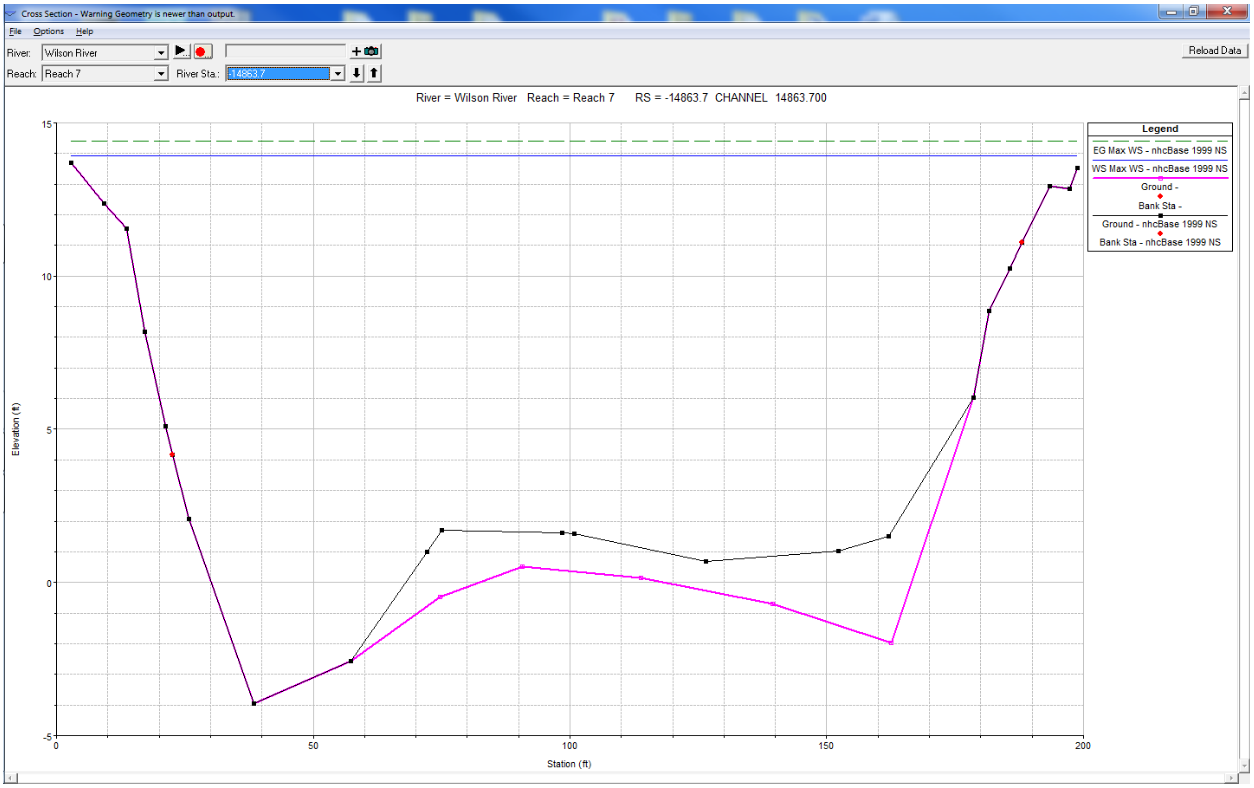


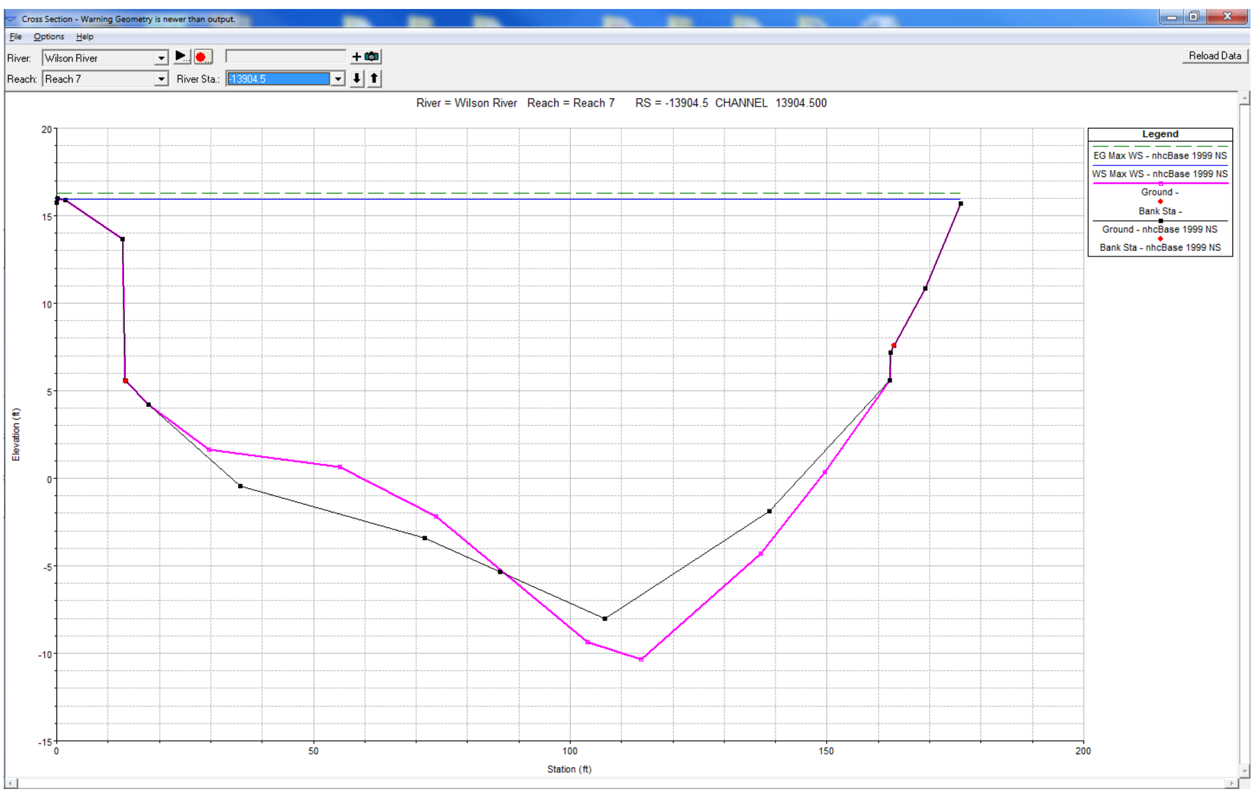
Wilson River 7

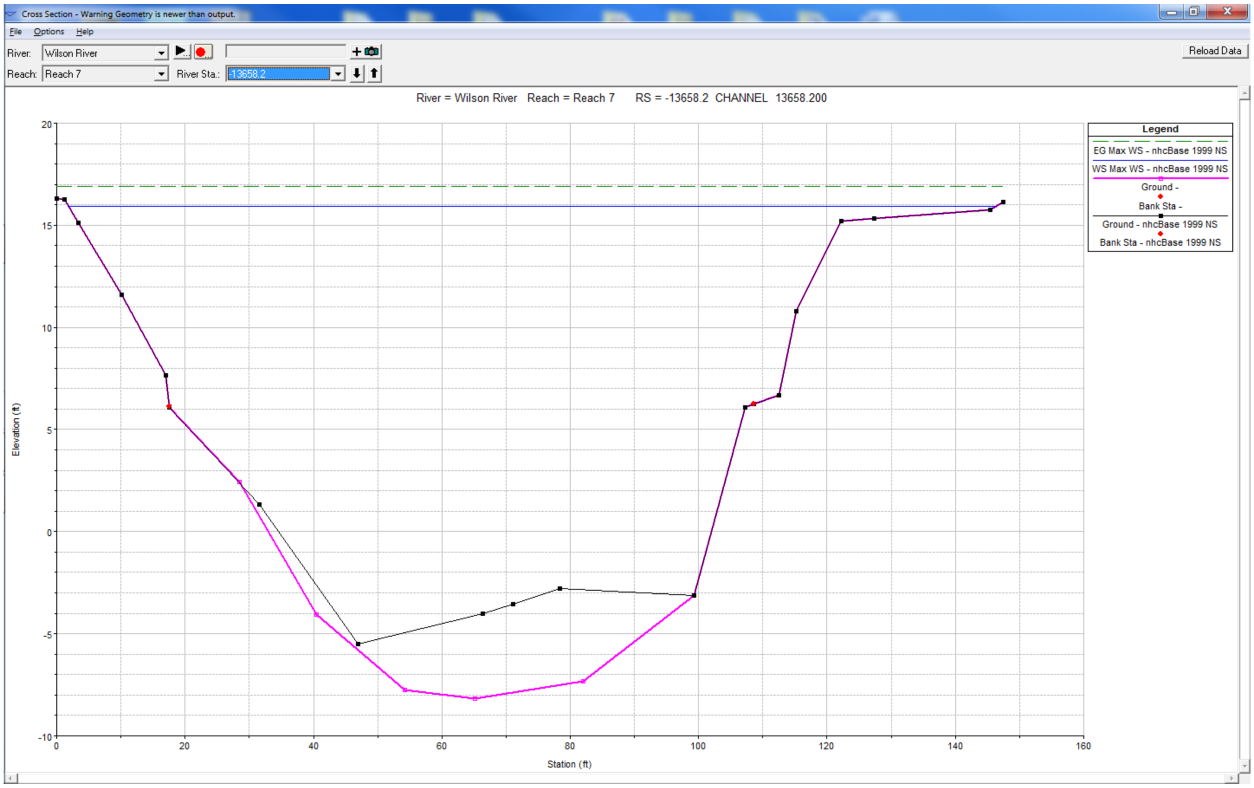


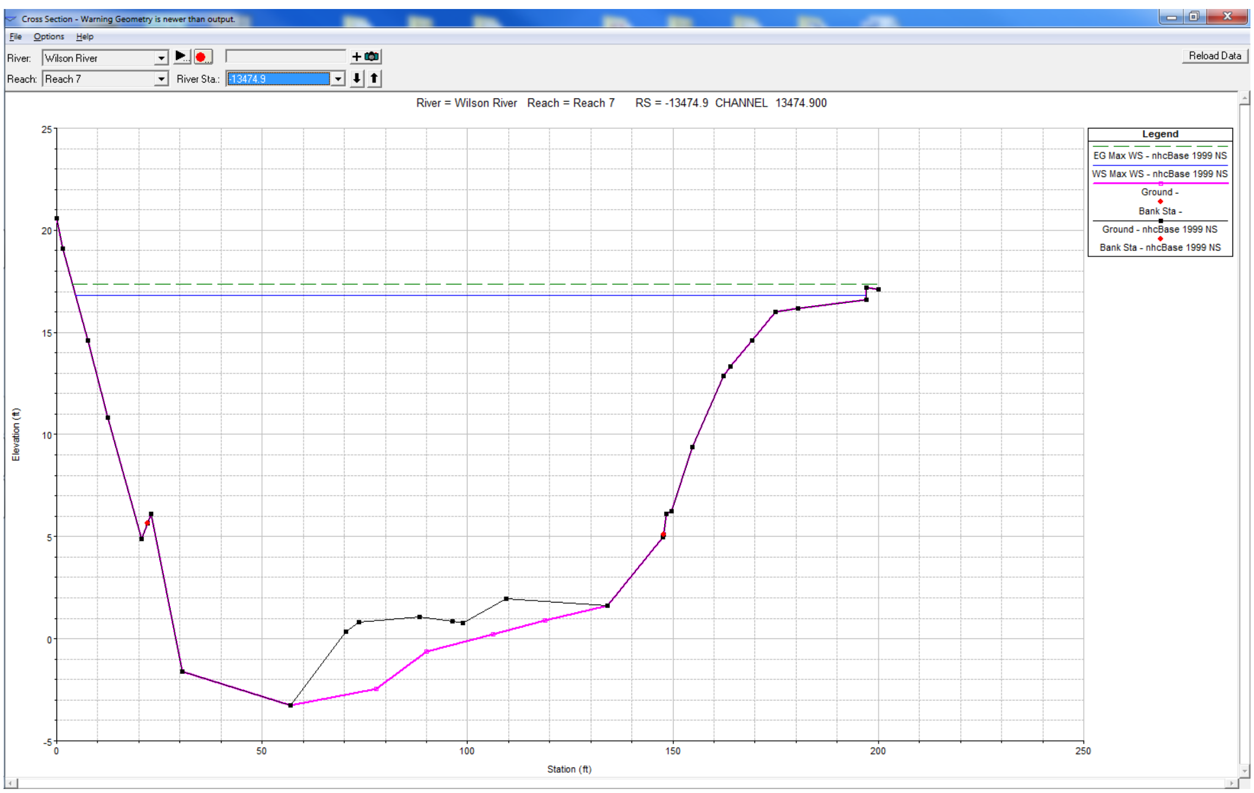

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7
River Sta.: -15271.7
Reload Data
River = Wilson River Reach = Reach 7 RS = -15271.7 CHANNEL 15271.700
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)
15
10
5
0
-5
0
50
100
150
200
250

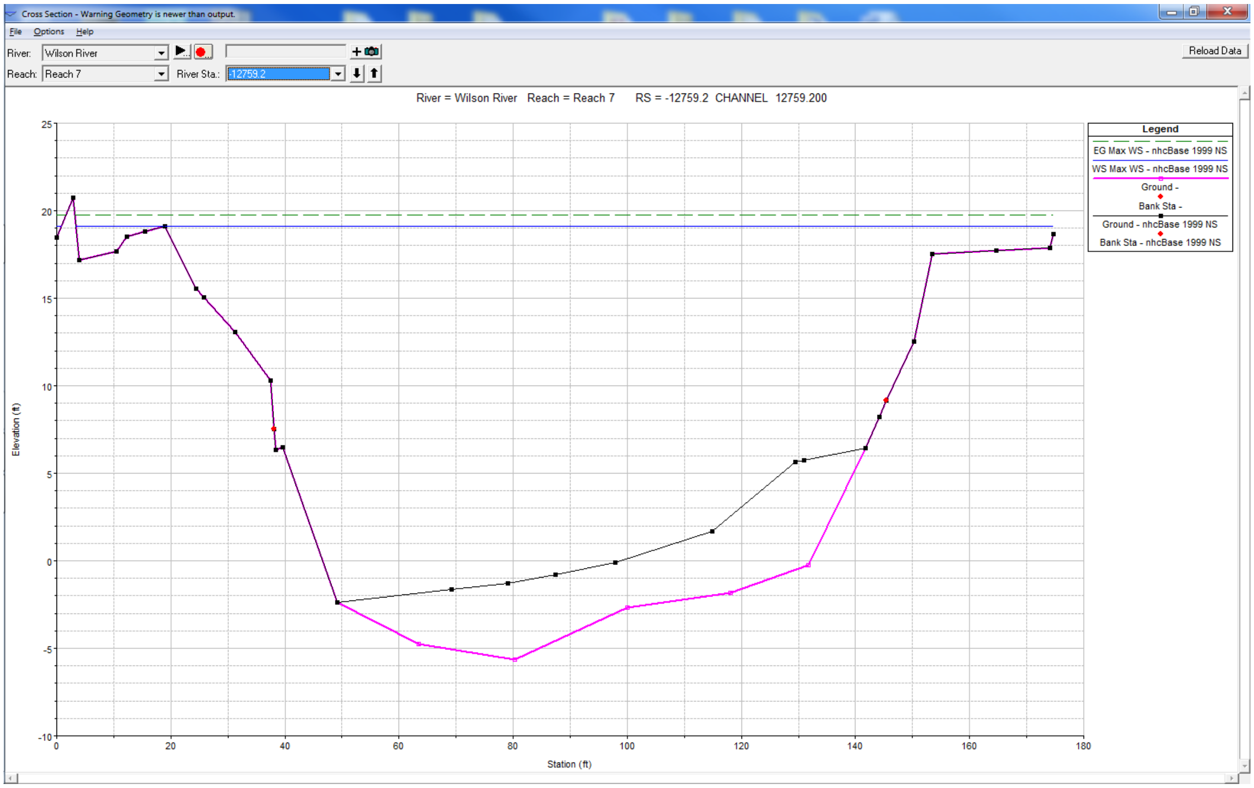

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7
River Sta.: -14901.2
Reload Data
River = Wilson River Reach = Reach 7 RS = -14901.2 CHANNEL 14901.200
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)
15
10
5
0
-5
-10
0
20
40
60
80
100
120
140
160

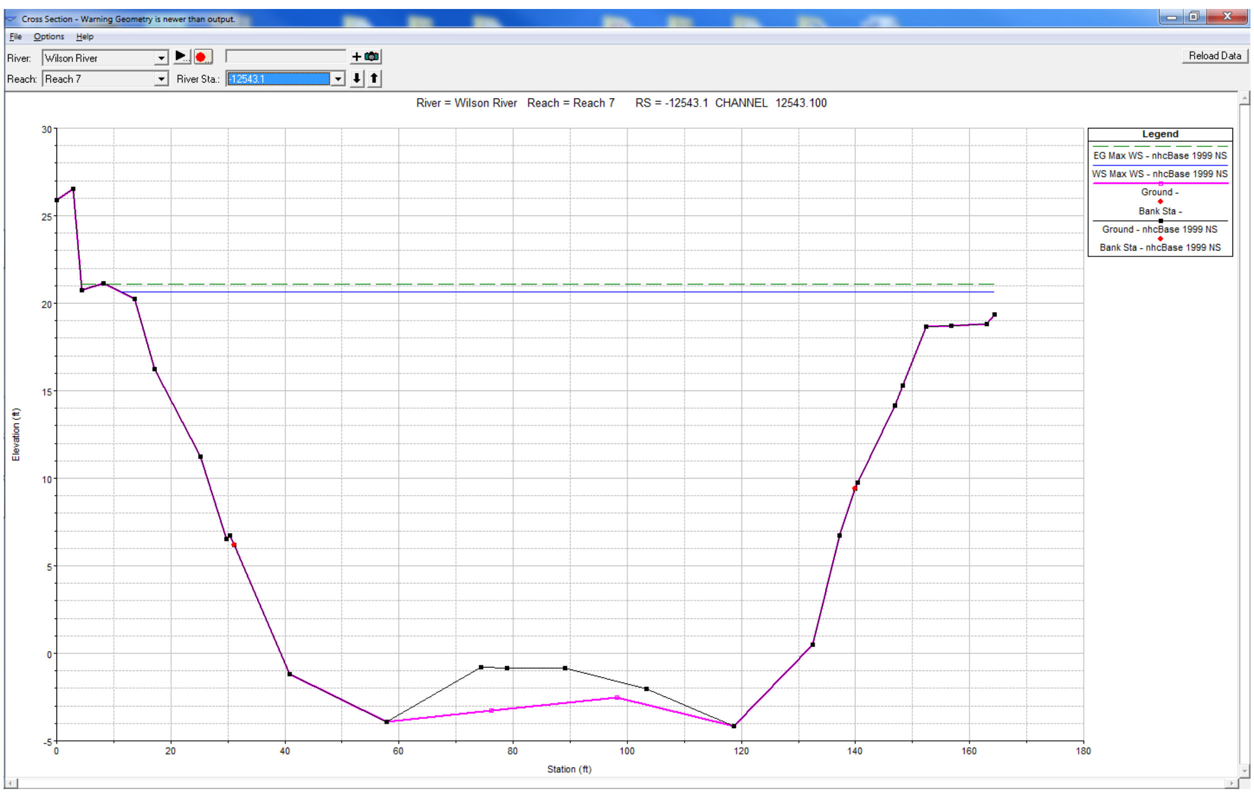

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7 River Sta.: -14863.7
Reload Data
River = Wilson River Reach = Reach 7 RS = -14863.7 CHANNEL 14863.700
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

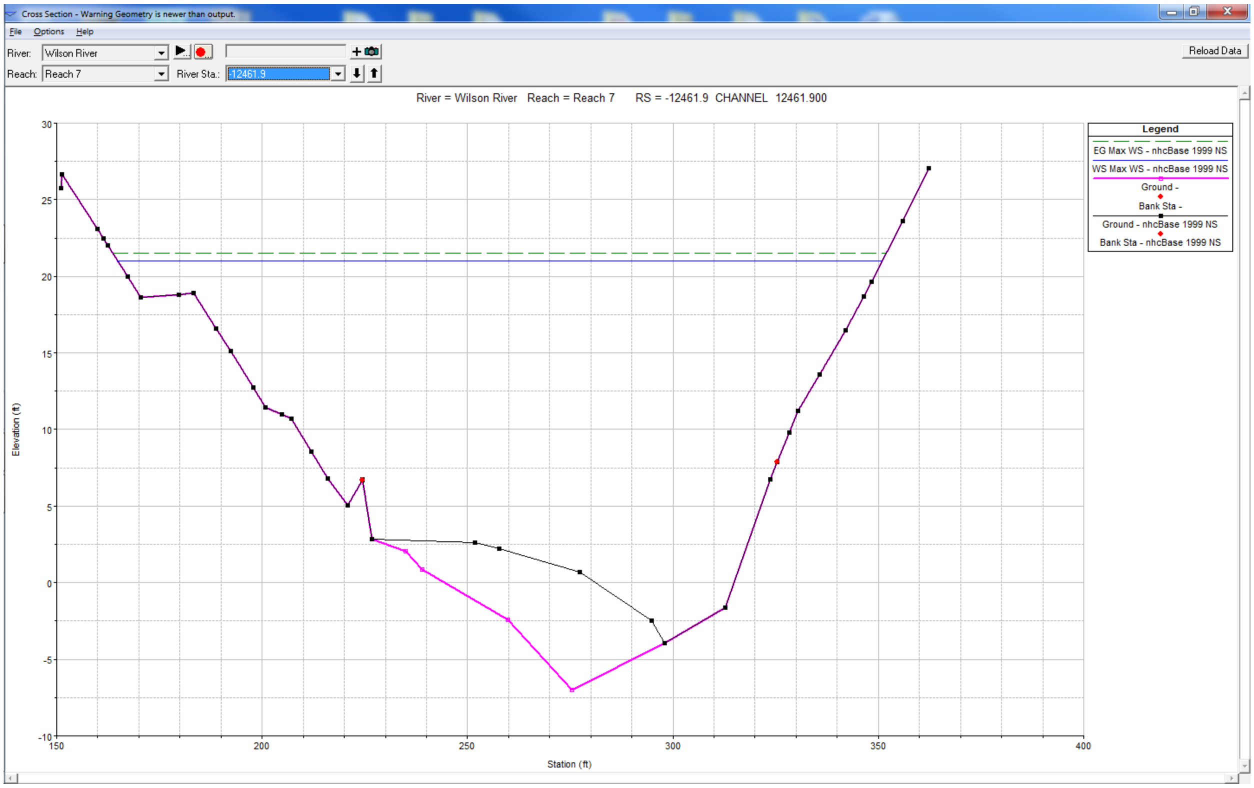

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7 River Sta.: -13904.5
Reload Data
River = Wilson River Reach = Reach 7 RS = -13904.5 CHANNEL 13904.500
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

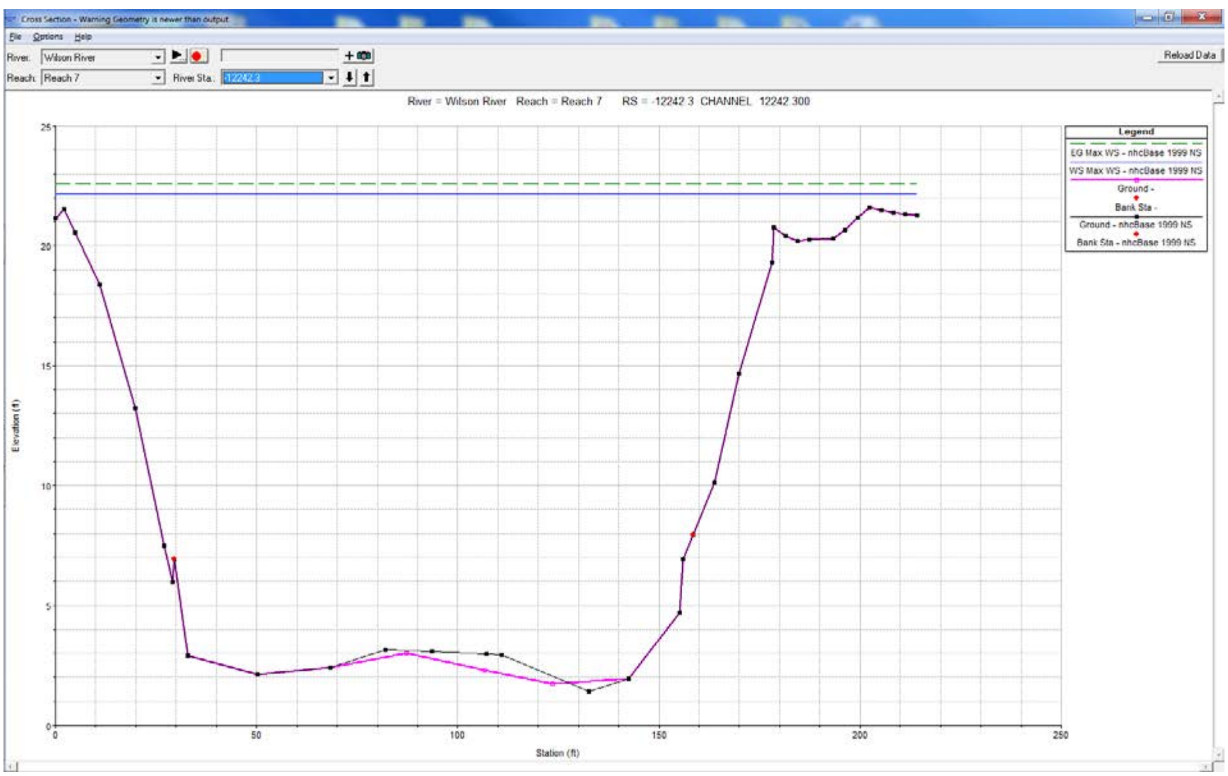

Cross Section - Warning Geometry is newer than output.
River: Wilson River
Reach: Reach 7
River Sta.: -13658.2
Reload Data
River = Wilson River Reach = Reach 7 RS = -13658.2 CHANNEL 13658.200
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
River: Wilson River
Reach: Reach 7
River Sta.: -13474.9
Reload Data
River = Wilson River Reach = Reach 7 RS = -13474.9 CHANNEL 13474.900
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

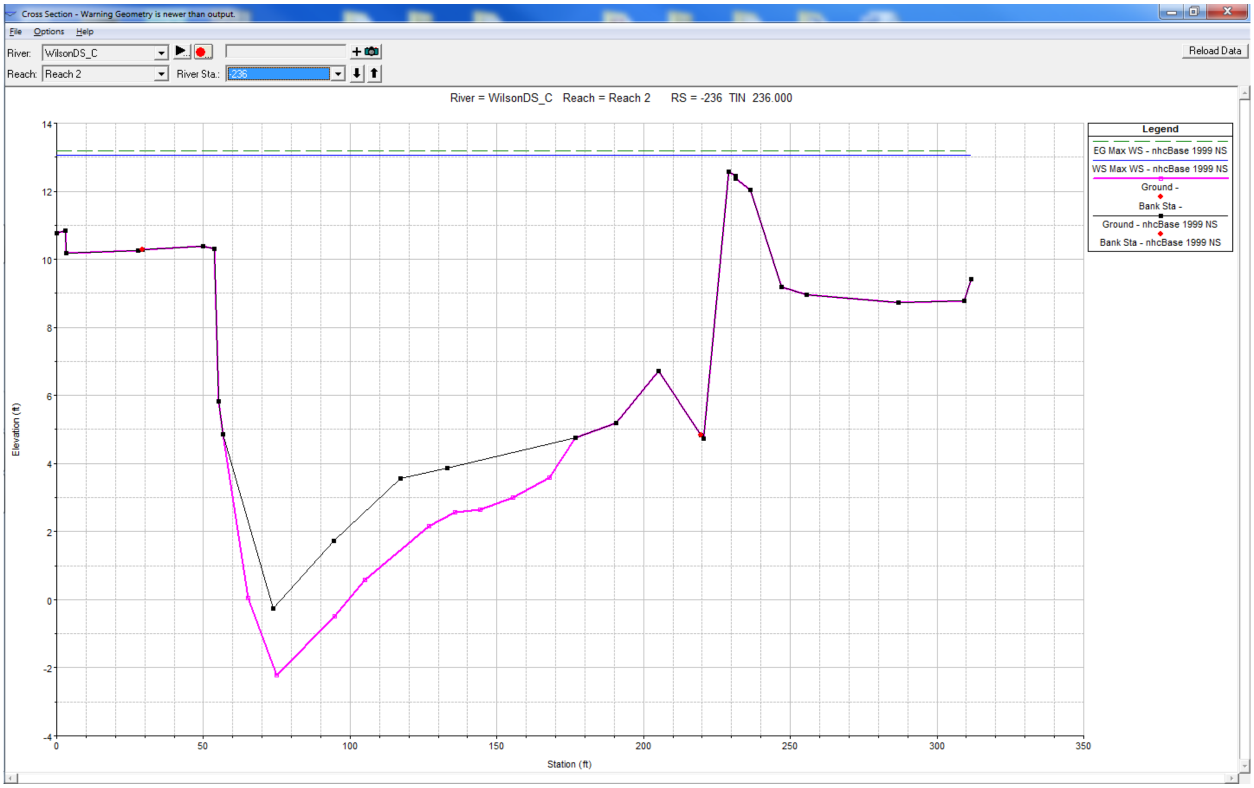

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7
River Sta.: -12759.2
Reload Data
River = Wilson River Reach = Reach 7 RS = -12759.2 CHANNEL 12759.200
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

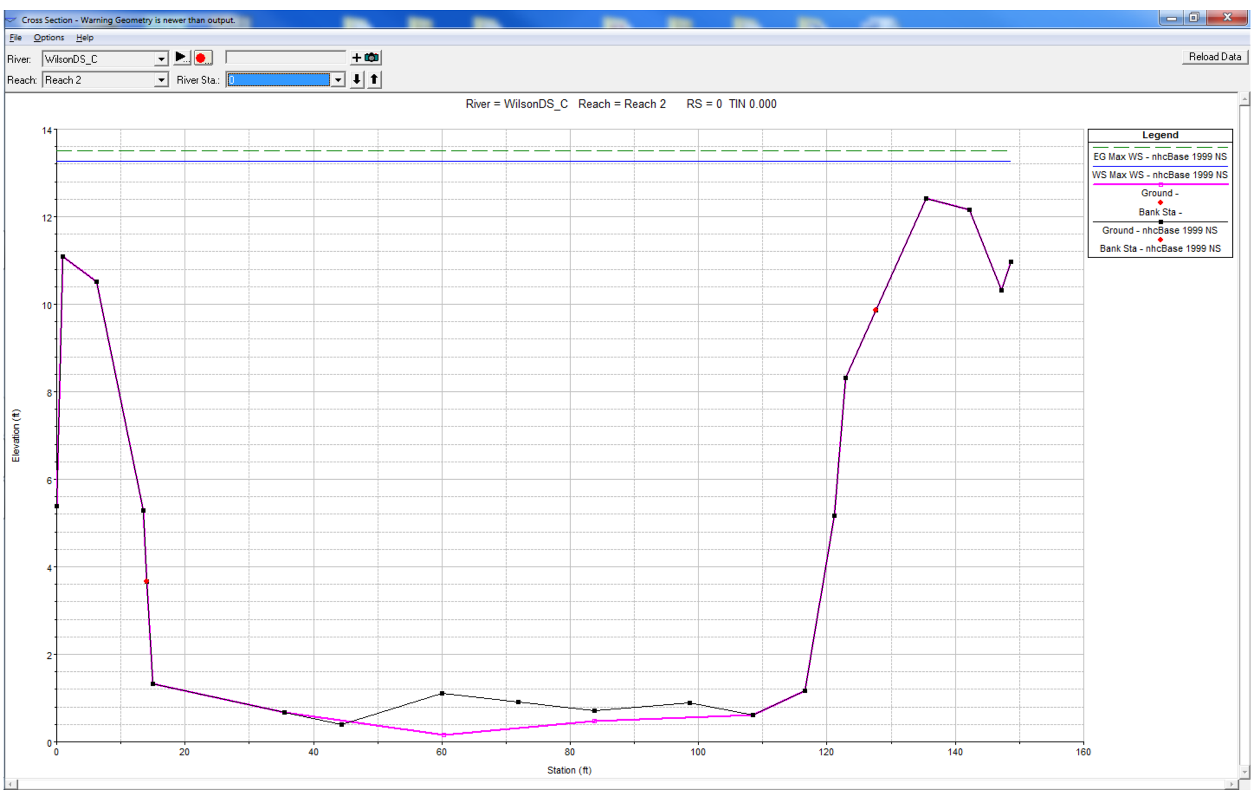

Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7
River Sta.: -12543.1
Reload Data
River = Wilson River Reach = Reach 7 RS = -12543.1 CHANNEL 12543.100
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: Wilson River
Reach: Reach 7
River Sta.: -12461.9
Reload Data
River = Wilson River Reach = Reach 7 RS = -12461.9 CHANNEL 12461.900
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output
File Options Help
River: Wilson River
Reach: Reach 7
River Sta.: -12242.3
Reload Data
River = Wilson River Reach = Reach 7 RS = -12242.3 CHANNEL 12242.300
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

WilsonDS_C


Cross Section - Warning Geometry is newer than output.
File Options Help
River: WilsonDS_C
Reach: Reach 2
River Sta.: -236
Reload Data
River = WilsonDS_C Reach = Reach 2 RS = -236 TIN 236.000
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)


Cross Section - Warning Geometry is newer than output.
File Options Help
River: WilsonDS_C
Reach: Reach 2
River Sta.: 0
Reload Data
River = WilsonDS_C Reach = Reach 2 RS = 0 TIN 0.000
Legend
EG Max WS - nhcBase 1999 NS
WS Max WS - nhcBase 1999 NS
Ground -
Bank Sta -
Ground - nhcBase 1999 NS
Bank Sta - nhcBase 1999 NS
Elevation (ft)
Station (ft)

Attachment C

Proposed Construction BMPs

This attachment includes a synopsis of sediment-related impacts, agency guidelines for construction BMPs for reducing erosion during construction, and additional suggestions for impact mitigation.

