Oregon South Coast Estuaries: Hunter Creek, Pistol River, Chetco River, & Winchuck River Tidal Wetlands Assessment

September 30, 2015

Funded by Oregon Watershed Enhancement Board Monitoring Grant 212-2058
"Curry Watersheds Monitoring Program 2012"

Prepared for the South Coast Watershed Council

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Executive Summary

Although tidal wetlands on the Oregon South Coast are limited in extent, they may be particularly valuable for a variety of wetland functions. This assessment combines the Brophy (2007) and Adamus (2005) approaches to quantify the extent and causes of habitat loss and hydrogeomorphic changes in tidal wetlands of four Oregon South Coast Estuaries. The potential for restoring critical habitat and wetland functions is ranked using Ecological Prioritization Criteria (Brophy, 2007), while indicators of function, risk, and integrity are evaluated using scoring models from the Adamus (2005) Hydrogeomorphic (HGM) Rapid Assessment Method.

The extent of inundation (head of tide) during King Tide conditions was observed and documented by staff and volunteers. Field measurements of salinity concentrations and stratification during high and low flow were tabulated. The historic aerial photo record was examined to detect channel migration, floodplain re-vegetation, and human-caused alterations. Related studies were combined with these observations to provide a summary of estuary hydrology, sedimentation, and channel stability related to wetland establishment and loss in each of the four estuaries. Ecological priority scores (Brophy, 2007) varied with wetland size, tidal channel condition, connectivity, and diversity of vegetation classes. Wetlands were categorized as restoration or conservation types, and priority ranks for wetlands were depicted on orthophoto base maps.

Tidal wetlands and nearby floodplain wetlands in a variety of geomorphic settings were surveyed using the HGM protocol, including one “reference” and one restoration site . The HGM survey scores 55 indicators, including botanical transects, used to rank wetland functions (calculated by indicator scoring models). Risks to wetlands include human disturbances in close proximity to the wetlands and floodplains, resulting from the narrow valley floors in this tectonically active region. Wetland integrity is threatened by a surprising large proportion of non-native species in the botanical transects, 40%. Wetland indicators that scored low, and could be restored or enhanced, are discussed in a restoration considerations narrative. Wetland descriptions include lists of plant species, grouped by wetland status, native/non-native, and perennial/annual persistence. In addition to the HGM scores, an analysis of cover and diversity of all plant species in plots, off-transect species diversity, and waterfowl food distribution was completed using a wetland vegetation database developed for the Oregon South Coast.

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Introduction

Purpose

Members of the South Coast Watershed Council and agency advisors had been concerned about losses of tidal wetlands due to historic development, particularly the effects on salmonid habitat. Salmon recovery planning at the regional scale cited alterations by destruction (loss of area) or modification (loss of complexity and connectivity) of estuarine subtidal and intertidal habitats, and associated tidal wetlands, resulting in the loss of important rearing and migration corridor habitat functions within the Southern Oregon/Northern California Coast Coho Salmon ESU (http://www.swr.noaa.gov/recovery/FINAL_2007_Rec_Outline_for_SONCCC_Salmon_121707.pdf).

Tidal wetlands within the estuaries of the Oregon South Coast are limited in extent, increasing the concern that there may be a threshold for alterations, beyond which they may no longer provide crucial functions or the resiliency to recover from disturbance. Fragmented wetland habitats may result in less structural stability to withstand either anthropogenic or climatic changes in the future (USFWS, 2011). As restoration and mitigation opportunities become more limited, failure to restore wetland hydrology and biological integrity may have long term ecological and economic impacts.

Tidal Wetland Investigation Objectives:

1. Provide data that promote strategic planning for conservation and restoration of tidal wetlands, and facilitate outreach about wetland functions, historic extent, and alterations.
2. Select eight tidal wetlands and conduct surveys of hydrogeomorphic indicators (rapid assessment method) to determine functions and values provided by each wetland.
3. Evaluate risks to integrity and sustainability of these wetlands.
4. Provide baseline data on indicators of wetland function that can be used to predict and monitor effectiveness.
5. Provide baseline data on species composition and cover to assist with project planning and implementation

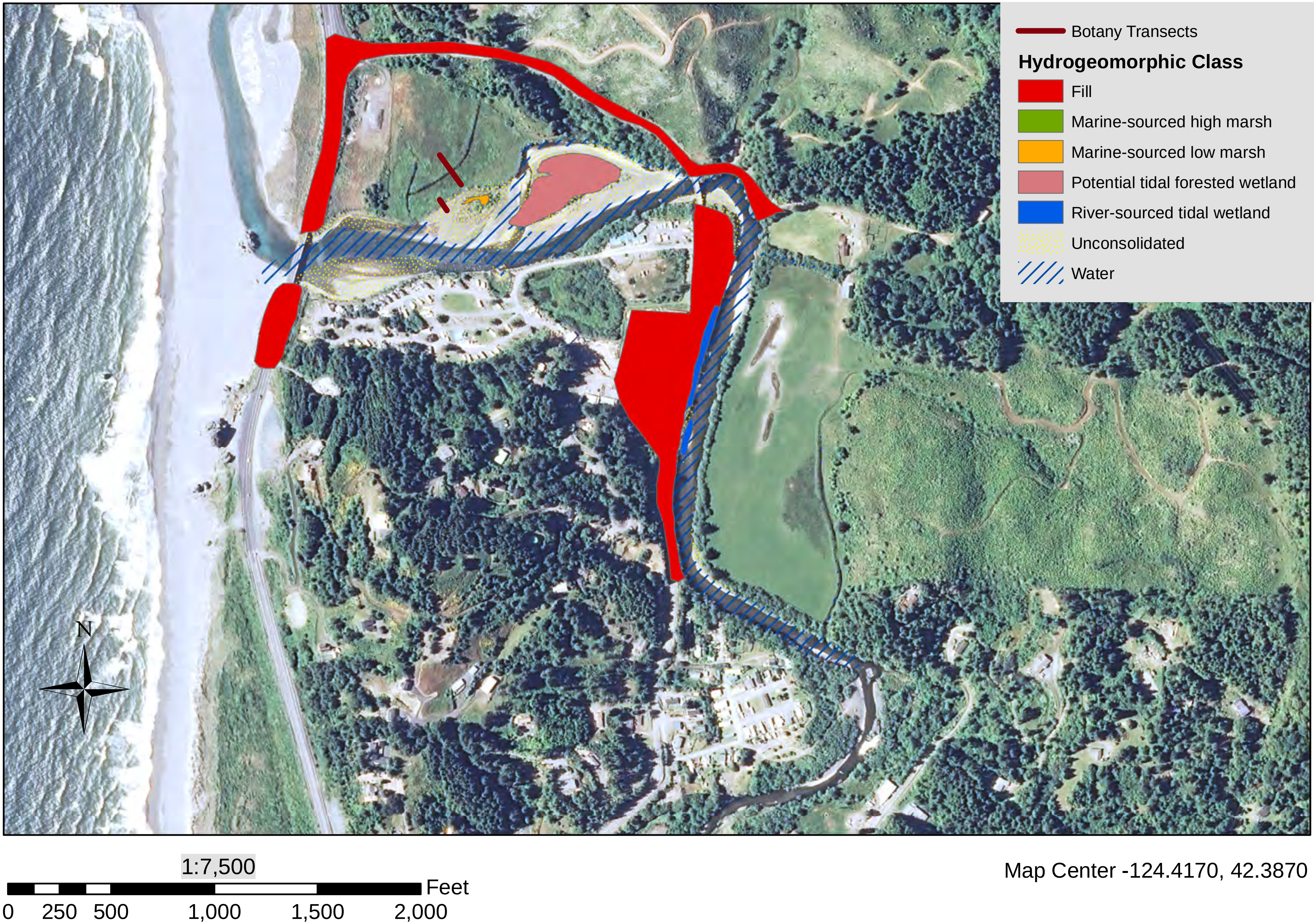
In 1979, Oregon Department of Fish and Wildlife (ODFW) published "Natural Resources of Chetco Estuary", an inventory of historical changes, physical and biological characteristics, habitats, and management recommendations. The National Wetland Inventory (Cowardin, and others, 1979) issued a set of maps using a classification system that identifies vegetation type, water regime, and alterations by humans or beavers.

Meanwhile, Scranton (2004) refined and updated maps of tidally-influenced wetlands on the Oregon Coast, and applied a hydrogeomorphic (HGM) classification of wetland types (figures 1-4). The HGM classification was the basis for a Tidal Wetland Rapid Assessment Method, developed by Adamus (2006), for wetland function, risk, and integrity.

Oregon Watershed Enhancement Board and the Department of State Lands added an Estuary Assessment Component to the Oregon Watershed Assessment Manual (Brophy, 2007). In 2008, South Slough National Estuary Research Reserve and Coos Watershed Association sponsored a training workshop on the application of OWEB Estuary Assessment and the HGM Rapid Assessment Method in Coos Bay. During this workshop, Jon Souder, Coos Watershed Association, shared a proposal to combine the Brophy and Adamus approaches for a broad-based Tidal Wetlands Assessment to be used for Strategic Planning.

In 2012, the South Coast Watershed Council, operating with the Curry Watersheds Partnership, was awarded a monitoring grant from the Oregon Watershed Enhancement Board (OWEB), for investigation of tidal wetlands in estuaries of the Oregon South Coast, south of the Rogue River. This current Tidal Wetlands Assessment combines the Brophy and Adamus approaches to quantify the extent and causes of habitat loss and hydrogeomorphic changes in tidal wetlands of four South Coast Estuaries. The potential for restoring critical habitat and wetland functions is ranked using Ecological Prioritization Criteria (Brophy, 2007), while indicators of function, risk, and integrity are evaluated using scoring models from the HGM method (Adamus, 2006). This assessment is expected to inform future efforts to engage the community and develop a strategic plan to guide restoration and conservation efforts in these estuaries.

Figure 1: Hunter CreekTidal Wetland
Hydrogeomorphic Classification, Scranton (2004)



Map Center -124.4170, 42.3870

Figure 2: Pistol River Tidal Wetland Hydrogeomorphic Classification, Scranton (2004)

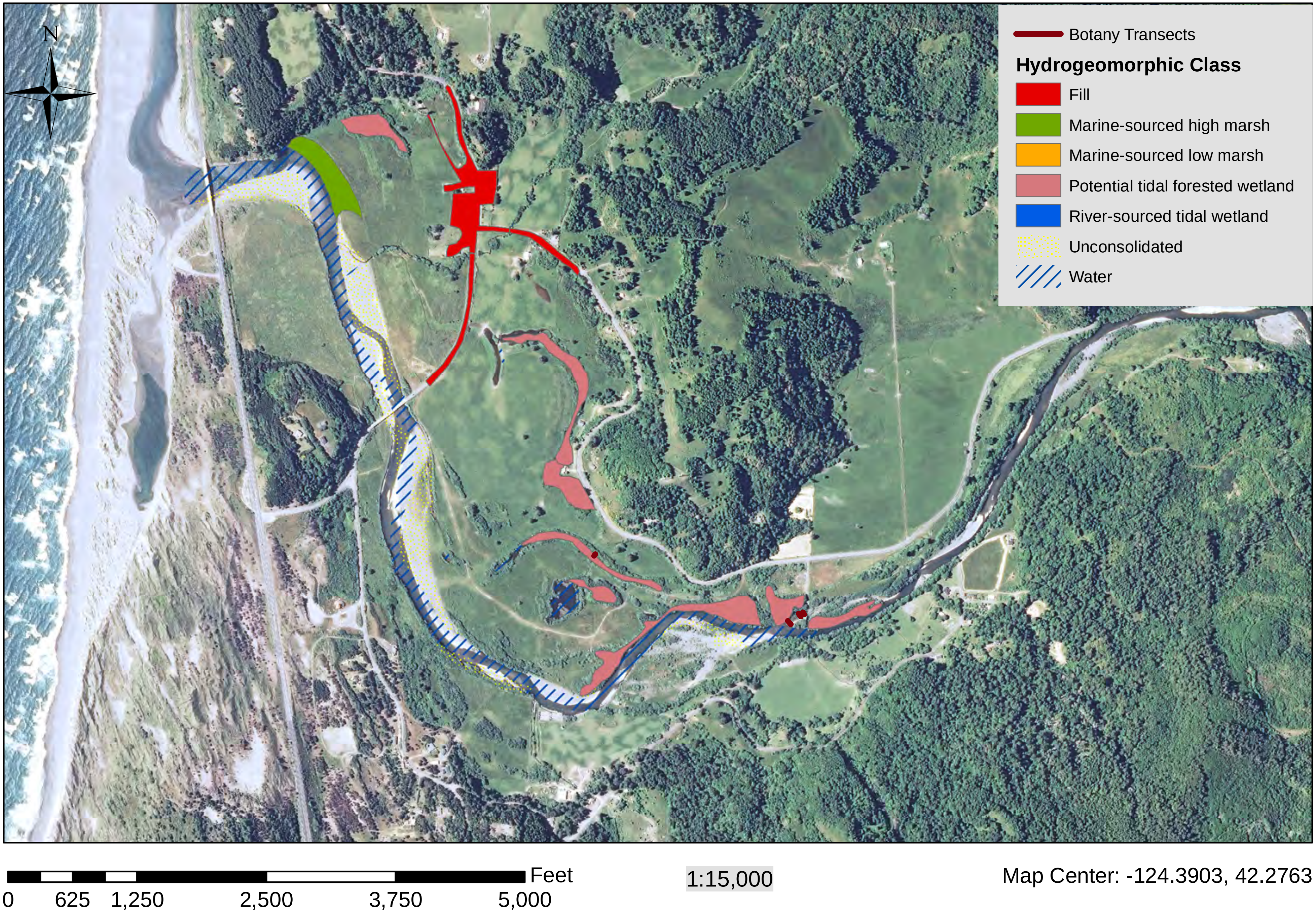


Figure 3: Chetco River Tidal Wetland
Hydrogeomorphic Classification, Scranton (2004)

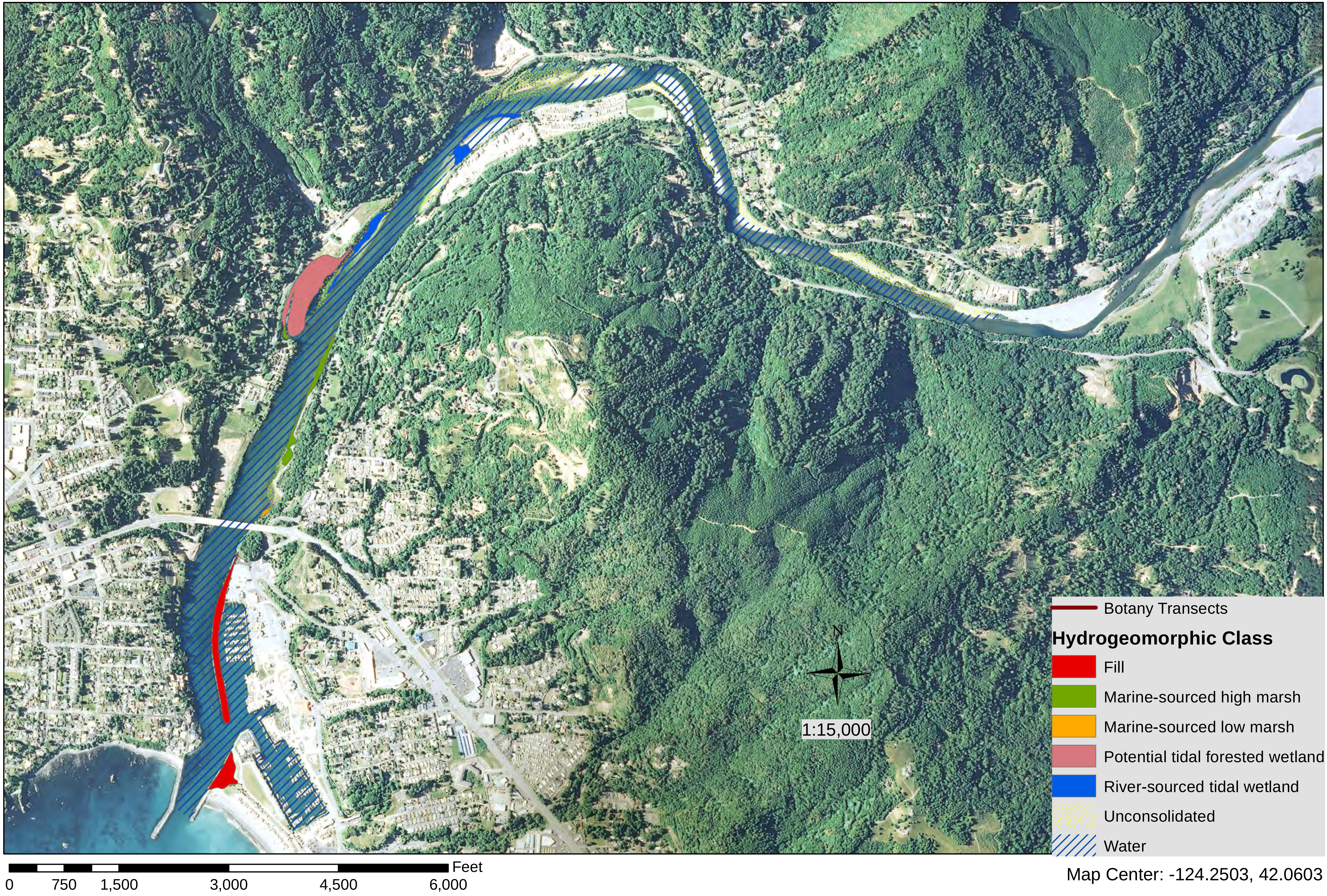
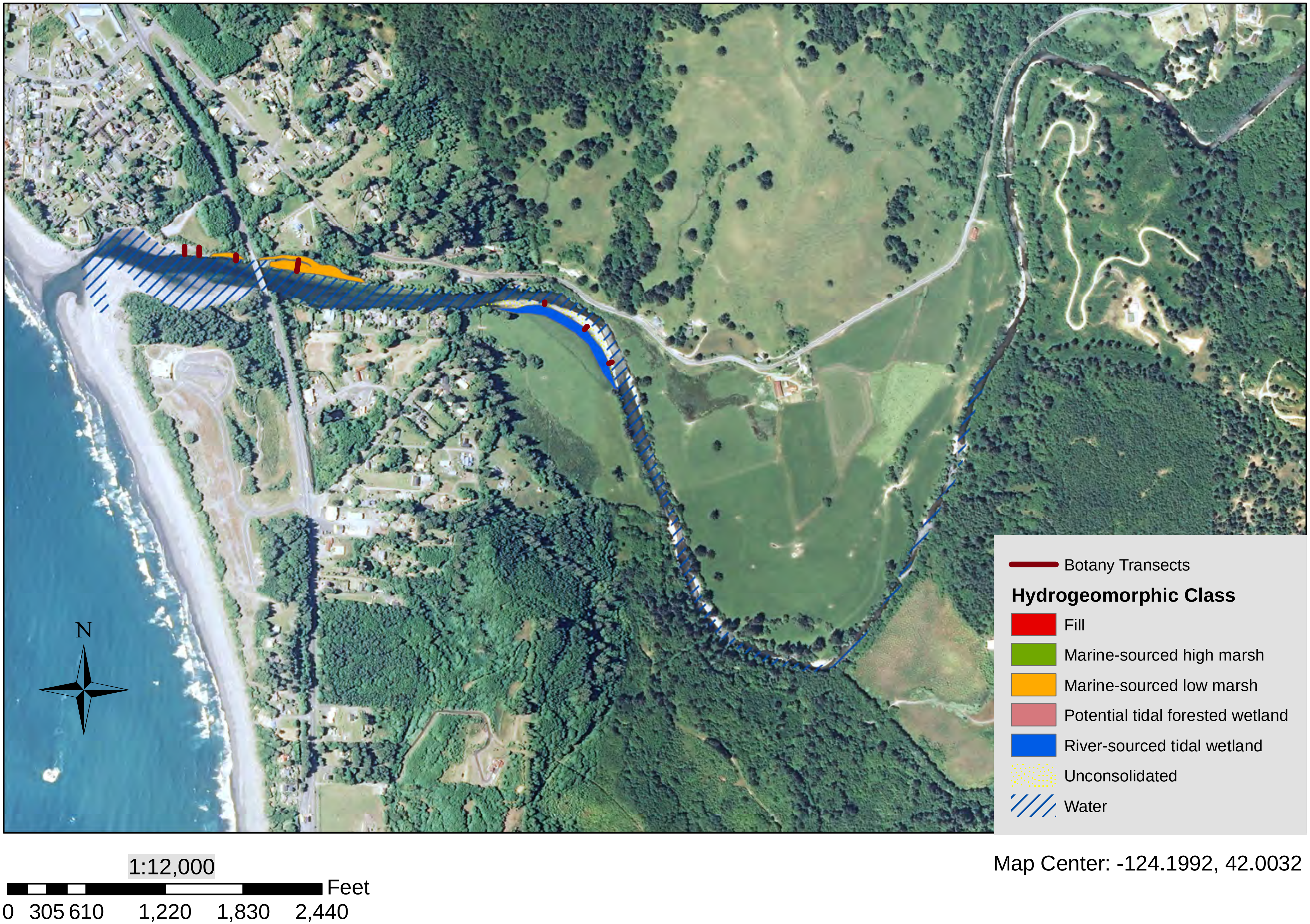


Figure 4: Winchuck River Tidal Wetland Hydrogeomorphic Classification, Scranton (2004)



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Estuary Hydrology, Sedimentation, and Channel Stability

Evidence for the upstream extent of tidal inundation and salinity, as well as estuarine mixing characteristics is summarized in Appendix A.

Sea-level rise over the last 12,000 years drowned river mouths to create long tidal reaches in most Oregon estuaries, but on southern half of the Oregon coast, recent uplift (associated with subduction along the tectonic plate margin) has been more rapid than the global rate of sea level rise (Komar,1997). Not only is the tidal reach shorter due to uplift, but the U.S. Geological Survey (USGS) cites evidence that several South Coast rivers and stream have transported gravel to the Pacific Ocean at a rate that has filled or nearly filled the depositional area created by Holocene sea-level rise (Wallick and others, 2009; Jones and others, 2012; Jones and others, 2011).

Considering the steep gradient of the South Coast river mouths and their narrow, confined valleys, development and maintenance of tidal wetlands depends on the stability of river bars, overflow channels and sloughs. Subtle changes in elevations within overflow channels on floodplains can lead to large scale movement of unconsolidated bars and changes in channel location. Erosion results where changes in current direction results in increased energy focused on banks, and deepening of the channel steepens and coarsens sediment on river bars. In other areas, readily mobilized sand may be deposited over existing stabilized wetlands. On sand and gravel-dominated bars, increased depth initially mobilizes sand and then gravel, leaving cobble bars remain to armor and temporarily stabilize the deposits. When the armor layer is breached, it takes less current to initiate movement. Historic photos document movement of banks and bars, but changes in the texture and armoring of bar sediments must be monitored on site.

When rivers overtop their floodplains, new overflow channels form wherever shear stresses exceed the critical value required to mobilize sediment on a bar. Ebb tide currents can also concentrate flow, forming channels in unconsolidated material and alcoves on the downstream ends of bars at elevations that are subject to tidal inundation. As these geomorphic features are colonized by wetland plants, they may perform some of the wetland functions of the classic sinuous tidal channels of Oregon coast tidal wetlands. Fine sediment and organic matter deposition at these locations will be critical for building soil. In locations that are regularly inundated, vegetation can survive even on gravel/cobble bars. For example, willows become established in “swales” and then slow currents and trap fine sediments and organic matter. In areas which are inundated less frequently, finer-textured soils are required to hold sufficient moisture for vegetation to become established. In some locations, active restoration could include placing energy-dissipation structures to promote stabilizing vegetation and/or increase fine-sediment deposition. Where fine sediment deposits are stable and being colonized, early intervention to remove or treat invasive species could be productive.

Hunter Creek

The USGS recently completed reconnaissance-level assessments of channel stability and bed-material transport on Hunter Creek (Jones et. al. 2011). The Hunter Creek Estuary (figure 5) is located within the Lower Study Reach (RM 0.0-3.7). The area of gravel bars was largest in this reach, where the channel is alluvial and alternates between confined (lacks a floodplain) and unconfined segments. Unconfined reaches tend to have large gravel bars while bars in confined reaches are relatively smaller.

Comparisons of bar-surface and bar-subsurface material at two survey sites indicate that transport capacity and sediment supply are relatively balanced. Bed material transport and the extent and area of gravel bars are likely to have been affected by aggregate extraction from gravel bars, and timber harvest and associated road construction. Cross-sections comparisons at four bridges indicate that the Hunter Creek channel shifts laterally and vertically, but there was little overall net change in bed elevation from 1994-2008.

Throughout the aerial photograph record from 1940-2009, upper bar surfaces were re-vegetated, resulting in a 52% reduction in the area of bed-material sediment. One explanation for this degree of revegetation was a reduction in the frequency of peak flows as shown for the USGS streamflow gage on the Chetco River (Wallick and others, 2009).

Fine sediment transport and deposition, potentially affecting tidal wetlands, was not addressed by the USGS assessment.

Pistol River

Within the Pistol River Watershed, Russell (1994) found that roads produced sediment at a rate 32 times that of surrounding undisturbed forest lands. Timber harvest, including streamside units, had increased sediment production rates by 2.8 times that of surrounding undisturbed forest lands. Typically, riparian buffers were not used in harvest areas on National Forest System lands until the mid 1980s. In the Pistol River Watershed, landslide sediment delivery is highest along slopes adjacent to streams (Jones and Ferrero 1990), particularly when they have been harvested.

Road construction and timber harvest, followed by peak floods in 1955, 1964, and 1971, resulted in high rates of erosion, landslides, pool filling, substrate embeddedness, and aggradation in the low gradient reaches that persisted at least until the 1990s (Russell 1994). The low gradient reaches in the lower Pistol mainstem (including Deep Creek and Sunrise Creek subwatersheds) and South Fork Pistol River have experienced the greatest effects on the aquatic system due to sediment transport from steeper reaches upstream, resulting in localized deposition and aggradation. Allluvial reaches have adjusted to high sediment loads, floods, and mechanical damage through bar development, lateral channel migration, and bank erosion (Evans, 2002).. Bank erosion contributes to sediment loading, resulting in channel aggradation. A number of reaches surveyed between 1991 and 1997 by FS and ODFW staff exceeded 10 percent bank instability (Evans, 2002).

Figure 5: River Mile Locations in Hunter Creek Estuary

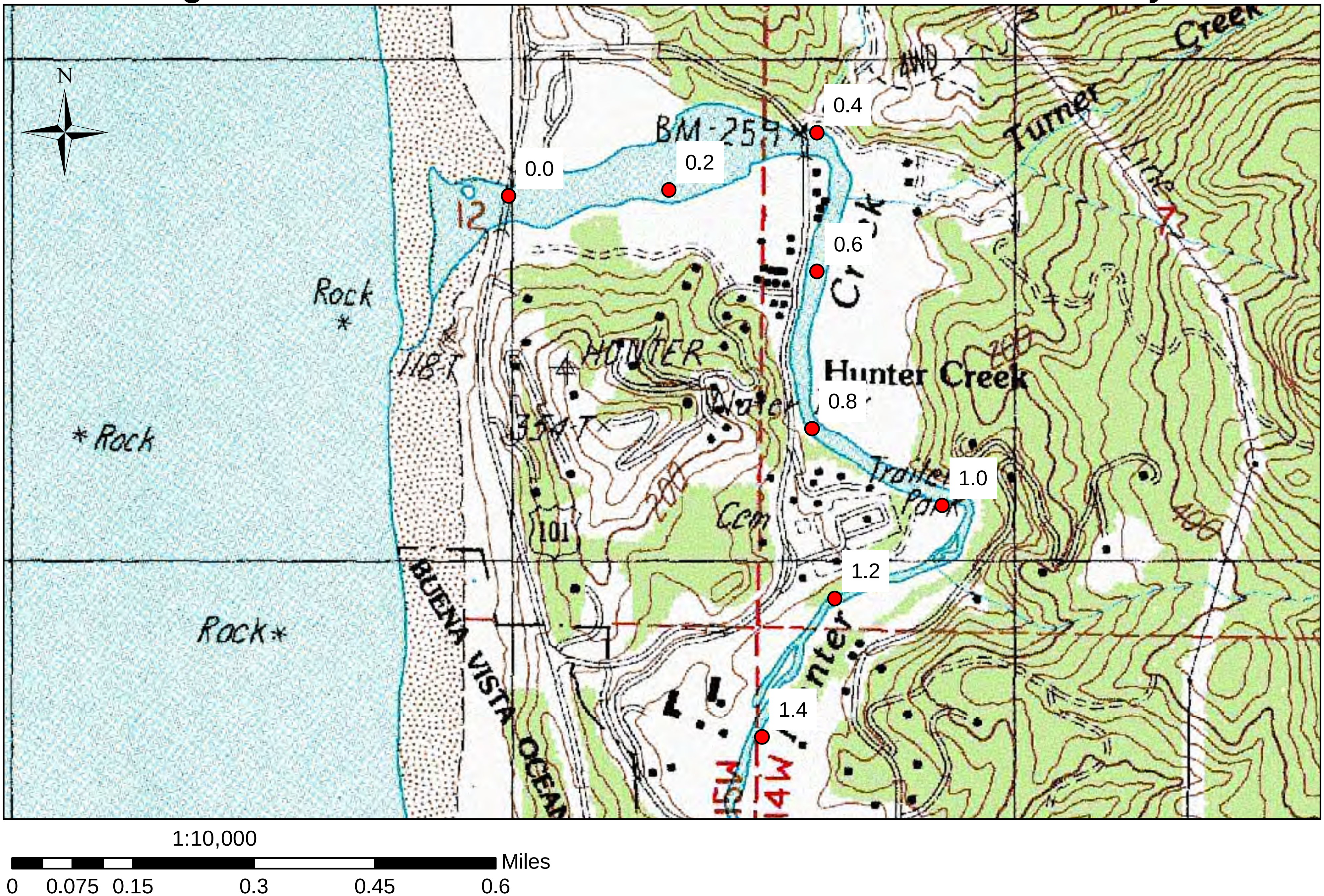
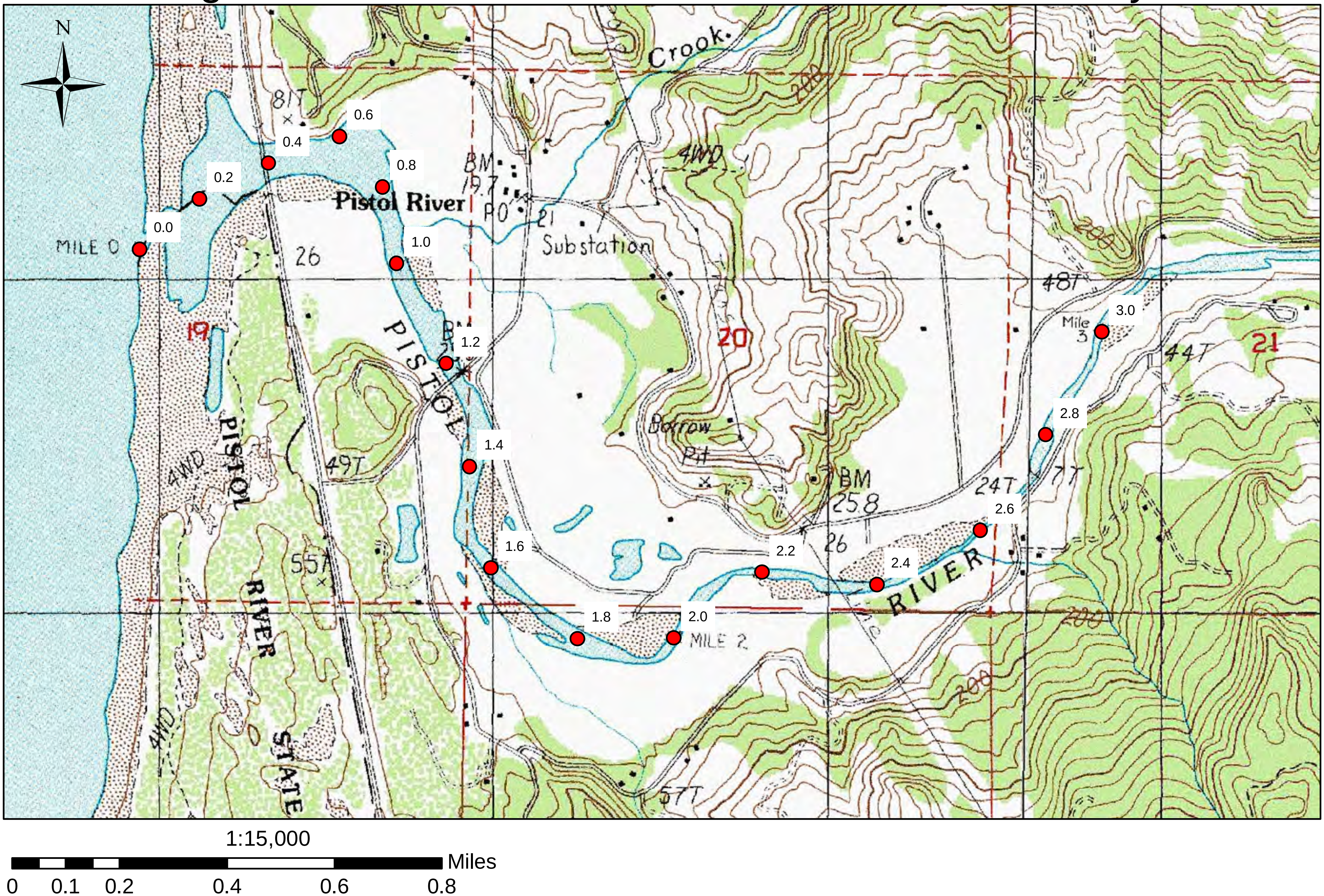


Figure 6: River Mile Locations in Pistol River Estuary



Chetco River

The USGS recently analyzed channel stability and bed-material transport on Chetco River (Wallick and others, 2009). The Chetco is one of the few gaged rivers on the Oregon South Coast. High annual runoff and flashy short-duration peak flows result from the steep terrain, high drainage density, and high rainfall. Little of the rainfall is stored, resulting in very low summer flows.

Watershed-scale disturbances such as floods, road construction and timber harvest, forest fires; and local activities including dredging for navigation, bank protection, and gravel extraction, are likely to have the greatest effect on sediment transport and channel stability (Wallick and others, 2009). Increased peak flows from roads and harvest units as well as increased frequency of landslides can result in sedimentation along lower reaches of affected basins. Although a basin-wide assessment of historical logging activities and effects is lacking for the Chetco River, it is possible that the period of peak logging in the 1950s–1960s affected sediment influx into the lower Chetco River.

In 2002, the Biscuit Fire burned more than 57 percent of the Chetco River Watershed with varying severity (Wallick and others, 2009). Possible long-term effects on Chetco River channel include enhanced runoff and erosion resulting from loss of vegetation (U.S. Forest Service and Bureau of Land Management, 2004), leading to downstream sedimentation.

Providing access through the bar that historically blocked seasonal entrance to the estuary (similar to the bars that develop on all South Coast Estuaries), included constructing a pair of jetties at the mouth of the river in 1959, and dredging an entrance channel (Wallick and others, 2009). Through the 1960s and 1970s, two boat basins were dredged in former tidelands and a protective dike was constructed (Ratti and Kraeg, 1979). In the process of developing port facilities, providing access to the boat basins, and reducing flooding, a shallow lagoon south of the jetty was filled (Ratti and Kraeg, 1979).

Since the early 1960s, the U.S. Army Corps of Engineers dredged the entrance to the Chetco River annually, removing an average of 29,000 cubic feet/yr (Wallick and others, 2009, c.f. Judy Linton, U.S. Army Corps of Engineers, 2009 written commun,). Although it is uncertain how much of this dredged sediment is derived from downstream river transport rather than marine transport into the lower Chetco River, mineral composition studies show that a substantial portion is from marine transport into the estuary for similar estuaries in Oregon and northern California (Wallick and others, 2009, c.f. Kulm and Byrne, 1966; Peterson and others, 1982; Ricks, 1995).

Wallick and others (2009) provide a detailed history of instream commercial gravel mining beginning in the early 1900s. From 1995-2008, four sites were being mined, including one within the estuary at river mile 1.8 (figure 7). From all sites, the average annual extraction volume during 2000-2008 was 77,000 cubic yards, including 10,600 cubic yards/yr removed from the estuary site, varying depending on gravel replenishment and permit conditions..

The Chetco River Estuary (figure 7) is located within the Estuary Reach (RM 0.0-3.5). The channel is confined between steep valley walls, but the channel has shifted laterally. Much of the

“Tidewater Estuary Bar” along the left bank was eroded due to lateral channel migration between 1965 and 1989. By 1989, the higher areas of this bar were protected by bank armor and developed. This and other development along the Estuary Reach has resulted in 41% of the channel margin now bordered by bank armoring (Wallick and others, 2009). At the mouth of the river, the channel has been straightened, and has narrowed to about half of the historic width (Wallick and others, 2009).

Upstream, within the North Fork Reach (RM 3.5-4.7), a wider valley experienced sediment deposition and channel migration to create a large meander bend near the confluence with the North Fork. The meander was abandoned (most likely due to floods in the early 1970s), decreasing the sinuosity and width, while increasing the gradient of the channel. Bank protection materials and bedrock now border 47 percent of the reach, in contrast to erodible alluvial floodplain materials that historically bordered more than 75 percent of the reach.

Longitudinal survey and cross-section comparisons show that the channel bed lowered between 1939 and 2008. In the reach from Highway 101 to Morris Rock, the channel bottom lowered an average of 1.6 feet. Reaches showing the greatest change include the Tidewater Estuary Bar, Snug Harbor (at RM1.3, alcove was more extensive and deeper, now filled with sediments and partially vegetated), and upstream of Highway 101 Bridge (channel flowed on the left, now migrated to the right, wetland created on left).

Dredging, jetty construction, and development have extensively modified the channel and floodplain between RM 0.0 and 1.5. In the upstream part of this reach, reductions in bar area are attributed to bank protection, fill, and development as well as commercial aggregate removal (Wallick and others, 2009). Within the reaches upstream, consistent indicators of a change from sediment surplus to bed material deficit include channel lowering, decreased recent rates of channel migration, diminished bar area, and lesser amounts of bare gravel and sparse vegetation. Such transformations would promote the conversion of bars to floodplain surfaces.

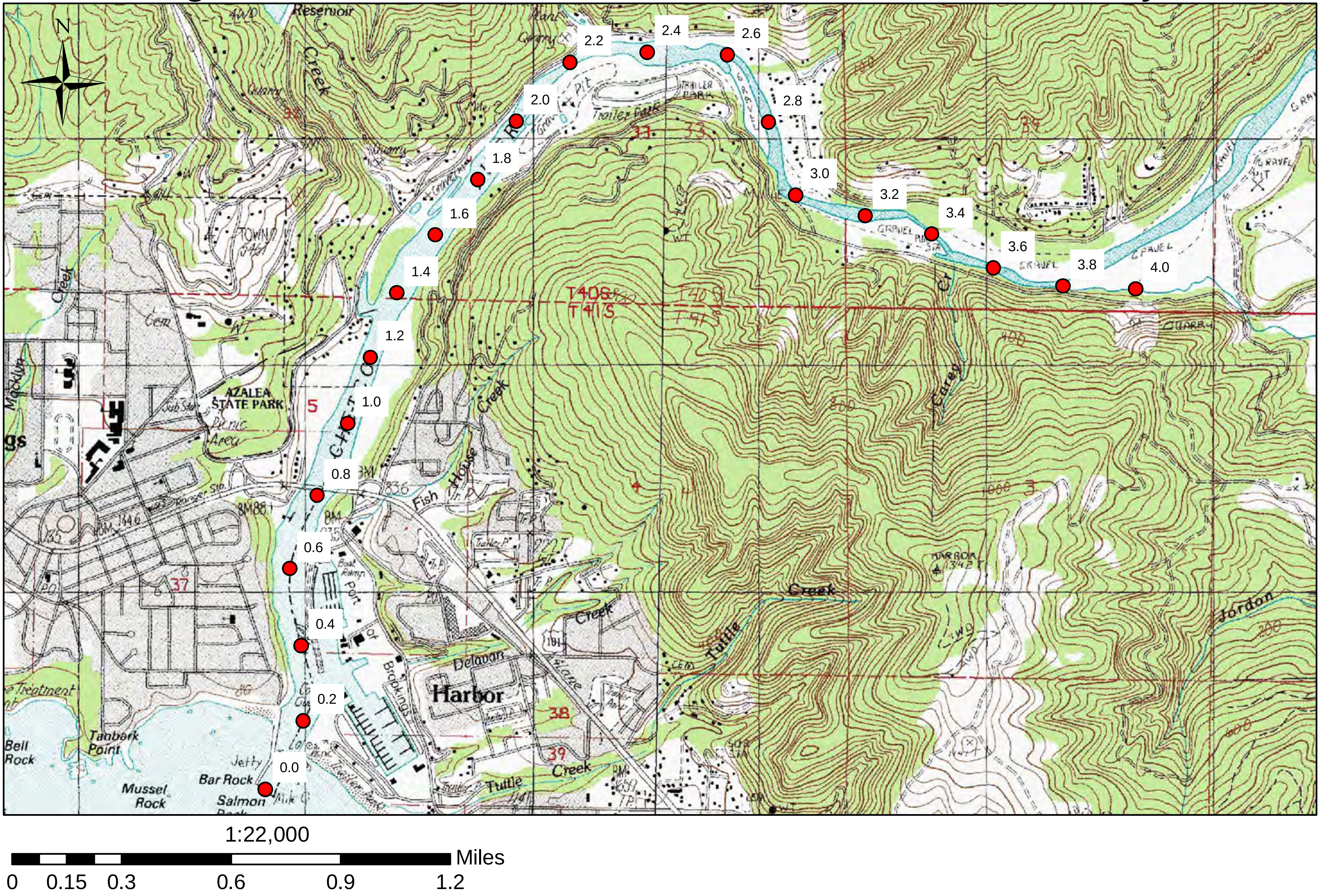
Throughout the aerial photograph record from 1939-2008, upper bar surfaces were re-vegetated, resulting in a 34% reduction in the area of bed-material sediment. In 1965, woody shrub and mature tree vegetation types decreased while sparse, bare, and water types increased. The upstream changes could either be the result of reduced supply from upstream relative to transport capacity or incision propagating from downstream areas where there has historically been substantial gravel extraction.