Sediment-Related Impacts, Agency Guidelines for Construction BMPs for Reducing Erosion During Construction, and Additional Suggestions for Impact Mitigation

The tables on the following pages provide details about possible sediment producing activities due to the proposed construction of the Southern Flow Corridor (SFC) Project, and the corresponding best management practices (BMPs) meant to reduce or avoid sediment impacts.

These tables summarize the relevant sediment impacts from each activity and paraphrase the relevant agency design guidelines or criteria regarding each potential impact. The final column summarizes general observations about sediment impacts associated with each activity, and contains some additional suggestions for consideration regarding each activity.

Table A reviews proposed sediment BMPs for the Landowner Preferred Alternative and Initial Alternative, and Table B addresses the Hall Slough Alternative. Because the Hall Slough Alternative has not been fully designed, erosion and sediment control BMPs have not been proposed by the applicant; thus, Table B only summarizes the agency guidelines. Therefore, the suggestions offered in the final column of Table B are general considerations.

The following construction design documents and agency best management practices documents were consulted for this review:

- Endangered Species Act-Section 7 Programmatic Conference and Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation (NMFS, 2013)
- Southern Flow Corridor. Landowner Preferred Alternative Preliminary Design Report (NHC, 2011)
- SFC Construction Sediment Control. Informal document (NHC, 2014b)
- Construction Stormwater Best Management Practices Manual.1200-C NPDES General Permit. March 2013 Version (DEQ, 2013)
- Water Quality and Habitat Guide Best Management Practices (ODOT, 2009)
- Fish Passage Programmatic Agreement. ODFW Reference #FPPA-0001 (ODFW, 2008)
- Hydraulic model development for the Tillamook Bay and Estuary Study. Final Report, March 2004. (WEST Consultants, 2004)
- Regional General Permit for Stream Habitat Restoration within the State of Oregon (RGP 3) (USACE, 2008)

TABLE A. Southern Flow Corridor Landowner Preferred Alternative and Initial Alternative. Proposed BMPs from NHC, 2011 and NHC, 2014, and NHC, personal communication, November 2014.

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
1. Construction Roadways, Stockpile and Staging Areas						
Construction Site Entrances	Trucks leaving work site could track mud onto roads, where it could be washed into the storm drainage system.	There will be about five construction entrances. Standard rock construction entrances will be installed to minimize transport of soil onto public streets.	BMP 2.1: - Gravel pad at entrance at least 50' long, 20' wide, 10" deep - Geotextile layer between rock and native soil - "Rumble track" reusable matting that will knock large amount of clinging sediment from tires - Wheel washes - Shaker rack	None provided.	Activity 180: Temporary Access Roads - Minimize the number and size of entry points or access into work area. - When action is completed, the entrances and access routes may be obliterated, removed, or mitigated; stabilize and restore vegetation, if possible.	Observation: - Fine-grained sediment in floodplain, frequent wet weather, and large amount of earth movement may cause mud to be picked up by truck tires. However, since most sediment will be re-used on site the number of trips off the construction site may be limited. Additional Suggestions: - Consider whether there are ways to reduce the number of construction entrances. - Consider using a shaker rack or rumble rack at end of construction entrance to remove mud from truck tires, especially during wet weather.
Staging and Stockpile Areas	Erosion of exposed stockpiles of levee material may enter drainage system. Erosion of cleared and compacted areas created for staging areas may also enter drainages.	Plastic sheeting will be used to cover exposed stockpiles.	- Avoid over compaction of disturbed areas prior to hydro seeding (BMP 2.4). - Use plastic sheeting to temporarily cover soil stockpiles or bare slopes until a more permanent stabilization can occur (BMP 2.7). - Use erosion control blankets and geotextiles (BMP 2.6) as a short term measure to prevent erosion on soil stockpiles.	PDC 16 – Staging, Storage and Stockpile Areas - Designate staging areas where hazardous materials or heavy equipment are stored or fueled at least 150' from natural water body or wetland, or on established paved area. - Dispose of material not used in restoration and not native outside of the functional floodplain. - Obliterate all staging storage and stockpile areas, stabilize soil, and re-vegetate.	Activity 081: - Ensure the stability of the stockpiled material. - Avoid wetlands, water bodies and cultural resources as stockpile areas Activity 180: Equipment Management - Vehicle maintenance, refueling and storage of vehicles and fuel should occur at least 150' from nearest high water body.	Observation: - Temporary stockpiles may be sediment source during construction, but plastic sheeting should reduce most of this. - Reducing erosion in staging areas should also be considered in the sediment reduction plan. Additional Suggestions: - To the extent possible, locate staging areas where eroded material has less chance of reaching stream network. - Obliterate all staging and stockpile areas, decompact soils, and revegetate.
Temporary Access Roads, Haul Roads, and Other Paths	Water or wind erosion of road surfaces due to wind, direct rainfall and runoff, or as a result of tidal and/or flood flows. .	Existing site roads used for haul are already rock/gravel surfaced. These roads will be repaired prior to haul, or resurfaced with crushed rock or hog fuel. Dry exposed soils will be watered. All existing gravel	- Avoid overcompaction of disturbed areas prior to hydroseeding (BMP 2.4). - Reduce vehicular speeds and irrigate soil surface (BMP 2.8). - Conduct road sweeping of paved areas if appropriate (BMP 2.20).	PDC 19 – Equipment, Vehicles, and Power Tools - Select, operate, maintain equipment to prevent leaks, and minimize adverse effects. - Minimize length and number of access roads, preferentially use existing access roads where possible. - Minimize removal of riparian vegetation for access roads; cut at ground level when necessary to remove vegetation.	Activity 180: Temporary Access Roads - When action is completed, the entrances and access routes may be obliterated, removed, or mitigated. - Stabilize and restore vegetation if possible.	Observation: -Using existing roads, resurfacing roads prior to haul, and watering soils should reduce sediment impacts from haul roads. Additional Suggestions: - If additional roads do need to be constructed, choose short paths far from channels where eroded material has less chance of reaching stream network - Obliterate all roads and paths, decompact

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
		roads will be removed and road beds decommissioned at end of construction.		- After construction is complete, obliterate roads and paths, and revegetate area. - In wet areas, decompact road surfaces and reshape to match original contours. PDC 31 – Site Restoration - Loosen soil in compacted areas as necessary for revegetation and infiltration. - Site restoration success criteria are provided under PDC 31.e		soils, and revegetate. - Do not remove existing vegetation for any new haul roads - If any stream crossings are planned, follow agency guidelines for stream crossings and include in engineering design plans.
Dust Abatement	Wind erosion of dry surfaces on temporary access roads can mobilize fine sediments, affecting water quality and air quality.	Dry exposed soils will be watered.	- Reduce vehicular speeds and irrigate soil surface (BMP 2.8). - Apply correct amount of water to avoid further erosion and tracking soil off site.	PDC 21 – Dust Abatement - Sequence and schedule work to reduce exposure of bare soil to wind erosion.	Dust Abatement (no activity number) - Apply dust palliatives (water, which may include additives) to control dust on access roads and maintenance yards. - Use water as dust palliative when possible.	<u>Observation:</u> - Watering dry exposed soils should sufficiently reduce dust. <u>Additional Suggestion</u> - Watering only needs to be done as needed. Save water by specifying no watering will be done if dust is not likely to occur, such as in wet weather.
2. In-Channel Work Areas (Including River Channels and Major Named Sloughs)						
Timing of In-Water Work	Improper sequencing of activities relative to tidal cycles could result in unnecessary erosion of soils, bank erosion, and other negative impacts.	- Perimeter levees will be removed in phases; first to an elevation above summer high tide levels, leaving a berm in place to separate floodplain surfaces from tidal flows in channels. Then remainder of levee removal will occur, along with other interior restoration elements and new levees are constructed. Finally, berms will be removed and tidal flooding will be allowed. - Berm removal cannot occur during high tides. There will	None provided.	PDC 25 – Timing of in water work - Limit in-water work window to windows established by ODFW (2008) - In-water work window for is specified as July 1-Sept 15 (Tillamook Bay Rivers) and November 1 – Feb 15 (Tillamook Bay Estuary)	Channel Maintenance (Activity 124) - Perform work during the ODFW in water work window	<u>Observation:</u> - Sequencing work relative to tides is central to reducing sediment impacts during construction. - Phasing as proposed is proper BMP for reducing impact of in-water work. <u>Additional Suggestion:</u> - None provided. Clearly follow ODFW guidelines for in-water work window.

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
		be one to two week periods when high tides will not reach the design level. These windows will be targeted as periods when most berm removal will occur. - Breaching below tide levels will occur in periods of low tide to extent possible, but lowest portions of breaches will require in-water excavation.				
In-Channel Work Area Isolation	In-water excavation or riprap removal may generate sediment that will increase turbidity locally and in downstream waters	- Construction will rely on proper sequencing to minimize the amount of in-water work that is performed. - For in-water work in ditches on floodplain, work area isolation dams will be used to prevent flow from ditches entering the main drainage network. This BMP will not be used where fish may be present. - The ability to use floating silt curtains will be limited, but they can be used in lieu of work area isolation dams in areas without deep water or high flow velocities.	None provided.	PDC 27 – Work Area Isolation - Isolate any work area within the wetted channel from active stream whenever ESA listed fish are reasonably certain to be present. <u>However, work area isolation may not always be necessary or practical in certain settings, including tidal zones.</u> [underline added] - Engineering design plans for work area isolation will include all isolation elements. - Dewater the shortest linear extent of work area practical. Use coffer dams and by-pass culvert or lined diversion ditch to divert flow. Pump water from work site to a temporary storage and treatment site, and monitor downstream of construction area to prevent stranding of aquatic organisms. Use fish screen when pumping water.	Channel Maintenance (Activity 124) - Remove any excess material from channel maintenance activities, and deposit above the ordinary high water line. - Stabilize material with spreading and top seeding, matting, or erosion control. - Work in the dry where practicable.	<u>Observation:</u> - Work area isolation for in-channel work may be difficult due to rapidly changing tidal conditions; however, the present plans for sequencing and silt curtains are reasonable precautions. - Dewatering portions of main rivers for work along the banks during low tide is not practical. <u>Additional Suggestion:</u> - Include any work area isolation dams explicitly in engineering design plans. - If possible, use riprap being removed on site for other project purposes
Removal of Bank Erosion Protection (Riprap)	Removal of riprap along banks along main river channels will	- Where possible, floating silt curtains will be used to isolate work areas. - Minimize in-water	None provided.	PDC 31 – Site Restoration - Restore significant disturbance of riparian vegetation, soils, stream banks or stream channel	Activity 124 – Channel maintenance - Attempt to use bioengineering solutions when sections of riprap are replaced or removed	<u>Observation:</u> - Major channel migration due to riprap removal is unlikely; channel migration is limited by cohesive banks and low stream power in tidal reach.

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
	generate turbidity during construction, and allow banks to erode after removal. Bank slumping could also occur following riprap removal.	contact time as a sediment control method. - Longer term bank erosion following project following the removal of riprap bank protection, is considered as a benefit; riprap removal is being done to allow for more natural channel forming processes.		PDC 38 – Streambank restoration - PDC 38 lists many possible streambank stabilization methods that may be used - Specifies that rock will not be used for streambank restoration except as ballast for large wood structures	- Work in the dry where practicable	- Local erosion of newly exposed bank material could be a significant but relatively short-lived sediment impact Additional Suggestions: - Consider treating newly exposed banks where riprap is removed with organic geotextiles, erosion control blankets or other biodegradable coverings to temporarily reduce erosion, to encourage re-establishment of natural vegetative cover, and improve in-channel habitat. - Consider using large wood emplacements or engineered log jams along banks where riprap is removed, to reduce erosion potential of flow in channels and to enhance in-channel habitat.
Remove Tide Gates and Flood Gates; Construct New Flood Gates	Construction or removal activities where tidegates and floodgates are being removed or constructed may generate sediment that could enter nearby waters. Additionally, flows passing through new flood gates could erode floodplain surface.	- New high-capacity flood gate will be set near floodplain elevation and therefore, elevation of flood gate will limit or prevent the amount of in-water work related to this activity.	None provided.	PDC 26 – Limit in-water work window to windows established in Oregon by ODFW. PDC 27 – Isolate work area in wetted area from active channel as specified in PDC 27.	Activity 121 and 129: - Tidegate maintenance: inspect and clean structures prior to the rainy season, if possible. - Remove any excess material associated with activity above high water or in appropriate locations	Observation: - Sediment impacts related to new flows on floodplain surfaces are inevitable, but expected to be relatively minor. Additional Suggestion: - Sediment impacts related to this activity could be reduced by placing soil stabilizing measures in newly exposed areas where tide gates are being removed.
3. Floodplain Work Areas (Including Small Tidal Channels through the Floodplain)						
Levee Fill Removal and Grading to Floodplain Surface (Not Including Channel	Clearing packed gravel surfaces from levees and removing underlying fill could generate sediment	- The exposed top surface will be graded towards the interior to prevent direct runoff to the river. - New levees will be covered with erosion control blankets once	None provided.	PDC 39 – Set-Back or Removal of Existing Berms, Dikes, and Levees - Design actions to restore floodplain characteristics similar to the unmodified condition - Remove pipes, fences and other	None provided.	Observation: - Due to their proximity to trunk streams, cleared surfaces where levees are to be removed could contribute sediment to drainage system if proper BMPs are not applied. - Grading surfaces toward interior, as

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
Breaches); Construction of New Levees.	through water erosion (raindrop impact, runoff and rill formation, slumping, flows, flood flows) in areas previously occupied by the levees.	constructed (as opposed to grass). The levees will be overbuilt and allowed to settle for a year and then re-graded; this plan is better managed with blankets than grass. - Hydroseeding will be used for temporary and permanent seeding of new levees using sterile grasses. - Sequencing of work will be planned to prevent tidal flows entering areas until restoration work is completed (see above).		features to extent possible - Remove nonnative fill material from the floodplain when possible - Where it is not possible to remove all levees and berms, create openings through breaches. - Breaches should be larger than active channel width to reduce chances of channel avulsion - Levees should be breached at downstream end of project to ensure flows can re-enter main channel and reduce fish entrapment - Sequence levee removal such that repairing or restoring estuary functions is possible once levees are removed or breached.		planned, will prevent most of the sediment produced in areas where levees are removed from reaching trunk streams. Additional Suggestion: - Apply standard and appropriate BMPs not only to new levees but also to areas where levees are removed. Use similar BMPs as planned for the decommissioned staging areas, haul roads, and other disturbed areas. - Examples of erosion BMPs would include compost berms, erosion control blankets, hydroseeding, mulching, etc. as appropriate.
Erosion Control and Mitigation for Disturbed Areas	Water or wind erosion of disturbed or bare surfaces – due to wind, direct rainfall and runoff, or as a result of tidal and/or flood flows – could cause sediment to be delivered to drainage system.	- Compost and/or brush berms will be used where sediment transport into nearby waterway is possible. They will be installed at the limits of clearing. - Hydroseeding will be possibly be used for new levees and other disturbed areas. - Mulching – brush and small trees removed in other parts of the project will be chipped and used for brush dams at clearing limits and as mulch spread over disturbed areas where low water velocities are expected.	- Use vegetated filter strip adjacent to disturbed areas to reduce flow and remove sediment and pollutants from runoff (BMP 2.2) - Reestablish vegetation on disturbed areas through seeding and mulching, seeding and matting, or sodding (design considerations in original document, BMPs 2.3 and 2.4) - Hydroseeding with mulch, seed and fertilizer mix (BMP 2.4) - Avoid overcompaction of disturbed areas prior to hydroseeding (BMP 2.4) - Add at least 3" compost cover on disturbed areas (BMP 2.5) - Surface roughening – create ridges or furrows to trap seed and reduce overland flow velocities and reduce sediment delivery to streams (BMP 2.9) - Straw wattles (BMP 2.16) or compost sock (BMP 2.18) to trap sediment, installed and staked on sloping surfaces during construction - Create berm surrounding construction areas from compost (BMP 2.17) - Install sediment fences where sheet flow is dominant (BMP 2.24)	PDC 17 – Erosion Control - Install temporary erosion controls downslope of construction to prevent sediment entering riparian area, wetlands, etc. - Use standard erosion controls as temporary measures including fiber wattles, silt fences, jute matting, mulch, geotextiles. - Install additional erosion control or barriers during construction, if eroded sediment appears to be able to enter streams - Maintain supply of sediment control materials at project site - Remove sediment from erosion controls when it reaches 1/3 the height of the control - Stabilize all disturbed soils after construction is complete or prior to any break in work. - Remove temporary erosion controls after site is stabilized	Activity 180: Emergency Maintenance Erosion Control and Site Management - If vegetation in the riparian area must be cleared, it will be trimmed at ground level not grubbed. - Use erosion control measures prior to ground disturbances - Inspect erosion and sediment control measures daily to ensure adequate function	Observation: - Erosion from disturbed construction areas is a common sediment impact from restoration projects. Proper BMPs are well established and will be applied on this project to avoid or reduce impacts. Additional Suggestion: - Apply proper BMPs as proposed, while also considering whether additional erosion control BMPs are necessary for portions of the project not specified. - Add a provision to the engineering design and construction plan to inspect erosion and sediment control measures at the end of each work day.

Table A – Southern Flow Corridor Landowner Preferred Alternative and Initial Alternative; Erosion and Sediment Control BMPs

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
				PDC 31 – Site Restoration - Loosen soil in compacted areas as necessary for revegetation and infiltration - Site restoration success criteria are provided under PDC 31.e PDC 32 – Revegetation - Plant and seed disturbed areas prior to first growing season after construction - Use diverse assemblage of species native to region; when feasible use vegetation salvaged from local areas - Short term stabilization measures, may use non-native sterile seed mix, jute matting, etc. -Do not apply surface fertilizer within 50 feet of any wetland or water body.		
Fill Ditches on Floodplain	New bare fill in areas of ditches to be filled could generate erosion. Greater runoff production in elongated strips may concentrate water and focus erosion, particularly following settlement of soils after construction is complete	None mentioned.		PDC 39.b – Estuary Restoration - Fill ditches constructed and maintained to drain wetlands. Some points in an open ditch may be over-filled, while other points may be left as low spots to enhance topography and encourage sinuosity of the developing channel PDC 27 – Work area isolation - Isolate any work area in the wetted channel from the active stream where ESA-listed fish may be present; however, work area isolation may not always be practical, such as in tidal zones.	Activity 120 – Ditch shaping and cleaning - Use erosion control devices such as check dams, silt mats, and so on when reshaping ditches causes potential sediment delivery to waters of the State. - Re-seed drainage ditches as appropriate. - Perform ditch work in optimum weather (ditch dry but sufficient soil moisture).	<u>Observation:</u> - If not properly shaped, filled ditches could concentrate flow and lead to increased erosion. <u>Additional Suggestions:</u> - Create slightly convex surface over ditches; a topographic high relative to surrounding surface will shed surface water. - If possible, shape topography in ways that encourage the formation of a more natural drainage network as opposed to the unnatural trellis shaped network of constructed ditches. - Hydroseed and revegetate bare surfaces previously occupied by ditches.
Reconnect Small Tidal Channels	Introducing tidal flows to small channels in the floodplain will generate sediment from erosion and expansion of	- Plans are to allow natural development and extension of tidal channels, rather than to create a design channel. - Natural development of tidal channel network will produce	None mentioned.	PDC 39.b in Estuary - “Channel construction may be done to re-create channel morphology based on aerial photograph interpretation, literature, topographic surveys, and nearby undisturbed channels. In some instances, channel construction is simply breaching the levee. For these sites, further channel development will occur	Activity 124 – Channel maintenance - Attempt to use bioengineering solutions when sections of riprap are replaced or removed - Work in the dry where practicable - Remove any excess material associated with activity above high	<u>Observation:</u> - Reconnection of small tidal channels will likely create a pulse of sediment of unknown duration (days to years) that will enter main channels and estuary. - Much or most of this sediment will probably be generated at or near the inlets to the reconnected tidal channels.

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Proposed BMPs for SFC Landowner Preferred and Initial Alternatives (NHC, 2011; NHC, 2014)	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additional Suggestions for Proposed BMPs
	tidal channel network.	some sediment. No mitigation activities mentioned.		through natural processes." - Implement sequencing in a way that "will not preclude repairing or restoring estuary functions once dikes/levees are breached and area is flooded" PDC 37 – Off and Side-Channel Habitat Restoration - Such projects can include minor excavation of naturally accumulated sediment within historic channels (<10% volume) as well as anthropogenic fill. - Excavation depth will not exceed maximum thalweg depth of the main channel. - Excavated material will be hauled to upland site or spread across floodplain as long as it does not increase flooding	water or in appropriate locations Activity 162 – Fish habitat and passage improvement - Install erosion control devices prior to culvert work when there is flowing or stagnant water - Complete any work performed in flowing water during ODFW in-water work window	<u>Additional Suggestions:</u> - Consider conducting additional geomorphic analyses to provide guidance on the expected sizes of reconnected tidal channels, and then sizing inlets closer to their expected final form. Guidance can be found from the results of hydraulic modeling (threshold channels), the sizes of channels in old air photos, or reference naturally formed channels. - If the above suggestion is adopted, also consider incorporating fabric-encapsulated soil lifts (FESL) or other erosion control at tidal channel inlets, to temporarily stabilize them and encourage vegetation establishment at inlets. - These suggested additional measures may be contrary to the design plan of allowing naturally sized tidal channels to develop; however, they could help both reduce the amount of sediment generated and also speed up the evolution of restored channels to their desired form.
Existing Vegetation	Removal of existing vegetation related to construction can increase runoff and erosion	- Clearing limits will be clearly marked - Vehicular traffic will be limited to haul roads and existing disturbed areas to extent possible. - The large pasture area along the Trask River will be protected and will function as a vegetated filter strip.	BMP 2.1: - Don't remove existing vegetation unless absolutely necessary - Preserve vegetation on all steep unstable slopes (in this case, bank slopes, where present)(- Avoid compaction or grading close to trees - Do not pile soil on top of roots - Establish "do not disturb zones" with stakes and tape or fencing		Activity 124: Tree management - Maintain or retain riparian trees and woody vegetated buffer along streams - Trees felled within 150' of the riparian corridor should be used in bioengineering on site if possible. - Replant two seedlings for woody vegetation for every tree over 12-inch DBH in riparian areas. Locate replanted trees so the trees will not pose a future threat to transportation	<u>Observation:</u> - Removal of existing vegetation will be minimized as specified in the engineering design plans. <u>Additional Suggestion:</u> - None provided.

TABLE B. Hall Slough Alternative. Design features of the Hall Slough Alternative are inferred from the DEIS (CCPRS, 2015) and from WEST Consultants (2004). *Entries in italics are common to proposed BMPs for the Landowner Preferred Alternative* (Table A).

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additions Suggestions for Proposed BMPs
1. Construction Roadways, Stockpile and Staging Areas					
Construction Site Entrances	*Trucks leaving work site could track mud onto roads, where it could be washed into the storm drainage system.*	*BMP 2.1:* *- Gravel pad at entrance at least 50' long, 20' wide, 10" deep* *- Geotextile layer between rock and native soil* *- "Rumble track" reusable matting that will knock large amount of clinging sediment from tires* *- Wheel washes* *- Shaker rack*	*None provided.*	*Activity 180:* *Temporary Access Roads* *- Minimize the number and size of entry points or access into work area.* *- When action is completed, the entrances and access routes may be obliterated, removed, or mitigated; stabilize and restore vegetation if – possible.*	*Observation:* *- Fine-grained sediment in floodplain, frequent wet weather, and large amount of earth movement may cause mud to be picked up by truck tires. However, since most sediment will be re-used on site the number of trips off the construction site may be limited.* *Additional Suggestions:* *- Consider whether there are ways to reduce the number of construction entrances.* *- Consider using a shaker rack or rumble rack at end of construction entrance to remove mud from truck tires, especially during wet weather.*
Staging and Stockpile Areas	*Erosion of exposed stockpiles of levee material may enter drainage system. Erosion of cleared and compacted areas created for staging areas may also enter drainages.*	*- Avoid over compaction of disturbed areas prior to hydro seeding (BMP 2.4).* *- Use plastic sheeting to temporarily cover soil stockpiles or bare slopes until a more permanent stabilization can occur (BMP 2.7).* *- Use erosion control blankets and geotextiles (BMP 2.6) as a short term measure to prevent erosion on soil stockpiles.*	*PDC 16 – Staging, Storage and Stockpile Areas* *- Designate staging areas where hazardous materials or heavy equipment are stored or fueled at least 150' from natural water body or wetland, or on established paved area.* *- Dispose of material not used in restoration and not native outside of the functional floodplain.* *- Obliterate all staging storage and stockpile areas, stabilize soil, and re-vegetate.*	*Activity 081:* *- Ensure the stability of the stockpiled material.* *- Avoid wetlands, water bodies and cultural resources as stockpile areas* *Activity 180:* *Equipment Management* *- vehicle maintenance, refueling and storage of vehicles and fuel should occur at least 150' from nearest high water body.*	*Observation:* *- Temporary stockpiles may be sediment source during construction, but plastic sheeting should reduce most of this.* *- Reducing erosion in staging areas should also be considered in the sediment reduction plan.* *Additional Suggestions:* *- To the extent possible, locate staging areas where eroded material has less chance of reaching stream network.* *- Obliterate all staging and stockpile areas, decompact soils, and revegetate.*
Temporary Access Roads, Haul Roads, and other Paths	*Water or wind erosion of road surfaces due to wind, direct rainfall and runoff, or as a*	*- Avoid overcompaction of disturbed areas prior to hydroseeding (BMP 2.4).* *- Reduce vehicular speeds and irrigate soil*	*PDC 19 – Equipment, Vehicles, and Power Tools* *- Select, operate, maintain equipment to prevent leaks, and minimize adverse effects.* *- Minimize length and number of access roads, preferentially use existing access roads where possible.*	*Activity 180:* *Temporary Access Roads* *- When action is completed, the entrances and access routes may be obliterated, removed, or*	*Observation:* *- Using existing roads, resurfacing roads prior to haul, and watering soils should reduce sediment impacts from haul roads.* *Additional Suggestions:* *- If additional roads do need to be constructed, choose short paths far from*

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additions Suggestions for Proposed BMPs
	result of tidal and/or flood flows. .	*surface (BMP 2.8).* *- Conduct road sweeping of paved areas if appropriate (BMP 2.20).*	*- Minimize removal of riparian vegetation for access roads; cut at ground level when necessary to remove vegetation.* *- After construction is complete, obliterate roads and paths, and revegetate area.* *- In wet areas, decompact road surfaces and reshape to match original contours.* *PDC 31 – Site Restoration* *- Loosen soil in compacted areas as necessary for revegetation and infiltration.* *- Site restoration success criteria are provided under PDC 31. e*	*mitigated.* *- Stabilize and restore vegetation if possible.*	*channels where eroded material has less chance of reaching stream network* *- Obliterate all roads and paths, decompact soils, and revegetate.* *- Do not remove existing vegetation for any new haul roads* *- If any stream crossings are planned, follow agency guidelines for stream crossings and include in engineering design plans.*
Dust Abatement	*Wind erosion of dry surfaces on temporary access roads cam mobilize fine sediments, affecting water quality and air quality.*	*- Reduce vehicular speeds and irrigate soil surface (BMP 2.8).* *- Apply correct amount of water to avoid further erosion and tracking soil off site.*	*PDC 21 – Dust Abatement* *- Sequence and schedule work to reduce exposure of bare soil to wind erosion.*	*Dust Abatement (no activity number)* *- Apply dust palliatives (water, which may include additives) to control dust on access roads and maintenance yards.* *- Use water as dust palliative when possible.*	*Observation:* *- Watering dry exposed soils should sufficiently reduce dust.* *Additional Suggestion* *- Watering only needs to be done as needed. Save water by specifying no watering will be done if dust is not likely to occur, such as in wet weather.*
2. Hall Slough and Immediate Surroundings					
Inlet to Hall Slough (near Wilson River Loop Road)	Active erosion at the inlet of Hall Slough could occur when flows are introduced, producing pulse of fine sediment, this could also impact the project's hydraulic performance. Section 3.5.2 of the EIS states: "The Hall Slough Alternative would require periodic dredging to maintain the design channel depths and widths.	- Use sediment fencing* around construction areas (BMP 2.24). *Only use sediment fence in sheet flow conditions; do not install sediment fences across streams or concentrated flows.	PDC 27 – Work Area Isolation - Isolate any work area within the wetted channel from active stream whenever ESA listed fish are reasonably certain to be present. However, work area isolation may not always be necessary or practical in certain settings, including tidal zones. [underline added] - Engineering design plans for work area isolation will include all isolation elements. - Dewater the shortest linear extent of work area practical. Use coffer dams and by-pass culvert or lined diversion ditch to divert flow. Pump water from work site to a temporary storage and treatment site, and monitor downstream of construction area to prevent stranding of aquatic organisms. Use fish screen when pumping water.	None provided.	Observation: - Sudden introduction of flood and tidal flow could induce more frequent high stresses at the inlet, and also introduce more sediment during floods. Concept plan is not far enough along to have fully developed plans for the inlet configuration. Proper planning and engineering of the inlet would be essential for the Hall Slough Alternative to reduce potential for erosion and sediment transport issues, as well as other problems. Additional Suggestion - A 2D hydraulic model for Hall Slough alternative followed by sediment transport capacity calculations could help identify and fix potential problems with the inlet during the design process. - Consider using multiple inlets at different elevations to address different flood sizes and provide flood relief backup, if one becomes clogged during flood. - Consider the use of FESL (Fabric encapsulated soil lifts) or other biodegradeable erosion protection feature, to help stabilize the inlet.

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additions Suggestions for Proposed BMPs
Channel Modification in Hall Slough – Widening and Dredging	Activities associated with enlarging the cross section of Hall Slough could produce sediment into Hall Slough that will be discharged into the Wilson River. Primary activities are channel widening and channel dredging.	- Use sediment fencing* around construction areas (BMP 2.24). *Only use sediment fence in sheet flow conditions; do not install sediment fences across streams or concentrated flows.	PDC 27 – Work Area Isolation - See above, under "Inlet to Hall Slough" for more details.	Ditch Shaping and Cleaning (Activity 121) - Use erosion control devices such as check dams, silt mats, and other erosion control measures when the potential exists to have sediment enter waters of the State. - Near riparian corridors, ensure there is existing barrier or natural bench to protect water bodies from fallback material. - Perform ditch work in optimum weather to reduce sediment - Re-seed ditches and steep slopes as appropriate. Channel Maintenance (Activity 124) - Perform work during the ODFW in water work window Fish Habitat Restoration (Activity 162)	<u>Observation:</u> - Primary sediment-producing processes are: (1) erosion of new banks along Hall Slough; and (2) sediment produced during dredging activity. Sediment BMPs should address these issues separately. <u>Additional Suggestions</u> (1) Erosion of new banks: - Phase work so that flows in Hall Slough are minimized during and immediately after construction. Complete construction along Hall Slough before opening the inlet. - Design and shape channel side slopes so they will be mostly stable during and after construction. - Consider the use of biodegradable erosion-control feature in the design of the banks, such as Fabric Encapsulated Soil Lifts (FESL) - Re-vegetate side slopes with appropriate species and methods to enhance quick establishment and reduce erosion. (2) Sediment production during dredging activity. - Phase work so that flows in Hall Slough are minimized during and immediately after construction. Complete construction along Hall Slough before opening the inlet. - Use silt curtains to maintain turbidity below thresholds in Hall Slough and at the downstream end of Hall Slough. Combination silt curtains might be considered, with one curtain suspended from floats and second curtain floating from anchors below. - If possible, isolate Hall Slough during construction, so that downstream end of slough does not receive tidal flows, and also, so sediment producing activities are isolated from Wilson River during main construction period. Rubber bladders may be useful for isolation. - Plan and budget for monitoring for turbidity levels throughout construction of Hall Slough.
Re-Entry Point Where Hall Slough Empties into Wilson River	Headward-migrating knickpoint could form at downstream end of Hall Slough when flows are re-introduced, contributing sediment to stream network.	- Use sediment fencing* around construction areas (BMP 2.24). *Only use sediment fence in sheet flow conditions; do not install sediment fences across streams or concentrated flows. - Use energy-dissipating device at outlet (BMP 2.15)	PDC 33.d – Headcut and Grade Stabilization - "Grade control materials can include both rock and large woods. Material shall not in any way consist of gabion baskets, sheet piles, concrete, articulated concrete blocks, or cable anchors". - Size rock appropriate to hydraulic conditions and be sure to allow fish passage (paraphrased)	None provided.	<u>Observation:</u> - There is a possibility that combining waters at the downstream end of Hall Slough could cause localized erosion, and possibly create a knickpoint moving upstream. <u>Additional Suggestion:</u> - None provided. In case design is done, consider this as a possible design hazard.

Table A – Southern Flow Corridor Landowner Preferred Alternative and Initial Alternative; Erosion and Sediment Control BMPs

Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additions Suggestions for Proposed BMPs
Timing of In-Water Work	*Improper sequencing of activities relative to tidal cycles could result in unnecessary erosion of soils, bank erosion, and other negative impacts.*	*None provided.*	*PDC 25 – Timing of in water work* *- Limit in-water work window to windows established by ODFW (2008)* *- In-water work window for is specified as July 1-Sept 15 (Tillamook Bay Rivers) and November 1 – Feb 15 (Tillamook Bay Estuary)*	*Channel Maintenance (Activity 124)* *- Perform work during the ODFW in water work window*	*Observation:* *- Sequencing work relative to tides is central to reducing sediment impacts during construction.* *- Phasing as proposed is proper BMP for reducing impact of in-water work.* *Additional Suggestion:* *- None provided. Clearly follow ODFW guidelines for in-water work window.*
In-Channel Work Area Isolation	*In-water excavation or riprap removal may generate sediment that will increase turbidity locally and in downstream waters*	*None provided.*	*PDC 27 – Work Area Isolation* *- Isolate any work area within the wetted channel from active stream whenever ESA listed fish are reasonably certain to be present. However, work area isolation may not always be necessary or practical in certain settings, including tidal zones. [underline added]* *- Engineering design plans for work area isolation will include all isolation elements.* *- Dewater the shortest linear extent of work area practical. Use coffer dams and by-pass culvert or lined diversion ditch to divert flow. Pump water from work site to a temporary storage and treatment site, and monitor downstream of construction area to prevent stranding of aquatic organisms. Use fish screen when pumping water.*	*Channel Maintenance (Activity 124)* *- Remove any excess material from channel maintenance activities, and deposit above the ordinary high water line.* *- Stabilize material with spreading and top seeding, matting, or erosion control.* *- Work in the dry where practicable.*	*Observation:* *- Work area isolation for in-channel work may be difficult due to rapidly changing tidal conditions; however, the present plans for sequencing and silt curtains are reasonable precautions.* *- Dewatering portions of main rivers for work along the banks during low tide is not practical.* *Additional Suggestion:* *- Include any work area isolation dams explicitly in engineering design plans.* *- If possible, use riprap being removed on site for other project purposes*
Remove Tide Gates And Flood Gates; Construct New Flood Gates	*Construction or removal activities where tidegates and floodgates are being removed or constructed may generate sediment that could enter nearby waters.* *Additionally, flows passing through new flood gates could erode floodplain surface.*	*None provided.*	*PDC 26 – Limit in-water work window to windows established in Oregon by ODFW.* *PDC 27 – Isolate work area in wetted area from active channel as specified in PDC 27.*	*Activity 121 and 129:* *- Tidegate maintenance: inspect and clean structures prior to the rainy season, if possible.* *- Remove any excess material associated with activity above high water or in appropriate locations*	*Observation:* *- Sediment impacts related to new flows on floodplain surfaces are inevitable, but expected to be relatively minor.* *Additional Suggestion:* *- Sediment impacts related to this activity could be reduced by placing soil stabilizing measures in newly exposed areas where tide gates are being removed.*

Table A – Southern Flow Corridor Landowner Preferred Alternative and Initial Alternative; Erosion and Sediment Control BMPs

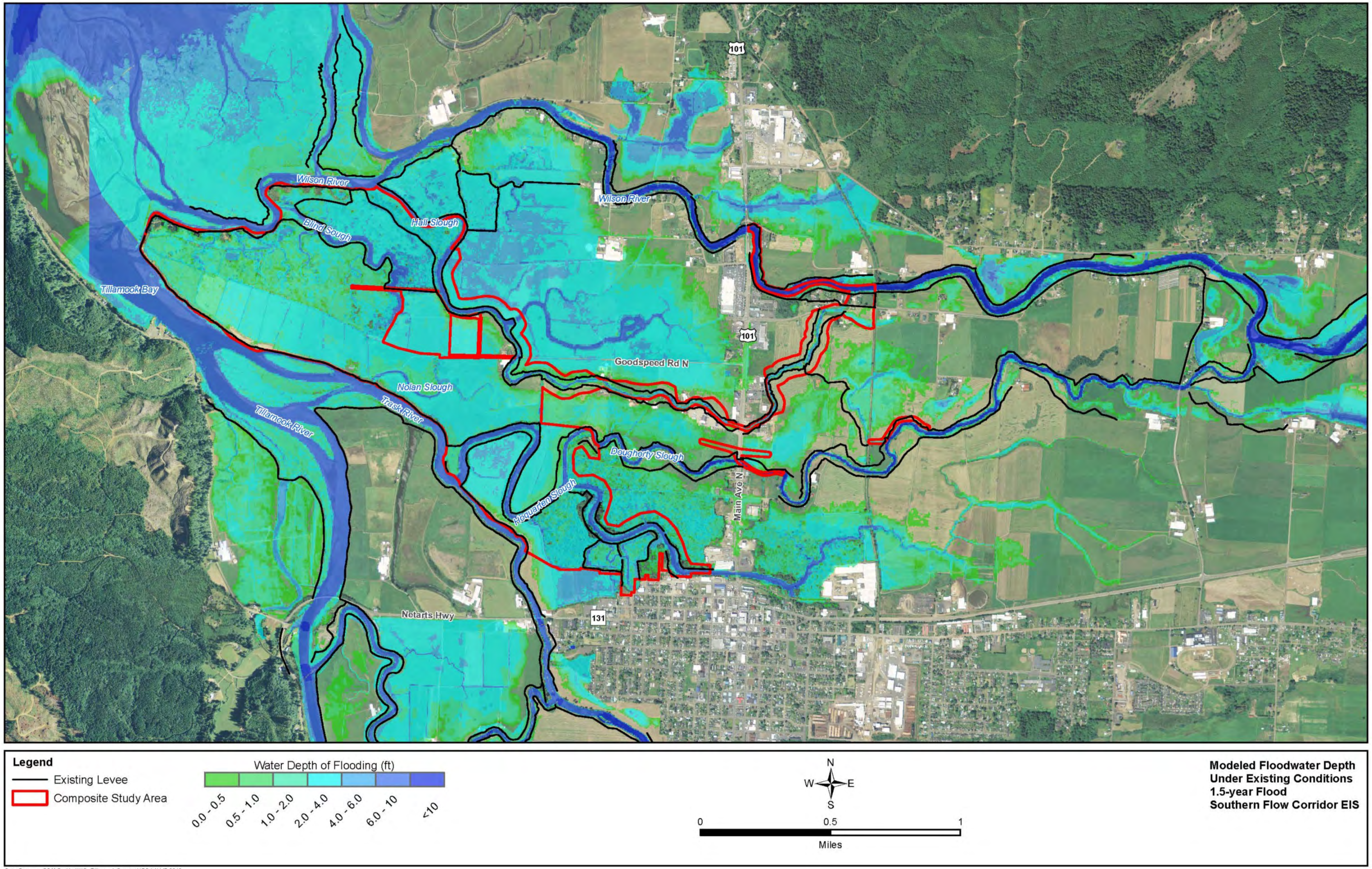
Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additions Suggestions for Proposed BMPs
3. Levee Areas					
Levee Fill Removal and Grading to Floodplain Surface (Not Including Channel Breaches); Construction of New Levees.	*Clearing packed gravel surfaces from levees and removing underlying fill could generate sediment through water erosion (raindrop impact, runoff and rill formation, slumping, flows, flood flows) in areas previously occupied by the levees.*	*None provided.*	*PDC 39 – Set-Back or Removal of Existing Berms, Dikes, and Levees* *- Design actions to restore floodplain characteristics similar to the unmodified condition* *- Remove pipes, fences and other features to extent possible* *- Remove nonnative fill material from the floodplain when possible* *- Where it is not possible to remove all levees and berms, create openings through breaches.* *- Breaches should be larger than active channel width to reduce chances of channel avulsion* *- Levees should be breached at downstream end of project to ensure flows can re-enter main channel and reduce fish entrapment* *- Sequence levee removal such that repairing or restoring estuary functions is possible once levees are removed or breached.*	None provided.	<u>Observation:</u> - Due to their proximity to trunk streams, cleared surfaces where levees are to be removed could contribute sediment to drainage system if proper BMPs are not applied. - Grading surfaces toward interior, as planned, will prevent most of the sediment produced in areas where levees are removed from reaching trunk streams. <u>Additional Suggestion:</u> - Apply standard and appropriate BMPs not only to new levees but also to areas where levees are removed. Use similar BMPs as planned for the decommissioned staging areas, haul roads, and other disturbed areas. - Examples of erosion BMPs would include compost berms, erosion control blankets, hydroseeding, mulching, etc. as appropriate.
Erosion Control and Mitigation for Disturbed Areas	*Water or wind erosion of disturbed or bare surfaces – due to wind, direct rainfall and runoff, or as a result of tidal and/or flood flows – could cause sediment to be delivered to drainage system.*	*- Use vegetated filter strip adjacent to disturbed areas to reduce flow and remove sediment and pollutants from runoff (BMP 2.2)* *- Reestablish vegetation on disturbed areas through seeding and mulching, seeding and matting, or sodding (design considerations in original document, BMPs 2.3 and 2.4)* *- Hydroseeding with mulch, seed and fertilizer mix (BMP 2.4)* *- Avoid overcompaction of disturbed areas prior to hydroseeding (BMP 2.4)* *- Add at least 3"*	*PDC 17 – Erosion Control* *- Install temporary erosion controls downslope of construction to prevent sediment entering riparian area, wetlands, etc.* *- Use standard erosion controls as temporary measures including fiber wattles, silt fences, jute matting, mulch, geotextiles.* *- Install additional erosion control or barriers during construction, if eroded sediment appears to be able to enter streams* *- Maintain supply of sediment control materials at project site* *- Remove sediment from erosion controls when it reaches 1/3 the height of the control* *- Stabilize all disturbed soils after construction is complete or prior to any break in work.* *- Remove temporary erosion controls after site is stabilized* *PDC 31 – Site Restoration* *- Loosen soil in compacted areas as necessary for revegetation and infiltration* *- Site restoration success criteria are provided under PDC 31.e* *PDC 32 – Revegetation*	Activity 180: Emergency Maintenance Erosion Control and Site Management - If vegetation in the riparian area must be cleared, it will be trimmed at ground level not grubbed. - Use erosion control measures prior to ground disturbances - Inspect erosion and sediment control measures daily to ensure adequate function	<u>Observation:</u> - Erosion from disturbed construction areas is a common sediment impact from restoration projects. Proper BMPs are well established and will be applied on this project to avoid or reduce impacts. <u>Additional Suggestion:</u> - Apply proper BMPs as proposed, while also considering whether additional erosion control BMPs are necessary for portions of the project not specified. - Add a provision to the engineering design and construction plan to inspect erosion and sediment control measures at the end of each work day.

Table A – Southern Flow Corridor Landowner Preferred Alternative and Initial Alternative; Erosion and Sediment Control BMPs

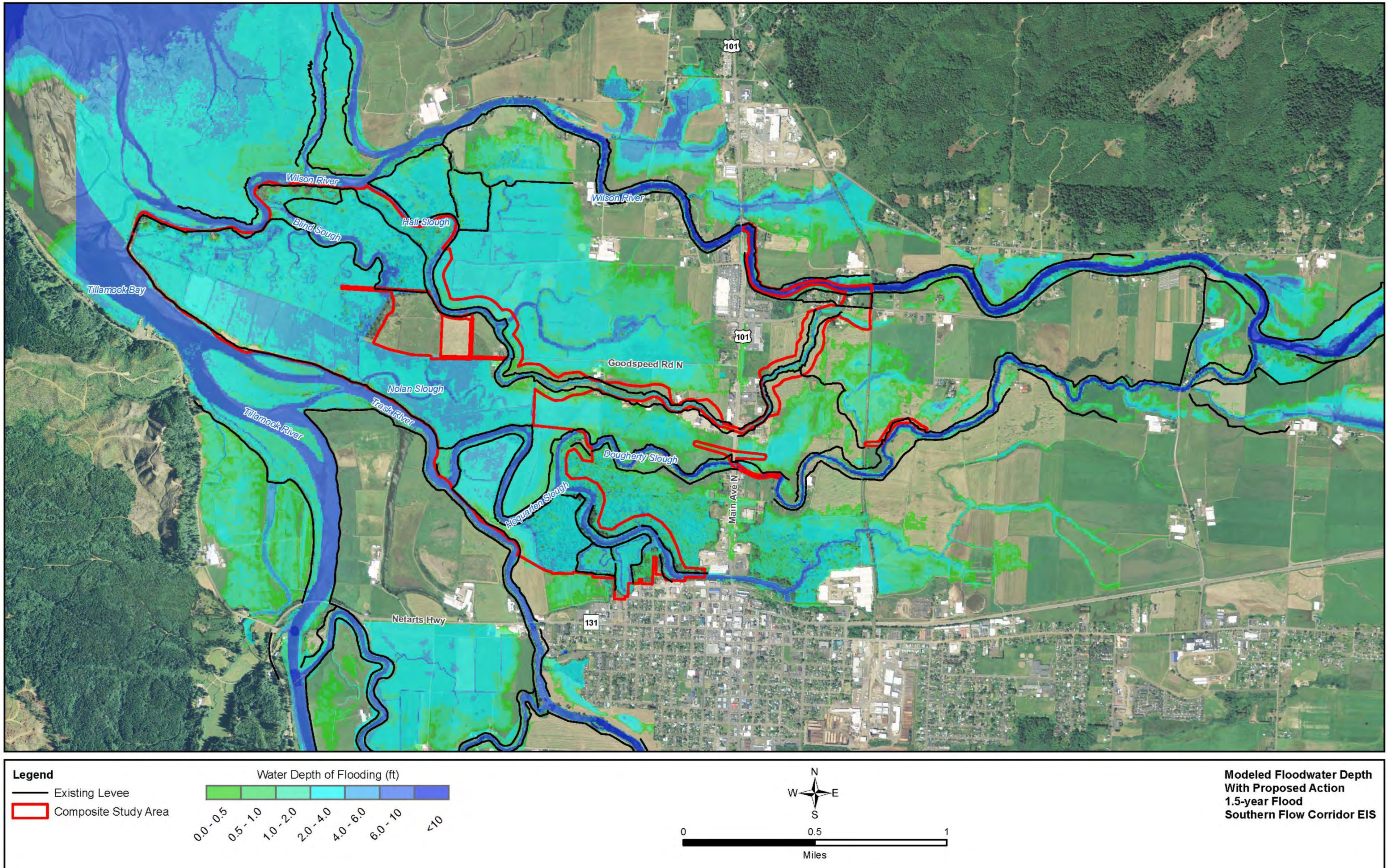
Potential Sediment Producing Location or Activity	Potential Sediment Impacts/ Processes	Summary of Relevant Oregon Department of Environmental Quality Guidelines (DEQ, 2013)	Summary of Relevant Project Design Criteria (PDC) in the NOAA Restoration Center Biological Opinion (NMFS, 2013)	Relevant Oregon Department of Transportation Mitigation and Avoidance Measures and BMPs (ODOT, 2009)	General Observations and Additions Suggestions for Proposed BMPs
		compost cover on disturbed areas (BMP 2.5) *- Surface roughening – create ridges or furrows to trap seed and reduce overland flow velocities and reduce sediment delivery to streams (BMP 2.9)* *- Straw wattles (BMP 2.16) or compost sock (BMP 2.18) to trap sediment, installed and staked on sloping surfaces during construction* *- Create berm surrounding construction areas from compost (BMP 2.17)* *- Install sediment fences where sheet flow is dominant (BMP 2.24)*	*- Plant and seed disturbed areas prior to first growing season after construction* *- Use diverse assemblage of species native to region; when feasible use vegetation salvaged from local areas* *- Short term stabilization measures, may use non-native sterile seed mix, jute matting, etc.* *-Do not apply surface fertilizer within 50 feet of any wetland or water body.*		
Existing Vegetation	*Removal of existing vegetation related to construction can increase runoff and erosion*	*BMP 2.1:* *- Don't remove existing vegetation unless absolutely necessary* *- Preserve vegetation on all steep unstable slopes (in this case, bank slopes, where present)* *- Avoid compaction or grading close to trees* *- Do not pile soil on top of roots* *- Establish "do not disturb zones" with stakes and tape or fencing*		*Activity 124: Tree management* *- Maintain or retain riparian trees and woody vegetated buffer along streams* *- Trees felled within 150' of the riparian corridor should be used in bioengineering on site if possible.* *- Replant two seedlings for woody vegetation for every tree over 12-inch DBH in riparian areas. Locate replanted trees so the trees will not pose a future threat to transportation*	<u>Observation:</u> - Removal of existing vegetation will be minimized as specified in the engineering design plans. <u>Additional Suggestion:</u> - None provided.

Appendix K
Proposed Action Flood Analysis Figures

Appendix K   Proposed Action Flood Analysis Figures



Data Sources: CDM Smith, NHC, Tillamook County, USDA NAIP 2012



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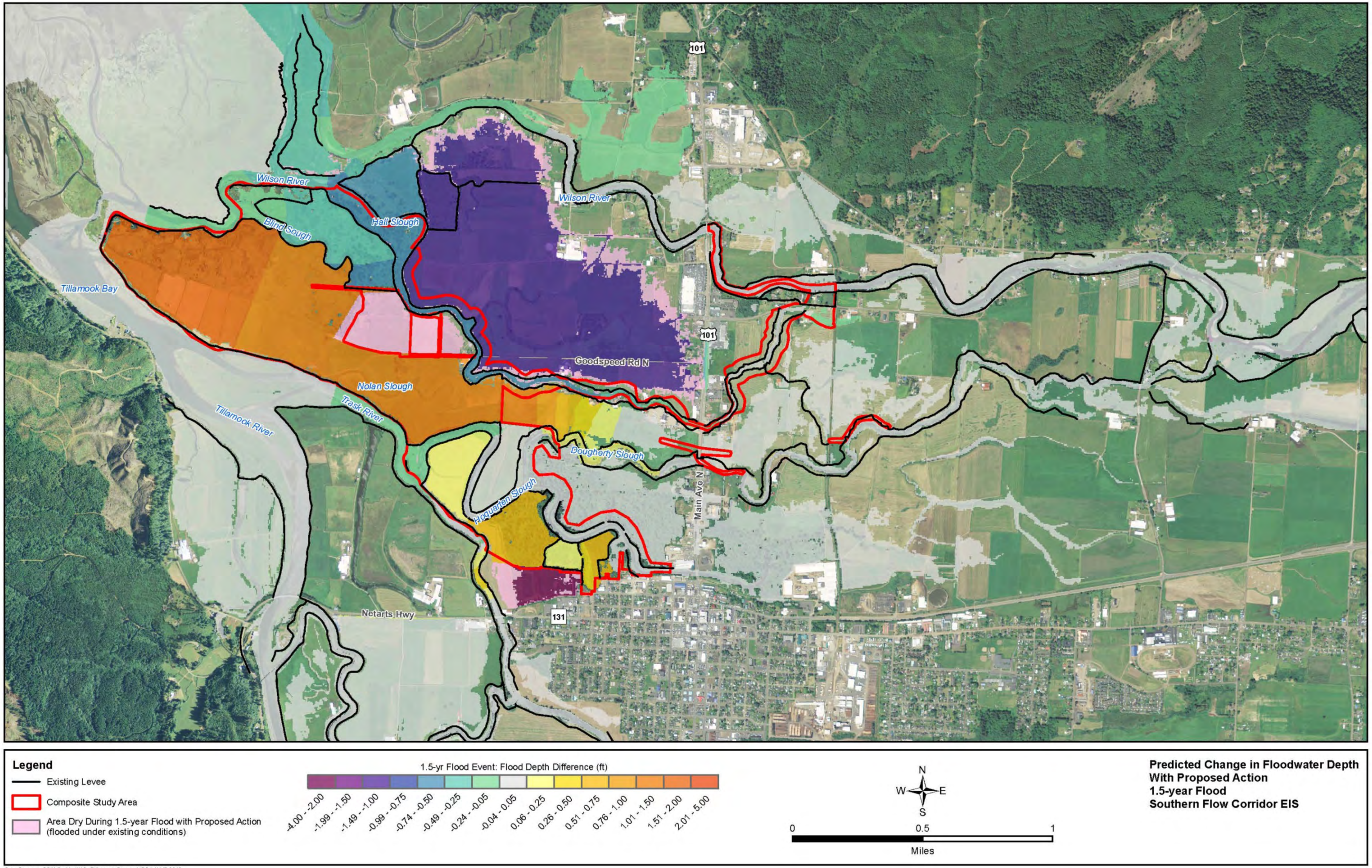