Another explanation for the long-term change is a reduction in the frequency of peak flows as shown for the USGS streamflow gage on the Chetco River (Wallick and others, 2009). Aggradation at the USGS gaging station in the late 1970s may have resulted from large volumes of sediment transported during the 1964 flood, followed by subsequent incision and reduction in bar areas, similar to the response on other rivers in the region (Wallick and others, 2009).

Modelling of streamflow profiles illustrates the decreasing influence of channel morphology, such as pool-and-riffle geometry as discharge increases, and the increasing influence of overall valley geometry on flow hydraulics at high discharge. For flows of 70,000 cubic feet/second, a decreased water surface slope corresponds with the significant increase in valley-bottom width near the North Fork confluence, which results in the dynamic channel and high sedimentation rates in this area (Wallick and others, 2009).

Armoring ratios indicate excess transport capacity relative to sediment supply in the North Fork and Estuary Reaches. Also the armoring ratio increased downstream as slope decreased, which is atypical and a possible indication of downstream reduction of sediment supply relative to transport capacity (Wallick and others, 2009). In the North Fork Reach sediment transport capacity is limited and most net sediment influx into the Chetco downstream of the USGS gage probably deposits in this reach. A small amount of fine gravel is transported into the Estuary Reach.

Figure 7: River Mile Locations in Chetco River Estuary



Winchuck River

USGS bedload and channel stability studies are lacking for the Winchuck River. Maguire (2001) summarized interviews conducted by Carol Davis with long-time residents including Bill Cochran, who lived 3 1/2 miles upstream, off and on from 1928-2000. His family place was four miles upstream.

> The biggest flood was in 1932 and it just flooded within the flood plain. It flooded the road about 1 mile up the river (where the cement bridge now crosses the river)*; the road was about 10' lower then. It would flood there almost every year; they would keep a car on both sides of that area so they could get to town. The flood would never last more than a week. It would rain for 30 days or so with out stopping, and was normal to get 3" to 5" in one day. In the summer (in the 20's and 30's) the river would get so low that the mouth would close. In the autumn they would have a party and go down and open the mouth of the river with a horse drawn fresno so the fish could come up the river

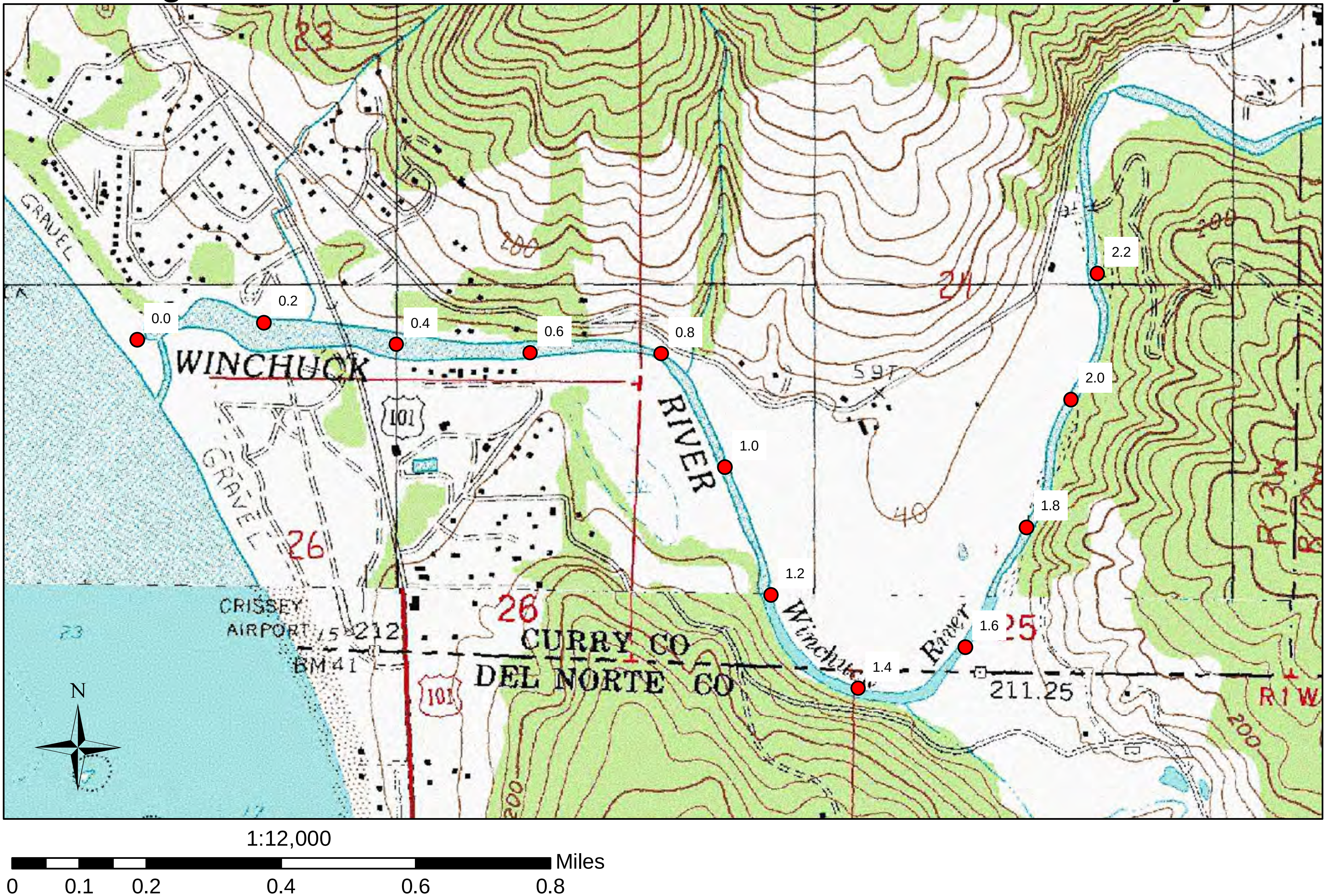
* it is uncertain whether Bill refered to the current bridge at RM 2.2 (figure 8) which would was probably lower at the time, or possibly more likely to the old crossing abutment at RM 0.6, shown to the right

> With all the logging, the gravel has filled in the holes. When he was a kid the river would run deeper, faster, and cleaner. There are not as many deep swimming holes in the river as there used to be, the river is shallower. He used to row a boat all the way to the mouth with about four riffles. The creek by the Fire Hall (four miles up the river) ran 10 to 11 months of the year now it only runs 6 or 7 months and then goes dry. There were no jams or wood in the river because they would clean them out and use the wood for firewood. The river has changed course very little. It has meandered a little in places, but not more than 100'.
>
> In the late 1930's there was a fire that burnt from the Winchuck to the Chetco and all the way to Harbor. The hills by Jack's Creek were real brushy; it was the worst fire he can remember.

In February 1986, a storm triggered a large landslide on National Forest land in the Wheeler Creek Watershed. It temporarily blocked the stream channel and after the debris dam was breached, left levees of unsorted sediment on either side of the channel.

Historic recollections seem to support the idea that there has been vertical adjustment of the Winchuck River to changes in sedimentation, but lateral channel migration was generally not observed.

Figure 8: River Mile Locations in Winchuck River Estuary



OWEB Estuary Assessment

Methods

The OWEB Estuary Assessment, Component XII of the Oregon Watershed Assessment Manual, is designed to identify, characterize, and prioritize tidal wetlands within individual Oregon estuaries (Brophy, 2007). The method is intended for use within a single estuary.

The initial base maps for delineation of wetland polygons (figures 1-4) use a hydrogeomorphic wetland classification (Scranton, 2004). Using a variety of information sources (estuary habitat classification, tidal influence codes, vegetation types, and soil types), polygons were refined to reflect the full extent of tidal wetlands (Appendix B).

Historic photos were examined to record alterations that occurred in the wetlands.
Wetland sites were created by splitting polygon subareas that have different levels or types of alteration, and by merging areas with "internally consistent" (similar) levels of alteration. Wetland sites were grouped into restoration or conservation sites based on extent of alteration.

Brophy (2007) reminds the user that

> "even conservation sites may offer opportunities for resource management or wetland enhancement…examples include removal of exotic species and establishment of offsite buffers." and "…to achieve both conservation and restoration goals, all conservation plans should include investigation of potential restoration actions, and all restoration plans should include mechanisms to protect the existing wetlands."

Brophy (2007) selected Ecological Criteria to address characteristics of Oregon estuaries south of the Colombia River as shown in the table below. Each criterion affects a broad range of functions, for example, larger sites benefit the quantity of sediment storage, nutrient processing, and area of wildlife habitat. The tidal channel condition score is doubled. Features of the least-altered tidal channels include full tidal exchange, no tide gates, no ditches, and the presence of many or undisturbed remnant channels. For prioritization ranking, ecological criteria were measured and scaled among wetlands in the four South Coast estuaries located south of the Rogue River.

Table 3. Summary of ecological prioritization criteria

Factor	Data source	Description	Levels and scoring
Size of site	Map of sites	Size in hectares or acres. You may choose to omit sites under 1 ha (2.5 A) in size.	Convert full range of values for study area to scores of 1 (smallest) to 5 (largest).
Tidal channel condition	Aerial photograph interpretation and field observation; Forms E4-A and E4-B	Look for visible tidal flow restrictions, ditching, dikes, and remnant channels.	See scoring matrix (Table 4). **This score is doubled in the final total score.**
Wetland connectivity	National Wetlands Inventory, Estuary Plan Book Habitat types mapping	Total area of wetlands and eelgrass beds within 1 mile of site, excluding the site itself.	Convert full range of values for study area to scores of 1 (smallest area) to 5 (largest area).
Salmonid diversity	ODFW salmonid distribution data	Number of salmon stocks spawning upstream of site ***in the stream system on which the site is located*** (main stem or tributary), including areas of historic use.	Convert full range of values for study area to scale of 1 (lowest # stocks) to 5 (highest # stocks).
Historic wetland type	Oregon Natural Heritage Program historic vegetation mapping and ranking	Percentage of site area that was historically tidal swamp (ranked by ORNHIC as critically imperiled) or other tidal swamp.	Convert full range of values for study area to scores of 1 (smallest percentage) to 5 (largest percentage).
Diversity of current vegetation classes	National Wetlands Inventory/Air photo interpretation	Number of Cowardin vegetation classes (emergent, scrub-shrub, forested wetlands) mapped on site, excluding classes mapped on <10% of site area.	One Cowardin class: score = 1 Two Cowardin classes: score = 3 Three Cowardin classes: score = 5
TOTAL SCORE			Add all 6 criteria scores, doubling the tidal channel condition score (maximum possible score = 35; minimum possible score = 7)

More detailed descriptions of the methods used for the OWEB Estuary Assessment, as well as any exceptions to the methods described above, are provided in Appendix B.

Tidal Wetland Extent

Tidal wetlands are defined as those wetlands that are periodically flooded by tidal waters, and do not include tidal flats or algal beds. Brophy (2007) cites the challenges of defining the limits of tidal influence in the upper estuary. Fringe areas, which are inundated by the highest tides of the year (King Tides), merge with floodplains which are inundated annually or less often. Brophy (2007) also notes that defining the tidal influence in this area is important, because among other biological benefits, the upper estuary is considered particularly important to juvenile salmon (Simenstad and Bottom, 2004).

The extent of inundation was observed and documented with photographs by staff and volunteers during four King Tide events, spanning 2012-2015. Head of tide observations on the mainstem and tributaries are included in Appendix A: South Coast Estuary Tidal Inundation: Water Levels and Salinity.

It is unknown to what extent the tides would affect water levels during high flows. The joint probability of experiencing a King Tide during an annual flow can be calculated. Because we are interested in wetland surfaces that are inundated at least annually and are tidally influenced, it would be useful to understand (at least theoretically), the influence of these high tides on water elevations.

Tidal Wetland Alterations

Historic vegetation maps (Christy et.al., 2001) indicate that historic tidal marsh was lacking in the South Coast estuaries. Small areas of willow swamp are present along floodplains adjacent to tidally influenced areas, with fringes that are tidally influenced. The description for the historic willow swamp type is:

> Willow swamp or "willow swale", sometimes "scattering." May include alder, cascara, ninebark, hardhack, briars, salmonberry, gooseberry, "swamp grass." Includes riparian stands on gravel or sand bars, with young cottonwood or driftwood.

Today's gravel and sand bars convert to floodplains dominated by willow, but young cottonwood stands are less common. South of the Rogue River, the largest cottonwood stand is located upstream of tidal influence, across from the mouth of North Fork Chetco (Follansbee, verbal communication, 2001).

Historically, large wood as "driftwood" may have been much more abundant than today (Brophy, 2007; Bierly, 2015 written communication), and likely affected channel roughness and sediment transport across the river bars as well as providing protection for vegetation establishment. Floods in the 1950's and 1960's floated away a generation's worth of large wood from some South Coast rivers (L. Johnson, Siskiyou National Forest, oral communication). Where accessible, river bars, swamps and tidal marshes have experienced ongoing wood removal.

River bars and sloughs may recruit wood differently. Because the bars are a higher energy environment, a willow swamp might help to anchor or slow the movement of wood pieces from upstream. Adjacent to the sloughs, local riparian vegetation may contribute a larger proportion of the total wood supply.

Where vegetation and woody material have been removed, channel roughness is reduced, which increases water velocity and reduces ability to trap organic matter transported from upstream. Although removal of willow destabilizes bars, given adequate moisture, willow will re-colonize rapidly.

Stands of sitka spruce on the margins of the tidal wetlands and floodplains are indicators of stability in this environment, and are relatively uncommon. Scattered spruce trees are present along the lower Winchuck, including on the banks of a slough, known as the Winchuck "reference" wetland.

This assessment had been expected to quantify changes in the areas affected by different types of alteration. This proved difficult because most of the changes had little to do with new alterations since Scranton (2004) delineated wetlands on 2001-2002 aerial photos. Changes were primarily the result of vegetation establishment on unconsolidated surfaces, identification of wetlands that had not been included on Scranton's maps, and exclusion of wetlands that were higher than annual floodplain inundation or upstream of head of tidal influence.

Compilation of acreage by type (from Scranton, 2004)									
Data not comprehensively field-verified									
Estuary	**Marine-sourced Low Marsh**	**Marine-sourced High Marsh**	**River-sourced Tidal Wetland**	**Wooded, flooded at least annually**	**Restoration Consider-ation Areas**	**Fill**	**Total excl water**	**Water**	**Total inc Water**
Pistol River[1]	0.00	4.30	0.00	19.16	20.23	9.42	53.11	33.81	86.92
Chetco River	0.17	2.33	3.84	8.6	0.00	6.35	21.29	175.81	197.10
Winchuck River	1.54	0.00	1.77	0.00	99.32	0.00	102.63	32.93	135.56
[1] Changes in mouth configuration have occurred since this assessment									
Hunter Creek not tabulated, but was mapped for this project									

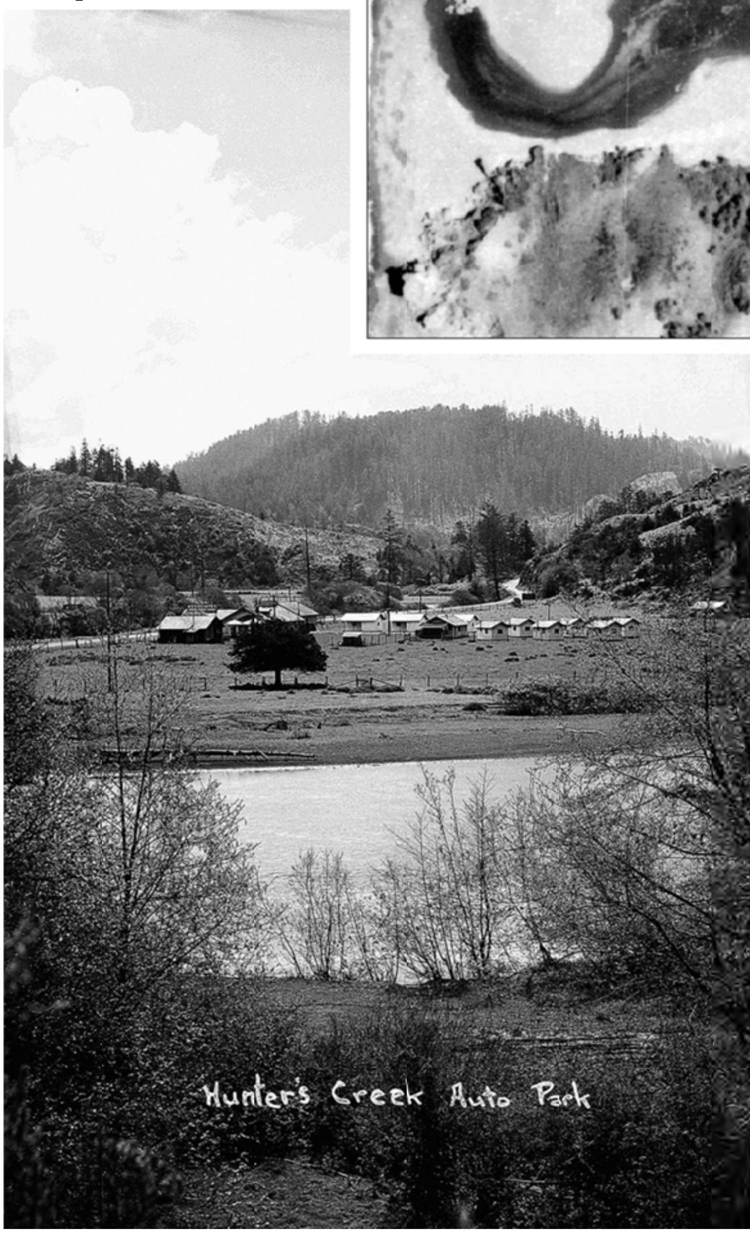
In the table below, comparing only the total difference between the current mapping and Scranton's maps gives the impression that a large percentage of wetlands within the area of tidal influence have been lost. However, this is not the case, particularly for the Winchuck River, where the landowner provided details about flood frequency across pastures that had been previously mapped as Restoration Consideration Areas (RCA).

	Total wetland acres excluding Water & Fill		
Estuary	**Current**	**Scranton**	**Reason for Change**
Hunter Creek	43.1	37.1	Added disconnected wetland, expanded RCA
Pistol River	38.0	43.7	Excl RCA & potl tidal forested wetland where above annual inundation
Chetco River	51.3	14.9	Added RCA acres, unconsolidated areas now vegetated
Winchuck River	20.2	102.6	Excl RCA in floodplain where above annual inundation
Total	**153**	**198**	

Historic photo comparisons, such as those on the following pages, are available in a PowerPoint presentation "South Coast Estuaries: Tidal Wetlands and Flooplain Alterations.ppt" which is a product of the assessment.

Hunter Creek

Compare the historic photograph from the north side of old bridge, of Hunter's Creek Auto Park (provided by Allen Wilson) to the 1940 aerial photo, prior to mill development and fill.



The 1951 aerial photo lacks resolution, but fill had been placed at the current Turtle Rock development site, resulting in the main channel migrating laterally to the north around the island and straightening. By 1965, south bank armoring was evident, protecting a mill pond that had been excavated. The abutments for Highway 101 had been placed and constricted the channel by ~275-300', and was aligned with the armored south bank.

As of the 1970 photo, the island had been scoured of vegetation, and was an active bar, connected to the north bank, while the main channel followed the armored bank. As of 1986, the south bank had eroded, and there was also erosion toward the fenceline of the Hunter north wetland. Continued erosion presumably breached the smaller mill pond as of the 1992 photo.

Turtle Rock RV Park was open as of the 2002 photo, which was taken when the mouth of the estuary was restricted enough to fill the estuary. Vegetation was well developed on the island. The oblique overflight photo to the right was taken on 1/16/2002. In 2014, the wet area on the east side pasture was much larger than before for an unknown reason (perhaps it had just rained?).

In 1940 the width of the active Hunter Creek channel measured approximately 600 feet, while in 1970, the south bank had been was armored so the width was only 425 feet. As of the 2008 LiDAR imagery, the south bank had eroded, leaving a width of 500 feet.

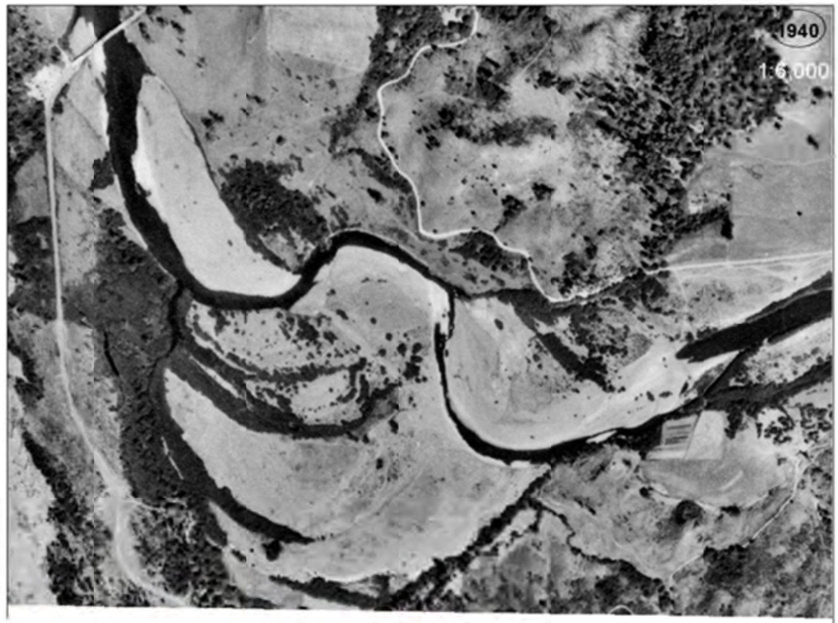
In 1940, a channel was evident in the Hunter north wetland, but didn't appear to be ditched as it was in 1970. 1n 1965, ODOT operations had been set up on the dune on the north side of Hunter Creek, and the Hunter north wetland channels had been ditched (flooding during King Tide in ditch shown to the left) Dark areas on the photo show where either vegetation was burned or the dark wetland soils were turned over (?).

In 1940 the mouth of Turner Creek was sinuous and exited to the north of the present mouth.

Pistol River

In 1940, around the northwest corner of the Pommerane pasture, high tides exchanged with water flowing in an old channel. This area later developed into high marsh. The high marsh at the Pommerane field is covered in 1965, the photo presumably taken at high tide. In 1986 the high marsh deposit is evident, and the outer margin corresponds with the property boundary.

As of 1940, the bridge at Pistol Loop Road had already been constructed and constricted channel width. Upstream, the main channel flowed across the pasture in a large meander on the north side. Today there is a narrow remnant channel along this location (a surveyed HGM wetland). Although the 1951 aerial photo lacks resolution, it is apparent that the northerly jog of the mainstem was abandoned for a broad turn on the southern pasture.



This dynamic area of the lower Pistol River is analogous to the depositional area at the confluence of the North Fork Chetco, described by Wallick and others, 2009. This area has a wider valley floor as a result of sediments filling the valley due to the Holocene sea level rise. Pistol River is similar in that the channel experienced an avulsion (rapid decrease of channel sinuosity, steepening of gradient, and narrowing). This movement of the channel also resulted in bank protection (described below), similar to the response on the Chetco River.

Floods between the 1951 and 1965 photos apparently straightened the channel over the head of the bar where it split into two channels, developed its current northerly route and scoured the vegetation. The south bank eroded and new bank protection was evidently installed. Fresh deposits were excavated into ponds/pits on the pasture bar. Apparently this material was used for Hwy 101 construction (per verbal communication with Neil Walker, long-time resident, 2015).

The Pistol River channel straightened further as of 1970, cutting between the split channels. The surveyed wetland located in an overflow channel (HGM survey, at the ODOT access upstream of the head of tide) was the location of the main channel in 1965. This channel was abandoned in 1979 for a southerly route. The ODOT staging area appeared in this photo, and it is unknown whether this may have been a site for gravel extraction. The south bank bar downstream of the ODOT access begins to vegetate as of 1986 (dark photo). The northern split channel had filled in and developed vegetation.

In 1992, the channel crosses from east bank to west bank at the Pistol Loop Bridge. As of 2002, the bars at Pistol Loop Bridge had migrated downstream. Little migration of bars was observed from this time until the 2009 photo. As of 2014 bars migrated again so the channel crossover is now from the west bank to the east bank.

In 2002, fresh deposits appeared in the overflow channel at the ODOT access. 2009? Willows rapidly filled in the overflow channel as of 2014.

During field surveys along the north bank where an overflow channel cuts into the floodplain, it was observed that construction materials (concrete, rip rap, soil) had been placed to form a plug to prevent the river from flowing into the former channel. Extra flow likely contributes to bank erosion, resulting in old fish hatchery structures dropping into channel (photo to the right). Higher water surface elevations probably also explain the active deposition of a gravel/cobble bar over the south bank.

Along the road bordering the north pasture, a fill was placed presumably to provide a future home site. This fill was once mapped as a wetland on the National Wetland Inventory (check to see when the fill occurred).

As of 1965, Crook Creek appears blown out of its original channel, exhibiting a braided channel pattern. As of 1970, Pistol River deposited a new bar across the mouth of Crook Creek, which lowered the base level and decreased the channel gradient. The future Crook Creek alignment is shown along a newly constructed road. As of 1986, Crook Creek had been re-located slightly to the north, and lengthened compared to the 1970 channel.

Chetco River

Wetlands on the east and west banks of the Chetco River, upstream of the Highway 101 bridge have had a history of alterations pre-dating the 1940 aerial photo. There was a wider floodplain on the west bank, occupied by a pasture. An un-named tributary channel flowed through the pasture, and at the downstream end it was well vegetated, and may have been tidal. The active bars were along the west bank. In 1952, both banks were in the same location, but the active bar shifted to the east bank. Riparian vegetation had been cleared along the pasture channel, and some sections of the channel appear to have been relocated against the hillslope. Although some error is associated with measurements from aerial photos, the west bank apparently eroded ~150 feet from the previous vegetation line as of 1965. The period since the previous aerial photo included floods in 1955 and 1964. The channel in the west pasture had been ditched and straightened on a more direct path to the river, and former channel had been filled. By 1970, the west bank had eroded further along the bare section. The bar on the east side was close to its current location, forming the substrate for establishment of a marine-sourced high marsh (photo taken at high tide or flow). In 1986, the downstream end of the bar on the east bank is shaped strangely, as though it had been excavated. During this period on-ramps to Highway 101 ramps were constructed, a new neighborhood appeared on the east bank, and more forest was cut on the west bank. In the 1992 photo, the "excavated" area of the bar on the east has filled with deposits. Part of the west pasture had been cleared/leveled as of 2002 and the high marsh was beginning to develop on the east bar. By 2005, clearing had expanded further north into the pasture. The eroded section of the west bank began to re-vegetate by 2009. The 2014 photo shows no new activity along the west bank and where the un-named ditched tributary flows to the Chetco River, vegetation that appears to be wetland is developing on the north end of the remnant pasture.

The bar at the mouth of Ferry Creek was more active in 1940 (below), appearing to be occupied regularly by the Chetco River and with side-channel flow scouring against the north bank. This is the process that maintained Snug Harbor, an alcove upstream of a rock on the north bank (right).

By 1965 the side channel was filled with vegetation, roads were cut to access the bar, and the Ferry Creek channel was ditched. Riparian vegetation across the bar was removed by 1970. Ferry Creek was vegetated (apparently with willow) except for a road access crossing as of 1986. Additional vegetation was cleared as of 2002. Scranton (2004) mapped the bar as a potential tidal forested wetland. More vegetation was removed from the bar as of 2005, and since then the wetland vegetation pattern on the upstream part of bar has not changed. In 2009 the bar was revegetating. As of 2014, fill piles were deposited on a wetland area shown on the National Wetland Inventory.

At Joe Hall Creek, the area currently occupied by the Datone operation was cleared as of 1965. At the mouth of the creek, a delta deposit was evident, but by 1970 had been eroded. The delta was re-deposited by 1986. Across the river, the Chetco River RV park was developed between 1970 and 1986. The point bar that had been on the south bank migrated into a mid-channel bar, likely due to development of a channel on the south bank at the base of the Chetco River RV bank protection (concentration of turbulence and energy deepening channel at higher flows). By 1992, the mid-channel bar was migrating toward the north bank. By 2002, deposition in the overflow channel increased upstream of the mouth of Joe Hall Creek, and the bar began to stabilize with willows. In 2005, the overflow channel deposits continued downstream, and/or sediment deposition from Joe Hall Creek exceeded transport capacity. Fresh deposits at the mouth of Joe Hall are evident in photos taken in 2005 and 2014. See Appendix A for photograph of deposits after box culvert was installed.

Winchuck River

The historic photo to the left was contributed by Ed and Andy Gross, and has a similar configuration of roads and vegetation to the 1940 aerial photo.

As of 1952, a road had been constructed up the south bank to the South Fork Winchuck.

Highway 101 bridge construction was underway in 1965, with equipment staged on the north side, a temporary bridge and fill in the channel. The fill that eventually became the Winchuck Wayside State Park was being disposed of along and within the estuary. It is uncertain whether the Hwy 101 bridge abutments were placed before the 1964 flood. As of the 1980 color infrared photo, the large fill at Winchuck Wayside had been completed. Upstream of the highway, sediment deposition along the north bank later became the "Reference wetland" site. Restoration of the site at Winchuck Wayside involved excavating part of the large fill, visible on the 2002 photo. On the 2005 aerial photo it is evident that sediment on south side of the estuary is transported onshore into the mouth, and eroded away during winter flows. On the south side of the estuary, the Crissy Field visitor center appeared in 2009. In the "Reference wetland", vegetation structures including shrubs and trees are evident in 2009.

The Johnson/DeMartin Ranch consists of pastures on the north and south sides of the Winchuck River estuary. Distinctive wetland vegetation is evident on the south pasture in the 1940 photo, but the source of the water is uncertain. The north (east) pasture drains via a channel from a wet area at the base of a terrace, which is still evident in 2008 LiDAR imagery and 2009 aerial photos. In 1992, Easter Lilies were cultivated on an elevated terrace within the north (east) pasture. On the downstream end of the south pasture, a bridge for livestock access was installed over a small tributary (evident in 2009 photo). As of the 2014 aerial photo, the south pasture retained the distinctive wetland vegetation evident in the 1940.

Restoration and Conservation Priorities

From interpreting the alteration history, and merging polygons with similar types and extents of alteration, 15 wetland sites were identified.

Overall, five wetland sites were classified in the conservation group, having minor alterations of grazing or invasive species. Ten wetland sites were classified in the restoration group, with alterations of flow restriction, fill, ditching, bank stabilization, excavation, and gravel extraction in addition to grazing and invasive species.

Wetland sites classified as restoration totaled 124 acres while the conservation group totaled 36 acres (table 1). Conservation sites range from the largest at the north bank of Pistol River upstream of Hwy 101 (Pistol march and swamp) with 12.5 acres, to the smallest Winchuck Reference wetlands with 0.9 acres. The two largest restoration sites at 25.5 acres each, are the Pistol Pasture channel and swamp (north bank upstream of Hwy 101) and the Hunter/Turner Creek pasture wetlands. Winchuck Wayside is the smallest restoration site at 0.9 acre.

Ecological Criteria for Wetland Site Prioritization

The six Ecological Criteria were proportionally converted to a 1-5 scale and summed. Since the tidal channel condition score is doubled, the ecological scores can range from 7 to 35. South Coast tidal wetland ecological scores range from 13.5 to 25.0 (table 1). In order to map sites by ecological priority, natural breaks were used to separate the ranks (Figures 9-12).

Considering the need for a stable substrate for successful wetland restoration, conservation, and colonization, stability is a factor that should be considered in tidal wetland prioritization, design, and implementation. It may be argued that stability is so important that it should be considered as a separate ecological criterion for tidal wetlands in South Coast estuaries.

Restoration and Conservation Considerations

Consider realignment of Crook Creek into the wall base channel position. This would enhance the swamp (forested wetland), provide a fresh water source adjacent to the high marsh, add more high quality habitat for rearing, and avoid continued alternating deposition and downcutting resulting from base level changes across the sand/gravel bar at the mouth.

Obtain conservation easement or purchase Pistol Pasture channel and swamp (Mildred Walker Estate property). This channel at the head of the estuary could be connected to the side channel on the right bank upstream of the bridge, enhancing a thermal refuge, providing flow for longer periods, and improving estuarine rearing habitat quality. Restore overflow channel by removing plug at the top and reconnecting at downstream end. May required hydrologic modelling to determine appropriate bed elevations and channel width. Attach any disconnected wall base springs.

Enhance creek on north side of Pistol River (flows through Hockema property on slope) where it goes subsurface across the bottomland pasture (may be wet on surface in some places?). Determine if the creek provides a thermal refuge upstream of the estuary, or if it flows into the wall base channel and into the former channel. On south side, investigate where stream exits to Pistol River.

Opportunity for conservation of botanical resources, wetland education, recreation enhancement on public access ODOT property upstream of estuary. Protect botanical resources by excluding livestock from overflow channel, wetland, and pond, while developing a recreational trail on the sandy slope above the wetland. Periodic sedimentation will require regular maintenance of trail and fencing (upstream end of overflow channel owned by Bandon Biota).

Periodically it is necessary to step back from the details of wetland vegetation classes, tidal channels, and food webs, to consider the context of processes in the watersheds. Effects of past disturbances such as harvest activities, wildfires, and landslides on stream flow and transport of sediment and organic matter are difficult to appreciate, considering the dynamic nature of the lower floodplains and tidal wetlands. However, the reduction of peak flows has a stabilizing influence along many miles of river, potentially providing opportunities for protected areas to stabilize and develop wetland characteristics.

Figure 9: Ecological Priority for Hunter Creek Tidal Wetlands

Figure 10: Ecological Priority for Pistol River Tidal Wetlands

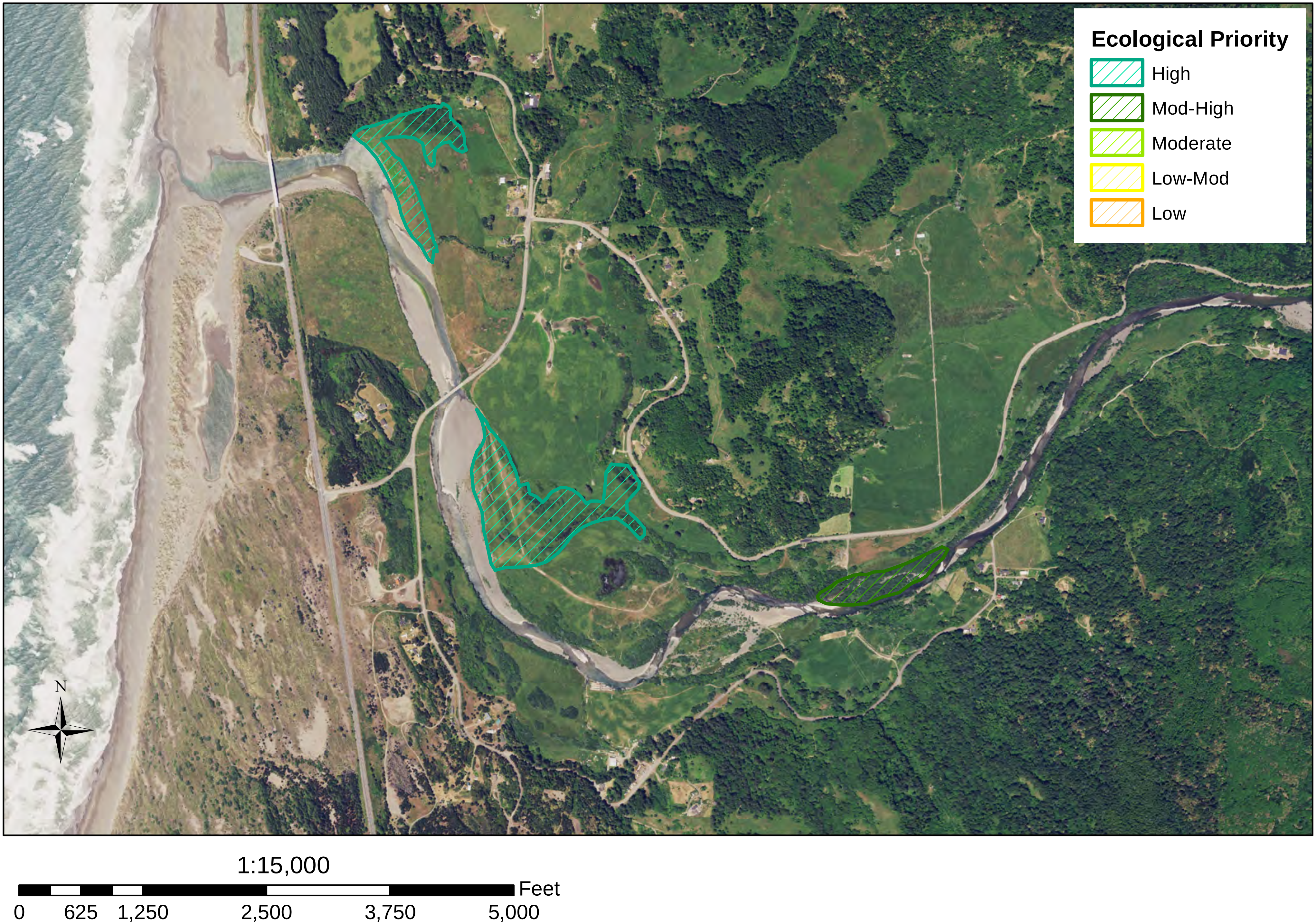


Figure 11: Ecological Priority for Chetco River Tidal Wetlands

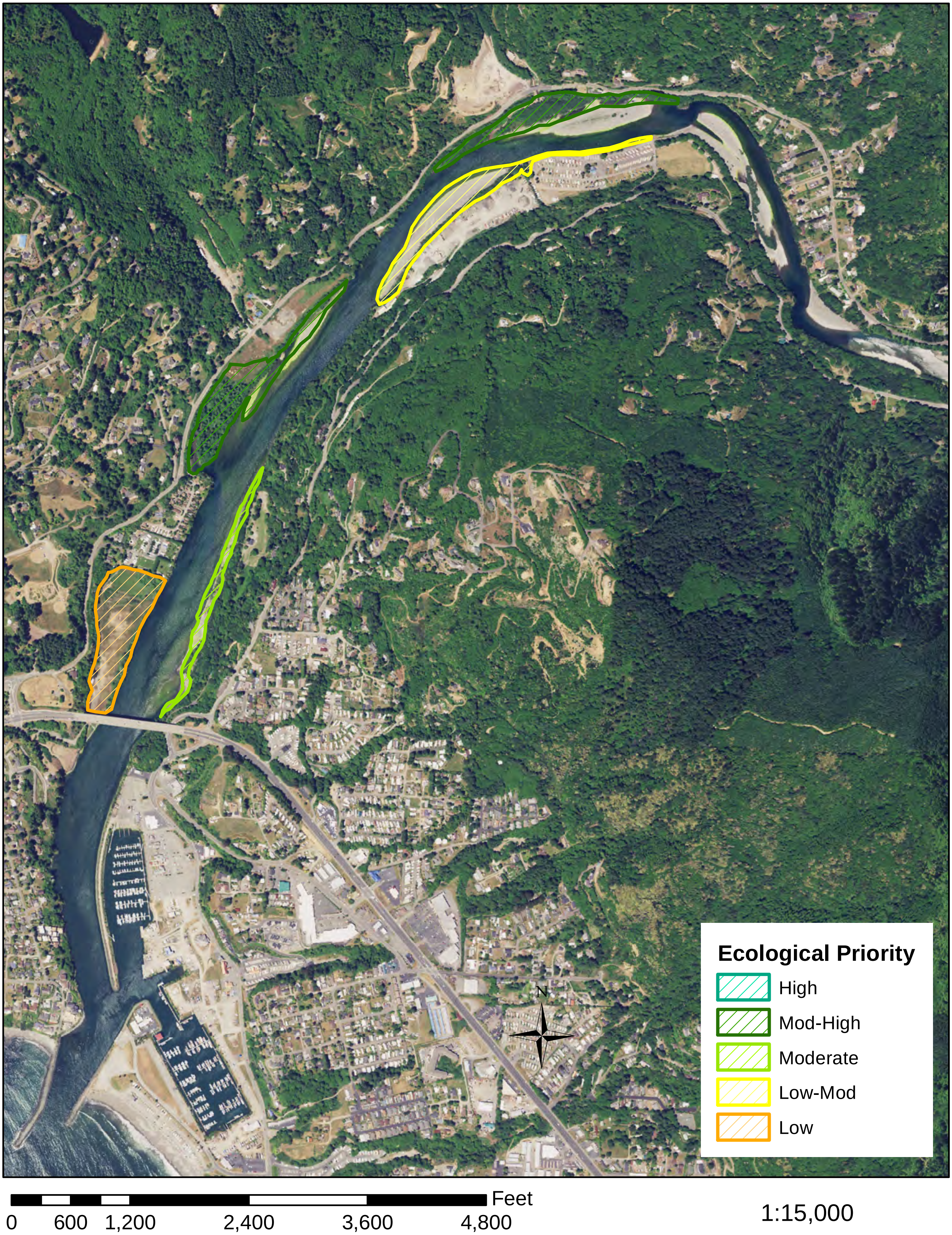
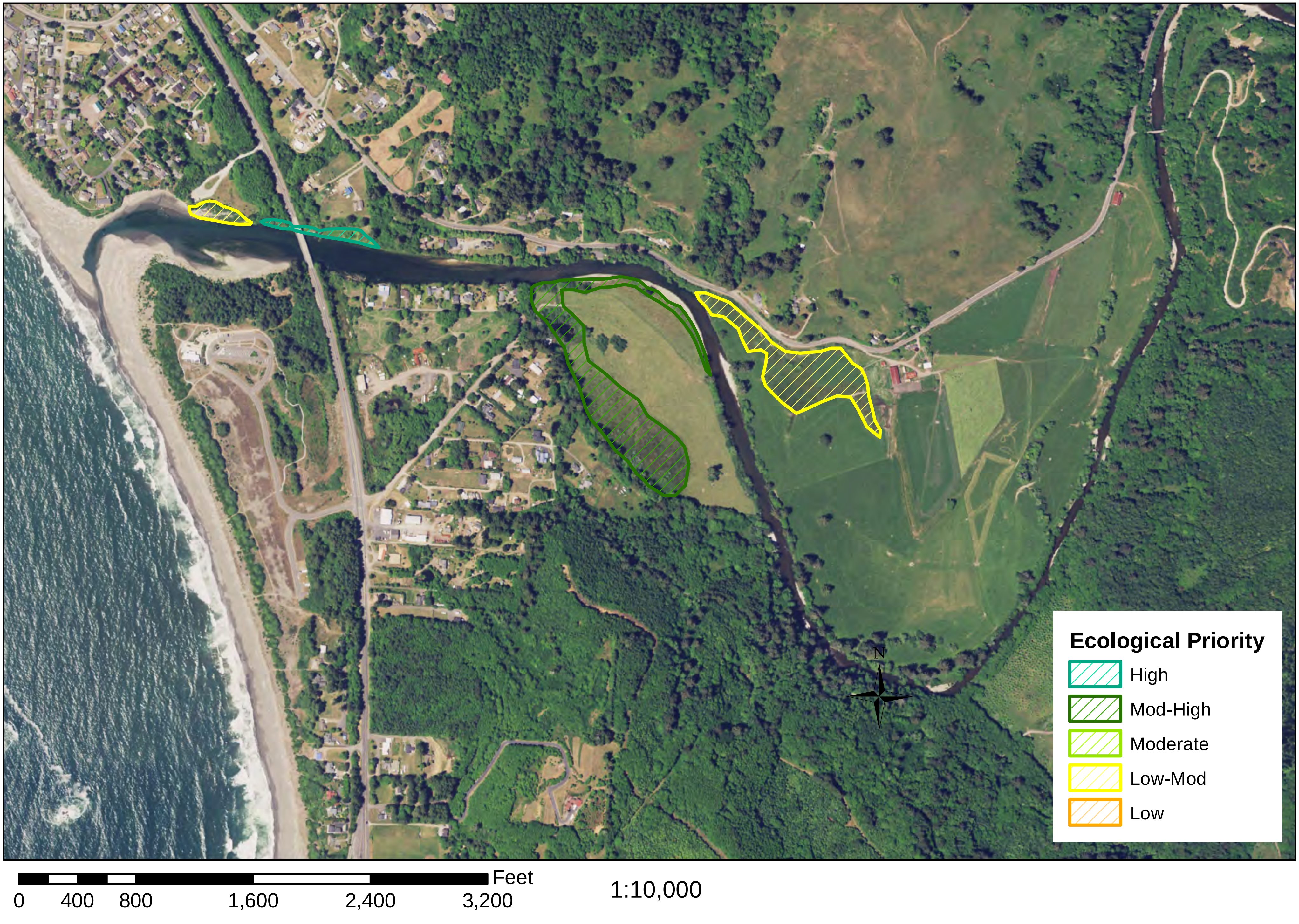