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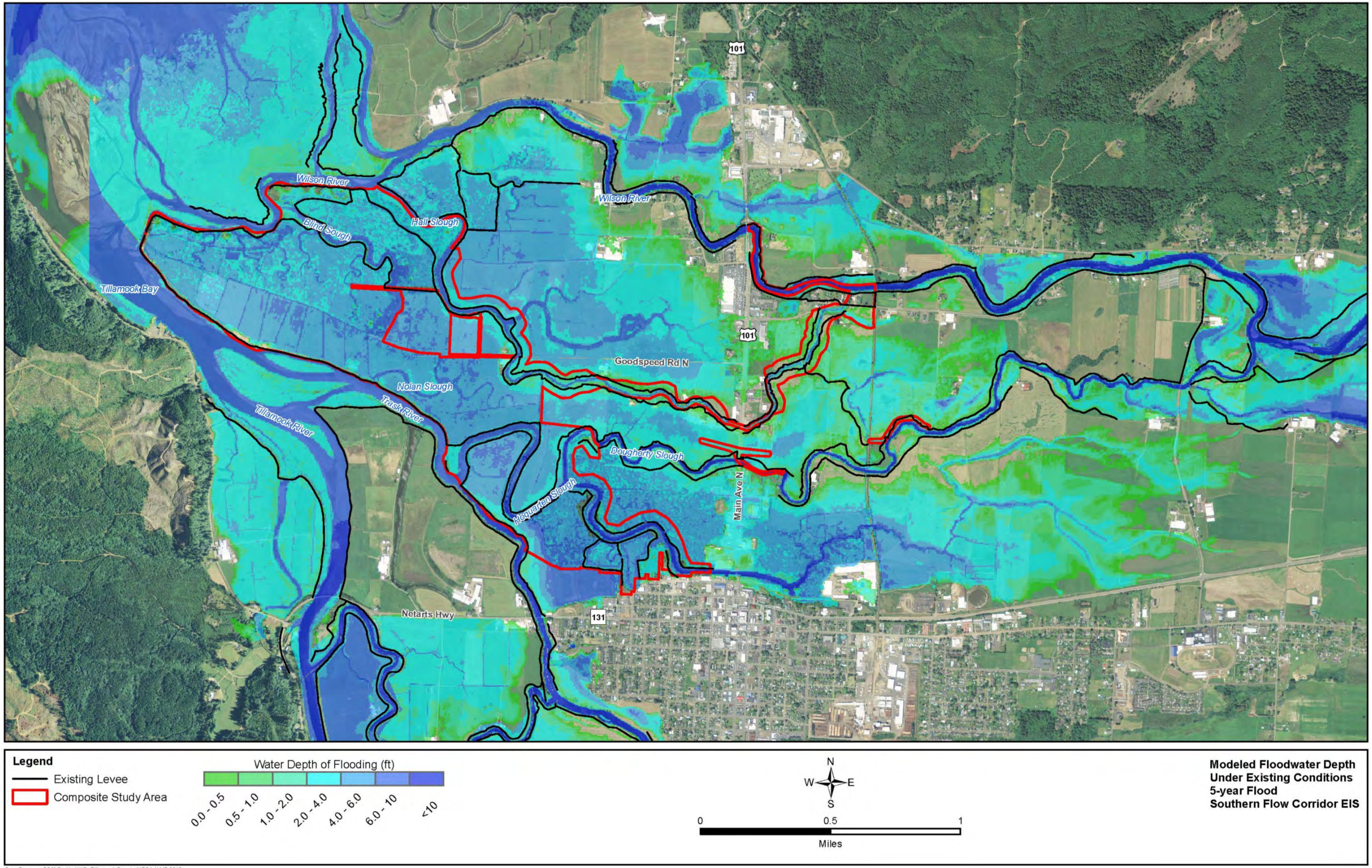
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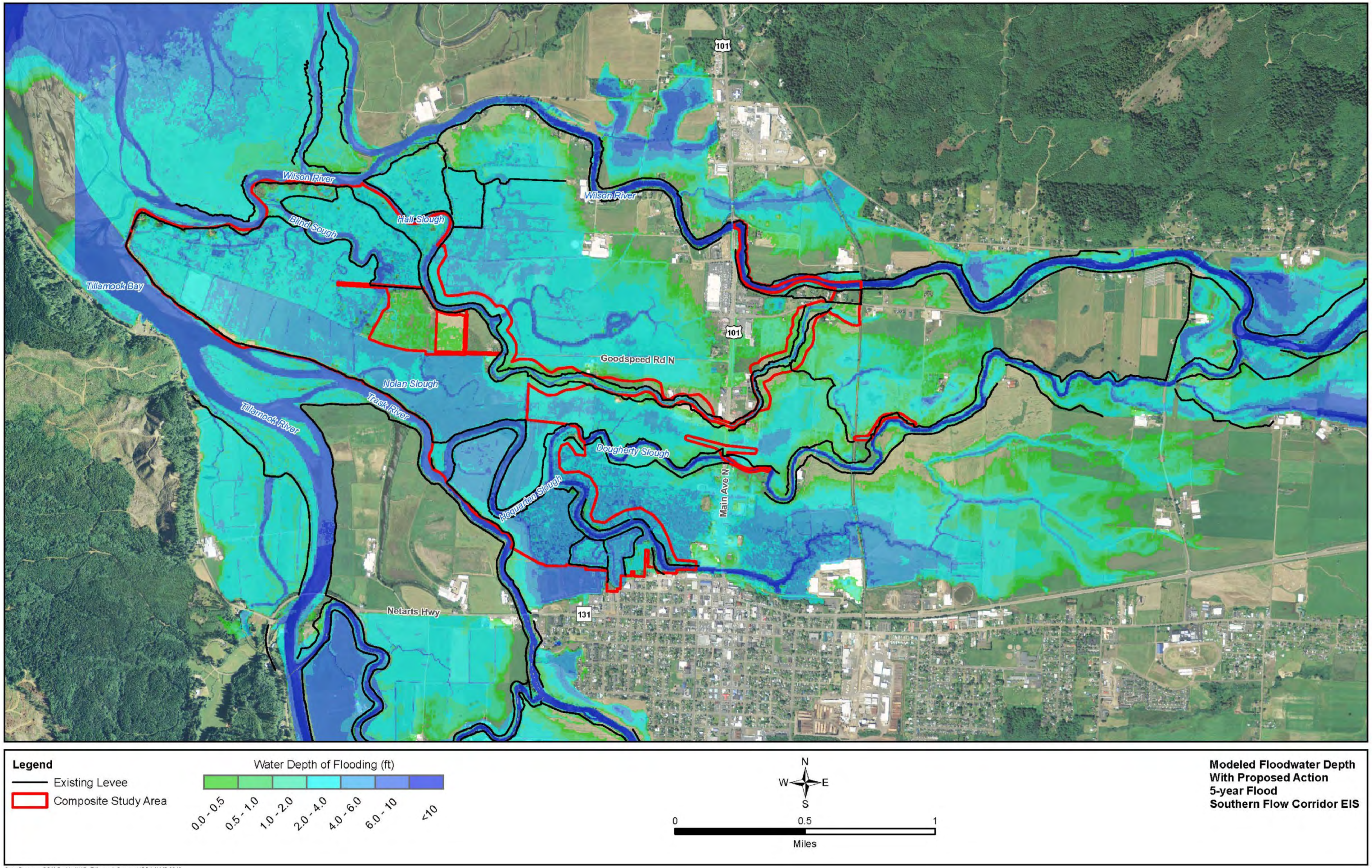
Data Sources: CDM Smith, NHC, Tillamook County, USDA NAIP 2012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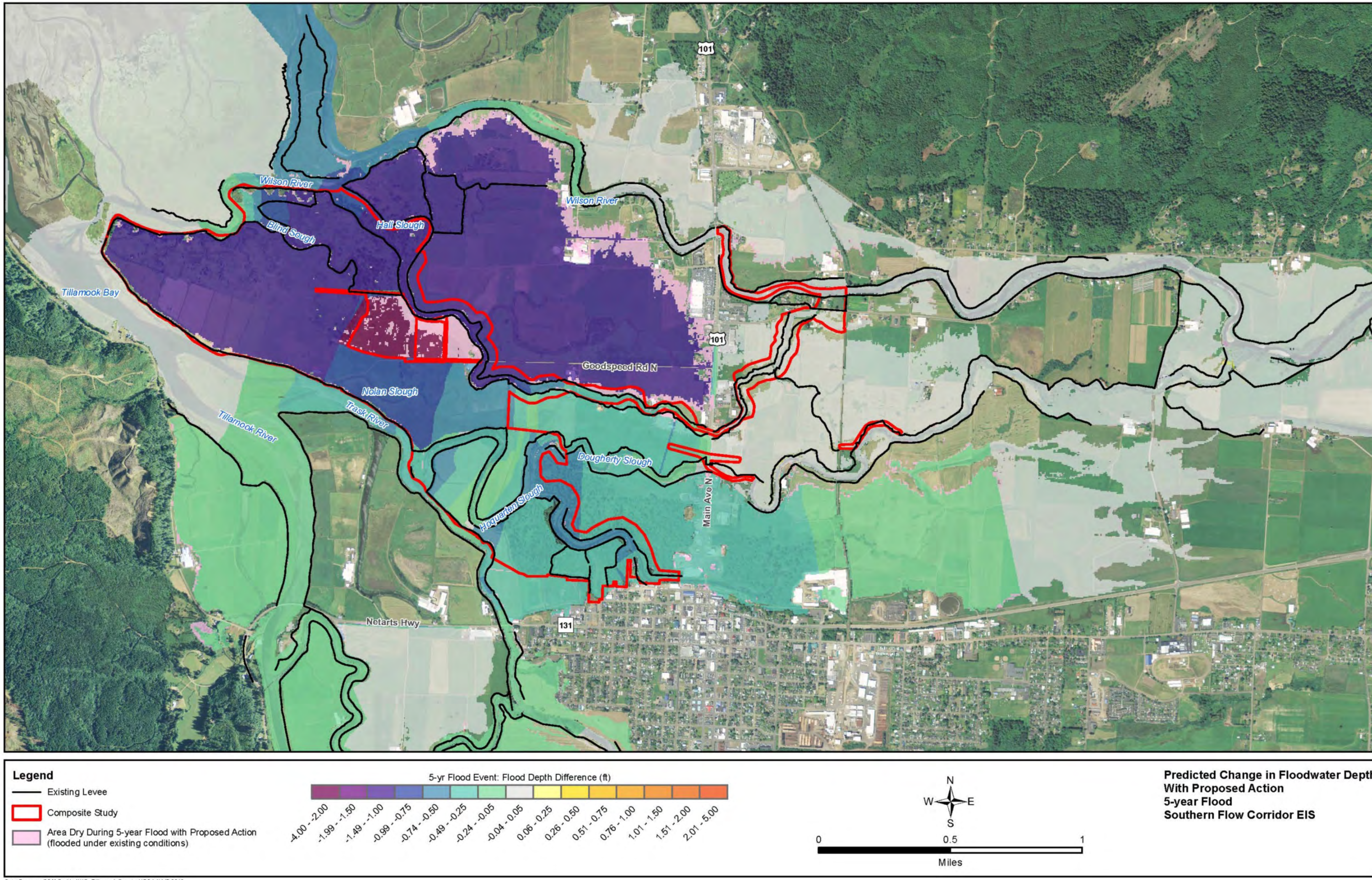

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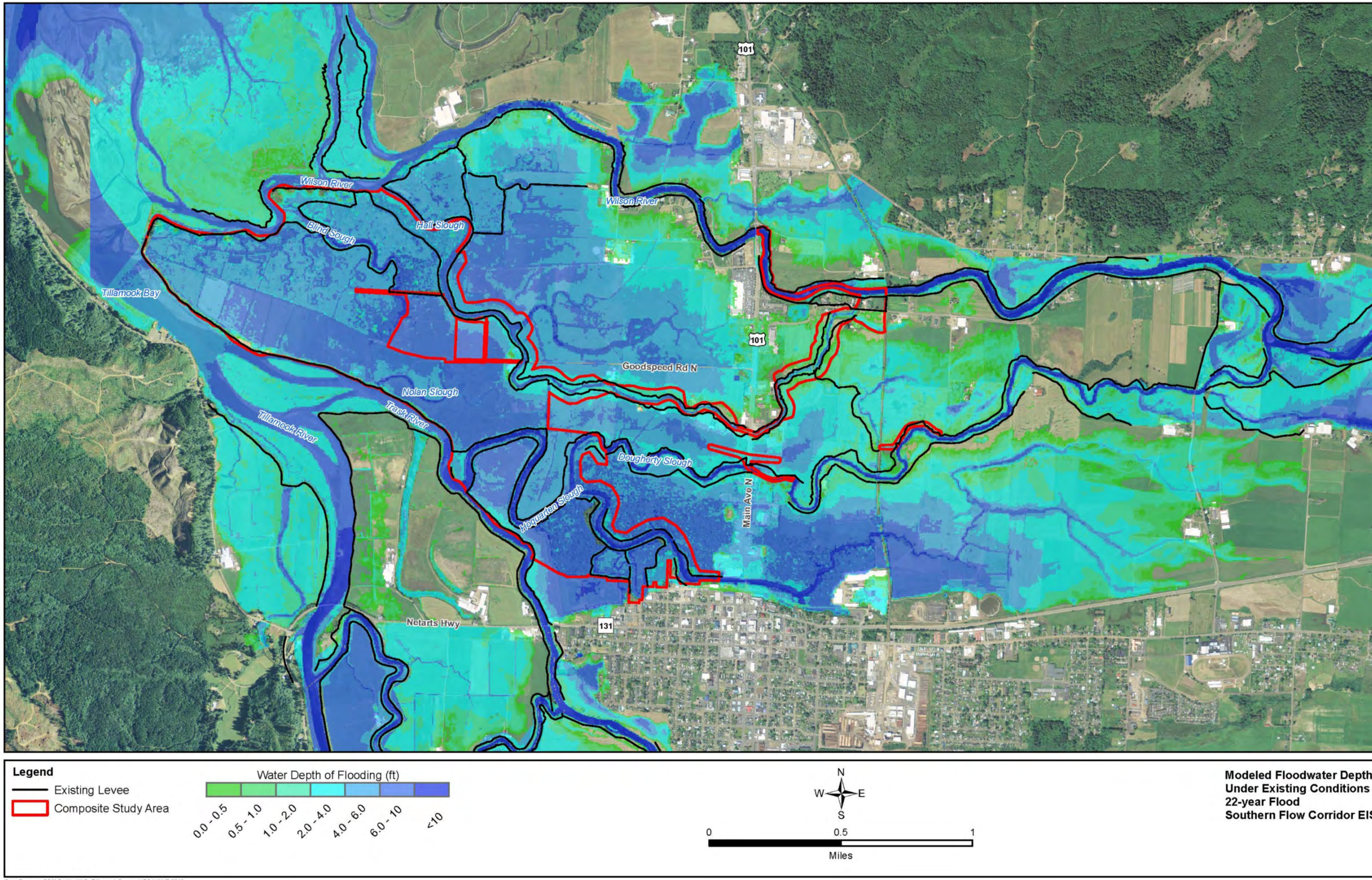

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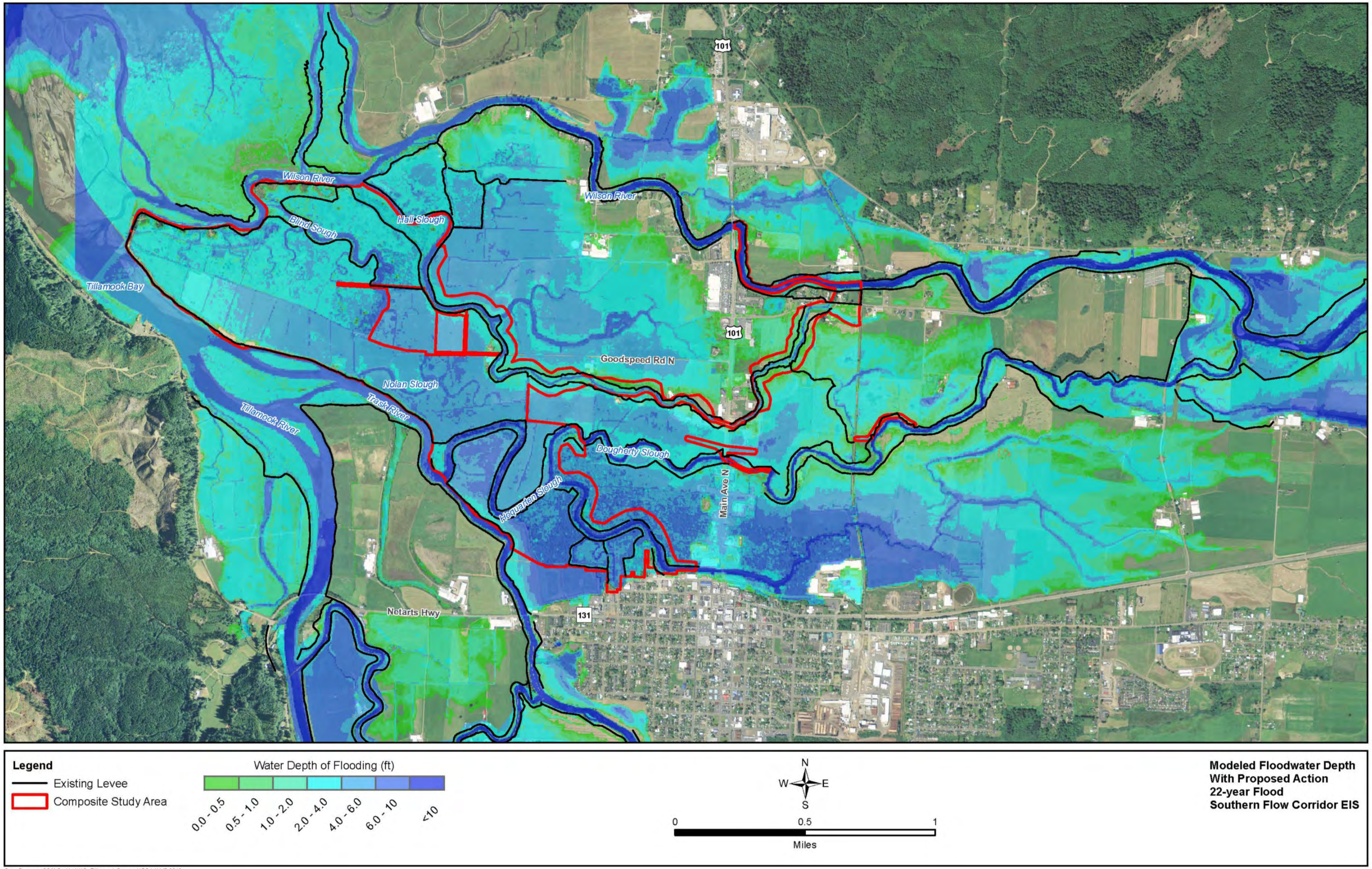
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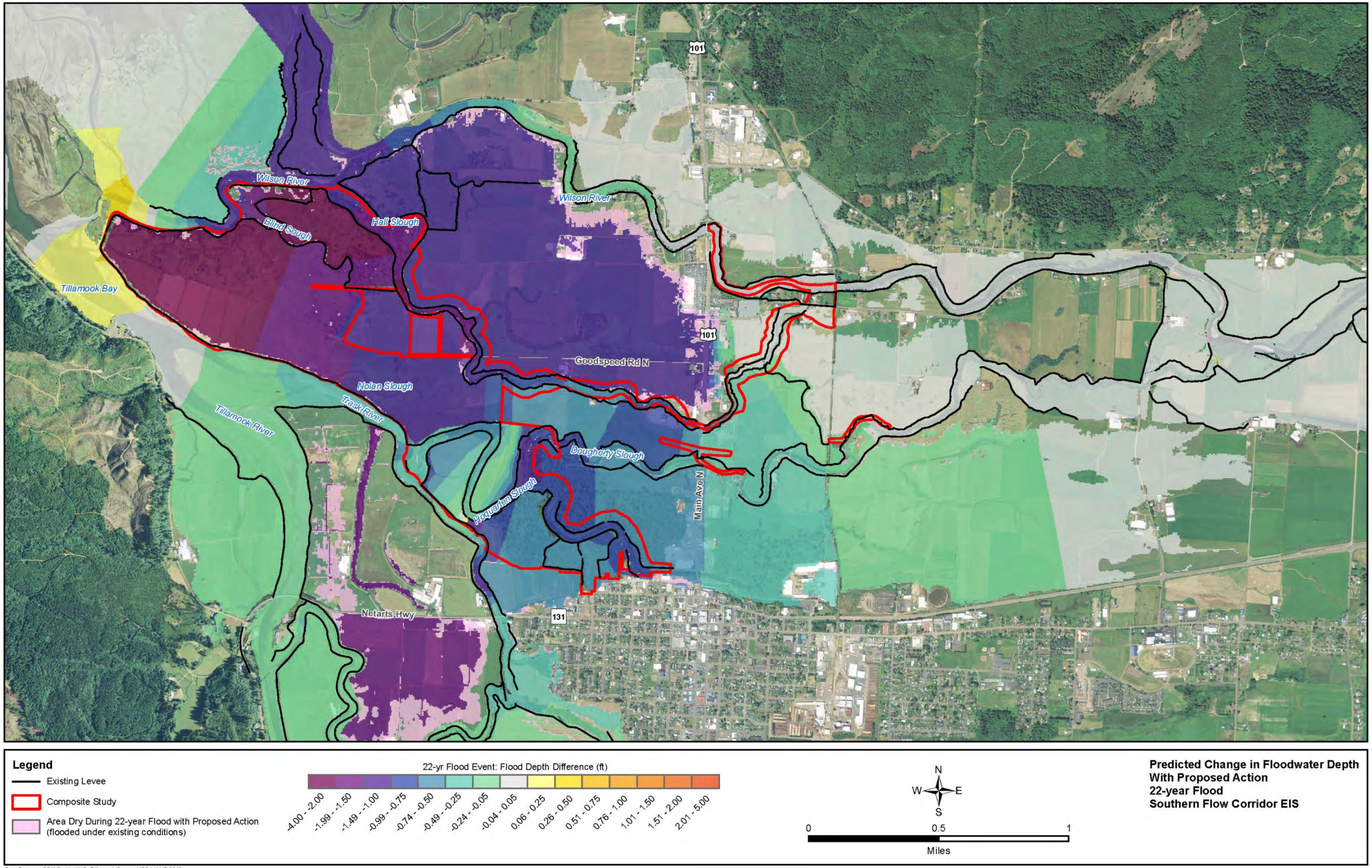

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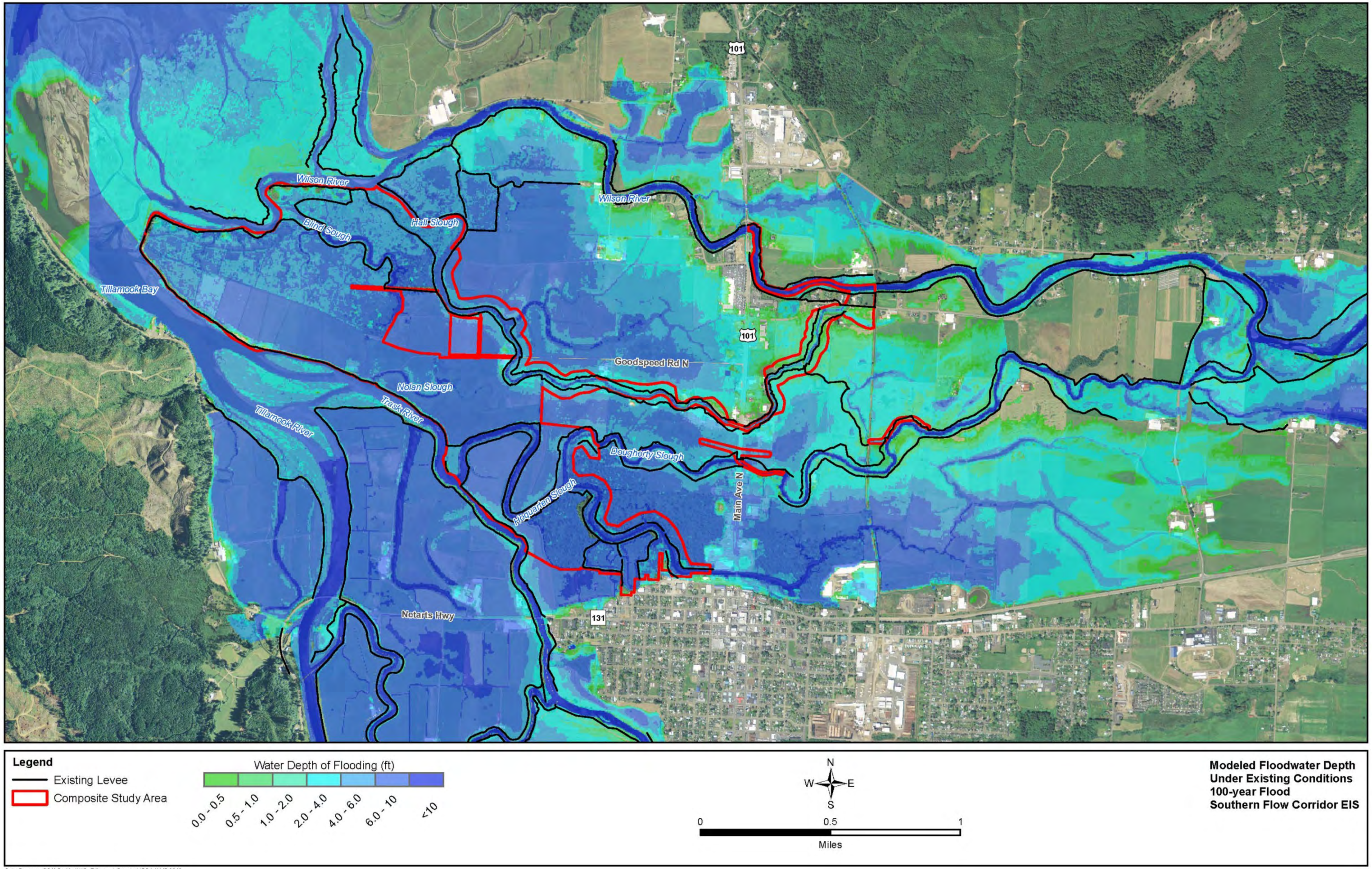

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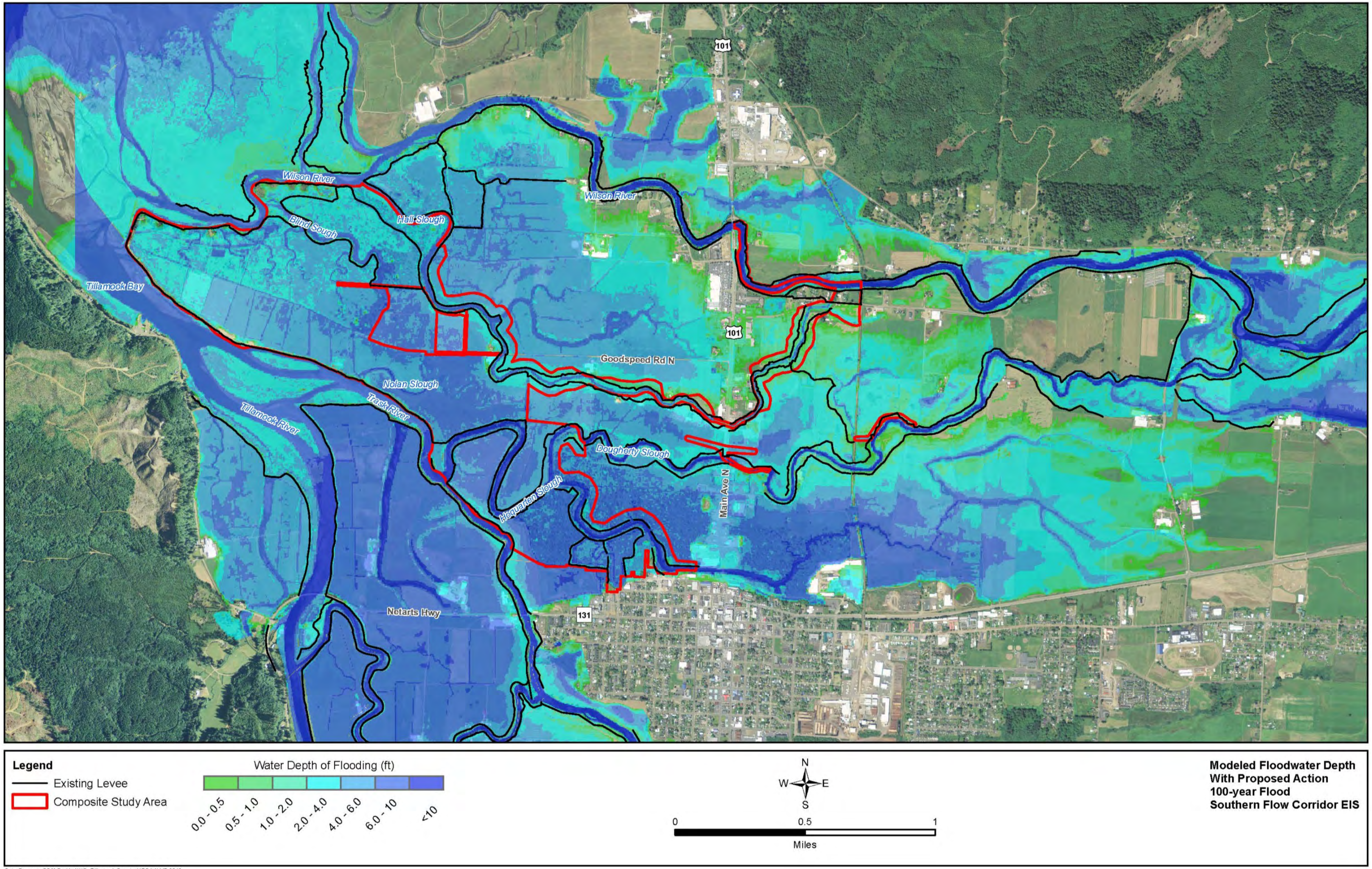
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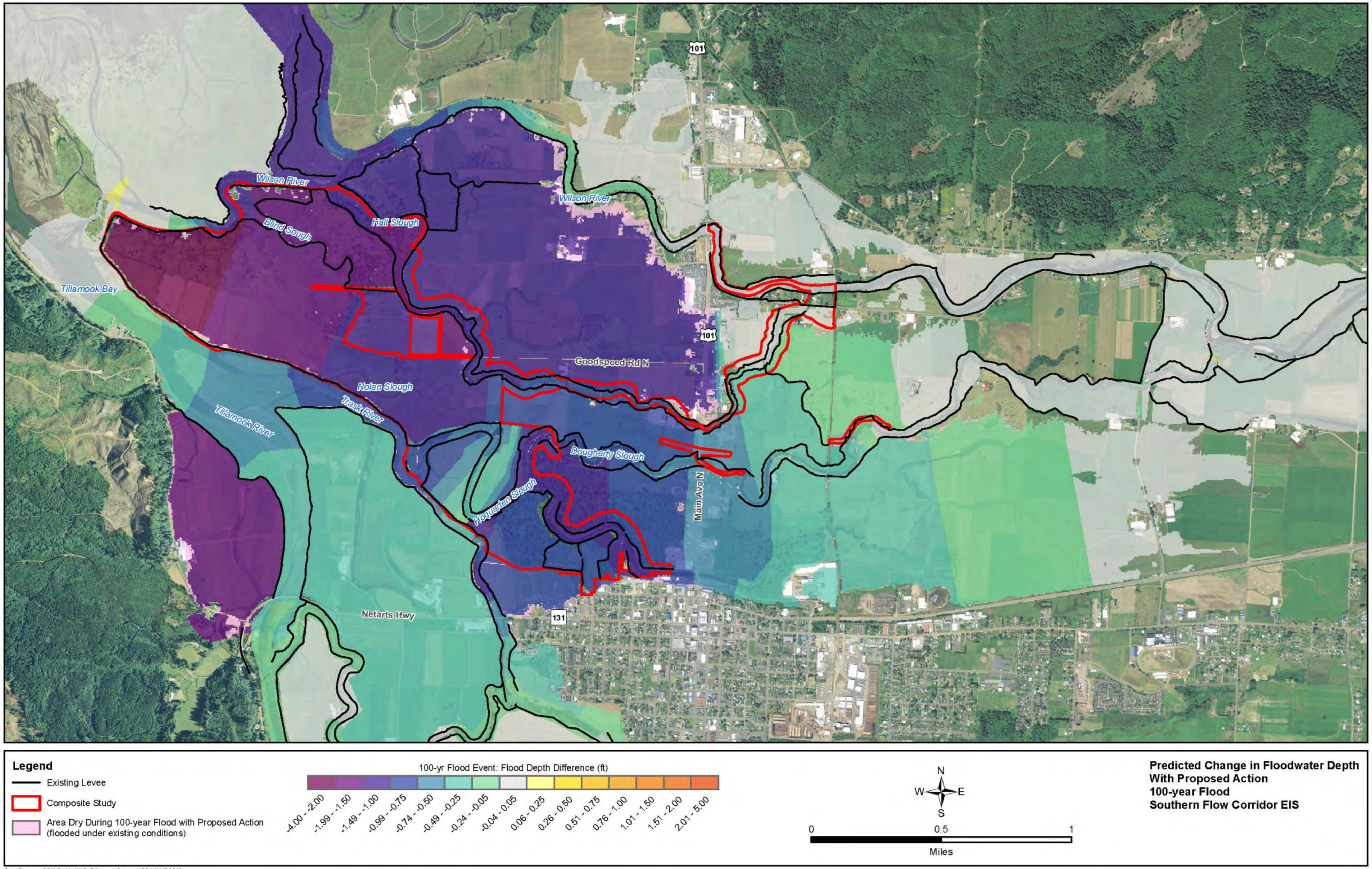

Data Sources: CDM Smith, NHC, Tillamook County, USDA NAIP 2012

Appendix L
Comments on Draft EIS and Responses

Appendix L Comments on Draft EIS and Responses

This appendix contains all of the comment letters, cards, and emails received on the Draft EIS per 40 CFR 1503.4(b). Each substantive comment in each letter has been delimited and assigned a comment number. Responses to each delimited comment are provided on the page opposite from the comment submission. When a change to the text of the EIS has been made in response to a comment, the change has been noted in the response.

Comments from members of the public are presented first, followed by comments from local, state, and federal agencies.

Public Comments

Tillamook Southern Flow Corridor Project

Environmental Impact Statement

Draft EIS Comment Form
Submit by July 13, 2015

Please provide comments on the proposed alternatives for the Southern Flow Corridor Project, potential impacts of the alternatives, and proposed mitigation measures. The Draft Environmental Impact Statement (EIS) is available at SouthernFlowEIS.org. Feel free to take an extra form and send comments to FEMA (address below).

Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name Scott Bailey Organization (if applicable) ______

Address 510 Madrona Ave.

City Tillamook State OR ZIP 97141

Email (optional) ______

Use the space below to provide comments on the Draft EIS.

1. Vegetation on soil removal areas should be stripped and hauled off site to avoid spread of invasives & differential settling.
2. Text on hydraulic modeling figures is confusing and misleading please clarify and inspect for accuracy (figures used in meeting were confusing)
3. I'd like to see as many large trees as possible left in place. Even if they die, they will provide benefits that won't be provided if they are removed and used in the project area. Standing dead trees have value.
4. Site has lots of invasive species. Project should consider this fact and strive to avoid spreading these.
5. It wasn't clear at the meeting that most tidal channel development is expected to occur naturally, ~~and~~ It seemed that there would be more constructed channels than there really will be. Please make sure this is clear in document.

Written comments must be postmarked, e-mailed, faxed, or otherwise submitted by **July 13, 2015**. Mail: FEMA, Attn: Mark Eberlein, Regional Environmental Officer, 130 - 228th Street SW, Bothell, WA 98021 Email: fema-sfc-eis@fema.dhs.gov Online: www.SouthernFlowEIS.org Fax: (425) 487-4613 Attention: FEMA SFC EIS.

FEMA

2015_June_17_Bailey_S

Comment Number	Response
1	As described in Section 4.6.1 Vegetation, there are some invasive species present on the site. During construction, measures would be implemented to minimize transport of invasive plants or seeds off-site (See Section 6, Bullet 11, Vegetation for specific measures). Many of the invasive species currently present on the site are not tolerant of saline conditions and are expected to die out over the transition period. However, initial retention of non-native grasses is an important component of the erosion control procedures (See Section 6, Bullet 11, Vegetation). There are some invasive estuarine species that are currently not present in Tillamook Bay, but which could become established in the restored tidal wetlands. The Port and the County will prepare a maintenance and monitoring plan that would include measures to address control of invasive species if they should attempt to colonize the project area. Invasive species currently present in the project area are described in Section 4.6.1.2.4 and potential impacts and mitigation measures related to invasive plant species are described in Section 4.6.1.3.2. Section 3.4.2 describes the process proposed for construction of new levees including the removal of vegetation and organic soils from the foundation footprint of the new levee. New levees would be designed to account for differential settlement based on existing geotechnical conditions.
2	Titles of hydraulic model results figures will be clarified. The titles of the figures in Section 4.5.1 and Appendix K were revised.
3	As described in Section 4.6.1.3.2, tree removal is limited to areas where levees would be removed, modified, or constructed. To the extent practicable, existing trees would be protected and left standing in place. This approach would be the applied under all of the action alternatives. Suitable trees that need to be removed would be reused as habitat structures on site or salvaged for habitat structures for other off-site projects. Trees that are not suitable for habitat structures due to their small size or species (such as alder) may be left on site to protect ground surfaces from equipment or used as mulch to reduce erosion. Trees that are not in an area where levees would be removed or constructed would be left standing in place as described in the EIS. Trees left within undisturbed areas may still die due to changes in salinity and tidal inundation, but they would be left in place to provide habitat as described in the EIS.
4	Invasive species currently present in the project area are described in Section 4.6.1.2.4 and potential impacts and mitigation measures related to invasive plant species are described in Section 4.6.1.3.2. During construction, measures would be implemented to minimize transport of invasive plants or seeds off-site (See Section 6, Bullet 11, Vegetation for specific measures).
5	Sections 3.4.1.6 and 4.5.3.4.2 indicate that relict tidal channels would primarily be expected to reform naturally. The text has been clarified in Sections 3.4.1.6 and 3.6.1.6 to describe the process of excavating a "starter" notch in the base of the former levee along the river's edge and a portion of the tidal channel length. The final channel cross section length and position would reform naturally.

Tillamook Southern Flow Corridor Project
Environmental Impact Statement

Draft EIS Comment Form
Submit by July 13, 2015

Please provide comments on the proposed alternatives for the Southern Flow Corridor Project, potential impacts of the alternatives, and proposed mitigation measures. The Draft Environmental Impact Statement (EIS) is available at SouthernFlowEIS.org. Feel free to take an extra form and send comments to FEMA (address below).

Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name David Harris Organization (if applicable) ______

Address 5725 Main St

City Bay City State OR ZIP 97107

Email (optional) ______

Use the space below to provide comments on the Draft EIS.

① In any of the alternatives considered, leaving all trees that
are not on fill to be removed would be the best mitigation
to account for those trees that must be removed. Standing
dead wood is one of the least abundant habitat forms
6 in our ecosystems, and should be encouraged whenever possible.

② In any of the alternatives considered, a plan should be
developed to screen all fill material containing noxious
exotic plant species. This screened material should be taken
off site and destroyed. Species include knotweeds, brooms,
7 parrot feather and others identified by ODA and other agencies.

③ Post construction grazing should be considered in all areas where inundation regime is not sufficient to eradicate vigorous non-native grass species such as reed canary grass. Species diversity of many organisms and foraging opportunity for raptors is severely reduced in continuous stands of grasses such as reed canary grass. Introducing structural diversity in these stands

Written comments must be postmarked, e-mailed, faxed, or otherwise submitted by **July 13, 2015**. Mail: FEMA, Attn: Mark Eberlein, Regional Environmental Officer, 130 - 228th Street SW, Bothell, WA 98021 Email: fema-sfc-eis@fema.dhs.gov Online: www.SouthernFlowEIS.org Fax: (425) 487-4613 Attention: FEMA SFC EIS.

FEMA

can alleviate some of these impacts. This should include a plan to protect sensitive wetland habitats from the
8 cattle being used to enhance structural diversity.

(4) In the portion of the property where drainage ditches are to be filled some "new" tidal channels should be constructed to initiate more complete channel development naturally into the future. Simply opening a notch in the riprap should not be the only construction activity to help initiate tidal channel
9 development.

(5) Along the Trask river margin of the property all rip-rap should be removed to allow natural bank/stream dynamics to occur. In addition to this dynamic connection riprap that is left ~~ex~~ in place negatively effects other portions of the nearby ecological systems. This removal may be accomplished by removing the rock utilizing a barge mounted excavator from the river side of the
10 structure.

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Fold Fold

Place stamp here

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

Tape Tape

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2015_June_17_Harris_D

Comment Number	Response
6	As described in Section 4.6.1.3.2, tree removal is limited to areas where levees would be removed, modified, or constructed. To the extent practicable, existing trees would be protected and left standing in place. This approach would be the applied under all of the action alternatives. Suitable trees that need to be removed would be reused as habitat structures on site or salvaged for habitat structures for other off-site projects. Trees that are not suitable for habitat structures due to their small size or species (such as alder) may be left on site to protect ground surfaces from equipment or used as mulch to reduce erosion. Trees that are not in an area where levees would be removed or constructed would be left standing in place as described in the EIS. Trees left within undisturbed areas may still die due to changes in salinity and tidal inundation, but they would be left in place to provide habitat as described in the EIS.
7	As described in Section 4.6.1.2.4, several invasive species are currently present within the project area. Section 4.6.1.3.2 indicates that most of these species are not expected to survive with the change in salinity and tidal inundation. Other saline-adapted invasive species have the potential to invade the site following restoration, but, with the exception of Japanese eelgrass, they are not currently present in Tillamook Bay. Japanese eelgrass is not listed as a noxious weed that requires control by the Oregon Department of Agriculture. Screening soil to be reused on site is not necessary. Potential control measures that might be applied in the long term are described in Section 4.6.1.3.2 and construction-related mitigation measures to control the spread of invasive species off site are described in Section 6, Bullet 11.
8	As described in section 4.6.1.3.2, control of invasive plants, including reed canarygrass, would be an important component of the monitoring program and adaptive management to ensure success. In the long term, the introduction of daily tides and the increase in salinity would change the plant species composition in the project area and saline tolerant species would be expected to replace the current invasive species mix including the dominant reed canary grass. As described in Section 3.3, under the terms of the grant agreements with USFWS and NOAA, agricultural activities including grazing are not allowed on the restoration lands. In addition, the daily tidal inundation would not be compatible with cattle use.
9	Sections 3.4.1.6 and 4.5.3.4.2 indicate that relict tidal channels would primarily be expected to reform naturally. The text has been clarified in Sections 3.4.1.6 and 3.6.1.6 to describe the process of cutting a "starter" notch in the base of the former levee along the river's edge and a portion of the tidal channel length would be excavated as a starter channel. Floodplain connectivity would be restored by removal of riprap and some excavation at approximately 20 reconnection points through the river banks to connect the Trask and Wilson Rivers with the approximate locations of historic channels. Tidal channels would reform from these starting locations; although, they may not reform with exactly the same cross section or in exactly the same places as the historic channels.

Comment Number	Response
10	As described in Section 3.4.1.6, approximately 2,025 linear feet of riprap would be removed along the north side of the Trask River where the river flows to the north before turning west. This would allow flood flows from the Trask River to move into the project area and allow for more natural channel forming processes to occur. Section 3.4.2.1 describes the proposed construction sequencing and methods. Text has been added to the EIS to clarify that the methods described in Section 3.4.2.1 would apply to both removal of fill materials and the removal of the riprap along the Trask River.

Tillamook Southern Flow Corridor Project
Environmental Impact Statement

Draft EIS Comment Form
Submit by July 13, 2015

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Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name: Neal Lemery Organization (if applicable): – retired –

Address: PO Box 789

City: Tillamook State: OR ZIP: 97141

Email (optional): nealclemery@gmail.com

Use the space below to provide comments on the Draft EIS.

I am a 62 year resident + 4th generation resident. I am a lifelong boater, hiker, + photographer around Tillamook Bay. I have observed many changes + decreasing health & diversity in this estuary.

I support this project. We need to improve salmon habitat + habitat for birdlife + mammals. Restoration of historic waterflows will improve the land + the estuary.

This project has taken into consideration many complex issues + situations, + takes a positive approach to resolving issues that have been increasingly degrading the ecology of this estuary.

Many people + groups with different perspectives have been part of this plan. Collaboration is positive + welcome.

The community has benefitted by this

Written comments must be postmarked, e-mailed, faxed, or otherwise submitted by **July 13, 2015**. Mail: FEMA, Attn: Mark Eberlein, Regional Environmental Officer, 130 - 228th Street SW, Bothell, WA 98021 Email: fema-sfc-eis@fema.dhs.gov Online: www.SouthernFlowEIS.org Fax: (425) 487-4613 Attention: FEMA SFC EIS.

FEMA

process & conversation.
Our youth have become engaged & are teaching the community about research based environmental preservation & improvements.

11

Neal C [signature] 6/17/15

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Place stamp here

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

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2015_June_17_Lemery_N

Comment Number	Response
11	Comment noted. Comments in support of project purpose and need.

Tillamook Southern Flow Corridor Project
Environmental Impact Statement

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Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name: Eric Peterson Organization (if applicable): Farmer

Address: 105 Bay Ocean Rd

City: Tillamook, OR State: OR ZIP: 97141

Email (optional):

Use the space below to provide comments on the Draft EIS.

This project is wrong!
Please send me a Hardcopy book I don't do on line!

What will you do for our Farm because of
12 Negative impact! Please contact me by mail.

Wave action against our Dyke needs to be adressed
strengthening armoring the dyke needs to be
14 adressed and raised up 4' higher.

Less Flow out of Tide gates because we
are at bottom of project. Pumping station
will need to be installed to lower water table;
15 on our property.

over

Didn't here about open house till today (Tida called)?
16 You need to use mail!

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FEMA

This needs to be adressed before project!

A pumping station for Eric and Loretta Peterson Farm 105 Bayocean Rd. The out flow ~~____~~ ~~___~~ at the lower end of our farm needs cleaned out and maintained at a proper depth; ~~____~~ side ~~__~~ from the dyke to the river; you need to do a maintance plan to keep this (water-way)

17 open all the way to river channel.

The ~~___~~ Dyke should be armored and raised

18 before project!

All this needs to be done before project!

~~I can't go thru a winter~~

Our Issue needs to be adressed before project!

Before you remove the dyke across from our farm, you need to clean out the outflow from tide gate to river and do maintance to keep this open. Pump needs to be installed and working before Dyke is removed. Our Dyke needs armored raise it up 4' and this is to be done before

19 Dyke is removed in you project!

Place stamp here

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Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

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2015_June_17_Peterson_E

Comment Number	Response
12	Comment noted. Comment in opposition to project. As described in Section 7.1.3.3, hardcopies of the Draft EIS were made available in several locations including 3 locations in Tillamook. As described in Section 7, notification was provided by email when individuals had provided an email address and by mail when only a postal address was available. Figures 4.5-4, 5, and 6 of the EIS indicate that water surface elevations between no action and the proposed action on both sides of the dike between the Peterson property and the Tillamook River are predicted to be reduced with the proposed project during modeled 1.5, 5, and 100-year flood events. The model results indicate that there would be either no change or potentially positive benefits on the property to the south and west of the SFC project area during flood conditions (i.e. the water surface is expected to be lower during flood events after construction of the proposed action as compared to current conditions).
14	Figures 4.5-4, 5, and 6 of the EIS indicate that predicted change in water surface elevations between no action and the proposed action on both sides of the dike between the Peterson property and the Tillamook River are negative for 1.5, 5, and 100-year events. This result indicates nominal to potentially positive benefits to this property during flood conditions (i.e. the water surface is expected to be lower during flood events after construction of the proposed action as compared to current conditions). The largest change that might affect wave action or erosive forces occurs during the 100-year event and is estimated to be a drop in water surface of 0.5-0.74 feet on the river side of the dike. It is not anticipated that this change would require mitigation to protect the dike relative to the No Action Alternative. The potential for wind generated waves to affect the Peterson levee following removal of levees around the SFC project area is expected to be negligible for several reasons. Winds that could drive waves into the southern end of Tillamook Bay would need to come from the north-northwest. Winds from this direction typically only occur in the summer months when the wind speeds are lower and are not associated with storms and storm surges. The high marsh to the north of the SFC project area would remain unaffected by the project and would continue to provide wave attenuation benefits. This area of high marsh has also been expanding in recent decades, which indicates that wave erosion is not occurring in the south end of the bay. There has been no evidence of wind generated wave erosion on the levees currently around the SFC project area and when the project designers modeled conditions for the proposed north levee within the proposed project area they did not find that additional measures were required to protect this levee from wind generated waves. The proposed north levee would be much more exposed to waves in the south end of the bay than the Peterson levee; therefore, no additional measures would be needed along the Peterson levee. There is currently some river erosion along the Tillamook and Trask rivers and this condition would not change with the proposed project. Additional text has been added to Section 4.7.1.2.

Comment Number	Response
15	Under a range of flood conditions, Figures 4.5-4, 5, and 6 indicate that there would be little change in water surface elevations on either side of the dike separating the Peterson property from the Tillamook River. The size and number of tide gates in the SFC area would not change, but they would be set back to the east. The position of the tide gates and levees on the SFC project area would not affect the daily tide cycles in the Tillamook and Trask Rivers; therefore, there would be no effect on water tables to the south of the rivers. Low flow modeling was conducted to determine if the change in the position of the levees and the resulting potential change in the tidal prism could result in tidal waters lingering longer against the new setback levees or other levees in the general area. If this occurred it could prevent water from properly discharging from the tide gates and result in flooding of the adjacent agricultural lands. Simulations of lower Tillamook River levels under average June and July flow conditions show changes in low tide levels of less than 0.05 feet or about one half inch (NHC 2015b). This change would have a negligible effect on water levels and would not affect the functioning of tide gates. This information has been added to Section 4.5.1.3.2.
16	As described in Section 7.1.3.1, notification of the availability of the Draft EIS and the open house was provided through several means. As described in Section 7, notification was provided by email when individuals had provided an email address and by mail when only a postal address was available. The commenter had participated in scoping and had provided an email address at that time. Therefore, an email notification was sent prior to the start of the public comment period about the open house and the availability of the Draft EIS. Notification was also provided through newspaper ads in the local papers and flyers posted in several community locations.
17	The issues raised in this comment refer to areas outside of the project area and to features that would not be affected by the project. The commenter may be expressing concern that the proposed project could result in higher water levels in this off-site area. Figures 4.5-4, 5, and 6 of the EIS indicate that predicted water surface elevations during floods would be lower after construction of the proposed project. Section 4.7.1.2.3 presents the results of the fluvial geomorphology analysis, which looks at how sediment transport might change in the river channels. The analysis concludes that, overall, most reaches would have no change or increased sediment transport capacity. Therefore, the proposed action would not significantly alter the outflow channel sedimentation rate or maintenance requirements. As described in the response to Comment #15, simulations of lower Tillamook River levels under average June and July flow conditions show changes in low tides levels of less than 0.05 feet, which would have a negligible effect on water levels and would not affect the functioning of tide gates.

Comment Number	Response
18	Figures 4.5-4, 5, and 6 of the EIS indicate that predicted water surface elevations during a variety of flood events would be lower with the proposed action than under the existing condition in the area south of the Tillamook River and over the Peterson farm property. The largest change that might affect wave action or erosive forces would occur during the 100-year event and is estimated to be a drop in water surface of 0.5-0.74 feet on the river side of the dike. It is not anticipated that this change would require mitigation to protect the dike relative to the No Action Alternative. Whereas with the projected lower flood levels throughout the area, raising the dike could increase flood levels on adjacent properties and within the Peterson property by trapping floodwaters behind a higher dike. The potential for wind generated waves to affect the Peterson levee following removal of levees around the SFC project area is expected to be negligible for several reasons. Winds that could drive waves into the southern end of Tillamook Bay would need to come from the north-northwest. Winds from this direction typically only occur in the summer months when the wind speeds are lower and are not associated with storms and storm surges. The high marsh to the north of the SFC project area would remain unaffected by the project and would continue to provide wave attenuation benefits. This area of high marsh has also been expanding in recent decades, which indicates that wave erosion is not occurring in the south end of the bay. There has been no evidence of wind generated wave erosion on the levees currently around the SFC project area and when the project designers modeled conditions for the proposed north levee within the proposed project area they did not find that additional measures were required to protect this levee from wind generated waves. The proposed north levee would be much more exposed to waves in the south end of the bay than the Peterson levee; therefore, no additional measures would be needed along the Peterson levee. Additional text has been added to Section 4.7.1.2
19	Figures 4.5-4, 5, and 6 of the EIS indicate that predicted water surface elevations during a variety of flood events would be lower with the proposed action than under the existing condition in the area south of the Tillamook River and over the Peterson farm property. This would have a beneficial effect on the farm referenced in the comment. It is not anticipated that this change would require mitigation to protect the dike relative to the No Action Alternative. The potential for wind generated wave erosion is addressed in the response to Comment # 18 and additional text has been added to Section 4.7.1.2.

Tillamook Southern Flow Corridor Project
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Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name: DAVID WELLS Organization (if applicable):
Address: 2390 NIELSEN ROAD
City: TILLAMOOK State: OR ZIP: 97141
Email (optional):

Use the space below to provide comments on the Draft EIS.

IN GENERAL I would support the "No Action" or "Hall Slough" Alternatives

20 ADDITIONAL INFORMATION FOR CONSIDERING IN YOUR DRAFT EIS:

- location ~~and~~ of White Tailed Kites within the project area, I have seen them more ~~in the~~ at the northern trail ~~fight~~ sign
21 area where the trail meets the field area.
- recreational use: there is a series of geo cache sites along
22 the trail road spaced out about every 200 meters
- recreational use: When hot in Portland it sends many people to the Coast seeking relief, with this area removed from
23 the walking base it will concentrate use in other areas.
- Economic: the continued removal of grass growing area from the economic base. No irrigation needed to grow grass here. There has been an erosion of farm land in the County as The
24 Nature Conservancy has been doing similar projects.

— OVER —

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FEMA

THOUGHTS FOR CONSIDERATION / FUTURE STUDY:

- will removing the berms & dikes increase ~~th~~ a tsunamis (earthquake generated wave) impact on Tillamook and ~~so~~ surrounding area.

25

- The ~~pice~~ price tag is estimated at $10,000,000 how about parking the dollars and while hard to predict let the tsunami do the dike rearranging flood ~~&~~ control action. This concept is sort of like creating old growth forests on National Forest Land just let the trees grow, let the water flow.

26

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Place stamp here

Tape Tape

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

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2015_June_17_Wells_D

Comment Number	Response
20	Comment noted. Comment in support of No Action or Alternative 2.
21	White-tailed kites are not a species of concern in the state of Oregon, but section 4.6.2 of the EIS has been revised to include a discussion of this species that is commonly observed within the project area including recent observed nesting activity. Tree removal would be conducted outside of the nesting season to minimize impacts on nesting birds.
22	Additional information on the geocaching sites has been added to Section 4.9.4. A new mitigation measure has been added to Section 6, Bullet 18, to ensure that notice is provided to the public about the timing of construction and closure of the trails within the project area, which would allow interested parties time to salvage the geocaches.
23	As described in Section 4.9.4.2.2, the new levees would be open for walking and bird watching, and waterways in the project area would be accessible to shallow draft boats. Under the Proposed Action, the length of the levees and roads within the project area would be reduced by approximately 5.5 miles, but the length of shallow channels potentially accessible to boaters at high tides is expected to increase by over 14 miles. The existing approximately 4 mile loop walk described on bird watching sites would be lost. While the new setback levees would be much shorter than the existing levee system, the new levees will be accessible from the same existing access point, and the range of species potentially visible to birders should be greater. Given that the location will remain accessible to recreationists and the quality of the site is anticipated to improve, major displacement of visitors to other sites in the area is not anticipated. In addition, the County has indicated that it plans to develop a management plan in the study area that will provide opportunities for community input on the types of recreational facilities that should be developed and recreation use types that should be encouraged in the project area.
24	Section 4.9.1.3.2 provides the evaluation of economic effects from conversion of farmland. The Proposed Action would convert approximately 219 acres of land currently in pasture and hay production to restored floodplain and wetland habitat. The No Action Alternative would also reduce the amount of land in current agricultural production due to restrictive grant agreements over the County-owned land within the project area. The difference in acreage of currently farmed land converted between the No Action Alternative and the Proposed Action would only be about 67 acres; therefore, there would be a negligible difference between the No Action Alternative and the Proposed Action, and this would be a less than significant impact. Tillamook County has 36,551 acres in farms and 14,482 acres of cropland. The removal of 219 acres of forage-land would not be a significant reduction of total cropland in the county. The land would remain in open space and would not be permanently degraded as it would if it were developed into urban uses. Similar Nature Conservancy projects that would restore wetlands and convert farmlands to non-agricultural uses have been added to the evaluation of cumulative impacts in Section 5.

Comment Number	Response
25	Section 4.7.1.1.2 describes the existing tsunami risk in the project area. As discussed in Section 4.7.1.1.3, none of the project alternatives would affect existing tsunami risks.
26	As described in Section 2 and 3, the Proposed Action was determined to be the most cost-effective project to address existing flooding issues and provide for habitat restoration. Tsunamis are infrequent events and the probability of one occurring is so low as to make it impracticable as an alternative to solving the need to reduce flood damages and restore habitat. In addition, while a tsunami would overtop the levee system, it is unlikely that it would re-arrange the levees into a configuration that would protect future agricultural uses outside of the project area.

IN THE STATE OF OREGON, COUNTY OF TILLAMOOK

In the Matter of the Southern Flow Corridor Project,
Tillamook County, Oregon

Draft Environmental Impact Statement
By
U.S. Department of Homeland Security, Federal Emergency
Management Agency (FEMA) Region X, Lead Agency
and
Cooperating Agencies: National Oceanic and Atmospheric
Administration (NOAA) Restoration Center, U.S. Fish and
Wildlife Service (USFWS), United States Army Corps of
Engineers, Port of Tillamook Bay (POTB), Tillamook County

Testimony concerning the Southern Flow Corridor Project in Tillamook County, Oregon, was taken before Lee Blackwood, Certified Court Reporter, at the Port of Tillamook Bay, Tillamook, Oregon, on June 17, 2015, during the Public Open House, 5:30 p.m. to 7:30 p.m.

Lee Blackwood
Blackwood Court Reporting
PO Box 536, Newport, Oregon 97365

CONTENTS

♀

June 17, 2015 - 5:30 p.m.

TESTIMONY OF DAVID DARNALL

MR. DARNALL: My main concern for being here was

because I live directly across from the flood gates that are currently in use. It appears that the proposed action is going to be beneficial with no impact on where I live, and huge impact on the environment. And I think it's a
27 very positive thing for us to be doing.

TESTIMONY OF DAVID WELLS

MR. WELLS:
Local interest in,
southern flow alternatives,
28 should be considered.

That's a haiku. Haiku is a form of poetry, and I just looked it up. You run five syllables, seven syllables, and five syllables.

And I think that covers it.

COURT REPORTER: Okay. Thank you.

(End of testimony)

*****

COURT REPORTER'S CERTIFICATE

I, Lee Blackwood, Certified Court Reporter for the State of Oregon, do hereby certify that the aforementioned witnesses personally appeared before me at the time and place set forth in the caption hereof; that at said time and place I reported in Stenotype all their testimony; that thereafter my notes were transcribed by me; and that the foregoing 3 pages constitute a true and accurate transcript of my original stenographic notes.

In witness whereof, I have hereunto affixed my signature this 1st day of July, 2015.

Lee Blackwood
Certified Court Reporter
Certificate No. 90-0130
Certificate expires 6-30-17

2015-06-17 CourtReporter-comments

Comment Number	Response
27	(Darnall) Comment noted. Comment in support of the Proposed Action.
28	(Wells) Section 1.5 and Section 7 describe the extensive outreach efforts conducted during public involvement activities to obtain local input on the project and development of project alternatives. The development of alternatives and selection of alternatives to analyze in detail in the EIS is described in Section 3.

Stenberg, Kate

Subject: FW: Georgine Beveridge

-----Original Message-----
From: Georgine Beveridge [mailto:georgineb22@gmail.com]
Sent: Saturday, June 20, 2015 10:00 PM
To: NWR SouthernFlowCorridor
Subject: Georgine Beveridge

Submitted on Saturday, June 20, 2015 - 21:59 Submitted by anonymous user: [75.142.21.31] Submitted values are:

Name: Georgine Beveridge
Mailing Address: 1009 Meadow Ave
City: Tillamook
State: OR
ZIP: 97141
Email: georgineb22@gmail.com
Comment:
I would like to start by stating I have past personal experience with the flooding that has occurred on Hwy 101 in Tillamook. I managed a business in the Northport Plaza that was raised with FEMA funds after the 2006 flood. Money well spent.

I also am a past POTB commissioner.

29 I support the no action choice.

The project has grown from the original "mitigation" project it was intended to be, and has become a big political project for several of the big federal agencies that have wanted to remake the area for a long time for purposes other than flood mitigation. They saw an opportunity with the big "seed"
30 money the port could contribute with the FEMA Alternate project money,and ran with it.

All the current action choices have a limited life span, no different than if the project were to simply be to dredge the
31 rivers, bay and reconnect the slews with the Wilson River.

I view any of the current "action" plans a colossal waist of time and tax payer money.
32

Thank you.