Figure 12: Ecological Priority for Winchuck River Tidal Wetlands



Hydrogeomorphic Tidal Wetlands Rapid Assessment Method

Methods

The Hydrogeomorphic Tidal Wetlands Rapid Assessment Method (HGM RAM) was conducted on six tidal wetland sites (of 15) and on 60 acres (of 159). One of the surveys included a non-tidal wetland at the downstream end of an overflow channel, which is hydrogeomorphically similar to habitats where tidal wetlands are located in South Coast estuaries.

Botanical transects and off-transect observations were also conducted in advance of a restoration project at Sullivan Gulch, in the Sixes River Estuary. Nine additional HGM RAM wetlands located north of the Rogue River will be added to these results on completion of the analysis under another OWEB grant.

Transects in a Variety of Habitats

Estuary	**Habitats**
Sixes	freshwater backwater flooding across floodplain, channels & flats
Hunter	fringing marsh, colonizing sand bar, tidal channel in ditch draining pasture
Pistol	former mainstem channel, wall base spruce swamp (survey only); overflow (secondary channel) pond upstream of head of tide
Chetco	former overflow channel (slough), now isolated due to increasing height at head of bar (access pending)
Winchuck	fringing marsh, “reference” island & slough, mouth of tributary, restored marsh

Forms and analytical tools develped by Adamus (2006), were used to monitor indicators of wetland function, biological and geomorphic condition, and potential risks to the wetland’s integrity. Field indicators address potential risks to wetland integrity and functions. For example the function of fish habitat depends on a network of wetland services, such as trapping sediment, immobilizing sediment/pollutants (locations of road drainage, stormwater runoff), supporting food webs, slowing floodwaters, and thermal regulation by groundwater exchange.

The surveys consist of assigning values for 55 indicators using definitions provided by Adamus (2006), at http://www.oregon.gov/dsl/WETLAND/docs/tidal_HGM_pt1.pdf (Appendix A Data Forms). Eleven botanical indicators are included, requiring surveys of species presence and abundance on 10 quadrats (one-meter plots) along each of two transects (shown in figures 1-4). Each indicator score and the vegetation percent cover data were entered into TidalWet_Calculator _HGM_Oregon June 2010.xls. The calculator uses scoring models (Appendix C) to combine the indicators for scores of 12 wetland functions, wetland condition, and potential risks to wetland integrity.

Tidal Wetland Quadrats Surveyed	
Sixes Sullivan Gulch	26
Hunter north slough & flat	20
Pistol overflow (ODOT pond)	17
Pistol former channel	4
Winchuck Ranch south	13
Winchuck Reference	20
Winchuck Wayside	18
Total Quadrats	118

Because brackish-tolerant species are less common in the river-sourced wetlands along the South Coast estuaries, a large number of plant species were present in addition to those used in the wetland integrity calculator. To facilitate analysis of these plots, we created a database to manage attributes of the wetlands, transects, and wetland plant taxa (Appendix C).

More detailed descriptions of the methods used for the HGM Rapid Assessment Method, including any exceptions to the methods described above, are provided in Appendix C.

Wetland Integrity

Adamus (2005) defines wetland integrity as

> "The ability of a wetland to support and maintain (a) dynamic hydrogeomorphic processes within the range found in wetlands that have experienced the least alteration by humans, and (b) a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that found in relatively unaltered native habitats of the region, as influenced by (and influencing) the geomorphic processes described previously. Together, these define the ability to support and maintain wetland complexity and capacity for self-organization with respect to species composition, physical and chemical characteristics, and functional processes. A wetland may be considered to have high integrity (or be in "intact" condition) when all of its natural processes and parts are functioning within their natural ranges of variation. Integrity often is used synonymously with "naturalness," although the linkage between naturalness, wetland complexity, and wetland self-organizing capacity may not be clearly apparent among some wetlands."

The Wetland integrity score is an average of scores for the difference from predicted values (statistically accounting for natural factors, discussed below)

- Positive influence: species per quad, mean % cover of tap-rooted wetland species, mean % cover of tuft-rooted wetland species
- Negative influence: proportion of plots that contain plant species with 90% or greater cover (dominance), proportion of plots that contain non-native species with 20% or greater cover, proportion of plots that contain annuals, mean % cover of stoloniferous species

Indicator Abbrev	Indicator Description	Hunter North	Pistol Ch & ODOT	Winchuck Wayside	Winchuck Reference	Winchuck Ranch S	Sixes Sullivan
SpDeficit	Difference between actual and predicted species per plot	0.75	0.75	0.25	0.01	1.00	0.50
DomDef	Difference between actual & predicted dominance (proportion of plots with>90% cover	0.75	1.00	0.25	0.50	1.00	1.00
Nndef	Difference between actual & predicted proportion of plots containing non-native species with >20% cover	0.25	0.50	0.25	1.00	0.50	0.50
AnnSp	Proportion of quadrats that contain annuals	0.01	0.01	0.01	0.01	0.50	1.00
TapSp	Mean percent-cover of tap-rooted wetland species among all quadrats	1.00	1.00	1.00	1.00	1.00	1.00
StolSp	Mean percent-cover of stoloniferous species among all quadrats	1.00	1.00	1.00	1.00	1.00	1.00
TuftSp	Mean percent-cover of tuft-rooted wetland species among all quadrats	0.01	0.50	0.01	0.01	0.01	0.01
	Wetland Integrity Score (Average)	0.54	0.68	0.40	0.50	0.72	0.72

Indicator predictions are based on species wetness index, percent cover and proportion of plots containing salt-tolerant species, marsh size (transect length), proportion of plots containing salt-intolerant species, tributary length, number of channel exits and channel junctions.

Wetland integrity includes a factor for tidal channel dimensions. In this discussion, the tidal channel indicator is excluded due to the difficulty of comparing wetlands lacking sufficient width for tidal channel development (e.g. Winchuck Wayside and Winchuck Ranch), with wetlands having very different channel types:

Hunter North - ditched channels
Pistol Channel – former mainstem channel, now infrequently flowing overflow channel
Winchuck Reference – off-channel slough

The highest wetland integrity scores were for Sixes Sullivan Gulch and the isolated wetlands along Winchuck Ranch. Both had the highest species wetness index (other than the non-tidal ODOT pond at Pistol River). Both had fewer than predicted plots with dominant plant species and less than expected percent cover of stoloniferous species. Sixes Sullivan Gulch scored higher due to a lower than predicted proportion of plots containing annuals, while Winchuck Ranch scored higher due to having more species per plot. Neither wetland contained the predicted percent cover of tuft-rooted species. Both similarly had fewer than predicted plots containing non-native species >20% cover.

Winchuck Reference wetland had fewer plots containing non-native species cover >20%. For Winchuck Reference plots, the mean number of species per plot was lower than predicted while the proportion of plots containing non-native species with >20% cover scored well. The number of species was likely affected by the presence of the garden escapee, *Croscosmia*, which isn't included in the TidalWet Calculator. As a dominant non-native, it covered >20% of 6 of the 8 plots where it was found, so that the wetland integrity has certainly been compromised.

Although Pistol River wetland complex had the fewest plots containing non-native species cover >20%., it had the third highest wetland integrity.

The lowest wetland integrity score was for the Winchuck Wayside, which is a restoration project where vegetative recovery is underway. In contrast to Winchuck Ranch, the Wayside has fewer than predicted species per plot, greater than predicted plots have dominant plant species, and more plots than expected contain non-native species. The predicted value of species per plot is higher at Winchuck Wayside, primarily due to its wetness index of 6.7, compared with 8.0 for Winchuck Ranch. It is difficult to know whether the lower wetness index is due to the elevation of the excavated surface, soil texture, or if vegetation succession has yet to fill all of the wetland niches. Winchuck Ranch wetlands are also re-vegetating after livestock were excluded from the tidal fringe in YEAR.

Wetness index and % cover are compared for abundant species in three wetlands in the same watershed below. At Winchuck Wayside, native diversity would improve if Lotus corniculatus were replaced by other species such as *Trifolium workskoljii* (also from the Pea Family). As the wetland matures, *Potentilla anserina* cover might increase. Clearly habitat conditions are favorable for *Schoenoplectus microcarpus* at Winchuck Wayside.

Species	Wetness Index	% Cover Winchuck Ranch	% Cover Winchuck Reference	% Cover Winchuck Wayside
Schoenoplectus microcarpus	10	0	1	16
Carex obnupta	10	3	21	4
Potentilla anserina	9	15	9	4
Trifolium wormskoljii	9	11	0	0
Agrostis stolonifera (non-native)	8	13	3	3
Lotus corniculatus (non-native)	5	5	5	39

Risk Assessment - Existing Potential Risks to Wetland Integrity

Values for the first 13 indicators are considered to represent “stressors” that a tidal wetland may face from human activities which may diminish wetland integrity. Adamus (2005) defines stressors as

> “…factors, processes, and their agents that potentially diminish the condition, functions, and/or sustainability of wetlands, their biological communities, and processes. Normally used to describe extreme conditions associated with anthropogenic (human-related) disturbances, such as aberrant levels or regimes of surface water or soil moisture, habitat connectivity, nutrients, sediments, organic loads, chemical contaminants, shade, temperature, acids, salts, and others. Levels that are within the range of natural variation (to which native species presumably are adapted) are instead called “natural disturbances.””

Adamus (2005) defines the risk to wetland integrity as

> **“**…the probability that stressors may, over the short or long term, threaten a wetland’s geomorphic and/or biological integrity, primarily as related to the magnitude and duration of the stressor rather than to the intrinsic sensitivity of the wetland.”

Adamus (2006) also comments on how risk assessments may be used, as well as their limitations

> "…risk assessments such as this are useful not only for assessing wetland integrity and function, but also for prioritizing sites for restoration based on a site's likelihood of having been ecologically degraded. Other factors, such as the wetland's intrinsic sensitivity, scarcity, geomorphic resilience, and land ownerships, should also be considered when prioritizing restoration.'

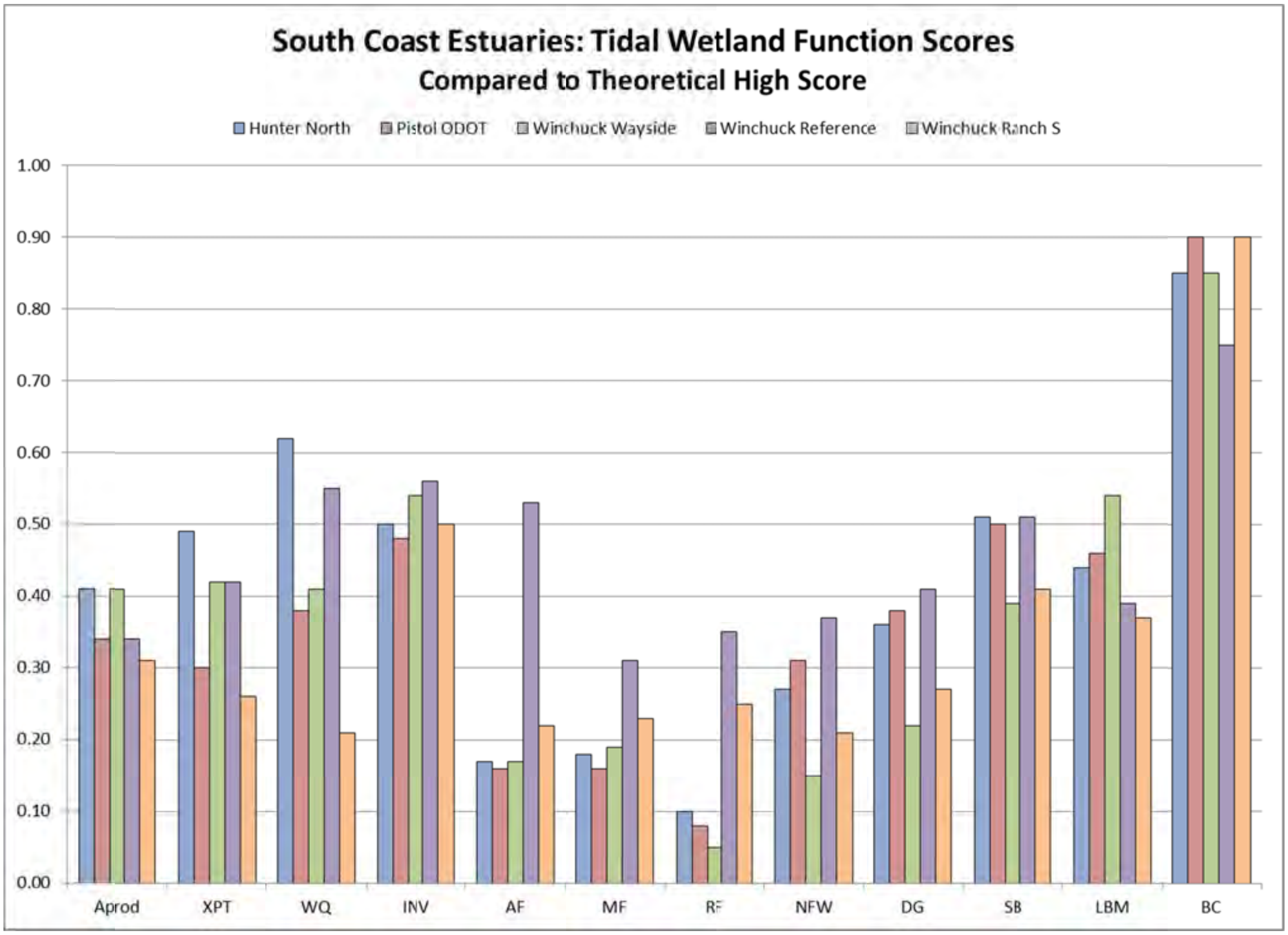
On a scale from 0 to 1, higher scores indicate higher potential risks to wetland integrity (Table 2). Winchuck Reference wetland has the lowest score for risk, while the Winchuck Wayside has the highest, although the highest (worst) risk only scores 0.43. Table 2 displays indicators that contribute to the potential risk. Indicators scoring more than 0.50 in at least one wetland include: risk of nutrient overload, incoming fine-sediment overload, artificial constrictions drying wetland, extent and frequency of wetland visitation, boat traffic frequency and proximity, inhabited structures, possible instability of the wetland, and persistently bare area around the wetland. Risks such as inhabited structures and developed (persistently bare) areas are less likely to change compared with treatments such as providing incentives for septic system maintenance (nutrient overload risk), storm-proofing roads for fine-sediment reduction, and removing artificial constrictions.

Within the confined valleys of the Southern Oregon Coast, vehicle and boat transportation routes, residences, and other facilities are in close proximity to tidal wetlands. Strategies for addressing this landscape-scale risk would invest in creating or enhancing buffers that effectively capture potential fine-sediment and nutrient overload. Education about potential risks associated with recreational and residential activities could raise awareness.

Assessment of Wetland Functions

Scores for wetland functions were adjusted to a scale of 0-1, using two different approaches (Adamus, 2005). Indicators were measured on a set of 120 Oregon Coast tidal wetlands, and the maximum value for each in combination provides a highest possible (theoretical) score for each wetland function. Data for the risk assessment indicators were analyzed to select 25 "least altered" wetlands, those least likely to have sustained lasting damage from human activities. The second approach uses these least-altered (best reference) surveyed sites to set the maximum scores.

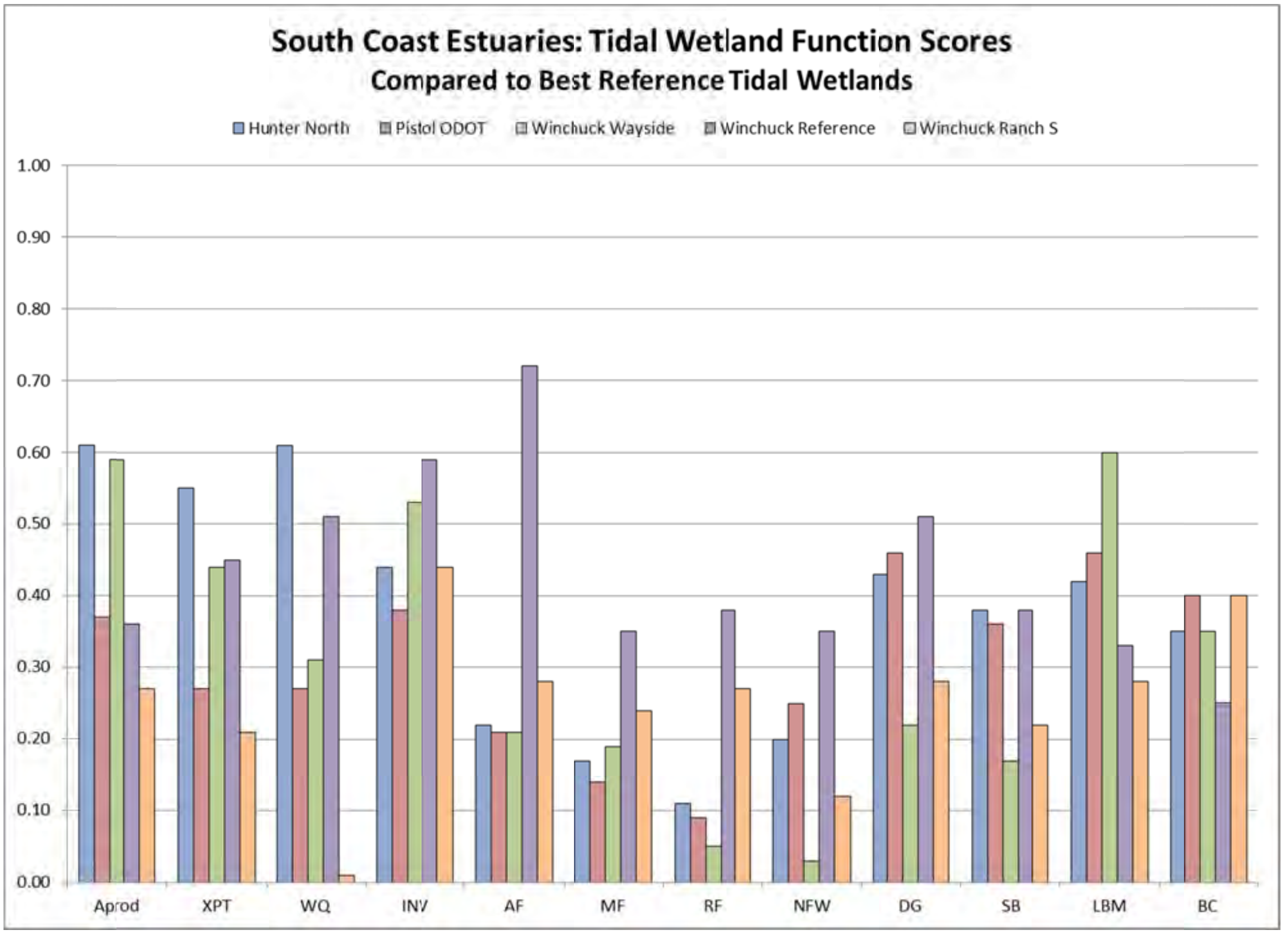
Calculated wetland function scores are provided in Table 3 and displayed in the two graphs below. Complete explanations for the wetland functions are provided in Appendix C. Several of the functions depend on each other, for example, production of aboveground organic matter (AProd) is an indicator for calculation of the native invertebrate habitat (INV) function. Native invertebrates are used to estimate the quality of the habitat for anadromous fish (AF). AProd is also an input for exporting aboveground plant and animal production (XPT) and for element cycling, pollutant processing, and sediment stabilization for water quality (WQ). Habitats for marine fish (MF), resident fish (RF), nekton-feeding wildlife (NFW), ducks & geese (DG), shorebirds (SB), and land birds & mammals (LBM) each are estimated by combining indicators as shown by their “scoring models” (Appendix C). Maintain natural botanical condition (BC) is based on species diversity and non-native plant cover.