Georgine Beveridge

The results of this submission may be viewed at:
http://southernfloweis.org/node/5/submission/277

2015-06-20_Beveridge _G

Comment Number	Response
29	Comment noted. Comment supports No Action Alternative.
30	As described in Section 2 and 3, the Proposed Action was determined to be the most cost-effective project to address existing flooding issues and provide for habitat restoration. Section 2 describes the purpose of and need for the project. Section 1 describes the history and background of the development of the project. Each funding agency will make a determination of whether the project is eligible for funding under its grant program criteria.
31	Section 3.7.3 describes alternatives that would focus on dredging. Dredging alternatives would not meet the purpose and need for the project.
32	Comment expresses support for the No Action Alternative. As described in Section 2 and 3, the Proposed Action was determined to be the most cost-effective project to address existing flooding issues and provide for habitat restoration. The proposed SFC project would reduce flood damages and restore fish and wildlife habitat. Future unmitigated flooding in the Tillamook Valley would continue to contribute to potential future life safety risks and physical and economic damages to property and businesses in the floodplains, and fish and wildlife habitats would be maintained in their degraded state. Please see section 4.9.1.3.1 (Economics) for a discussion of economic impacts under the No Action Alternative.

Stenberg, Kate

Subject: FW: Scott Bailey

-----Original Message-----
From: Scott Bailey [mailto:scott@tbnep.org]
Sent: Thursday, June 25, 2015 9:50 AM
To: NWR SouthernFlowCorridor
Subject: Scott Bailey

Submitted on Thursday, June 25, 2015 - 09:50 Submitted by anonymous user: [68.185.9.242] Submitted values are:

Name: Scott Bailey
Mailing Address: 510 Madrona Ave
City:
State:
ZIP: 97141
Email: scott@tbnep.org
Comment:
I attended the public meeting in June 2015 and received conflicting information from the project staff regarding the new tidal channels that are anticipated at the project site, post construction. I submitted comments at the time, but wanted to emphasize an apparent problem with the presentation and materials prepared for the project through this online comment format.

The design engineer indicated that new tidal channels would be constructed and the old drainage ditches would be filled. He indicated that where the new channels cross the filled ditches, plugs would be constructed of wood and clean fill to minimize potential for erosion of the fill in the old ditches.
He also indicated that "dirtier fill" (soil with organic matter) would be used as the primary fill material for the old drainage ditches.

During another discussion with the EIS document preparation team leader I was told that no new channels would be constructed (she did say that the current drainage ditches would be filled). She indicated that openings would be created at the margin of the project and that new channels would be allowed to form naturally from tidal flows entering primarily through these discrete openings. The EIS seems to support her statements.

The information I received at the public meeting are very contradictory statements and, if the latter statements are true then I think it is misleading to indicate that the project would result in 14 miles of new channels when this is, at best, a modeled guess. You need to more clearly identify that this expected benefit of the preferred action is based solely on
33 modeling and is not based on actual construction actions.

The results of this submission may be viewed at:
http://southernfloweis.org/node/5/submission/288

2015-06-25_Bailey_S

Comment Number	Response
33	Sections 3.4.1.6 and 4.5.3.4.2 indicate that relict tidal channels would primarily be expected to reform naturally. The text has been clarified in Sections 3.4.1.6 and 3.6.1.6 to describe the process of cutting a "starter" notch in the base of the former levee along the river's edge and that a portion of the tidal channel length would be excavated as a starter channel. The text has also been further clarified to indicate that the expected amount of restored tidal channel is based on historic photos that show the tidal channels prior to the construction of the dikes and LiDAR that provides a guide to the eventual channel length that might be expected to evolve on the site. We acknowledge that there may have been some confusion based on statements made at the public meeting. About 30,000 linear feet of tidal channel would be excavated and 24,000 feet of ditch filled as part of the Proposed Action. The newly excavated tidal channels would tie into either existing relict channels on the site or be connected via breaches in the existing levees to the adjoining rivers.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Tuesday, June 30, 2015 1:49 PM
To: Stenberg, Kate
Subject: FW: Scott Bailey

-----Original Message-----
From: Scott Bailey [mailto:scott@tbnep.org]
Sent: Thursday, June 25, 2015 9:50 AM
To: FEMA-SFC-EIS
Subject: Scott Bailey

Submitted on Thursday, June 25, 2015 - 09:50 Submitted by anonymous user: [68.185.9.242] Submitted values are:

Name: Scott Bailey
Mailing Address: 510 Madrona Ave
City:
State:
ZIP: 97141
Email: scott@tbnep.org
Comment:
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The design engineer indicated that new tidal channels would be constructed and the old drainage ditches would be filled. He indicated that where the new channels cross the filled ditches, plugs would be constructed of wood and clean fill to minimize potential for erosion of the fill in the old ditches.
He also indicated that "dirtier fill" (soil with organic matter) would be used as the primary fill material for the old drainage ditches.

During another discussion with the EIS document preparation team leader I was told that no new channels would be constructed (she did say that the current drainage ditches would be filled). She indicated that openings would be created at the margin of the project and that new channels would be allowed to form naturally from tidal flows entering primarily through these discrete openings. The EIS seems to support her statements.

The information I received at the public meeting are very contradictory statements and, if the latter statements are true then I think it is misleading to indicate that the project would result in 14 miles of new channels when this is, at best, a modeled guess. You need to more clearly identify that this expected benefit of the preferred action is based solely on
34 modeling and is not based on actual construction actions.

The results of this submission may be viewed at:
http://southernfloweis.org/node/5/submission/288

2015-06-25_Bailey_S_2

Comment Number	Response
34	See response to Comment 33.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Tuesday, June 30, 2015 1:48 PM
To: Stenberg, Kate
Subject: FW: EIS Draft Comments

From: TBHEID [mailto:TBHEID@tillamookoffice.com]
Sent: Thursday, June 25, 2015 10:23 AM
To: FEMA-SFC-EIS
Cc: 'R C'; Chad Allen
Subject: EIS Draft Comments

RSC Dairy (Goodspeed Road farm) public comments for the record on FEMA SFC EIS draft……

Tilda @ TBHEID Office

From: R C [mailto:rscdairy@gmail.com]
Sent: Thursday, June 18, 2015 12:31 PM
To: TBHEID
Subject: Re: EIS Draft comment.

TBHEID

WE ARE CONCERNED ABOUT CHANGES.

WE ARE A FAMILY FARM HOPING THAT THE SODIUM LEVELS IN THE SOIL WILL NOT
35 ELEVATE WITH THIS PROJECT, AS IT MAY EFFECT THE GROWTH OF QUALITY DAIRY
PASTURE. 36 IT WILL PROBABLY INCREASE THE NUMBER OF GEESE ALSO.

REGARDS

CHELONE FAMILY
(Goodspeed Road, Tillamook, OR)

2015-06-25_RSC Dairy

Comment Number	Response
35	Effects on groundwater are discussed in Section 4.5.5 and on water quality in Section 4.5.4. Sodium levels in soils could increase if there were an increase in sodium levels in ground or surface waters. However, the analysis indicates that there would not be any change in groundwater and surface waters on the upstream side of the new setback levees would remain a freshwater dominated system.
36	Section 4.6.2.3.2 has been revised to include a discussion of potential effects on Canada geese. Because geese graze in both fresh and saltwater habitats as well as agricultural lands, it is expected that there would be little change in the population over the long-term.

Tillamook Southern Flow Corridor Project
Environmental Impact Statement

Draft EIS Comment Form
Submit by July 13, 2015

Please provide comments on the proposed alternatives for the Southern Flow Corridor Project, potential impacts of the alternatives, and proposed mitigation measures. The Draft Environmental Impact Statement (EIS) is available at SouthernFlowEIS.org. Feel free to take an extra form and send comments to FEMA (address below).

Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name BOB WEEKS Organization (if applicable) ______

Address 501 MAIN AVE

City TILLAMOOK State OR ZIP 97141

Email (optional) ______

Use the space below to provide comments on the Draft EIS.

DEAR MARK;

THANK YOU FOR TAKING TIME TO WALK ME THROUGH THE PROJECT. I AM CERTAINLY QUITE UNQUALIFIED TO JUDGE THE PROPOSED ALTERNATIVES BUT BASED ON WHAT I HAVE SEEN I WOULD RATE THE ALTERNATIVES IN
37 THE FOLLOWING ORDER - 1, 3, & 2.

ALSO, WOULD'NT IT HELP TO DREDGE TILLAMOOK
38 BAY?

Bob Weeks

Written comments must be postmarked, e-mailed, faxed, or otherwise submitted by **July 13, 2015**. Mail: FEMA, Attn: Mark Eberlein, Regional Environmental Officer, 130 - 228th Street SW, Bothell, WA 98021 Email: fema-sfc-eis@fema.dhs.gov Online: www.SouthernFlowEIS.org Fax: (425) 487-4613 Attention: FEMA-SFC-EIS

FEMA

RECEIVED
JUN 29 2015
FEMA REGION X

2015-06-29_Weeks_B

Comment Number	Response
37	Comment noted. Comment expressing a preference for Alternative 1.
38	As described in Section 3.7.3, dredging would not result in measurable flood reduction benefits beyond the dredged area. In addition, dredging would result in adverse habitat impacts and would require long-term maintenance. Dredging alternatives would not meet the purpose of and need for the project. USACE does conduct limited dredging in Tillamook Bay as described in Section 5.1.2.

Please provide comments on the proposed alternatives for the Southern Flow Corridor Project, potential impacts of the alternatives, and proposed mitigation measures. The Draft Environmental Impact Statement (EIS) is available at SouthernFlowEIS.org. Feel free to take an extra form and send comments to FEMA (address below).

Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name Dale Buck Organization (if applicable) Retired Tillamook Dairy Farmer

Address 25590 Chinook St Cloverdale, OR 97112

City ____ State ____ ZIP ____

Email (optional) dalebuck c centurylink.net

Use the space below to provide comments on the Draft EIS.

The landowner Preferred alternative should be constructed. I served on the committee that proposed it.

Hall Slough should be cleared and reconnected to the Wilson river, for fish and some flood reduction. Corp said it would cost to much

39 funding for the benefit. Thank you

Dale Buck

Written comments must be postmarked, e-mailed, faxed, or otherwise submitted by **July 13, 2015**. Mail: FEMA, Attn: Mark Eberlein, Regional Environmental Officer, 130 - 228th Street SW, Bothell, WA 98021 Email: fema-sfc-eis@fema.dhs.gov Online: www.SouthernFlowEIS.org Fax: (425) 487-4613 Attention: FEMA-SFC-EIS

FEMA

2015-07-08_Buck_D

Comment Number	Response
39	Comment noted. Comment expressing a preference for both Alternative 1 and 2. The estimated cost of implementing each alternative is described in Section 3. Implementing both alternatives would approximately double the estimated cost of the project.

Stenberg, Kate

Subject: FW: Ken Chamberlain

-----Original Message-----
From: Ken Chamberlain [mailto:kjchamberlain@comcast.net]
Sent: Wednesday, July 08, 2015 11:33 AM
To: FEMA-SFC-EIS
Subject: Ken Chamberlain

Submitted on Wednesday, July 8, 2015 - 11:33 Submitted by anonymous user: [98.246.203.95] Submitted values are:

Name: Ken Chamberlain
Mailing Address: 3433 SW Carolina St
City: Portland
State: Or
ZIP: 97239
Email: kjchamberlain@comcast.net
Comment:
Federal Emergency Management Agency, c/o Mark Eberlein, Regional Environmental Officer I am a birder that visits the "Tillamook Bay Wetland" site located at the end of Godspeed Rd. regularly. I have read the draft EIS and am not clear where public access will be under the proposed alternative. I am concerned about future access to the area. I am aware of the county road status and the existing walking routes on the "Tillamook Bay Wetland" parcel and use them often. My reading of the EIS leaves me in doubt regarding the plans for all aspects of future public access. I would like to see clearly described public access in the completed proposed alternative. This would include any trails, roads, channel
40 footbridges/crossings, dike tops, etc.
Thank you for considering my comments. Please let me know if you have any questions.
Ken Chamberlain

The results of this submission may be viewed at:
http://southernfloweis.org/node/5/submission/311

2015-07-08_Chamberlain_K

Comment Number	Response
40	The text in Section 4.9.4.2.2, under the Proposed Action, has been revised to clarify that the new levees would be open for walking and bird watching, and waterways in the project area would be accessible to shallow draft boats. Under the Proposed Action, the length of the levees and roads within the project area would be reduced by approximately 5.5 miles, but the length of shallow channels potentially accessible to boaters at high tides is expected to increase by over 14 miles. The existing approximately 4 mile loop walk described on bird watching sites would be lost. While the new setback levees would be much shorter than the existing levee system, the new levees will be accessible from the same existing access point, and the range of species potentially visible to birders should be greater. Section 4.6.2.3.2 describes the expected effects on fish and wildlife from each alternative. Given that the location will remain accessible to recreationists and the quality of the site for fish and wildlife is anticipated to improve, major displacement of visitors interested in wildlife-related activities to other sites in the area is not anticipated. In addition, the County has indicated that it plans to develop a management plan in the study area that will provide opportunities for community input on the types of recreational facilities that should be developed and recreation use types that should be encouraged in the project area.

The Nature Conservancy
Protecting nature. Preserving life.™

The Nature Conservancy in Oregon
821 SE 14th Avenue
Portland, OR 97214-2537

tel 503 802-8100
fax 503 802-8199
nature.org/oregon

July 10, 2015

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021
email: fema-sfc-eis@fema.dhs.gov

Dear Mr. Eberlein:

Thank you for the opportunity to comment on the Draft Environmental Impact Statement (EIS) and associated documents for the Southern Flow Corridor Project (SFC). The Nature Conservancy appreciates that this is a complex project and supports the projects proposed goal to reduce flood damage and restore important Coastal Coho salmon habitat.

41

The Nature Conservancy is a non-profit organization dedicated to the conservation of lands and waters on which all life depends. Estuaries serve as the ecological link between freshwater and marine systems as well as an essential component to biological diversity and coastal communities. Many species on the Oregon coast rely upon estuaries at some point in their life cycle, including Oregon's iconic salmon and Dungeness crab. Healthy estuaries help fuel sustainable commercial and recreation fisheries. In the Tillamook area, estuaries have suffered considerable losses of tidal wetland habitat. Restoration is an essential activity for ensuring the recovery of species, habitats and ecological processes; restoration is also important for the sustainability of the local communities.

Regarding the Draft EIS, the Conservancy supports the Proposed Action for the proposed SFC as it meets the specific needs of flood control for Tillamook combined with significant restoration of estuary wetlands within the project area. The Preferred Action addresses certain landowner issues and will have substantive benefits regarding flood mitigation by utilizing tidal wetland habitats. The use of nature-based solutions to increase resilience against flood waters and other natural disasters is gaining recognition throughout the United States.

42

We do recommend that you revisit one aspect of the EIS more fully -- how the Proposed Action will respond to climate change impacts in the project area over the next 50 to 100 years. Appendix H discusses climate change in conjunction with air quality concerns, but this is limited to issues related to emissions released during and immediately following construction. The broader issue for a project of this scale is how it will respond to future conditions given predicted climate change impacts on the landscape. There has been considerable information collected about the potential impacts of climate change and these impacts have been down-scaled such that reasonable impact predictions can be made for the Tillamook Bay. For example, a recent report by the Oregon Climate Change

Research Institute (OCCRI 2012) detailed impacts for Tillamook Bay and noted in particular that sea level rise and precipitation will have measurable effects on coastal habitats. Incorporating climate change into the project designs will provide additional assurance that the planned restoration activities will have the intended benefits into the
43 future as defined by the climate change models.

In Tillamook County, the Conservancy has invested significant time and resources to restoring tidal wetlands on the Miami and Kilchis rivers. At this time, we are restoring a 67 acre property that has many analogous characteristics and restoration actions as proposed in the SFC (e.g. removing levees and restoring wetlands). The Conservancy also incorporated the scaled-down climate change models and impacts into the restoration design for the Kilchis Estuary Preserve wetland restoration project. Climate change data informed future tidal and river water levels for the site that was utilized to modify designs of tidal channels, adjust wetland re-vegetation plantings and to predict future flood effects in the watershed. Our hands-on experience in the same basin as the SFC provides an important perspective for large scale tidal restoration. We would welcome the opportunity to share our experience with the SFC engineering consultants, federal agencies and others associated with this project to transfer the lessons we've learned
44 through our ongoing restoration work.

In closing, the Conservancy supports the Proposed Action for the SFC project and encourages that the project go forward. To follow up on this invitation, please contact our Tillamook project manager, Dick Vander Schaaf, at dvanderschaaf@tnc.org.

Respectfully,

Catherine Macdonald
Director of Conservation Programs
The Nature Conservancy

2015-07-10_Vanderschaaf_D_TNC_1.pdf

Comment Number	Response
41	Comment noted. Comment expressing support for the project purpose and need.
42	Comment noted. Comment expressing support for Alternative 1, Proposed Action.
43	Appendix H of the Draft EIS was only intended to summarize the methodology used to estimate air quality and GHG emissions and does not analyze environmental consequences. The main text of the Draft EIS discusses both the effects of each alternative on climate change and the effects of climate change on the alternatives. Section 4.7.4.3.5 presents the projected regional sea level rise. This regional projection is based on the regional downscaled models prepared by OCCRI as noted in the comment. Section 4.7.4.4.2 discusses how the Proposed Action would respond to climate change. As discussed in this section, it is predicted that improvements associated with the Proposed Action would assist the community in adapting to sea level rise that would occur from climate change. Section 4.5.1 and 4.5.2 also discuss the effect of each alternative in providing some resiliency against sea level rise. The proposed project has been designed to account for the expected sea level rise over its 40 to 50 year design life. As described in Section 4.5.3, the projected flood reduction benefits would be sustained even with the amount of sea level rise estimated to occur over the project design life.
44	As described in Section 3.4.2.2, a maintenance and monitoring plan that includes adaptive management elements would be developed by the Port and the County. The project proponents welcome the opportunity to discuss any lessons learned with the Nature Conservancy. The Nature Conservancy projects on the Miami and Kilchis rivers have been added to Section 5, Cumulative Effects, to evaluate the potential for cumulative effects on the natural and social environment.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Monday, July 13, 2015 10:14 AM
To: Stenberg, Kate
Subject: FW: Southern Flow Corridor EIS Comments
Attachments: EIS comment Southern Flow Corridor final.docx

From: Dick Vanderschaaf [mailto:dvanderschaaf@TNC.ORG]
Sent: Friday, July 10, 2015 10:33 AM
To: FEMA-SFC-EIS
Subject: Southern Flow Corridor EIS Comments

Dear Mr. Eberlein,

45 Please accept our comments on the Southern Flow Corridor EIS. If you have any questions regarding our comments please don't hesitate to contact me directly.

Regards,

Dick

Dick Vander Schaaf
Associate Coast and Marine Conservation Director
The Nature Conservancy of Oregon
821 SE 14th Avenue
Portland, OR 97214
(503) 802-8100 X136
email: dvanderschaaf@tnc.org

2015-07-10_Vanderschaaf_D_TNC_2.pdf

Comment Number	Response
45	No response needed.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Monday, July 13, 2015 10:13 AM
To: Stenberg, Kate
Subject: FW: FEMA SFC EIS

From: Gus Meyer [mailto:gusmeyer9@gmail.com]
Sent: Saturday, July 11, 2015 8:48 PM
To: FEMA-SFC-EIS
Subject: FEMA SFC EIS

ATTENTION: Southern Flow EIS Organization:

Southern Flow Corridor_Landowner Preferred Alternative initiative has been deemed as a Flood Reduction Project with Ecosystem Restoration Benefits.

46
- Major flooding of 1999 established baselines of Tillamook County/USACE Feasibility Study.
- EIS paragraph 1.5 omits mention of the 1999 flood while the next page Figure 1-3 depicts a picture of the 1999 flooding.

47A

<u>My Preferred Alternative(with minor additions):</u>

- Southern Flow Corridor_Landowner Preferred Alternative
  - With added ESH/EFH restorations

47B
  - Restoration of quality slough rearing waters in project area including:
    - Hoquarton Slough
    - Dougherty Slough
    - Hall Slough
    - ODFW Paul Atwood, Biologist, presentation June 30, 2015 on necessity of lower Tillamook Basin slough quality rearing waters and adult waters.
    - Address initiatives within EIS for Hall Slough Alternative to all sloughs within project area-but not am not in support of the full Hall Slough Alternative Project.

47C
    - Address Section 4.5 Water Resources
      - Regulated Clean Water Act, EO 11990, FEMA 44 CFR
      - DEQ Water Pollution Control Act

47D
    - Address Section 4.5.1.2
      - Support of fisheries

47E
    - Address 4.5.4.2.3 Dissolved Oxygen standards

47F
    - Address 4.6.2.1 Aquatic Habitats are priorities for anadronomus fish.

47G
    - Address 4.7.2 Important Habitat

47H
    - Address 4.7.3 Air Quality OARs 340-202-0050 through 0130
      - Volatile organic components NOx, NH3, through methane created by salt water intrusion and decay of upland vegetation in projet area.

47I
  - Address 4.6.2.2 Important shellfish harvest area for both commercial and recreational use.
  - Thereby, address reducing current dead fish impacts, deoxygenation, new zealand mud snails, and poor tidal exchanges within the three sloughs in the project area.

EIS Review Comments:

1. Grammatical throughout the EIS and all Appendices
   - 48 Replace *" **could, should, and would**" with "**is committed to**"*.

Earthquake Sirens:

49 1. Tillamook County elected to withdraw from earthquake siren program initiatives some 4-5 years ago.

Farmland Importance:

1. Dairy is a critical component of revenue for all of Tillamook County.
   - Loss of some 504 dairy land acres is of great economic impact-some 4-5 times dairy revenue generated overall (ColPac EDC).
     - Tax values take on importance when personal property taxes on farm houses and buildings are included.
     - Of 36,551 zoned acres
     - Some other 800 + acres have previously been wetland restored.
   - Our land uses and zoning have coveted lands available within the Tillamook Basin.
   - 50 Farmland is also of statewide importance not just for revenue but also trade exports.

Siltation Impacts:

1. DSL Platted oyster beds are a shellfish revenue of Tillamook Bay.
   - Minor floods as well as major floods now provide siltation shoalling of oyster beds with current levee systems.
     - One oyster farmer states small sized siltation shoals move off oysters now by tidal flow after storm erosional depositions.
     - 51 Address erosional siltation deposition impacts of the SLC_LPA Project.

County Roads:

1. County roads shall be maintained in good working order during construction.
   - Address control of dust, roughness, and other safety issues.
   - Maintain stormwater flow effectiveness during project construction.
   - Rebuild after project construction is completed.
   - 52 Provide funding for necessary road or road portion vacations.

Recreational Uses:

1. Provide for recreational uses previously identified.
   - Horseback trails and parking.
   - Bike and foot trails and parking.
   - Fishing accesses and parking, including some boat ramps..
   - Birdwatching blinds and parking (could be concurrent with trails established.
   - 53 Water fowl hunting access.

Community Rating System:

1. Draft SFC EIS document doesn't address proposed CRS benefits to businesses and landowners within
54 the SFC_LPA Project impact area, tourists and shoppers to this area.

Conclusion:

The expenditure of some $13 million public dollars building upwards deserves serious attention to details outlined above, as well as other EIS comments submitted. Secured project revenues, and their timeliness are of concern. Let's make this a go for the good of all project from the project start. Some members of the
55 community are concerned as to project committed Maintenance Plan implementation.

Sincerely,

A.D. "Gus" Meyer

1715 Skyline Drive,

Tillamook, OR., 97141-9609

Email: gusmeyer9@gmail.com

Tillamook County Soil & Water Conservation District Assoc. Dir.
County Roads Advisory Committee
Tillamook Bay Watershed Council Member
.

2015-07-11_Meyer_G.pdf

Comment Number	Response
46	The 1999 flood is mentioned in Sections 1.1.1 and 1.1.2. The 1999 flood is listed in both Table 1-1 and Table 1-2. Text references to Figure 1-3 include the notation that it depicts the 1999 flood. No text revisions needed.
47A	Additional ESH/EFH restoration - The project has been reviewed by NMFS, which has regulatory responsibility for protection of EFH and no additional mitigation measures were determined to be necessary. The comment is not specific as to what additional restoration actions the commenter feels might be needed.
47B	Sloughs - Section 3.4.1 describes the elements of the Proposed Action. As part of the Proposed Action, the levees along Hoquarten Slough and Dougherty Slough would be modified improving riparian edges, which would improve rearing habitat. The Proposed Action would improve the hydraulic connectivity between Hall and Blind Sloughs in order to improve rearing habitat and habitat connectivity.
47C	Water Resources - The Clean Water Act, EO 11990, FEMA 44 CFR Part 9, and the ODEQ Water Pollution Control Act are discussed and addressed in Section 4.5.4.
47D	Fisheries - The potential effects of the project on fisheries is discussed in Section 4.6 (Biological Resources). The effects of each alternative on the natural beneficial functions of floodplains are discussed in Section 4.5.1. Text added to clarify that natural beneficial functions include fish rearing. The Proposed Action would result in a long-term benefit to fisheries.
47E	Dissolved Oxygen - As described in Section 4.5.4.2.3, implementation of the Proposed Action could lead to decreased dissolved oxygen concentrations as a result of accelerated biological processes from the nutrient loading. However, water quality in the study area would quickly return to levels found within normal tidal wetland areas.
47F	Aquatic Habitats - As described in Section 4.6.2.3.2, aquatic habitats would be improved through implementation of the Proposed Action.
47G	Coastal Resources - As described in Section 4.7.2.3.2, the Proposed Action would enhance coastal resources by restoring natural tidal processes and improving water quality, wetlands, and habitat in the project area.
47H	Air Quality - The air quality analysis determined that impacts related to criteria pollutant emissions from implementation of the Proposed Action would be minor, local, and less than significant, and mitigation would not be required. The restoration of the former wetlands would be expected to increase CO_2 storage from reduced oxygen in the soils, but it could also increase CH_4 emissions during the transition period as existing upland vegetation decays. It is not possible to predict which condition will dominate during this period of time. Overall natural tidal wetlands are more likely to provide more CO_2 storage than CH_4 emissions and a beneficial effect overall on GHG emissions in the long-term.

Comment Number	Response
47l	Shellfish Harvest - As discussed in Section 4.6.2 and 4.9.1.3.2, the Proposed Action would increase estuarine habitat, leading to increased fish and shellfish abundance and habitat and foraging opportunities for the entire suite of fish, wildlife, and invertebrate species in this ecosystem. Long-term effects on recreational activities as a result of the Proposed Action could affect the regional economy. Effects on fish and shellfish populations could also benefit commercial fishing opportunities by increasing harvest. The Proposed Action would provide ecological benefits that could improve salmon rearing and growth of juveniles. This would result in lower mortality rates and increases in fish populations. Commercial fishing landings would increase because of increased salmon abundance and harvest. Participants in the ocean commercial fishery potentially affected by the Proposed Action likely consist primarily of small, independently owned and operated trollers. Tidal Exchanges - As described in Section 4.5.3.4.2, the Proposed Action would affect surface water hydrology by increasing the area influenced by the tides. The Proposed Action would allow new tidal channels to develop in the project area. Other relict tidal channels also would adjust and reform as they begin to convey tidal flows in and out of the site again. Approximately 14 miles of tidal channels are expected to be restored within the project area. Blind Slough would enlarge as it would become an important flood flow channel, conveying flows both from new floodgates in the new setback levee and from the flows from the northern part of the project area. Some lateral movement and change of the main river channels can also be expected where rock armoring would be removed. However, channel migration is expected to be relatively minor based on historic patterns. Additional text has been added regarding the presence of New Zealand mudsnails in Section 4.6.2.
48	It is typical in NEPA documents to use could and would to describe impacts related to the alternatives. Mitigation measures are described in more concrete terms, such as by using "will." Section 6 of the Draft EIS describes mitigation measures that will be implemented to reduce impacts of the Proposed Action. Commitments for action are made in the Record of Decision, which will be prepared after the Final EIS is completed and released.
49	References to tsunami sirens have been removed from Section 4.7.1.1 and 4.9.3. Per Gordon McCraw, Tillamook County, there were over 30 Tsunami Sirens in the county owned by various organizations. The decision was made by most siren owners 3 or 4 years ago, including the County, to no longer support the sirens and the majority of them were removed. A few Fire Districts and private users have kept theirs for other signaling uses.

Comment Number	Response
50	The 392 acres previously purchased for open space are no longer contributing to County property tax revenues. The Proposed Action would also require the acquisition of an additional approximately 146 acres. About 21 acres of this would be leased back for agricultural uses, and presumably, the lease revenues would offset any potential property tax revenues that may be otherwise lost. Therefore, only 125 additional acres would be taken off the property tax rolls, which would be a negligible effect on County property tax revenues. Specific tax data was not available; therefore, the evaluation remains qualitative. Impacts on farmland of statewide importance is evaluated in Section 4.7.1.3.3. Not all areas designated as farmland of statewide importance within the project area are currently farmed. Some of these lands are forested or are not farmable due to surface water inundation or saturated soils. The Proposed Action would convert approximately 219 acres of land currently in pasture and hay production to restored floodplain and wetland habitat. Because the No Action Alternative would also phase out current agricultural activities within the project area, the Proposed Action would only remove an additional 67 acres from current production. The conversion of farmland associated with the Proposed Action would have a minor, local, long-term adverse impact on the regional economy that would be less than significant. Text has been added on the value of production lost based on USDA National Agricultural Statistics Service data for Oregon. Text has also been added on the economic effects to the dairy industry.
51	In the fluvial geomorphology study of the DEIS (Section 4.7.1.2), the change in the sediment transport capacity of the rivers due to the Proposed Action was evaluated. Per this study, during the construction and transitional periods, the Proposed Action would have moderate, localized impacts on the sediment transport capacity in the Wilson River near the project area. In the Trask River, potential impact on sediment transport capacity would be negligible. Over the long-term, most reaches would have no change or increased sediment transport capacity except for lower Hall Sough which shows a risk of sediment accumulation. In-channel bed sediments in the area are primarily sands and small amounts of gravel. The rivers also transport a large amount of silt that is carried in suspension out to Tillamook Bay. Numerous studies of other tidal restoration projects have found that when formerly diked areas of subsided land are reconnected to the tides, the land begins to rebuild by capturing sediment from the adjoining river channels on each high tide. Comparison with reference tidal marshes adjacent to the project site and the Garibaldi tide gage indicate the expected re-accreted marsh elevation will be at least elevation 8 feet (NAVD88 datum). There is over 800,000 cubic yards of potential sediment storage volume in the project area below elevation 8 feet. The sediment that is captured by the project and stored on site would be primarily silts and clays that would otherwise be transported into and mostly deposited in the Bay. Therefore, based on this study, the impact on siltation on oyster beds due to the Proposed Action would be negligible or slightly beneficial. Although this study was focused on identifying general trends in sediment transport capacity of the rivers within the project area and did not evaluate localized effects on siltation shoaling of oyster beds in the Bay, given the potential sediment storage capacity within the

Comment Number	Response
	project area, it is reasonable to conclude that there would be little change in the existing conditions within the bay. Additional text has been added to Section 4.9.1 and 4.9.4 regarding oyster production.
52	Section 6 of the Draft EIS describes mitigation measures that will be implemented to reduce impacts of the Proposed Action. Item 17 addresses dust abatement during construction. Construction impacts on stormwater would be minor; the project contractor will follow the BMPs and mitigation measures in Section 6 to reduce impacts. The low and temporary increase of traffic due to construction would not degrade the physical condition of area roadways (see Section 4.4.2). There would be no long-term effects on area roadways related to the Proposed Action; the provision of funding for road repairs is not a necessary mitigation measure.
53	The existing recreational uses described for the project area in Section 4.9.4.1 of the EIS would remain unchanged following implementation of the Proposed Action. As noted in 4.9.4.2.2, a reduction in total miles of accessible trail would occur, but new levees and water ways developed in the same area would be open to recreational use. As noted in Section 2.1 of the EIS, the purpose of the Tillamook Bay SFC project is to reduce life safety risk from floods and reduce flood damages to property and other economic losses from floods while also contributing to the recovery of federally listed Oregon Coast coho and restoring habitat for other native fish and wildlife species. The addition of these recreational features is not proposed as a part of this project but implementation of this project would not preclude their consideration in future projects. The County has indicated that it plans to develop a management plan for the study area that will provide opportunities for community input on the types of recreational facilities that should be developed and recreation use types that should be encouraged in the project area.
54	Tillamook County is currently not eligible to be a CRS community. The County's status was rescinded in 2013. The County is working towards being eligible for CRS status again, but the Proposed Action would not make the County eligible for CRS status. Therefore, there are no potential CRS benefits to the County as a result of the Proposed Action at this time.
55	As described in Section 2 and 3, the Proposed Action was determined to be the most cost-effective project to address existing flooding issues and provide for habitat restoration. Maintenance costs and measures are described in Section 3 for each alternative. Current expenditures for maintenance of the levee system are described in Section 3.3 and projected annual maintenance costs for the Proposed Action are described in Section 3.4.2.2. The County and other agencies currently responsible for maintenance have committed to continue their responsibilities. In addition, the County and POTB would develop a maintenance and monitoring plan as a condition of their grants through a thoughtful, thorough, and transparent process with key partners. Development of a maintenance and monitoring plan with an adaptive management component would occur in 2017 following construction.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Monday, July 13, 2015 10:13 AM
To: Stenberg, Kate
Subject: DEIS Comment

-----Original Message-----
From: Ken Bell [mailto:kebell36@icloud.com]
Sent: Sunday, July 12, 2015 8:16 AM
To: FEMA-SFC-EIS
Subject: Removel of Dikes

56 I question the removal of the Dikes along the Trask river, Head waters of Tillamook Bay and along the Wilson River as there doesn't appear to be a study was not done of the effects of some value of a Tusuma protection dike!

Ken Bell

2015-07-12_Bell_K.pdf

Comment Number	Response
56	Section 4.7.1.1.2 describes the existing tsunami risk in the project area. As discussed in Section 4.7.1.1.3, none of the project alternatives would affect existing tsunami risks.

Eric and Loretta Peterson
105 Bayocean Rd
Tillamook, OR 97141

July 12,2015

FEMA/ ATTN: MARK EBERLEIN,
REGIONAL ENVIRONMENTAL OFFICER
130-228th St. S.W. Bothell, WA. 98021

Proposed Southern Flow Corridor Project,
ENVIRONMENTAL IMPACT STATEMENT

Dear Sir,

The Peterson Farm was started in the early 1900s. We have been proud owners since October 1979, 35 years ago and have made many improvements to keep producing the highest quality of milk for the Tillamook County Creamery Association. Our milk is made from lush grass produced on our dairy and grazed by our cows. We are grass fed based dairy and our fields are our livelihood.

OUR POSITION IS NO ACTION ALTERNATIVE
The decision to remove existing dikes and levees along Tillamook Bay, Tillamook River, Trask River, Hall Slough and Hoquartin Slough as in the proposed Southern Flow Corridor Project will have negative effects on our farm and existing landowners and
57 threatens our financial livelihood in the dairy industry.

The Southern Flow Corridor presents more problems than answers. The depth of the rivers will severely impact landowners adjacent and upriver from project site as the
58 siltation builds in the coming years.

Before project begins:

1. Armor our dikes from a higher water level, and as the water level increases from siltation in Tillamook River, raise dike up to keep the farm protected.

2. Replace existing tide gates and tubes with new better fish friendly gates.

3. Install a pumping station to lower ground water that is trapped inside our farm from
59A your Southern Flow Corridor project.

4. Write provisions for the lower West end outflow into Tillamook River to be kept open and free of siltation build up.

5. If tide gates totally fail to open, you must install more pumps and pay all restoration
59B costs and electrical cost to operate pumps.

6. Loss of saleable farm ground compensation provision.

7. Provision of loss of farming ability for our farm as this might be within first year of installing your project.

8. Compensation rate will start at $40,000.00 per acre set in an account for said loss of farming provision: after 5 years price will increase 10% per year.

9. FEMA will ensure we will be able to clean and maintain our ditches and waterways without specialized permits.

59C

10. Reconnect Tomlinson Slough on South end using at least 5' diameter fish friendly tide gate.

11. We request Tillamook River depths be recorded and monitored yearly and a written report delivered to us by certified letter, by a non-biased third-party with appropriate credentials. Monitoring needs to start 1/2 mile below the outflow into the Tillamook River from our lower tide gate and 1/2 mile above our two upper tide gates, also out from the outflow to the middle of the Tillamook River channel for any siltation build-up negatively effecting our farmland from this project. From November to May, at the outflow of our tide gates, we suggest monitoring the depth of the river to record the amount of time water takes to leave our farm. The data should be collected for three years and factor in rainfall to get an average. We request a starting point both parties can agree upon.

59D We will be monitoring the ditch northeast of our barn and record our own data.

12. Canals, waterways and the lower rivers need to be kept cleaned out just like they do in Germany and the Netherlands, where they protect their agricultural farmlands with efficient dikes and drainage.

As the population keeps growing, food is in demand. We need to keep these farms producing for the farm families supplying much needed milk to the Tillamook County Creamery Association.
If the Southern Flow Project ruins our fields of lush grass, the Tillamook Southern

59E Corridor Project and FEMA will be held responsible.

Peterson Farm
105 Bayocean Rd.
Tillamook, OR 97141

Eric L. Peterson
Loretta Y. Peterson
Robert S. Gowler-Peterson
Kathleen M. Peterson-Wolfe
Jordan A. Wolfe
Kelly Benson-Peterson
Troy L. Peterson
Dr. Roy H. Peterson
Claire L. Peterson

2015-07-12_Peterson_E.pdf

Comment Number	Response
57	Comment expresses support for the No Action Alternative. The Peterson Farm is located south and west of the SFC project area across the Tillamook and Trask Rivers. The hydraulic modeling described in Section 4.5.3 and shown in Appendix K show slight reductions in flood depths under various flood scenarios across the Peterson farmland. These reductions, while not eliminating flood damages, would be expected to reduce the severity of some flood events, resulting in a beneficial effect.
58	Please refer to the response to Comment # 51 for details about the sediment transport study of the DEIS. Per the fluvial geomorphology study in the DEIS (Section 4.7.1.2), the impact on siltation would be very minor or negligible in most rivers in the study area. That is, there would be very little change from the existing conditions. Although this study was focused on identifying general trends in sediment transport capacity of the rivers within the project area and did not evaluate localized effects on specific adjacent property owners, it may be reasonable to conclude that if there are minor to negligible changes expected in the stream capacity of the rivers that there would be little change in the existing conditions adjacent to the rivers.
59A	The commenter is requesting additional mitigation measures for the Peterson Farm which is located to the south and west of the project area. 1. As described in Section 4.7.1.2.3, there would be a reduction in sediment conveyance capacity compared with the current condition, however it would not be significantly different from the No Action Alternative where sea level rise would also cause channel aggradation of the river beds. The Peterson Farm property would not experience impacts related to sea level rise because of the Proposed Action; armoring of the Peterson Farm dike is not a necessary mitigation measure. 2. The project would be designed to prevent fish stranding and to allow fish passage through tide gates in the project area in compliance with state and federal regulations and the PROJECTS design criteria. Section 6 (Mitigation), item 4 (Fish Passage) describes additional details. This mitigation measure would only be applied within the project area. 3. As described in Section 4.5.5.3.2, there would be no change expected in shallow groundwater levels in areas adjacent to, but outside of, the project area. See also the response to Comment #15, for a discussion of the potential for tidal waters to become trapped inside levees. Simulations of lower Tillamook River levels under average June and July flow conditions show changes in low tide levels of less than 0.05 feet or about one half inch (NHC 2015b). This change would have a negligible effect on water levels and would not affect the functioning of tide gates. This information has been added to Section 4.5.1.3.2.

Comment Number	Response
59B	4. See Response 1 in Comment 59A above. The lower west end outflow to the Tillamook River would not experience changes in capacity related to the Proposed Action; additional provisions beyond those described in Section 6 are not necessary. 5. Tide gates are assumed to function properly as part of this NEPA analysis. Mechanical problems related to the tide gates should be addressed with the manufacturer. Tide gates within the project area would be maintained as described in Section 3. The project would not affect and would not maintain tide gates outside of the project area. See also the response to Comment #15.
59C	6, 7, 8. Changes in the amount of land currently being farmed under each alternative are described in Section 4.7.1.3. Any farmland converted to non-agricultural uses would be purchased in fee by the Port and the County. The economic effects of a reduction in farmland are described in Section 4.9.1. There would be no loss of farmland outside of the project area. Additional mitigation measures are not necessary. 9. See Response 1 in Comment 59A above. The Peterson Farm ditches and waterways would not experience impacts because of the Proposed Action; permit waivers are not a necessary mitigation measure.
59D	10. Tomlinson Slough would not experience impacts because of the Proposed Action; a new tide gate on Tomlinson Slough is not a necessary mitigation measure. 11. The river systems are complex and dynamic and there are many parameters that influence channel erosion or aggradation. As described in Section 4.7.1, the best available science indicates that there would not be a significant change in existing river processes as a result of the Proposed Action. Therefore, additional mitigation measures are not required.
59E	12. The proposed action would restore natural processes to the southern flow corridor project area. The lower Tillamook estuary is a complex and dynamic system that is influenced by many factors throughout the watershed from the upper watershed in the mountains to sea level rise in the bay. The Proposed Action would not significantly alter the existing condition of erosion or aggradation within the river and slough channels and additional mitigation is not required.

FEMA SFC EIS/Mark Eberlein **July 10, 2015**
130 – 228th Street SW
Bothell, WA 98021

Re: Tillamook Southern Flow Corridor (SFC) Project EIS Comments

Dear Mr. Eberlein,

In the Tillamook County February 2014 Memorandum of Agreement (MOA) for the Southern Flow Corridor (SFC) Project, the Tillamook Bay Habitat & Estuary Improvement District (TBHEID) management team obligation is to "Ensure the Project meets the intent of reducing flood hazards." TBHEID review of the May 2015 informative draft Environmental Impact Study (EIS) is focused on EIS flood hazard reductions and Appendix E, the Hydraulic Modeling Peer Review Report.

TBHEID is generally concerned with public and agencies "significant reservations" (p. 5-4) and March 2015 conclusion that "… the performance of an action alternative *(vs No Action)* relative to other actions being considered cannot be assessed with analysis performed to date." (p. 9-6). The reported 6-inch decrease to 2-inch increase in flood water levels in the high human risk and developed state Highway 101 area of northern City of Tillamook (p. 9-9) is untenable. Completion of the five recommendations, in particular, on report page 11-4 would be helpful in gaining community and TBHEID
60 **confidence in the SFC Project obligation to reduce flood hazards.**

Other District interests in gaining community flood hazard reduction support include:
1) More on-the-ground information to optimize the percentage of accuracy and decrease subjective/synthetic generalizations used in current 1D hydraulic modeling (as in 100-year synthetic/hypothetical flood and map). The Hall-Dougherty Slough area, specifically, needs the most accurate and least synthetic projections with the increased flows of Alternative 1. Develop a 2D/3D HEC-RAS model to validate 1D
61 **hydraulic model. (P. 11-4) More sensitivity analysis. (p. 11-4)**
2) Sediment loads (Section 9) follow-up with dredging alternative report
62 **and plan to meet community public meeting interests. (p. 5-4)**
3) Include post-project County Maintenance Plan to maintain public investment into future with ongoing flood hazard reduction and eco-system restoration work. Dredging plan and permits, more flood gages/instruments, and monitoring with more
63 **flood data collection (possibly using tracers such as dyes) addressed. (pp. 6-12-13-14)**

To increase the confidence of TBHEID and the 30% peer uncertainty level (p. 9-7) in the March hydrologic and hydraulic model, FEMA assurance and confidence
64 **of an optimum flood-ecosystem final project is needed. Thank you.**

Respectfully,
Chad Allen
TBHEID President
SFC Project County Management Team Member

2015-07-13_Allen_C_TBHEID_1.pdf

Comment Number	Response
60	The applicant's engineer responded to the peer review memo (Appendix E) and addressed each recommendation (memo dated 05 March 2015). This response has been incorporated in the Final EIS and appended to Appendix E.
61	The applicant's engineer responded to the peer review memo (Appendix E) and addressed each recommendation (memo dated 05 March 2015). This response will be incorporated in the Final EIS and appended to Appendix E. The applicant has developed and is implementing a monitoring plan for the project, including extensive water level monitoring.
62	In the fluvial geomorphology study of the EIS (Section 4.7.1.2), the change in the sediment transport capacity of the rivers due to the Proposed Action was evaluated. The sediment transport capacity is defined as the stream's ability to carry the sediment in the flow. Therefore, when the sediment capacity of the river changes, sediment accumulation (siltation) or erosion can occur on the streambed. Generally, when the sediment transport capacity increases, erosion of the streambed occurs, and when the sediment transport capacity decreases, sediment accumulates on the streambed. Per this study, during the construction and transitional periods, the Proposed Action would have moderate, localized impacts on the sediment transport capacity in the Wilson River near the project area. In the Trask River, potential impacts on sediment transport capacity would be negligible. Over the long-term, most reaches would have no change or increased sediment transport capacity except for lower Hall Sough which shows a risk of sediment accumulation. Therefore, based on this study, the impact on siltation due to the Proposed Action would be very minor or negligible in most rivers in the study area. In addition, the dredging alternatives were described and evaluated in Section 3.7.3.
63	Section 6 of the Draft EIS describes mitigation measures that will be implemented to reduce impacts of the Proposed Action. The mitigation measures include long-term measures to maintain the benefits of the Proposed Action. As described in Section 3.4.2.2, the County and POTB would develop a maintenance and monitoring plan as a condition of their grants through a thoughtful, thorough, and transparent process with key partners. Development of a maintenance and monitoring plan with an adaptive management component would occur in 2017 following construction. The existing monitoring program includes a network of flood gages to monitor water levels across the lower Tillamook, Trask and Wilson Rivers.
64	The applicant's engineer responded to the peer review memo (Appendix E) and addressed each recommendation (memo dated 05 March 2015). This response will be incorporated in the Final EIS and appended to Appendix E.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Tuesday, July 14, 2015 8:11 AM
To: Stenberg, Kate
Subject: FW: Tillamook SFC Project EIS Draft Comments by TBHIED
Attachments: letters(2)3.doc

From: TBHEID [mailto:TBHEID@tillamookoffice.com]
Sent: Monday, July 13, 2015 4:39 PM
To: FEMA-SFC-EIS
Subject: Tillamook SFC Project EIS Draft Comments by TBHIED

65 Please confirm receipt of attached TBHEID letter of record regarding Tillamook SFC Project draft EIS comments. Thank you, Tilda @ TBHEID Office

2015-07-13_Allen_C_TBHEID_2.pdf

Comment Number	Response
65	No response needed.

ORCA: Oregon Coast Alliance
P.O.Box 857, Astoria OR 97103
(503) 391-0210 http://www.oregoncoastalliance.org

Protecting the Oregon Coast

July 13, 2015

SFC-EIS
Federal Emergency Management Agency (FEMA)
Region 10
130-228th St. SW
Bothell, WA 98021

Sent via email: fema-sfc-eis@fema.dhs.gov

Re: Southern Flow Corridor Project DEIS, Tillamook County, Oregon

Dear Sir/Madam,

Oregon Coast Alliance (ORCA) is an Oregon nonprofit corporation whose mission is protection of coastal natural resources and aiding coastal communities in creating and maintaining livable communities. We write these comments on behalf of our members in Tillamook County.

Having studied the DEIS for the Southern Flow Corridor Project, ORCA writes this letter in support of the Landowner Preferred Alternative. Farmland is critical to Tillamook County, as farming operations are a major portion of the County's economy; but flood reduction, increasing the ecological integrity of Tillamook Bay and critical wetland habitat restoration are equally valuable. In such a situation, working out a solution to the identified problem (i.e., flooding) must be a work-in-progress with all stakeholders represented at the table.

SFC is a successful outcome of a longterm process to create a solution that retains and protects farmland, restores wetlands, reduces flooding and aids in the difficult task of
66 increasing the ecological integrity of Tillamook Bay.

The only suggestion ORCA would add to this outcome is that the framework set in place for SFC be continued even after all components of land purchase, levee removal, new levee construction and so on are completed. The vagaries of weather, combined with land and water accommodation to new flow patterns, may mean that modifications

need to be made on the ground once the new system begins to work. Hydrological modeling is helpful, but can only take planners so far. Levees many need to be
67 adjusted, other lands purchased, flowage easements expanded or shifted, for example.

SFC is a remarkable collaboration resulting from diverse parties' decision to address a serious ongoing problem, and find a workable solution. ORCA hopes the public process concludes in the same spirit of collaboration, as well as the actual implementation of the project when it begins.

Sincerely,

Cameron La Follette

Cameron La Follette
Executive Director

2015-07-13_LaFollette_C_ORCA_1.pdf

Comment Number	Response
66	Comment expresses support for the Proposed Action.
67	Section 6 of the Draft EIS describes mitigation measures that will be implemented to reduce impacts of the Proposed Action. The mitigation measures include long-term measures to maintain the benefits of the Proposed Action. As described in Section 3.4.2.2, the County and POTB would develop a maintenance and monitoring plan as a condition of their grants through a thoughtful, thorough, and transparent process with key partners. Development of a maintenance and monitoring plan with an adaptive management component would occur in 2017 following construction.

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Tuesday, July 14, 2015 8:11 AM
To: Stenberg, Kate
Subject: FW: Southern Flow Corridor comments
Attachments: ORCA to FEMA re South Corridor DEIS July 15.pdf

-----Original Message-----
From: Cameron La Follette [mailto:cameron@oregoncoastalliance.org]
Sent: Monday, July 13, 2015 12:19 PM
To: FEMA-SFC-EIS
Subject: Southern Flow Corridor comments

Dear Sir/Madam,

68 Attached are the comments of Oregon Coast Alliance on the Draft EIS for the Southern Flow Corridor project in Tillamook County. Please place these comments in the record.

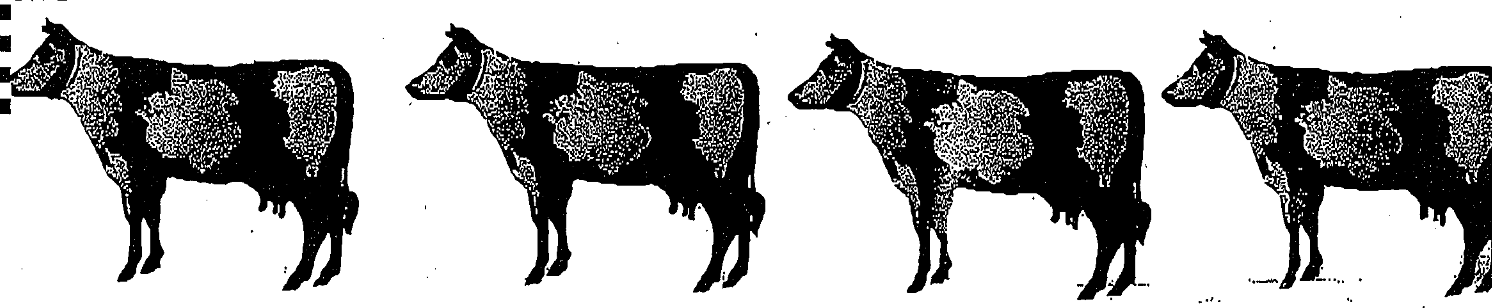
Sincerely,

Cameron la Follette
--

Cameron La Follette
Executive Director
Oregon Coast Alliance
P.O. Box 857
Astoria, OR 97103
(503) 391-0210
cameron@oregoncoastalliance.org
www.oregoncoastalliance.org

2015-07-13_LaFollette_C_ORCA_2.pdf

Comment Number	Response
68	No response needed.



FAIRVIEW ACRES DAIRY FARMS, INC.

FAX COVER SHEET

Richard Obrist
7615 Trask River Road
Tillamook, Or 97141

Home Phone number (503) 842-4603
Barn Phone number (503) 842-2930
Fax number (503) 842-0457

TO: Mark Eberlien

COMPANY: Fema

RE: Fema SFC EIS

FROM: Richard Obrist - Fairview Acres Dairy

DATE: 7-13-15

Number of pages: (including cover page) 5

MESSAGE : Written Comments

Fairview Acres Dairy Farms Inc
7615 Trask River Road
Tillamook, Oregon 97141
503-801-3231

July 13, 2015

To Mark Eberlein,
Subject: Fema SFC EIS

My name is Richard Obrist, 65 years old and born and raised here in Tillamook, Oregon. Growing up here in the dairy industry I have be involved in every part of day to day decisions. For the past 16 years I have been the President of the North Coast unit of the Oregon Dairymen Association, with about 100 members. Last Falls Annual meeting The Southern Flow Corridor was discussed at length.

Taking 150 current acres out of production in Tillamook County that can raise animals and grow crops is a economical loss. I know the land because my dairy used it for about 2 years for raising Holstein heifers. I was able to use the Loafing barn that was there for feeding and shelter. The Engles Family used to milk there. The milking Parlor was still looking good about 25 years ago.

My Family was Able To buy A vacant dairy next To our main Farm so we gave up our Lease about 20 years Ago. CHAD Allen dairy now grows 2 To 3 cuttings of grass From the same 150 Acres of Farm Land and can still sell extra Tons of Feed To other dairies. Calculations of Tons From this well groomed Farm Land would be about 2000+ Tons per year.

Field Corn can also be grown on this Land. 100 Acres will produce 20+ Tons per Acre. Beinger Farms is in the same Area and is producing good quality Corn silage and grass. So 100 Acres x 20 Ton per Acre = 2000 Tons. THATS about 65 Semi Loads of Silage That doesn't need To come From Willamette Valley Farms. Last winter's price For Field Corn To Tillamook was $78 per Ton. 2000 Tons x $78 = $156,000 for Tillamook dairies To Pay. The $156,000 would be paid To the Willamette Valley grower instead of Keeping the money in the Local economy. The grass That Allen Dairy grows is worth at least $250,000 with good management.

Every dollar that stays in The local Community makes more dollars. Tillamook is now Showing That grass and Corn Silage for cows is needed To Keep our operating Costs At A lower level To keep in business

The Statement in (4.7.1.32 Affected Environment) about few crops can be economically grown and harvested because of the low numbers of heat units to mature crops is not true. The last few years Tillamook grass and corn silage fields are doing very well.

70

Mr Collins who is studying this area for flood reduction was asked at a meeting if well groomed farm land would allow flood waters from Tillamook to get to the bay faster than if it had to move thru converted wetlands or marshgrass that is overgrown. He said yes it would. David Geinger who farms next to the 150 acres asked if the conversion would help his farm or hurt his farm. Mr Collins said "I think it will help". This really isn't a good answer because nobody knows for sure.

71

If all the current tide gates are removed and the diking lowered a lot of locals believe that the bay will fill up with silt which will hurt our Tillamook Bay. Example would be like taking a nozzle off of a hose if the big tide gates are removed. The high tides would also be allowed closer to Tillamook.

72

73

I Am Also A Past President of Tillamook County Farm Bureau for 6 years. Currently I serve on the excutive board that meets monthly. Our board believes the No Action Alternative is the best Thing To happen and That Tillamook County overtime could phase it out of Agriculture production because of the grant funding Terms.

Thank you for your time,

Richard Obrist

2015-07-13_Obrist_R.pdf

Comment Number	Response
69	Farmland of statewide importance is evaluated and in Section 4.7.1.3.3. Not all areas designated farmland of statewide importance within the project area are currently farmed. Some of these lands are forested or are not farmable due to surface water inundation or saturated soils. The Proposed Action would convert approximately 219 acres of land currently in pasture and hay production to restored floodplain and wetland habitat. Because the No Action Alternative would also phase out current agricultural activities within the project area, the Proposed Action would only remove an additional 67 acres from current production. The conversion of farmland associated with the Proposed Action would have a minor, local, long-term adverse impact on the regional economy that would be less than significant. Text has been added on the value of production lost based on USDA National Agricultural Statistics Service data. Text has also been added on effects to the dairy industry.
70	The statement in Section 4.7.1.3.2 is referring to the definition of "prime farmland". The soils in the project area and through much of the Tillamook Valley are identified as "farmland of statewide importance". These terms have specific definitions set by NRCS and do not necessarily imply that agricultural pursuits are not successful.
71	Sections 4.5.1 and 4.5.3 and Appendices E and K describe the potential effects of the alternatives on floodplains and flood depths and extent. The hydraulic modeling from which the estimates of potential effects are drawn are based on standard engineering principals and developed from surveys of the project area and data on previous flood events. Most of the project area is expected to convert from pasture and freshwater scrub/shrub wetlands to mudflat and high and low tidal marsh. Mudflats and low tidal marsh are around the same or lower roughness than pasture. These vegetation types present less roughness than the freshwater scrub/shrub wetlands that currently exist on the site. While pasture presents a low roughness to overland flows of floodwaters, the effects are minimized because of the dikes that must surround the pasture to prevent tidal flooding. The dikes cause flood levels to be artificially dammed up within the pasture and lower water velocities in the fields. The Geinger farm area is predicted to see some reductions in flood levels. However, much of this farm is on the bay front, so high water levels are tied to tides and storm surges more than river flooding. The project would have no impact on extreme high tides or storm surge levels.

Comment Number	Response
72	The Proposed Action would move the levees and tide gates further inland away from the edge of the bay, it would not remove them completely from the landscape. Per the fluvial geomorphology study of the EIS (Section 4.7.1.2), during the construction and transitional periods, increased sedimentation on the floodplain surface would result from the Proposed Action. Numerous studies of other tidal restoration projects have found that when formerly diked areas of subsided land are reconnected to the tides the land begins to rebuild by capturing sediment from the adjoining river channels on each high tide. Comparison with reference tidal marshes adjacent to the project site and the Garibaldi tide gage indicate the expected re-accreted marsh elevation will be at least elevation 8 feet (NAVD88 datum). There is over 800,000 cubic yards of potential sediment storage volume in the project area below elevation 8 feet. The sediment that is captured by the project and stored on site would be primarily silts and clays that would otherwise be transported into and mostly deposited in the Bay. The current project area has subsided because sediment carried by the rivers and floodwaters has been excluded from the project area by the current levee system. With the levees removed and set back, the project area will be available for deposition of the sediment loads carried by floodwaters and by the adjacent rivers. As described in Section 3.4.2.2, the County and POTB would develop a maintenance and monitoring plan as a condition of their grants through a thoughtful, thorough, and transparent process with key partners. Development of a maintenance and monitoring plan with an adaptive management component would occur in 2017 following construction.
73	Comment expresses support for the No Action Alternative. The land within the SFC study area that was previously purchased by Tillamook County is required to prohibit agricultural uses under the terms of the grant funding used to purchase the land. Agricultural production would be phased out over time under the No Action Alternative and the Hall Slough Alternative, and it would be phased out more quickly under Alternatives 1 and 3.

Tillamook Southern Flow Corridor Project
Environmental Impact Statement

Draft EIS Comment Form
Submit by July 13, 2015

Please provide comments on the proposed alternatives for the Southern Flow Corridor Project, potential impacts of the alternatives, and proposed mitigation measures. The Draft Environmental Impact Statement (EIS) is available at SouthernFlowEIS.org. Feel free to take an extra form and send comments to FEMA (address below).

Comments collected at this time will become part of the project record. Responses to comments will be provided in the Final EIS. **Comment forms must be submitted by July 13, 2015** to be included in the project record.

Name Tom ToBin Organization (if applicable) Peterson Farm

Address 6525 E St

City Bay City State Ore ZIP 97107

Email (optional)

Use the space below to provide comments on the Draft EIS.

The Removal of Levees in The SFC Will impact Lower section's of The Bay and Dairy Land By Raising The Level of The Available Storm Storage Water There By making it neccesary To Raise Levee's on Down Stream Property's

1. Raise Dyke By 4 Ft minamum
2. Install New ~~Fl~~ Tide gates
3. Add Pump's.

Written comments must be postmarked, e-mailed, faxed, or otherwise submitted by **July 13, 2015**. Mail: FEMA, Attn: Mark Eberlein, Regional Environmental Officer, 130 - 228th Street SW, Bothell, WA 98021 Email: fema-sfc-eis@fema.dhs.gov Online: www.SouthernFlowEIS.org Fax: (425) 487-4613 Attention: FEMA SFC EIS.