Restoration Considerations for Wetland Functions:

<u>Production of Aboveground Organic Matter (AProd)</u>

Onsite soil disturbance by livestock on fresh overflow channel deposits decreases AProd at Pistol ODOT. While potential nutrient overload elevates the risk to wetland integrity, it also increases AProd at Winchuck Wayside, Hunter North and Winchuck Ranch. Winchuck Ranch lacks multiple vegetation structure types. Although low shade cover on wetlands at Hunter North, Pistol, and Winchuck Wayside decreases some functions, it also increases AProd. The presence of freshwater sources at Winchuck Reference and Winchuck Ranch are beneficial AProd, but didn’t overcome the effect of the shade.



<u>Export Aboveground Plant and Animal Production (XPT)</u>

AProd is an indicator for XPT along with an average of several other indicators. Winchuck Reference scores better on this function (relative to its score on AProd) due to channel complexity provided by the slough and wetland area accessible to young anadromous fish. The channel with an internal channel junction and some complexity in the Hunter North wetland is a positive influence (even though it is ditched), but is offset slightly by crossing the widest of the wetlands (although none are considered "wide").

<u>Maintain Element Cycling Rates & Pollutant Processing; Stabilize Sediment (WQ)</u>

The scoring model for WQ is complex, including Aprod added to four indicators, and reduced by an average of four indicators. Wetland width is a positive influence on this function, along with channel complexity and accessible wetland area as above. At Winchuck Ranch, it was difficult to determine how frequently the pasture would be flooded by the Winchuck, to be considered as a non-tidal wetland rather than upland. Based on the wetland vegetation visible in the color infrared photos (likely due to drainage from the hillslope rather than flooding), it was assumed that the pasture was not an upland perimeter (reducing the WQ function score).

Soil characteristics for Winchuck Wayside and Winchuck Ranch indicate that their wetlands are less mature. When Winchuck Wayside was excavated, the exposed surface lacked roughness to slow current velocity. Cobbles, gravel, and coarse sand deposited over the surface, and large wood rafted into the site. Establishment of willow and alder along with other wetland cover will trap finer-textured sediments and promote this water quality function. Where the isolated wetlands had developed along Winchuck Ranch, the primary substrate type was coarse sand.

Pistol ODOT wetlands lack internal channel complexity and have a small part of the wetland accessible (poor filtration). It has a small perimeter of upland because non-tidal wetlands are present on the pasture. It has a well-defined remnant of the original Pistol River mainstem, which reduces the contact time for filtration. Accessibility to tidal influence could be improved for this wetland.

Winchuck Reference could score higher if the transition angle along the mainstem were more gradual and stable. Steep banks on the mainstem side may result from the wetland's location upstream of the Highway 101 bridge.

<u>Maintain Habitat for Native Invertebrates (INV)</u>

The scoring model for INV is even more complex, involving several averages and reductions from risk indicators. Channel characteristics were best for Hunter North and Winchuck Reference as for XPT above. Vegetation structures, vegetation forms, and species diversity scores averaged less than 0.50 for all wetlands, but were slightly worse for Winchuck Ranch, which lacked vegetation structures and species diversity. Upland edge bounded by alder scored best for Hunter North and Winchuck Wayside. Winchuck Ranch and Pistol ODOT lack an upland perimeter as for WQ above. Winchuck Wayside is most exposed to waves and river currents, with a defined driftwood line which provides invertebrate habitat. Winchuck Reference has wood in its tidal slough. The highest risk of instability is primarily for the Pistol ODOT wetland located in a mobile overflow channel, but also in the former mainstem channel of Pistol River if flood flows were diverted enough to deposit bedload. Hunter North was judged to have the highest risk of incoming fine-sediment overload (burial).

Stabilizing wetlands, reducing fine-sediment overload, adding wood to tidal channels and sloughs, increasing vegetation structures and forms, increasing species diversity, and promoting alder in the upland edge will all increase the habitat for native invertebrates.

<u>Maintain Habitat for Anadromous Fish (AF)</u>

Winchuck Reference scores higher for this function due to having better quality invertebrate habitat, internal channel complexity (slough), wood in the slough, more wetland area accessible to young anadromous fish, multiple types of internal freshwater sources, and more shaded low marsh.

Although many of these indicators could be improved for all of the wetlands, the maximum score that could be achieved for this function is limited by a lack of long fish accessible non-tidal tributary channels feeding the wetlands and a lack of tidal marsh acreage in these small estuaries.

<u>Maintain Habitat for Marine Fish (Mfish) and for Other Visiting and Resident Fish (Rfish)</u>

Similar to anadromous fish, habitat for these fish depends on some indicators that may be modified, such as accessible wetland area, internal channel complexity, and channel exits and junctions. The potential habitat is limited by a lack of tidal marsh acreage in the estuaries.

Maintain Habitat for Nekton-feeding Wildlife (NFW)

Nekton-feeding wildlife depend on Afish, Mfish, or Rfish as a food source. Winchuck Reference and Hunter North have higher average scores for internal channel complexity, junctions, and exits. Bare substrate is lacking overall, but is more available at Pistol (ODOT wetland) and Hunter North. Within 1.5 miles, the availability of ponds, nontidal marsh, or bottomland pasture is greatest for Pistol, and also relatively higher for Winchuck Wayside and Winchuck Reference wetlands. Foot and boat visitation (more frequent at Winchuck Wayside) can be partially offset by the percent of cover available within a 3000 foot buffer.

Maintain Habitat for Ducks and Geese (Dux)

Hunter North and Winchuck Reference have protected habitat in the part of the wetland that is an island, partially flooded during tides. Pistol habitat benefits from adjacent ponds, nontidal marsh, or bottomland pasture and could benefit from being connected to the adjoining tideflat at the mouth of the former Pistol channel. Winchuck Wayside and Winchuck Ranch score lower than the other wetlands. Both lack tidal channels. Winchuck Wayside is more exposed to waves and currents (a permanent feature of this location), but the habitat value is also decreased by the frequency of foot and boat traffic. Winchuck Ranch lacks some vegetation structures. Winchuck Reference and Winchuck Ranch benefit from having multiple types of freshwater feeding the wetland.

All of the wetlands could have more vegetation structures. Many of the other contributors to habitat are inherent and not subject to enhancement.

Maintain Habitat for Shorebirds (Sbird)

Winchuck Wayside and Winchuck Ranch have the lowest quality shorebird habitat. In particular, Winchuck Wayside lacks potential shorebird roosts within 1.5 miles, has many vegetation forms, is bounded by upland rather than tideflat, wetland or water, and has a higher frequency of foot and boat visitation. All of the wetlands are narrow, particularly those along the Winchuck estuary.

Hunter North has the most types of shorebird roosts, Pistol ODOT benefits from adjacent ponds, nontidal marsh, and bottomland pasture, and Winchuck Reference has a higher proportion of the wetland accessible to young anadromous fish.

Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators (LBM)

Winchuck Wayside has the best habitat for this group due to high scores in mean species per plot, habitat for native intertebrates (INV), large wood pieces protecting at least 1 m above the wetland surface, and a the driftwood line (lacking in other wetlands). This habitat could be enhanced for all of the wetlands by increasing the vegetation structures, number of projecting large wood pieces, and any indicators involved in native invertebrate habitat.

Maintain Habitat for Native Botanical Conditions

This function is based on indicators obtained from botany plots along transects, for species included in the TidalWet calculator. The proportion of plots that contain non-native species (with a % cover of 20 or greater) is offset from the average number of species per plot.

Winchuck Ranch and Pistol ODOT had the highest scores for this function. Winchuck Ranch had more wetland species per plot than Pistol ODOT, while Pistol ODOT had a smaller proportion of plots with non-native cover >20%. Winchuck Reference scored the lowest, due to containing fewer wetland species per plot. As discussed previously under Wetland Integrity, the non-native species that was most dominant in the Winchuck Reference wetland was not counted in the calculations, but is likely the reason for the fewer wetland species.

Indicator Description	Hunter North	Pistol Ch ODOT	Winchuck Wayside	Winchuck Reference	Winchuck Ranch S	Sixes Sullivan
Actual number of wetland spp per quadrat	**4.50**	**3.70**	**4.67**	**2.55**	**4.54**	**3.88**
Actual proportion of quadrats that contain non-native spp >20% cover	**0.85**	**0.33**	**0.83**	**0.35**	**0.54**	**0.38**
Sum of scaled values	0.70	0.80	0.70	0.50	0.80	0.70
Function compared to theoretical highest	0.85	0.90	0.85	0.75	0.90	0.85
Function compared to best reference	0.35	0.40	0.35	0.25	0.40	0.35

For each wetland function, other considerations of their Values are described in Adamus (2005). For the HGM Rapid Assessment Method, Data Form C is identified as an optional form (Adamus, 2006), but it would facilitate evaluation of relative abundance/scarcity/populations, geographic distribution of wetland subclasses, habitats, food webs, and functions, as well as economic values. For example, tidal wetlands partially forested with Sitka spruce are relatively scarce on the Oregon Coast (Adamus, 2006). Technical Advisory Committee members could contribute their expertise to evaluating these values, which would inform ongoing strategic planning.

Botany Transects and Off-Transect Surveys

Of the 118 quadrat plots, all but 12 contained at least some obligate wetland species, and these all contained facultative wetland species (wetland indicator status categories below).

Indicator categories

Indicator Code	Indicator Status	Designation	Comment
OBL	Obligate Wetland	Hydrophyte	Almost always occur in wetlands
FACW	Facultative Wetland	Hydrophyte	Usually occur in wetlands, but may occur in non-wetlands
FAC	Facultative	Hydrophyte	Occur in wetlands and non-wetlands
FACU	Facultative Upland	Nonhydrophyte	Usually occur in non-wetlands, but may occur in wetlands
UPL	Obligate Upland	Nonhydrophyte	Almost never occur in wetlands

Within the 118 quadrats, 88 taxa were recorded, including 55% native, 31% introduced, and 15% not determined. Of the" not determined" taxa, all but two averaged 5% or less cover on the quadrats where they were observed. *Persicaria* was identified to genus (photo to the right), but there are four natives and two introduced species in Curry County. *Persicaria spp* was present on three plots on the Winchuck, where it averaged 41% cover.

Spergularia/Stellaria was also not determined, and covered 10% of one plot at Sullivan Gulch.

Phalaris arundinacea (reed canarygrass) is included in the non-native group based on its status in the TidalWet Calculator spreadsheet provided by Adamus. The origin of reed canarygrass as a native North American species appears to be clear, but sources also agree that its pre-agricultural distribution is uncertain due to widespread cultivation from European introductions (http://www.fs.fed.us/database/feis/plants/graminoid/phaaru/all.html). Reed canarygrass threatens wetland and aquatic wildlife habitat by displacing desirable native wetland plants. It was identified on 18 plots in the Hunter North wetland, where it averaged 35% cover.

From observations off-transect, 65 additional taxa were recorded, including 62% native, 31% introduced, and 7% not determined species.

The average % cover of native plants among all quadrats is 59%, with 40% introduced, and another 2% not determined.

The percentage cover of native perennial species was calculated for each transect as a measure of the stability of the vegetation. The average and the range of percent cover is shown in the table below. Three wetlands with the highest average % native perennial cover were: located in a sedge wetland (*Carex obnupta*) in Sullivan Gulch, in a freshwater pond located on the downstream end of a Pistol River overflow channel, and on a deposit at the mouth of a tributary to the Winchuck River Estuary. It is also interesting that the lowest maximum native perennial cover was in a former channel of the Pistol River, and on one transect of the Winchuck Wayside restoration wetland.

Native Perennial % Cover Transect Summary			
	Minimum	**Average**	**Maximum**
Sixes Sullivan Gulch -pasture	3	52	95
Sixes Sullivan Gulch -sedge	72	92	100
Hunter North - slough to fence	10	34	89
Hunter North - pasture & ditch	20	52	93
Pistol overflow & freshwater pond	17	82	100
Pistol former main channel	14	33	57
Winchuck Ranch S brackish fringe ds	5	44	96
Winchuck Ranch S brackish fringe mid	19	53	89
Winchuck Ranch S - brackish fringe us	2	58	90
Winchuck reference island & slough	0	32	100
Winchuck reference trib mouth	33	79	100
Winchuck Wayside restored us	13	46	94
Winchuck Wayside restored ds	20	43	56

When a transect includes a both a low average cover and a high maximum cover of native perennials, stabilizing plant resources are present along the transect, but the overall composition is undesirable. Along the Hunter North – slough to fence transect, several quadrats were dominated by *Phalaris arundinacea* and pasture species such as *Lotus corniculatus* and *Schedonorus arundinaceus*. Desirable native perennial species in this transect include *Eleocharis palustris*, *Potentilla anserina*, *Trifolium wormskioldii*, *Hordeum brachyantherum*, *Juncus breweri*, *Juncus bolanderi*, *Cyperus eragrostis*, *Juncus balticus ssp. ater*, and *Epilobium ciliatum*. The native tree, *Fraxinus latifolia*, and shrub, *Salix spp*, were also present.

Along the Winchuck reference island & slough transect, several quadrats were dominated by *Crocosmia X Crocosmiiflora and Schedonorus arundinaceus*. Four of the 13 quadrats on this transect did not contain the wetland indicator species, *Potentilla anserina*. Excluding these quadrats, the calculated average is 45% cover of native perennials. Desirable native perennial species in this transect include *Deschampsia caespitosa*, *Potentilla anserina, Juncus exiguous*, and *Symphyotrichum subspicatum*.

Supplemental Analysis - Waterfowl Foods

To date, the complete list of waterfowl food plants present within Curry County includes 43 native species and 7 introduced species (table 4). Several of these species are distributed within coastal lakes such as Floras and Garrison, while others may be found in the Rogue Basin and not on the adjacent South Coast.

At least 14 plant species important to waterfowl were present within plots on these South Coast wetlands. The table to the right displays the total percent cover averaged over all 118 plots. During off-transect surveys, five additional waterfowl food taxa were recorded: *Nuphar polysepala, Distichlis spicata, Glyceria striata, Potamogeton natans, and Sparganium euryccarpum.*

Scientific Name	% cover for all plots
Carex obnupta	14.5
Eleocharis palustris	13.1
Scirpus microcarpus	5.1
Juncus balticus	2.8
Equisetum spp	2.4
Typha latifolia	1.4
Persicaria spp	1.4
Distichlis spicata	0.3
Cyperus eragrostis	0.3
Glyceria striata	0.2
Triglochin maritima	0.1
Potamogeton natans	0.1
Juncus balticus ssp. ater	0.1
Schoenoplectus americanus	0.01

Of the 118 plots in these South Coast wetlands, 89 contained at least some cover of waterfowl food species (75%). Within the plots that lacked waterfowl foods, other dominant species (in order of frequency of plots in which they dominated) included *Crososmia X crocosmiiflora*, *Potentilla anserina, Agrostis stolonifera, Deschampsia caespitosa, Schedonorus arundinaceus*, *Phalaris arundinacea, Ranunculus repens, Juncus effusus, Juncus hersperius, Juncus breweri*, *Lotus corniculatus, Holcus lanatus, and Salix* spp.

Phalaris arundinacea is also known to be a component of ducks stomachs during fall and winter east of Cascades, and of Mallards stomachs in Washington (Yocum, 1951). However, this species was not included in a chapter on important plants for waterfowl, presumably either due to the plant's non-native status, or its invasive character.

Wetland Descriptions

Wetland Name: Hunter North **SiteID**: 4
Botany Survey Date(s): July 18 and 22, 2013

This wetland is located north of Hunter Creek and upstream of the Highway 101 Bridge. It is bounded on the north by the road fill for Hunter Creek Loop Road and upland hillslopes, tapering to an end at the County Road Bridge over Hunter Creek.

Hydrogeomorphic Setting
The earliest historic aerial photographs (1940) show that wetland vegetation was more broadly distributed prior to ditching of the wetlands.

During the winter, the saltwater wedge reaches upstream to the County Road Bridge across Hunter Creek infrequently, generally at high tides (based on a year of biweekly sampling). During the summer, brackish conditions (<2ppt and >200uS) were detected in 10% of weekly samples. More intensive summer sampling showed that in some years the mouth is sealed so that salinity is not detected, although conductivity increases through the summer months, presumably due to overwash during the highest tides. In other summers, when the mouth is open periodically, salinity intrusion results in stratification at the deeper stations. When stratified, the surface layer, at <1 meter in depth, was generally <1 ppt.

Risk Assessment
Score: 0.36
(ranged from 0.44 highest risk to 0.27 lowest risk, for 2013 wetlands).
Risk factors that scored the highest were incoming fine-sediment overload, close proximity to the nearest inhabited structure, and risk of nutrient overload.

Vegetation
Wetland Integrity Score: 0.50
(ranged from 0.89 best to 0.40 worst)

Botanical Condition Score: 0.85
(ranged from 0.90 best to 0.15 worst)

These transects are the second most diverse of the eleven wetlands surveyed in 2013. Of the 43 species found on the Hunter North Transects, the non-native *Phalaris arundinacea* (reed canarygrass) is dominant, followed by wetland obligates *Potentilla anserina* (common silverweed) and *Eleocharis palustris* (common spikerush), together covering 54% of all quadrats. Non-native perennial creeping bentgrass, *Agrostis stolonifera* and redtop, *Agrostis gigantea* together cover 12%. At 6%, *Juncus balticus ssp. ater* is a brackish-tolerant perennial FACW rush. The remaining 37 species are all present at less than 5% cover, including six native perennial wetland obligates, and 11 native FACW species (including one annual and one tree).

- Brackish-tolerant perennial natives
  - wetland obligate species: *Lilaeopsis occidentalis*

    - FACW species: *Hordeum brachyantherum* (a native grass, meadow barley) *Plantago maritima* (salt marsh plantain), *Symphyotrichum subspicatum* (American aster), and *Trifolium wormskioldii* (cows clover)
- Other perennial natives
    - wetland obligate species: *Carex obnupta* (slough sedge), *Juncus bolanderi* (Bolander's rush) *Schoenoplectus americanus* (three-square, bulrush), *Stellaria humifusa* (saltmarsh starwort)
    - FACW species: *Cyperus eragrostis* (tall flatsedge), *Epilobium ciliatum* (fringed willowherb), *Equisetum spp* (horsetail), *Fraxinus latifolia* (Oregon ash, tree), *Juncus breweri* (Brewer's rush, salt rush), and *Juncus hesperius* (bog rush, coast rush)
- Annual native FACW *Juncus bufonius* (toad rush)

Non-native species are dominantly perennial, and include *Cirsium arvense* (Canadian thistle), two additional pasture grasses, *Holcus lanatus* (common velvet grass) and *Schedonorus arundinaceous* (tall fescue).

Transect 1 (Quadrats #1-#10) begins at an unconsolidated bar within the slough and trends northwest across the tidal fringe and up the bank to the fence. This transect was spaced with one meter between each plot, for a total distance of 19 meters. *Phalaris arundinacea* dominated this transect, at 25% overall (but ranging from 0-87% in each plot). Non- native grasses *Agrostis solonifera* and *Schedonorus arundinaceus*, covered 17% and 8% of the quadrats respectively, while wetland obligates *Eleocharis palustris* and *Potentilla anserina* covered 9% and 7%. *Fraxinus latifolia* covered 6% overall, but was confined to 55% of a single quad, at 6-8 feet tall. This transect contained over twice as many species as Transect 2, with 37 species identified.