FEMA

4. Set money in Escrow For Flood Damages To Farm Land when The Flood Event Breaches Dykes Do to Storm surge, allowing this SFC To Happen will cause Harm To Life & Property 74

I am For NO Action.

I Grew up on a Farm in The Purposed Project area. owned 12 acres at The End Goodspeed R.D.. The Project will Do No good In Helping The Flood event's on 101. The Bay is Too Shallow. 75

Fold

Fold

Place stamp here

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

Tape

Tape

Tape

Eric and Loretta Peterson
105 Bayocean Rd
Tillamook, OR 97141

July 12,2015

FEMA/ ATTN: MARK EBERLEIN,
REGIONAL ENVIRONMENTAL OFFICER
130-228th St. S.W. Bothell, WA. 98021

Proposed Southern Flow Corridor Project,
ENVIRONMENTAL IMPACT STATEMENT

Dear Sir,
The Peterson Farm was started in the early 1900s. We have been proud owners since October 1979, 35 years ago and have made many improvements to keep producing the highest quality of milk for the Tillamook County Creamery Association. Our milk is made from lush grass produced on our dairy and grazed by our cows. We are grass fed based dairy and our fields are our livelihood.

OUR POSITION IS NO ACTION ALTERNATIVE
The decision to remove existing dikes and levees along Tillamook Bay, Tillamook River, Trask River, Hall Slough and Hoquartin Slough as in the proposed Southern Flow Corridor Project will have negative effects on our farm and existing landowners and threatens our financial livelihood in the dairy industry.

The Southern Flow Corridor presents more problems than answers. The depth of the rivers will severely impact landowners adjacent and upriver from project site as the siltation builds in the coming years.

Before project begins:

1. Armor our dikes from a higher water level, and as the water level increases from siltation in Tillamook River, raise dike up to keep the farm protected.

2. Replace existing tide gates and tubes with new better fish friendly gates.

3. Install a pumping station to lower ground water that is trapped inside our farm from your Southern Flow Corridor project.

4.Write provisions for the lower West end outflow into Tillamook River to be kept open and free of siltation build up.

5. If tide gates totally fail to open, you must install more pumps and pay all restoration costs and electrical cost to operate pumps.

6. Loss of saleable farm ground compensation provision.

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JUL 15 2015
FEMA REGION X

7. Provision of loss of farming ability for our farm as this might be within first year of installing your project.

8. Compensation rate will start at $40,000.00 per acre set in an account for said loss of farming provision: after 5 years price will increase 10% per year.

9. FEMA will ensure we will be able to clean and maintain our ditches and waterways without specialized permits.

10. Reconnect Tomlinson Slough on South end using at least 5' diameter fish friendly tide gate.

11.We request Tillamook River depths be recorded and monitored yearly and a written report delivered to us by certified letter, by a non-biased third-party with appropriate credentials. Monitoring needs to start 1/2 mile below the outflow into the Tillamook River from our lower tide gate and 1/2 mile above our two upper tide gates, also out from the outflow to the middle of the Tillamook River channel for any siltation build-up negatively effecting our farmland from this project. From November to May, at the outflow of our tide gates, we suggest monitoring the depth of the river to record the amount of time water takes to leave our farm. The data should be collected for three years and factor in rainfall to get an average. We request a starting point both parties can agree upon.
We will be monitoring the ditch northeast of our barn and record our own data.

12.Canals, waterways and the lower rivers need to be kept cleaned out just like they do in Germany and the Netherlands, where they protect their agricultural farmlands with efficient dikes and drainage.

As the population keeps growing, food is in demand. We need to keep these farms producing for the farm families supplying much needed milk to the Tillamook County Creamery Association.
If the Southern Flow Project ruins our fields of lush grass, the Tillamook Southern Corridor Project and FEMA will be held responsible.

Peterson Farm
105 Bayocean Rd.
Tillamook, OR 97141

Eric L. Peterson
Loretta Y. Peterson
Robert S. Gowler-Peterson
Kathleen M. Peterson-Wolfe
Jordan A. Wolfe
Kelly Benson-Peterson
Troy L. Peterson
Dr. Roy H. Peterson
Claire L. Peterson

76

2015-07-13_Tobin_T.pdf

Comment Number	Response
74	Figures 4.5-4, 5, and 6 of the EIS indicate that predicted change in water surface elevations between no action and the proposed action are generally negative for 1.5, 5, and 100-year events. This result indicates nominal to potentially positive impacts on properties in the lower portion of the Bay during flood conditions (i.e. the water surface is expected to be lower during flood events after construction of the preferred alternative as compared to current conditions). It is not anticipated that this beneficial change would require additional mitigation measures. Please refer to Sections 4.5.1 and 4.5.3 and Appendices E and K for a detailed discussion of relative impacts of each alternative on flood conditions in and around the study area. Impacts vary by specific location, although generally, water surface elevations are lowered under a range of large flow conditions (flood events).
75	Comment expresses support for the No Action Alternative. Section 4.5.1 and 4.5.3 and Appendices E and K describe the potential for reductions in flooded area and flood depths under various flood recurrence intervals. While the project would not eliminate flooding in the Tillamook Valley, it is predicted to reduce flood damages. Analyses performed by the applicant and previous studies by USACE indicate that local flooding conditions in the study area are primarily caused by upstream riverine flows, not from the Bay.
76	This second copy of the letter is entered into the record, but responses to the comments in that letter are associated with 2015-07-12_Peterson_E.pdf.

Agency Comments

Tillamook County

Board of Commissioners
Tim Josi, Mark Labhart, Bill Baertlein
201 Laurel Avenue
Tillamook, Oregon 97141
Phone 503-842-3403
Fax 503-842-1384
TTY Oregon Relay Service

Land of Cheese, Trees and Ocean Breeze

June 24, 2015

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

To Mr. Eberlein:

A1

The Tillamook County Board of Commissioners strongly supports and is committed to the Oregon Solutions Southern Flow Corridor - Landowner Preferred Alternative Project.

As a direct consequence of this project, flooding will be reduced over 3,000 acres thereby directly benefitting 540 structures and resulting in $9.2 million in avoided flood damage over the life of the project.

Sincerely,

BOARD OF COMMISSIONERS FOR
TILLAMOOK COUNTY, OREGON

Tim Josi, Chair

Mark Labhart, Vice Chair

Bill Baertlein, Commissioner

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JUN 26 2015
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G:LETTERS\SUPPORT\FEMA SFC EIS Support Letter 2015 06-24.doc

2015-06-24_Tillamook_Co_Commissioners

Comment Number	Response
A1	Comment noted. Comment expresses support for the Proposed Action.

Stenberg, Kate

From: Kerschke, William <William.Kerschke@fema.dhs.gov>
Sent: Tuesday, June 16, 2015 10:03 AM
To: Stenberg, Kate
Subject: FW: Review of Effect Table - Southern Flow Corridor

Hi Kate,

Amy forwarded this comment from Madeleine Vander Heyden, Fish and Wildlife Biologist, Oregon Coastal Program, Bandon Marsh National Wildlife Refuge. Looks like she just looked at the Table.

From: Horstman, Amy [mailto:amy_horstman@fws.gov]
Sent: Monday, June 15, 2015 11:25 AM
To: Kerschke, William; Madeleine VanderHeyden
Subject: Fwd: Review of Effect Table - Southern Flow Corridor

Hi Bill, My colleague Madeleine provided some comments on the draft EIS that might be helpful in formulating the final document. No proposed major changes, but some clarifications that do appear very value added - see below.

Can this email work to get these comments into consideration for the final EIS language?

thanks,

Amy Horstman
Habitat Restoration Program
USFWS -Columbia River Fisheries Program Office
1211 SE Cardinal Court, Suite 100
Vancouver, WA 98683
amy_horstman@fws.gov
Phone: 360.604.2512; cell: 503.704.7508; fax 360.604.2505

---------- Forwarded message ----------
From: **Madeleine VanderHeyden** <madeleine_vanderheyden@fws.gov>
Date: Mon, Jun 15, 2015 at 11:12 AM
Subject: Review of Effect Table - Southern Flow Corridor
To: amy_horstman@fws.gov
Cc: Laura Todd <Laura_Todd@fws.gov>

As requested, I read **Table ES-1. Summary of Potential Effects** from the Draft EIS for the Southern Flow Corridor Project. I do not have any comments on the conclusions drawn from the analysis but I do have a few suggestions that may help the reader evaluate the alternatives.

A2 1) Provide definitions of: significant, long-term, short-term, local, regional. Definitions would change depending on the resource category. For example, a significant effect for coho may be an affect at the population level, whereas for water quality it may refer to crossing a defined threshold related to temperature, or turbidity (or other).

A3 2) Where effects are exactly the same for one or more alternatives, say so. For example, the proposed alternative and alternative 3 are similar in many aspects in terms of effects. It would be helpful to point out where the differences and similarities exist. It is hard to compare and contrast within the current table's format.

A4 3) Consider splitting out freshwater wetlands from tidal wetlands as the effects are different.

A5 4) The Fish and Wildlife table does not mention bald eagle nesting habitat.

How would you suggest these comments be carried forward?

Best of luck with the complex but great project.

Madeleine

Madeleine Vander Heyden

Fish and Wildlife Biologist, Oregon Coastal Program

Bandon Marsh National Wildlife Refuge

83673 North Bank Lane

Bandon, Oregon 97411

541-347-1470 ext. 4

2015-6-15 VanderHeyden USFWS

Comment Number	Response
A2	Section 4.1 provides the definitions for each of the terms noted in the comment. The criteria used for determining the significance of impacts are described in each section. Significance is based on thresholds described for each resource area.
A3	Detailed discussions of effects by alternative are found in Section 4. The summary table is an abbreviated summary and will be reviewed to add additional detail as needed.
A4	Freshwater and tidal wetland effects are described separately in the summary tables ES-1 and 4.3-1 and in Section 4.5.2, Wetlands.
A5	Table 4.6-3 lists special status wildlife species; bald eagle is not included in the table because it is no longer federally listed. Existing bald eagle nesting habitat is discussed in Section 4.6.2.2 and Section 4.6.2.3.2 describes potential effects on bald eagle nesting habitat. Section 6 includes Mitigation Measure #7 to avoid disturbance of nesting bald eagles. Potential effects on bald eagles will be added to the summary tables ES-1 and 4.3-1.

Tillamook County Soil and Water Conservation District
6415 Signal Street - Tillamook, Oregon 97141 Phone (503) 842-2240 / Fax (503) 842-2760
Website - http://www.tbcc.cc.or.us/~tcwrc/swcd E-Mail: tcswcd@oregoncoast.com

Federal Emergency Management Agency
130-228th Street SW
Bothell, Washington 98021

July 7, 2015

Mark Eberlein, Regional Environmental Officer

Dear Mr. Eberlein:

The Tillamook County Soil and Water Conservation District has reviewed the Tillamook Southern Flow Corridor Project's Environmental Impact Statement. We have the following concerns:

A6
- Farmland Protection The conversion of 320 acres of agricultural land is more than minor. Agricultural land in Tillamook County is a finite resource. We have very few acres. The Tillamook County Soil and Water Conservation District's position regarding the loss of agricultural land is no net loss. Our agricultural acres support a major dairy industry in Tillamook County. The Tillamook County Creamery Association's Cheese plant provides jobs and economic benefits for Tillamook County. Your Environmental Impacts fails to address the economic loss to the dairy industry by converting the 320 acres to wetlands. There is more than just flooding that must be addressed

A7
- The accumulation of gravel and sediment in our lower river channels and sloughs will be more than minor. Removing tide-gates and dikes will only accelerate gravel deposition in the lower river channels and the sloughs. The economic impacts of gravel accumulation needs to be addressed. Will increased gravel accumulation increase streambank erosion and damage existing streambank protection projects that have been installed. The Soil and Water Conservation District does support any beneficial effects as a result from natural channel formation. Streambank erosion will further erode our county's finite resource.

A8
- Increased flooding and associated drainage of the lower agricultural lands because of removing dikes and tide-gates will further the loss of agricultural lands above the 320 acres due to increased drainage problems and salt water intrusion. The loss of productive livestock forage will results. The Environmental Impact Statement must address those agricultural lands adjacent to the project that will be impacted.

A9
- The destruction of animal waste storage facilities in the project area. The manure storage structures include 2 below ground liquid manure tanks, an above ground liquid waste storage tank, and a solid manure storage facility. These facilities could easily be used by a dairyman to increase their manure storage capacity. The environmental impact statement must address this loss.

Rudy Fenk

- Rudy Fenk, Chairperson
  Tillamook County Soil and Water Conservation District

2015-07-07_Fenk_R_TillamookCoSWCD.pdf

Comment Number	Response
A6	Farmland of statewide importance is evaluated and in Section 4.7.1.3.3. Not all areas designated farmland of statewide importance within the project area are currently farmed. Some of these lands are forested or are not farmable due to surface water inundation or saturated soils. The Proposed Action would convert approximately 219 acres of land currently in pasture and hay production to restored floodplain and wetland habitat. Because the No Action Alternative would also phase out current agricultural activities within the project area, the Proposed Action would only remove an additional 67 acres from current production. The conversion of farmland associated with the Proposed Action would have a minor, local, long-term adverse impact on the regional economy that would be less than significant. Text has been added on the value of production lost based on USDA National Agricultural Statistics Service data. Text has also been added on effects to the dairy industry.
A7	In the fluvial geomorphology study of the DEIS (Section 4.7.1.2), the change in the sediment transport capacity of the rivers due to the Proposed Action was evaluated. Per this study, during the construction and transitional periods, the Proposed Action would have moderate, localized impacts on the sediment transport capacity in the Wilson River near the project area. In the Trask River, potential impact on sediment transport capacity would be negligible. Over the long-term, most reaches would have no change or increased sediment transport capacity except for lower Hall Sough which shows a risk of sediment accumulation. In-channel bed sediments in the area are primarily sands and small amounts of gravel. The rivers also transport a large amount of silt that is carried in suspension out to Tillamook Bay. Numerous studies of other tidal restoration projects have found that when formerly diked areas of subsided land are reconnected to the tides, the land begins to rebuild by capturing sediment from the adjoining rivers on each high tide. Therefore, based on this study, the impact on sedimentation from the Proposed Action would be very minor or negligible in most rivers in the study area.

Comment Number	Response
A8	Section 4.5.1 and 4.5.3 describe expected effects on floodplains and flood levels under various flood event scenarios. Generally, flood depths are expected to be reduced both within the project area and on floodplain properties adjacent to the project area; although, the project will not eliminate flooding in the Tillamook Valley. Section 4.5.5 describes potential effects on groundwater and negligible to minor effects are expected. Saltwater intrusion is not currently an issue for production of livestock forage in areas adjacent to tidal waters. Because the proposed project would not affect the tidal prism against the new levees and the new levees would be less permeable than the existing levees, salt water intrusion is not expected to be an effect of the project. Additional information has been added to Section 4.5.5 to clarify the existing condition. The concern expressed is that the change in the position of the levees and the resulting potential change in the tidal prism could result in tidal waters lingering longer against the new setback levees. If this occurred it could prevent water from discharging from the tide gates properly and result in flooding of the adjacent agricultural lands. Low flow modeling was conducted to determine if this potential effect could occur in the SFC area. Simulations of lower Tillamook River levels under average June and July flow conditions show changes in low tide levels of less than 0.05 feet or about one half inch (NHC 2015b). This change would have a negligible effect on water levels and would not affect the functioning of tide gates. This information has been added to Section 4.5.1.3.2.
A9	There is a manure storage shed on the Jones parcel that would need to be removed. This manure shed, described in Section 3.4.1.7 is currently not in use and is in very poor condition. It cannot be assumed that the shed would be used in the future in its current condition. There would be no economic impact from removal of the shed relative to the No Action Alternative.

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
620 SW Main Street, Suite 201
Portland, Oregon 97205-3026

IN REPLY REFER TO:
9043.1
ER15/0316

Electronically Filed

July 13, 2015

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 - 228th Street SW
Bothell, WA 98021

Dear Mr. Eberlein:

A10 The Department of the Interior has reviewed the Draft Environmental Impact Statement for the Federal Emergency Management Agency for the Southern Flow Corridor Flood Reduction and Habitat Restoration Project, Tillamook County, Oregon. The Department has no comments on the document at this time.

We appreciate the opportunity to comment.

Sincerely,

Allison O'Brien

Allison O'Brien
Regional Environmental Officer

Stenberg, Kate

From: FEMA-SFC-EIS <fema-sfc-eis@fema.dhs.gov>
Sent: Tuesday, July 14, 2015 8:11 AM
To: Stenberg, Kate
Subject: FW: DEIS: FEMA's Southern Flow Corridor Flood Reduction and Habitat Restoration Project, Tillamook County, Oregon
Attachments: 20150713_ER15_0316_nc_DEIS.pdf

From: Milchak, Brian [mailto:brian_milchak@ios.doi.gov]
Sent: Monday, July 13, 2015 11:54 AM
To: FEMA-SFC-EIS
Cc: Lisa Treichel; Allison O'Brien; John Fuhrer
Subject: DEIS: FEMA's Southern Flow Corridor Flood Reduction and Habitat Restoration Project, Tillamook County, Oregon

Hello Mr. Eberlein,

Attached please find the Department of the Interior's comments on the subject DEIS.

Have a great day,
A11 Brian Milchak

--
Brian Milchak
Regional
Environmental
Assistant

Office of Environmental Policy and Compliance, Pacific Northwest Region
620 SW Main Street, Suite 201
Portland, OR 97205
Telephone: (503) 326-2489
Mobile: (503) 320-3319
Fax: (503) 326-2494
States: WA, OR, ID
http://www.doi.gov/pmb/oepc/portland.cfm

2015-07-13_Milchak_B_DOI.pdf

Comment Number	Response
A10	No response needed.
A11	No response needed.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, WA 98101-3140

OFFICE OF
ECOSYSTEMS, TRIBAL AND
PUBLIC AFFAIRS

July 13, 2015

Federal Emergency Management Agency
c/o Mark Eberlein, Regional Environmental Officer
130 – 228th Street SW
Bothell, Washington 98021

Dear Mr. Eberlein:

We have reviewed the Federal Emergency Management Agency's May 2015 Draft Environmental Impact Statement (DEIS) for the Southern Flow Corridor Project, Tillamook County, Oregon (EPA Region 10 Project Number: 14-0023-FEM).

Our review was conducted in accordance with the EPA's responsibilities under the National Environmental Policy Act and Section 309 of the Clean Air Act. Section 309 specifically directs the EPA to review and comment in writing on the environmental impacts associated with all major federal actions. Our review of the DEIS prepared for the proposed action considers expected environmental impacts and the adequacy of the EIS in meeting procedural and public disclosure requirements of the NEPA.

We are rating the DEIS Lack of Objections (LO). A copy of our rating system is enclosed.

Project summary

The Southern Flow Corridor Project DEIS evaluates the environmental effects that could occur if activities to reduce flood damage and restore Coastal Coho habitat in the Tillamook Bay estuary are implemented. The Proposed Action would remove approximately 6.9 miles of levees, modify 2.9 miles and construct 1.4 miles of new setback levees, and restore tidal wetlands on 522 acres.

The EPA supports this project

We support this project because restoring approximately 522 acres of tidal wetlands and associated fish and wildlife habitat would have major, long-term beneficial effects on wildlife and threatened and endangered species, including the threatened Coastal Coho salmon. In addition, the Proposed Action would reduce flooding during small flood events, as well as the 100-year flood.

As stated in our 2014 scoping comments, we support actions that restore natural processes, especially where there may be a dual benefit such as flood risk reduction. And, we reiterate our position that emphasis on achieving both flood risk reduction and environmental benefits is consistent with federal agencies', including FEMA's, responsibilities to the Tillamook Bay Comprehensive Management Plan
A12 (CCMP); which the EPA has approved under the Federal Clean Water Act.

Adaptive management

Our scoping comments included a recommendation for the DEIS to include a "...detailed draft monitoring and adaptive management plan..." We noted and continue to believe that the January, 2014 Southern Flow Corridor Effectiveness Monitoring Plan is a useful start, especially for establishing baseline information and monitoring planning. The DEIS's indication that "The County and POTB (Port of Tillamook Bay) would develop a maintenance and monitoring plan as a condition of their grants that will include performance standards and adaptive management components for vegetation"[1] and is partially responsive to our interest in ensuring that adaptive management supports the accomplishment of project goals.

Moving forward, we recommend that the Final Environmental Impact Statement (FEIS) include additional information on adaptive management. In particular, we suggest that the FEIS identify: (i) likely topics and/or concepts for key performance standards, (ii) related potential management responses, and (iii) responsible parties.

Additional effort on adaptive management is appropriate because, as the Hydraulic Modeling Peer Review Report usefully observes, "The project area is located within an unusually complex hydrologic and hydraulic system. Even with substantial effort to collect data and construct analytical and simulation tools that represent that system, uncertainty exists about how it performs under current conditions and how it may perform under action alternatives."[2] In addition to complex hydrology, there are also social and economic risks to achieving project goals. For example, project funding would come from numerous sources, including: FEMA, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, State of Oregon, Oregon Watershed Enhancement Board, Tillamook County, and other public and private entities. Given the number of physical, social and economic factors relating to project success, we believe the Final EIS can add value to the process by identifying the highest priority performance standards, related management responses, and responsible parties.

A13

Significance criteria

Our scoping comments included a suggestion to utilize project-specific significance criteria because we believe this style of disclosure can be an effective strategy for meeting the intent of 40 CFR Part 1502.1. We would like to highlight our appreciation for this DEIS's inclusion of thresholds of significance. Overall the DEIS's thresholds are appropriate for this project and help to sharply define the issues. For example, the DEIS clearly discloses that the No Action Alternative would result in significant adverse impacts to floodplains, wetlands, hydrology, water quality, fish and wildlife, threatened and endangered species and critical habitat, coastal resources, hazardous materials, economics, public health and safety, visual quality, and recreation. In contrast, the Proposed Action reduces impacts to these resources to a level where they would be less than significant. This contrast between No Action and the Proposed Action helps decision makers and the public understand the degree to which the Proposed Action is environmentally preferable.

A14

[1] DEIS, p. 4-40 and elsewhere
[2] DEIS, Appendix E, p. 6-14

Thank you for this opportunity to comment and if you have any questions please contact me at (206) 553-1601or by electronic mail at reichgott.christine@epa.gov, or you may contact Erik Peterson of my staff at (206) 553-6382 or by electronic mail at peterson.erik@epa.gov.

Sincerely,

Christine B. Reichgott, Manager
Environmental Review and Sediment Management Unit

Enclosure:
1. U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements

U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements Definitions and Follow-Up Action*

Environmental Impact of the Action

LO – Lack of Objections

The U.S. Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC – Environmental Concerns

EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO – Environmental Objections

EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU – Environmentally Unsatisfactory

EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 – Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 – Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 – Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

2015-07-13_Reichgott_C_EPA.pdf

Comment Number	Response
A12	Comment expresses support for the Proposed Action and the purpose and need.
A13	We have expanded the discussion of the monitoring and maintenance plan in the project description in section 3 based on continuing discussions with the project applicant and other funding agencies. The timing, responsible parties, and proposed process for the development of the plan are described in a new section 3.4.2.2.
A14	Comment noted. Comment expresses agreement with the analysis and method of presentation of impacts in the EIS.

From: Lawrenson, Kenneth M CIV
To: Kerschke, William
Cc: Morrison, Sean F LT; Moriarty, John F CIV; Owens, Jarrett M LT; FEMA-SFC-EIS; Hellberg, Jonathan CDR; Dewey, Curtis S BMCS; Bontempo, Michael J BMC; Bertheau, Torrey H LCDR
Subject: RE: Southern Flow Corridor Project Draft Environmental Impact Statement
Date: Tuesday, June 09, 2015 4:53:33 PM

William,

Thanks for the heads-up on the Tillamook Southern Flow Corridor Project. I have reviewed the background posted on the project website, done a quick look at the DEIS, and discussed the project and its impacts with personnel from Coast Guard Station Tillamook Bay in Garibaldi. My review focused on answering two issues: first, are there aspects to the project that have a direct relationship to Coast Guard statutory authorities and jurisdiction; and second, are there impacts to Coast Guard operations.

A15

It appears that there are sections of the Tillamook River adjacent to the preferred alternative that are considered by the Coast Guard to be "navigable waters." There is some seasonal recreational small boat traffic operating in the vicinity of the Memaloose boat ramp for the purpose of recreational fishing and hunting. We are unaware of any commercial activity in this area, although there is the possibility that some of the recreational fishing may be conducted from guided (i.e. commercial) boats. My read of the DEIS and project description is that there will be no project impacts to the waterway itself other than potential access issues during the construction work. Safety concerns over temporary access issues can be mitigated with Coast Guard outreach to the affected users (published in the Local Notice to Mariners, broadcast on the radio, etc). I recommend the FEIS contain specific language to address the issue of waterway impact and small boat access in the area of the project.

A16

It also appears to us that there is no direct impact to Coast Guard operations by the preferred alternative. Coast Guard Station Tillamook Bay decommissioned its flood response skiffs around 2007, leaving only one small 16-ft skiff with a draft shallow enough to permit operations in the area adjacent to the project. This skiff has transited this area less than once a year for the past several years. With the rescue capability of Coast Guard helicopters from the Airstation in Astoria, no increase in Coast Guard skiff operations is forecast for the area adjacent to the project. The Station's normal complement of Motor Lifeboats draw too much water to be sent into the southern end of Tillamook Bay, the Tillamook River, or the Wilson River. In addition, there are no routine Coast Guard operations that would be impacted by roadway construction activities described in the preferred alternative on HWY 101, OR 131, Wilson River Loop, or Goodspeed Road. From the perspective of the Coast Guard's operations, we agree with the DEIS statement that there will be no effect on emergency services.

As a first response organization, the Coast Guard supports efforts that will prevent loss of life and property damage during future natural disasters, like the historic flooding of the Tillamook Bay area. Our concerns are foremost with life safety.

If you have any questions or concerns, please contact me.

Regards,

Ken
K. M. Lawrenson

Waterways Management & Facilities Inspection
US Coast Guard Marine Safety Unit
6767 N. Basin Avenue
Portland, Oregon 97217-3992

503 247-4004 work
503 240-2586 fax

-----Original Message-----

From: Kerschke, William [mailto:William.Kerschke@fema.dhs.gov]
Sent: Tuesday, June 09, 2015 8:24 AM
To: Morrison, Sean F LT; Lawrenson, Kenneth M CIV
Subject: Southern Flow Corridor Project Draft Environmental Impact Statement

Hi Sean and Kenneth,

I understand that you will be the points of contact regarding our Draft Environmental Impact Statement.

The Federal Emergency Management Agency (FEMA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Fish and Wildlife Service (USFWS), with state and local partners, are proposing to fund a project to reduce flood damage and restore habitat in the Tillamook Bay estuary. FEMA has prepared a Draft Environmental Impact Statement (EIS) to document the benefits and impacts of possible alternatives to address these issues. Your agency is invited to provide comments on the Draft EIS.

The Southern Flow Corridor Project's purpose is to reduce life safety risk from floods, reduce flood damages to property and other economic losses from floods, while also contributing to the recovery of federally listed Oregon Coast coho salmon and restoring habitat for other native fish and wildlife species. The proposed project would accomplish this by removing and modifying levees to allow flood waters to flow across the project area, restoring wetlands and constructing new levees to protect some agricultural lands.

The Draft EIS includes an analysis of potential effects on the natural and social environment, including fish and wildlife, cultural and historic resources, agriculture, economic development, water quality, and wetlands. Along with your agency, the public has been invited to review the Draft EIS and provide comments through July 13, 2015. The Draft EIS can be downloaded at www.SouthernFlowEIS.org.

An open house will be held from 5:30-7:30 p.m. on Wednesday, June 17, 2015 at the Port of Tillamook Bay Officer's Mess Hall (6825 Officers Row, Tillamook). Information on the public meeting can be found at www.SouthernFlowEIS.org.

Your agency may submit comments via mail, email, or fax:

* Mail: FEMA c/o Mark Eberlein, Regional Environmental Officer

130 - 228th Street SW

Bothell, WA 98021

* Fax: (425) 487-4613 Attention: FEMA SFC EIS

* Email: fema-sfc-eis@fema.dhs.gov <mailto:fema-sfc-eis@fema.dhs.gov>

* Website: www.SouthernFlowEIS.org.

Written comments must be postmarked, emailed, faxed, or otherwise submitted by July 13, 2015. If we do not hear from you within this time period, we will assume your agency has no comments at this time. If you have any questions, please contact me at 425-487-4735 or via email at Mark.Eberlein@fema.dhs.gov.

Sincerely,

Mark Eberlein

Regional Environmental Officer

Federal Emergency Management Agency, Region 10

Comments must be submitted by July 13, 2015.

Message-----
From: Owens, Jarrett M LT
Sent: Friday, June 05, 2015 8:42 AM
To: Eberlein, Mark
Subject: FEMA Letter - Southern Flow Corridor Project Draft Environmental Impact Statement

Good morning Sir; your Coast Guard POCs for this issue are sean.f.morrison@uscg.mil <mailto:sean.f.morrison@uscg.mil> and kenneth.lawrenson@uscg.mil <mailto:kenneth.lawrenson@uscg.mil> . They are located in Portland, OR. Have a nice day!

Sincerely,

LT Jarrett Owens

USCG District 13

Waterways Management (DPW)

Operations Officer

915 2nd Ave., Room 3510

Seattle, WA. 98174-1067

Jarrett.M.Owens@uscg.mil <mailto:Jarrett.M.Owens@uscg.mil>

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Comment Number	Response
A15	Section 4.9.4, Recreation, has been revised to require coordination with the USCG in the event of construction activities, such as the use of barges, in adjacent waterways.
A16	Comment noted. Comment expresses agreement with EIS conclusions on emergency services effects. Clarification added to Section 4.9.3 Emergency Services and 4.9.4 Recreation.