Transect 2 (Quadrats #11-#20) begins at the fence and crosses the largest tidally influenced ditched channel (shown to the right during December 2012 King Tide), ending at an open area composed of sandy soils. The total distance was 55 meters, spaced at five meters between plots. This transect was more uniformly vegetated, except for plots in the ditch channel. Sixteen species were identified on this transect, and only five species exceeded 5% cover, including 39% cover of *Phalaris arundinacea* (present in all plots, ranging from 7-73% cover). *Potentilla anserina* (15%), *Eleocharis palustris* (13%) and *Juncus balticus* (12%), all perennial native obligate or FACW species, covered 40% of plots.

Off-Transect Surveys

An additional 16 species were recorded off-transect. Most of these were associated with dune habitat, including:
Native perennial
Abronia latifolia (yellow sand verbena)
Ambrosia chamissonis (silver bursage)
Bromus briziformis (rattlesnake brome)
Lathyrus spp (likely beach sweet pea)
Polygonum paronychia (beach knotweed)

Non-native perennial
Achillea millefolium (common yarrow)
Ammophila arenaria (European beachgrass)
Cynosurus cristatus (crested dog's tail grass)
Dactylis glomerata (orchardgrass)

Non-native annual
Vicea tetrasperma (lentil vetch)

Alnus rubra (red alder), *Baccharis pilularis* (coyote bush), and *Heracleum maximum* (American cow-parsnip) created a native shrub layer in some locations. Native perennials, *Senecio spp* (on gravel bar) and *Iris tenax* (toward channel) were also present.

One additional FACW species was noted, but it is an invasive perennial, *Crocosmia X crocosmiiflora*. Of particular concern is the evergreen shrub, *Cotoneaster spp* located on the road fill on the north slope adjacent to this wetland. It has escaped garden cultivation in California, and is invading from the south along road sides and disturbed areas. In autumn and winter, the dispersal of the abundant red berries is facilitated by birds. The California Invasive Plant Council identifies management concerns and strategies at.http://www.cal-ipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=36&surveynumber=182.php.

Restoration Considerations

- Remove and treat non-native species, particularly *Phalaris*, *Cotoneaster* spp and *Crocosmia X crocosmiiflora*.
- Promote dune species along buffer adjacent to ODOT property.
- Vegetate "upland" with native shrubs and trees, *Fraxinus* in wet areas.
- Compare ditched channel to tidal channels in terms of width/depth ratio, sinuosity, and gradient. Determine if wetland area can be expanded if channel incision is reduced, or whether additional junctions could be developed.
- Investigate road drainage inflow locations for erosion, pollutants during first flush from road.

Scientific Name	Common Name	Pct Cover
Phalaris arundinacea	reed canarygrass	32
Potentilla anserina ssp pacifica	common silverweed, cinquefoil	11
Eleocharis palustris	common spikerush	11

Agrostis stolonifera	creeping bentgrass	9
Juncus balticus	baltic rush	6
Schedonorus arundinaceus	Tall Fescue, Alta Fescue, Kentucky Fescue	4
Agrostis gigantea	redtop, black bent	3
Rubus ursinus	California blackberry	3
Fraxinus latifolia	Oregon Ash	3
Lotus corniculatus	bird's-foot trefoil	2
Hordeum brachyantherum	meadow barley	2
Juncus breweri	Brewer's Rush, Salt Rush	2
Equisetum spp	horsetail	2
Carex obnupta	slough sedge	1.4
Trifolium wormskioldii	cows clover	1.2
Mentha pulegium	Pennyroyal	1.1
Lupinus spp	lupine	0.8
Leucanthemum vulgare	Ox-Eye Daisy	0.6
Symphyotrichum subspicatum	Leafy-Bract American-Aster	0.6
Hypochaeris spp	cat's ear	0.5
Holcus lanatus	common velvet grass	0.5
Cyperus eragrostis	Tall flatsedge	0.4
Juncus bolanderi	Bolander's Rush	0.4
Epilobium ciliatum	fringed willowherb	0.4
Plantago maritima	goosetongue, seaside or salt marsh plantain	0.3
Gnaphalium spp	cudweed	0.3
Salix spp	willow	0.3
Juncus balticus ssp. ater	baltic rush	0.3
Cirsium arvense	canadian thistle	0.2
Juncus hesperius	bog rush, coast rush	0.2
Oenanthe sarmentosa	Pacific water-dropwort, water parsley	0.2
Rumex acetosella	Common Sheep Sorrel, Sour weed	0.2
Rumex crispus	curly dock	0.2
Juncus bufonius	toad rush	0.2
Vicia spp.	Vetch	0.1
Lilaeopsis occidentalis	Western Grasswort, Lilaeopsis	0.1
Daucus carota	Queen Anne's-lace	0.1
Asteraceae, genus unk	Sunflower Family	0.1
Hypericum perforatum	Common St. John's-Wort	0.1
Melilotus alba	white sweet-clover	0.1
Schoenoplectus americanus	American bulrush, three-square, chairmaker's Club-Rush	0.1
Angelica lucida	Seacoast Angelica	0.1
Stellaria humifusa	Saltmarsh Starwort	0.1

Wetland Name: Pistol North upstream/ODOT pond **SiteID**: 6
Botany Survey Date(s): August 23, 2013

This wetland is located north of Pistol River, upstream of the Pistol Loop Bridge, and consists of scattered potential tidal forested wetlands (Scranton, 2004) in different habitats

Hydrogeomorphic Setting
The Pistol River channel transports a relatively high volume of bedload, which may explain the dynamic channel pattern observed in the historic photo record since 1940.

Most of the quadrats were located across a shallow pond on the downstream end of an overflow channel (right). This wetland is located upstream of tidal influence (based on observations during a King Tide).
Another set of quadrats cross a former channel of Pistol River (evident in the 1940's historic aerial photographs). The transect location may be tidally influenced infrequently, only during extreme high flows. Off-transect surveys include the mainstem riparian area (also infrequently tidally influenced), and a freshwater swamp fed by drainage from the hillslope (a "wall base" wetland).

During October-May, the saltwater wedge extends upstream of the Pistol Loop Bridge an estimated 7% of the time (based on 29 bimonthly samples, with a peak concentration of 19 ppt). During June-September, saltwater influence depends on development of a sill at the mouth, varying from 35-40% during July-August, up to 100% in September at concentrations <1 ppt, while the mouth was closed. The highest measured concentration was 16 ppt in July.

Risk Assessment
Score: 0.33
(ranged from 0.44 highest risk to 0.27 lowest risk, for 2013 wetlands).
Risk factors that scored the highest were close proximity to the nearest inhabited structure, possible instability of the wetland, and drying of wetland as result of blockage (fill culverted at downstream end of former channel?).

Vegetation
Wetland Integrity Score: 0.75
(ranged from 0.89 best to 0.40 worst)

Botanical Condition Score: 0.90
(ranged from 0.90 best to 0.15 worst)

Of the 31 species identified on the Pistol transects, wetland obligate *Eleocharis palustris* (common spikerush), was dominant, followed by non-native *Agrostis stolonifera* (creeping bentgrass), and *Salix spp* (willow). Together these three species make up 2/3 of the cover in the quadrats. Native wetland obligates *Scirpus microcarpus* (small-flowered bulrush), *Typha latifolia* (broadleaf cattail), and *Lemna spp* (duckweed) as well as FACW species *Equisetum spp* (horsetail) were the next most abundant. The remaining 24 species each cover 1% or less of the plots, including:

- 7 perennial native wetland obligates: *Potentilla anserina* (common silverweed), *Juncus bolanderi* (Bolander's rush), *Carex obnupta* (slough sedge), *Glyceria striata* (fowl mannagrass), *Veronica americana* (American-brooklime), *Potamogeton natans* (floating pondweed, left), and *Callitriche spp** (water-starwort).
- 4 perennial native FACW species: *Juncus diffusissimus* (slim-pod rush), *Cyperus eragrostis* (tall flatsedge), *Epilobium ciliatum* (fringed willowherb), and *Plantago maritima* (salt marsh plantain)
- 1 annual native FACW species*: Juncus bufonius* (toad rush)
- 4 native non-wetland species (FAC and FACU): *Alnus rubra* (red alder), *Carex leptopoda* (taper-fruit, short-scale sedge), *Rubus ursinus* (California blackberry), and *Vicia spp** (vetch)
- 3 non-native wetland obligates - perennial: *Sparganium emersum* (European burr-reed) and *Mentha pulegium* (pennyroyal); annual *Spergularia salina* (saltmarsh sandspurry)
- 4 non-native FAC species*: Lotus corniculatus* (bird's-foot trefoil), *Schedonorus arundinaceus* (tall fescue), *Rumex crispus* (curly dock) and *Cirsium arvense* (canadian thistle)

* not identified to species, two natives and one non-native species reported in Curry County.

Transect 1 (Quadrats #1-#17) is actually a series of three transects across a scour pond in an overflow channel of Pistol River. Quadrats #1-#4 cross the upstream end of the pond, quadrats #5-#10 cross the downstream end, and quadrats #11-17 cross an alcove adjacent to the river on the downstream-most end of the overflow channel. This transect was spaced with one meter between each plot, for a total distance of 32 meters. *Eleocharis palustris* (common spikerush) dominated this transect, at 43% overall (but ranging from 0-100% in each plot). Patches of *Salix spp* (willow) covered 15%, with individual plots up to 40%. A patch of *Typha latifolia* (broadleaf cattail), was concentrated at the upstream end of the scour pond (up to 86% cover, right)

Transect 2 (Quadrats #18-#21) crosses a ponded section of a narrow linear channel extending across the floodplain. This transect was spaced with one meter between each plot, for a total distance of 7 meters. *Agrostis stolonifera* (creeping bentgrass) dominated this transect, but the most abundant wetland obligates were *Scirpus microcarpus* (small-flowered bulrush), *Glyceria striata* (fowl mannagrass), and *Carex obnupta* (slough sedge).

Off-Transect Surveys

Additional species were noted in habitats that were surveyed off-transect. In the overflow channel and scour pond area around Transect 1, native wetland obligates: *Eleocharis parvula* (dwarf spikerush) and *Juncus acuminatus* (taper-tipper rush) were recorded.

In the remnant freshwater spruce swamp at the base of the hillslope (wall base), *Picea sitchensis* (sitka spruce) provided cover for the wetland, but the wettest area was also exposed in open pasture, including native perennial wetland obligates *Juncus mertensianus* (Merten's rush), *Lysichiton americanus* (yellow skunk cabbage), and *Oenanthe sarmentosa* (water parsley). *Juncus lesueurii* (salt rush), a FACW species, was also identified. The native fern, *Pteridium aquilinum* (northern bracken fern), was present in adjacent drier areas.

On moist banks in the riparian area and overflow channel, native perennial FACW species included *Fraxinus latifolia* (Oregon ash), *Juncus patens* (spreading rush), *Gnaphalium palustre* (western marsh cudweed), *Stachys mexicana* (Mexican hedge-nettle), and *Agrostis exarata* (spike bentgrass).

In drier habitats such as sandy deposits in the overflow channel and more exposed areas of the riparian area, native FAC, FACU, and UPL shrubby species included *Amelanchier alnifolia* (Saskatoon serviceberry), *Artemisia spp* (sage brush, wormwood), *Gaultheria shallon* (salal), and *Rubus spectabilis* (salmonberry). Ferns included *Polystichum munitum* (common swordfern) and *Pteridophyta spp*. *Phacelia bolanderi* (Bolander's phacelia) and *Tolmiea menziesii* (Piggyback-plant) were native forbs. One native annual, *Navarretia squarrosa* (skunkweed) was true to its name and will not be forgotten. *Baccharis pilularis* (coyote brush), a native shrub, was common on the pasture, in the overflow channel, and on gravel bars.

Across a variety of habitats, non-native perennial species, *Rubus armeniacus* (Himalayan blackberry), *Holcus lanatus* (common velvet grass), *Senecio jacobaea* (tansy ragwort), and *Cytisus scoparius* (Scotch broom), as well as possibly non-native *Rununculus spp* (buttercup) and *Rumex spp* (dock), were common. In drier locations, non-native species observed less frequently, but persisting as perennials or bi-annuals included: *Cirsium vulgare* (bull thistle), *Daucus carota* (Queen Anne's-lace), *Hypericum perforatum* (common St. John's-wort), *Melilotus alba* (white sweet-clover), *Leucanthemum vulgare* (ox-eye daisy), *Lolium perenne* (perennial ryegrass), *Plantago major* (common plantain), and *Prunella vulgaris* (common selfheal). Also in drier locations, non-native annuals, *Echinocystis lobate* (wild cucumber) and *Senecio sylvaticus* (woodland ragwort), were noted. One non-native FACW species, *Crocosmia X crocosmiiflora (montbritia)* was growing on a berm of excavated deposits.

Restoration Considerations

- Treat non-native species, particularly bull thistle, Canadian thistle, scotch broom, tansy ragwort, and Himalayan blackberry. Although *Crocosmia* is not on priority weeds list, it is an introduced species that persists and spreads, often from old gardens.
- Vegetate "upland" or buffer with native shrubs and trees, including Oregon ash, Sitka spruce, and red alder.
- Investigate hillslope drainage and provide technical assistance for wetland reserves on spruce swamp in wall base locations.
- Investigate the effects of a constructed barrier at the head of an overflow channel on erosion on opposite bank of Pistol River.
- Address effects of old fish hatchery facility falling into Pistol River due to bank erosion (right).

Scientific Name	Common Name	Pct Cover
Eleocharis palustris	common spikerush	35
Agrostis stolonifera	creeping bentgrass, spreading bent	19
Salix spp	willow	12
Scirpus microcarpus	small-flowered bulrush	7
Typha latifolia	broadleaf cattail	6
Equisetum spp	horsetail	6
Lemna spp	Duckweed	5
Potentilla anserina ssp pacifica	common silverweed, cinquefoil	1
Juncus bolanderi	Bolander's Rush	1
Glyceria striata	Fowl mannagrass	1
Alnus rubra	red alder	1
Cyperus eragrostis	tall flatsedge	1
Juncus bufonius	toad rush	1
Sparganium emersum	European Burr-Reed, simple stem bur reed	1
Rubus ursinus	California blackberry	0.5
Epilobium ciliatum	fringed willowherb	0.3
Juncus diffusissimus	Slim-Pod Rush	0.3
Potamogeton natans	Floating pondweed	0.3
Rumex crispus	curly dock	0.3
Carex obnupta	slough sedge	0.3
Schedonorus arundinaceus	Tall fescue, Alta fescue, Kentucky Fescue	0.2
Vicia spp.	Vetch	0.1
Mentha pulegium	Pennyroyal	0.1
Carex leptopoda	Taper-Fruit Short-Scale Sedge	0.1

Lotus corniculatus	bird's-foot trefoil, garden bird's-foot trefoil	0.1
Herb Unknown		0.1
Plantago maritima	goosetongue, seaside or salt marsh plantain	0.1
Cirsium arvense	canadian thistle	0.1
Callitriche spp	water-starwort	0.1
Veronica americana	American-Brooklime, Am Speedwell	0.1
Spergularia salina	Saltmarsh sandspurry	0.05

Wetland Name: Winchuck Ranch (south) **SiteID**: 7
Botany Survey Date(s): 8/26/13

This wetland is located south of Winchuck River, bounded by hillslopes on the south side, including a scour pond that feeds a small tributary to the Winchuck mainstem. The upstream limit is at the end of the floodplain, and the downstream limit is the tributary noted above.

Hydrogeomorphic Setting
Scour pond likely formed when the Winchuck occupied an overflow channel on the floodplain. Tidal wetland species are fringing a pasture that was fenced and planted for a restoration project in 2009.

No salinity data were collected during October-May. During the summer months, samples from upstream (Winchuck above salt at snags) and downstream (Winchuck at red barn) indicate that the water column is periodically stratified, with the surface layer up to 1.0 ppt , and the bottom layer up to 27 ppt. Salinity can intrude as high at the "above salt at snags" station, but as the bar builds up at the mouth, salinity intrusion is progressively restricted.

Risk Assessment
Score: 0.28
(range for 2013 wetlands is 0.44 highest risk and 0.27 lowest risk).
Risk factors that scored the highest were close proximity to the nearest inhabited structure and risk of nutrient overload in the wetland.

Vegetation

Wetland Integrity Score: 0.64
(ranged from 0.89 best to 0.40 worst)

Botanical Condition Score: 0.70
(ranged from 0.90 best to 0.15 worst)

Tidal wetlands are narrow, so three transects were located perpendicular to the channel bank, where wetland species were present and relatively diverse. Because the banks are now protected from the effects of livestock trampling and grazing, it is expected that species diversity may increase over time.

Of the 21 species found on the plots, wetland obligate perennial native species covered 36%, including *Potentilla anserina* (common silverweed), Persicaria spp* (smartweed), *Eleocharis palustris* (common spikerush), *Carex obnupta* (slough sedge), and *Juncus articulatus* (jointleaf rush). *Eragrostis hypnoides* (teal love grass) is an annual wetland obligate native. FACW species, *Trifolium wormskioldii* (cows clover) and *Deschampsia caespitosa* (tufted hairgrass), covered 21% of the plots and are also tolerant of brackish conditions (along with Potentilla). Another native perennial FACW species was *Stachys spp* (hedgenettle). On drier sites up the bank, FAC species included non-native perennials *Agrostis stolonifera* (creeping bentgrass), *Ranunculus repens* (creeping buttercup), *Holcus lanatus* (common velvet grass), and Lotus *corniculatus* (bird's-foot trefoil). FACU species were also primarily non-native perennials: *Rumex acetosella* (common sheep sorrel), *Tanacetum vulgare* (common tansy), *Medicago lupulina* (black medick), and *Prunella vulgaris* (common selfheal). One native FACU species was also present, *Rubus ursinus* (California blackberry).

**Persicaria spp* (smartweed) was not identified to species but is likely a native based on species distribution on the Oregon Flora Project Plant Atlas.

Transect 1 (Quadrats #1-#3) begins at the water's edge with 49% cover of *Deschampsia caespitosa*. Up the bank, non-natives including *Agrostis stolonifera* and Ranunculus *repens*, cover nearly half of the plot.

Transect 2 (Quadrats #4-#8) begins at the water's edge, dominated by *Trifolium wormskoljii* at 50% and *Persicaria spp* at 40% (and increasing to 80% in the next plot). Up the bank, *Agrostis stolonifera* dominates at 41% cover.

Transect 3 (Quadrats #9-#13) begins at the water's edge, dominated by *Eleocharis palustris* at 55% cover, and transitioning up the bank to *Holcus lanatus* (48%) and *Lotus corniculatus* (45%).

Off-Transect Surveys

Additional species were noted in habitats that were surveyed off-transect. Along the tributary that drains the scour pond wetland, the trees *Alnus rubra* (red alder) and *Picea sitchensis* (sitka spruce) were in the overstory along with *Salix spp* (willow), *Malus fusca* (Oregon crabapple), and *Rubus spectabilis* (salmonberry). No wetland obligates were observed, but FACW perennial native species included *Juncus lesueurii* (salt rush), *Juncus hesperius* (coast rush), *Cyperus eragrostis* (tall flatsedge), *Saxifraga mertensiana* (woodland saxifrage), and *Ranunculus occidentalis* (western buttercup). Native ferns, classified as FACU, included *Polystichum munitum* (common swordfern) and *Pteridium aquilinum* (northern bracken fern). Unidentified species of *Epilobium* (willowherb), *Vicia* (vetch), and *Rumex* (dock) were present.

Non-native perennials *Lolium perenne* (perennial ryegrass), *Dactylis glomerata* (orchardgrass), *Schedonorus arundinaceous* (tall fescue), and *Trifolium repens* (white clover) as well as biennial-perennial *Digitalis purpurea* (purple foxglove) were observed. Non-native perennial invaders *Rubus armeniacus* (Himalayan blackberry) and *Fallopia japonica* (Japanese knotweed) were also present, and the latter weed was pulled.

Adjacent to and within the scour pond, *Alnus rubra* provides an overstory, and wetland obligates *Lysichiton americanus* (yellow skunk cabbage), *Callitriche spp* (water-starwort), and *Potamogeton crispus* (curly pondweed). The latter species is not native.

Along the bank of the Winchuck River, native perennials FAC shrub *Lonicera involucrata* (black twinberry) and FACW *Juncus exiguus* (Klamath rush) were added to the list. *Galium spp* was noted, and is likely to be a native perennial.

Crocosmia X crocosmiiflora (montbritia) is a non-native perennial garden escapee.

Continuing upstream on the bank of the Winchuck, a cobble bar also supported FACW perennial natives *Cyperus eragrostis* (tall flatsedge) and *Juncus balticus* (Baltic rush). FAC and unknown wetland status native perennials, not seen previously, included *Agrostis oregonensis* (Oregon bent), *Equisetum arvense* (field horsetail), *Lupinus rivularis* (river-bank lupine), *Plantago spp* (plantain), and *Phacelia spp* (scorpion-weed).

The only wetland obligate species noted off-transect was the non-native, but naturalized *Mentha pulegium* (pennyroyal). Non-native FAC species included the annual *Dysphania ambrosiodes* (marshland goosefoot) and perennial *Cirsium arvense* (canadian thistle). Non-native perennial FACU species included, *Hypochaeris radicata* (hairy cat's-ear), *Taraxacum officinale* (common dandelion), and *Fallopia japonica* (Japanese knotweed).

Restoration Considerations

- Continue to treat non-native species, particularly *Fallopia japonica* (Japanese knotweed) and *Cirsium arvense* (canandian thistle).
- Search for upstream sources of *Crocosmia* rhizomes, provide outreach materials, and determine if landowners might be willing to substitute native species.
- Vegetate "upland" or buffer with native shrubs and trees, including *Picea sitchensis* (sitka spruce), *Alnus rubra* (red alder), and *Malus fusca* (Oregon crabapple).
- Develop Sitka spruce swamp adjacent to the scour pond. This area doesn't appear to be tidally influenced at normal flows, but at extreme events the tributary could connect with the scour pond and be affected by backwater during high tide.
- Consider introducing other native perennial species to outcompete non-native grasses in the newly fenced riparian area.

Scientific Name	Common Name	Pct Cover
Potentilla anserina ssp pacifica	common silverweed	15
Agrostis stolonifera	creeping bentgrass	13
Trifolium wormskioldii	cows clover	11
Deschampsia caespitosa	tufted hairgrass	10
Persicaria spp	smartweed	10
Ranunculus repens	Creeping Buttercup	9
Eleocharis palustris	common spikerush	7
Holcus lanatus	common velvet grass	6
Lotus corniculatus	bird's-foot trefoil	5
Equisetum spp	horsetail	5
Carex obnupta	slough sedge	3
Rumex acetosella	Common Sheep Sorrel, Sour weed	2
Rubus ursinus	California blackberry	0.9
Tanacetum vulgare	Common Tansy	0.8
Juncus articulatus	jointleaf rush, jointed rush	0.8
Poaceae, genus unknown	Grass	0.4
Medicago lupulina	black medick	0.4
Eragrostis hypnoides	Teal Love Grass	0.3
Lolium spp	Rye grass	0.2
Prunella vulgaris	Common Selfheal	0.2
Stachys spp	hedgenettle	0.1

Wetland Name: Winchuck Reference Wetland **SiteID**: 8
Botany Survey Date(s): 9/6/13

This wetland was selected for HGM field evaluation as a relatively undisturbed or "reference" wetland for the southern group of the South Coast wetlands. This wetland consists of two areas separated by Highway 101, on the north side of the Winchuck River. The larger upstream area is bounded on the north by a hillslope, including the north abutment of Highway 101 on the downstream end. The smaller downstream area is located at the mouth of a tributary on the east side of the Winchuck Wayside State Park.

Hydrogeomorphic Setting
A railroad trestle once crossed the Winchuck Estuary in this location, and the remaining wood pilings upstream of the Highway 101 bridge are likely remnants of that use.
The upstream wetland area includes an intertidal slough that separates the hillslope from an island. The transect was located from bank to bank across the island for 13 quadrats, but four of these plots lack the wetland indicator species, *Potentilla anserina*. The downstream wetland area is located on a delta-like deposit at the tributary mouth.

No salinity data were collected during October-May. During the summer months, samples from upstream (Winchuck at red barn) and downstream (Winchuck at Highway 101) indicate that the water column is stratified, with the surface layer up to 1.0 ppt , and the bottom layer up to 30 ppt.

Risk Assessment
Score: 0.27
(range for 2013 wetlands is 0.44 highest risk and 0.27 lowest risk).
Risk factors that scored the highest were close proximity to the nearest inhabited structure and boat traffic nearness and frequency (includes disturbance from paddleboards launching at Winchuck Wayside).

Vegetation
Wetland Integrity Score: 0.47
(ranged from 0.89 best to 0.40 worst)

Botanical Condition Score: 0.75
(ranged from 0.90 best to 0.15 worst)

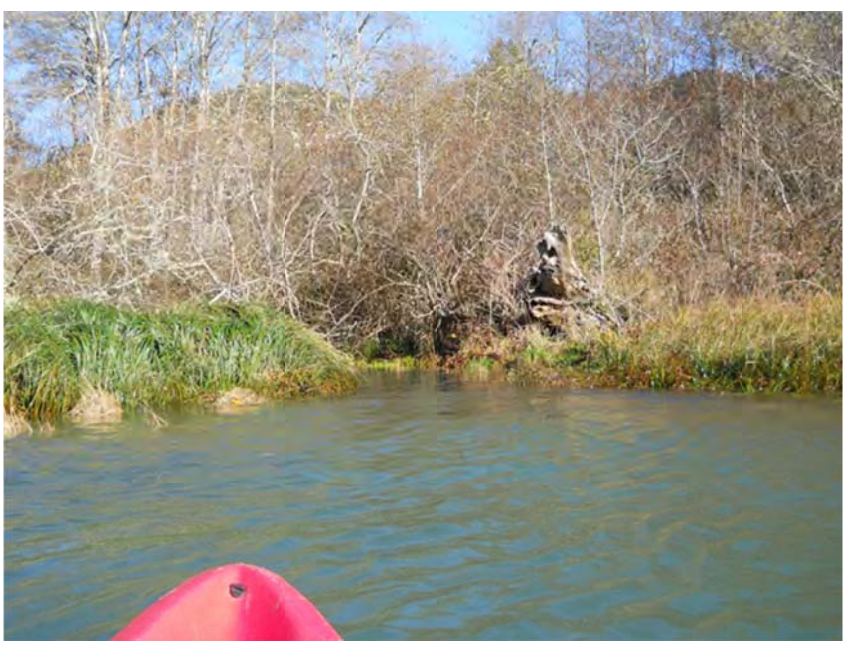
The scattered Sitka spruce and salt-tolerant wetland species make this one of the few tidal spruce swamps in these South Coast estuaries.

Of the 20 species found on the transects, wetland obligate perennial native species covered 31%, including *Carex obnupta* (slough sedge), *Potentilla anserina* (common silverweed), and *Scirpus* microcarpus (small-flowered bulrush). FACW species, Deschampsia caespitosa (tufted hairgrass) Juncus exiguus (Klamath rush), Distichlis spicata (saltgrass), Symphyotrichum subspicatum (leafy-bract American aster), and Epilobium ciliatum (fringed willowherb) covered 17% of the plots. Of these, brackish-tolerant plants include Potentilla anserina, Deschampsia caespitosa, Distichilis spicata, and Symphyotrichum subspicatum. Other native perennials include the shrubs

Salix spp (willow), Rubus specabilis (salmonberry), FAC species Carex leptopoda (taper-fruit short-scale sedge), and FACU species Rubus ursinus (California blackberry).

The dominant species in this wetland is an escaped garden plant Crocosmia X crocomiiflora (montbritia), with a FACW status, covering 22% of the plots. Over 18% of plots are covered by perennial non-native grasses, Schedonorus arundinaceus (tall fescue), Agrostis stolonifera (creeping bentgrass), and Holcus lanatus (common velvet grass). Other FAC and FACU non-natives include Rubus armeniacus (Himalayan blackberry), Lotus corniculatus (bird's-foot trefoil), and Rumex crispus (curly dock).

Transect 1 (Quadrats #1-#13) begins at the Winchuck River bank and continues across the widest part of the island, toward the large spruce west of the home located upslope. *Deschampsia caespitosa* dominates the first two quadrats, and then again on the last quadrat in the slough (shown to the right). Overall, *Crocosmia* covers 33% of the transect, although four of the plots do not contain the wetland indicator species, *Potentilla*. Excluding these plots from the transect, the wetland is covered primarily by 27% *Deschampsia*, 22% *Schedonorus*, 19% *Crocosmia*, 13% *Potentilla*, and 9% *Lotus*.



Transect 2 (Quadrats #14-#20) begins at the Winchuck River bank and rises over the vegetated deposit parallel with the tributary stream channel, ending in shrub and forest including *Alnus rubra* (red alder), *Salix spp* (willow), *Rubus armeniacus* (Himalayan blackberry).

Carex obnupta (slough sedge) dominated this transect with 60% cover. *Rubus armeniacus* covered over 20% of the last four plots, for a total of 16% cover. In the last plot, *Juncus* *exiguus* (Klamath rush) covered 20%, with *Crocosmia* at 15%, followed by *Distichlis* and *Lotus*. *Potentilla* was also present in the transect at 10% cover. *Scirpus microcarpus* appeared in one plot at 20% cover.

Off-Transect Surveys

Additional species were noted in habitats that were surveyed off-transect. The wetland obligate, *Eleocharis parvula* (dwarf spikerush) was submerged in the slough along with a *Plantago spp*, which was most likely P. *maritima*, a native FACW species, both brackish-tolerant. On the island, *Equisetum spp*. (horsetail) and *Fraxinus latifolia* (Oregon ash), both native FACW species, were present. Native FACU species included *Rubus ursinus* (California dewberry), *Rubus parviflorus* (western thimbleberry), and *Lonicera hispidula* (pink honeysuckle).

Non-native perennial wetland obligate *Potamogeton crispus* (curly pondweed) was observed on a sandy shore of the north bank. Noxious weed species (non-native FACU) included *Fallopia japonica* (Japanese knotweed), *Senecio jacobaea* (tansy ragwort), and *Cortaderia jubata* (jubata grass). An additional concern is the evergreen shrub, *Cotoneaster spp* located on the point between the tributary and the Winchuck Wayside, and also observed upstream of this wetland in a residential yard. It has escaped garden cultivation in California, and is invading from the south along road sides and disturbed areas. In autumn and winter, the dispersal of the abundant red berries is facilitated by birds. The California Invasive Plant Council identifies management concerns and strategies at.http://www.cal-ipc.org/ip/management/ipcw/pages/detailreport.cfm@usernumber=36&surveynumber=182.php. Non-native FACU species, Dactylis glomerata (orchardgrass) and Tanacetum vulgare (common tansy) were also observed.

Restoration Considerations

- Secure protection for these wetlands which include a spruce swamp in the upstream area and the downstream area covered by a high percentage of native perennial species.
- Continue to treat non-native species, particularly Japanese knotweed, tansy ragwort, *jubata* grass and *Crocosmia*.
- Search for upstream sources of *Crocosmia* rhizomes and *Cotoneaster* shrubs, provide outreach materials, and determine if landowners might be willing to substitute native species.
- Vegetate “upland” or buffer with native shrubs and trees, including *Picea sitchensis* (sitka spruce), *Alnus rubra* (red alder), *Fraxinus latifolia* (Oregon ash), *Salix spp*. (willow) *Rubus ursinus* (California dewberry), *Rubus parviflorus* (western thimbleberry), and *Lonicera hispidula* (pink honeysuckle).
- Expand Sitka spruce swamp adjacent to the slough.

Scientific Name	Common Name	Pct Cover
Crocosmia X crocosmiiflora	montbritia	22
Carex obnupta	slough sedge	21
Schedonorus arundinaceus	tall fescue, alta fescue	14
Deschampsia caespitosa	tufted hairgrass	12
Potentilla anserina ssp pacifica	common silverweed, cinquefoil	9.3
Rubus armeniacus	Himalayan Blackberry	5.5
Lotus corniculatus	bird's-foot trefoil	4.8
Agrostis stolonifera	creeping bentgrass	2.7
Juncus exiguus	Klamath rush, weak rush	1.9
Holcus lanatus	common velvet grass	1.4
Distichlis spicata	saltgrass, coastal salt grass	1.2
Scirpus microcarpus	small-flowered bulrush	1.0
Symphyotrichum subspicatum	Leafy-Bract American-Aster	1.0
Epilobium ciliatum	fringed willowherb	0.4
Salix spp	willow	0.3
Rubus spectabilis	salmonberry, salmon raspberry	0.3
Carex leptopoda	taper-fruit short-scale sedge	0.3
Ranunculus spp	buttercup	0.2
Rubus ursinus	California blackberry	0.2
Rumex crispus	curly dock	0.1

Wetland Name: Winchuck Wayside **SiteID**: 5
Botany Survey Date(s): 7/26/13

This wetland is located north of Winchuck River, bounded by hillslopes on the upstream and downstream ends, and to the north by a large fill that underlies the parking area of the Winchuck Wayside State Park.

Hydrogeomorphic Setting
This wetland was created in 2001 by excavating a portion of the fill which was deposited here in ~1965, during construction of the Hwy 101 bridge. Photo above right taken in December, 2001 following fill removal (H. Hoogesteger). Photos below taken August 2012.

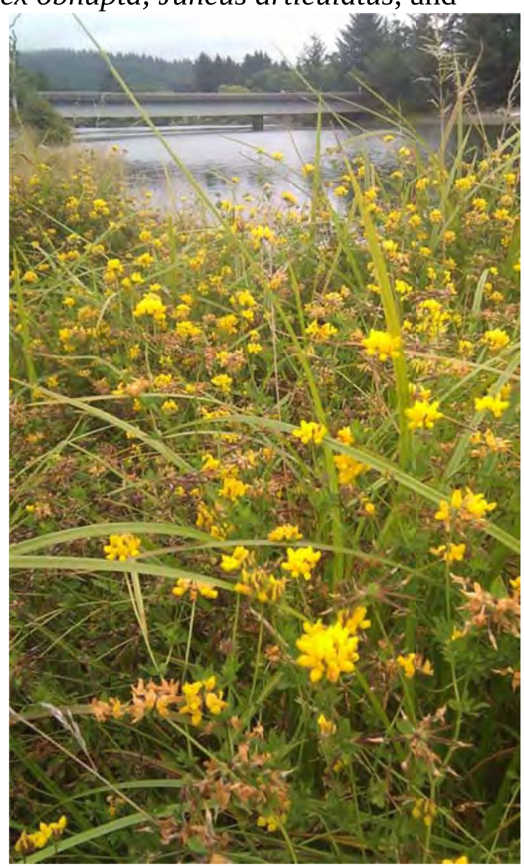
No salinity data were collected during October-May. During the summer months, samples from upstream (Winchuck at Highway 101) and downstream (Winchuck at mouth) indicate that the water column adjacent to the wetland is periodically stratified, with the surface layer up to 1.0 ppt , and the bottom layer up to 30 ppt.

Risk Assessment
Score: 0.43
(range for 2013 wetlands is 0.44 highest risk and 0.27 lowest risk).
Risk factors that scored the highest were risk of nutrient overload in the wetland, close proximity to the nearest inhabited structure, extent and frequency of wetland visitation, and boat traffic nearness and frequency (includes disturbance from paddleboards launching at Winchuck Wayside).

Vegetation
Wetland Integrity Score: 0.40
(ranged from 0.89 best to 0.40 worst)

Botanical Condition Score: 0.85
(ranged from 0.90 best to 0.15 worst)

Of the 29 species found on the transects, 16 were native, and were primarily wetland obligate or FACW plants. Native perennial wetland obligate species cover 30% of plots, including *Scirpus microcarpus, Eleocharis palustris, Potentilla anserina, Carex obnupta, Juncus articulatus,* and *Triglochin maritima* (seaside arrow-grass). Another 8% of the cover is composed of native perennial FACW species: *Juncus balticus, Deschampsia caespitosa, Cyperus eragrostis*, and *Plantago maritima*. Of these, *Eleocharis, Potentilla, Triglochin, Deschampsia*, and *Plantago* are brackish-tolerant species. Salix spp and *Alnus rubra* add another 6% of native cover. Native *Elymus mollis* (American dunegrass) is present at 1%. An annual rush, *Juncus bufonius,* is also a native FACW species.



Non-native perennial *Lotus corniculatus* (bird's-foot trefoil) is the dominant cover for the wetland at 39% (photo to the right). Other FAC non-native perennials include grasses: *Holcus lanatus, Agrostis stolonifera, Schedonorus arundinaceus,* and *Agrostis gigantea* covering 9% of plots. *Trifolium repens* (white clover) and *Parentucellia viscosa* (yellow glandweed) are also FAC non-natives, and have smaller percent cover along with FACU non-natives *Tanacetum vulgare, Ammophila arenaria, Medicago lupulina*, and *Hypochaeris spp*. *Spergularia salina* (saltmarsh sandspurry), a non-native wetland obligate that is brackish-tolerant, was present.

Transect 1 (Quadrats #1-#10) crosses the widest section of the restored area, which is further upstream than transect 2. Transect 1 begins at the Winchuck River mainstem bank and continues north to the break in slope where the fill excavation ends. *Lotus corniculatus* dominates this transect at 28% cover, as high as 60% in one plot, but is one of 27 taxa on this transect. *Salix spp* and *Juncus balticus* cover 19% of the transect and dominate 3 quadrats near the center of the transect. *Eleocharis palustris* and *Isolepis cernua* cover 14% and are located in the six quadrats closest to the river. *Scirpus microcarpus*, while covering only 5% of the transect, dominates one plot at 50% cover (occurring with *Eleocharis*). Non-native grasses cover 13% of the transect. One plot contains the native *dunegrass, Elymus mollis*, at 15% cover.

Transect 2 (Quadrats #11-#18) begins at the break in slope on the north and continues south to the Winchuck River mainstem bank. *Lotus corniculatus* dominates this transect at 52% cover, and covers as much as 74% of one plot. In contrast with transect 1, only 14 taxa were identified on this transect. *Scirpus microcarpus* averaged 28.5% cover, with as high as 55% in one plot. *Carex obnupta* and *Potentilla anserina* tended to occur together, and covered another 13% of the transect.

Off-Transect Surveys

Additional species were noted off-transect. A fourth *Juncus, J. lescurii* (San Francisco rush), is a perennial native FACW species. Two additional native perennials were present, *Vicia spp* (vetch), and *Lonicera hispidula* (pink honeysuckle). Due to the large area invaded upstream, it is not surprising to find the invasive perennial, *Crocosmia X crocosmiiflora (montbritia).* Non-native *Lolium perenne* (perennial ryegrass) was also present in the restoration area. Non-natives *Rapanus sativus* (wild radish) and *Cakile maritima* (European sea rocket), were present at the mouth of the Winchuck. *Rumex spp* (dock) was not identified to species, so is not determined if native.

Restoration Considerations

- Increase frequency of plant surveys, to manage non-natives as the vegetation continues to develop wetland characteristics.
- Search for upstream sources of *Crocosmia* rhizomes and *Cotoneaster* shrubs, provide outreach materials, and determine if landowners might be willing to substitute native species.
- Remove non-native species, particularly *Crocosmia, Spergularia salina*, and Ammophila *arenaria*.
- Consider nitrogen-fixing native alternatives to replace *Lotus corniculatus*, such as *Lupine spp*.
- Diversify "upland" buffer with native shrubs such as pink honeysuckle, salmonberry, California dewberry, and western thimbleberry.
- Monitor continued development of wetland vegetation for decisions about whether to remove additional fill to expand wet areas.
- Look for opportunities to infiltrate stormwater from the parking lot, and protect soils where runoff occurs.

Wetland Name: Sixes River - Sullivan Gulch SiteID: 10
Botany Survey Date(s): 9/13/13

Landowner: Oregon State Parks

One field day was allocated for a rapid assessment of botanical resources in the restoration project area of Sullivan Gulch. Two transects were located in backwater restoration areas identified by the Project Manager, Matt Swanson (map attached).

Transect Locations and Habitats

Transect 1 includes Quadrats #1-#15

Q#1 is located in the shade of a spruce tree at the base of a hill at the pasture margin. Within this transect, open pasture is dominated by non-native facultative species: *Agrostis stolonifera* (bentgrass), *Ranunculus repens* (buttercup), and *Lotus corniculatus* (birdsfoot trefoil). Non-natives distributed locally and with less cover include *Trifolium repens* (white clover), *Holcus lanatus* (velvet grass), and *Rumex crispus* (curly dock). Wetland indicator species increased to the north, consisting of wetland obligate *Potentilla anserina* (silverweed), and facultative wetland *Juncus* species, *hesperius* (bog rush) and *effusus* (soft rush). In two quadrats, *Carex obnupta* (slough sedge) dominated the *Juncus* species (79% maximum cover).

Q#3 is located in a wet swale, pugged by livestock, accounting for the estimated 10% bare soil cover. Wetland obligate species in the swale include *Eleocharis palustris* (25%), *Oenanthe sarmentosa* (10%), *Veronica americana* (8%), *Carex obnupta* (4%), and *Callitriche spp* (3%). Facultative wetland species include *Juncus hesperius* (15%), *Juncus balticus* (10%), and *Epilobium ciliatum* (3%).

Transect 2 includes Quadrats #16-#26

The photo on the right is the view along Transect 2, from the end on Cape Blanco Road to the beginning at the base of the hill. Wetland obligate, *Carex obnupta* dominates most of the quadrats, while *Juncus hesperius* is also abundant. In more open areas, *Oenanthe sarmentosa* comprises up to 35% and *Potentilla anserina* up to 40%. In less than half of the quadrats, *Lotus corniculatus* is present and covers up to 15%.

The photo to the left is taken from a quadrat dominated by *Carex obnupta*.

Off-Transect Surveys

Plants recorded during off-transect observations are tabulated in Sullivan Gulch Plant List.xlsx. At the crossing of the oxbow, native wetland obligate species *Carex obnupta* (slough sedge), *Eleocharis palustris* (spike rush), and *Callitriche spp* (water starwort), are associated with *Potomogeton crispus* (curly pondweed), a non-native aquatic plant.

Along the margin of the ponded area to the east of the oxbow, near the hill, both wetland and upland species are in close proximity. Native wetland obligates include *Lysichiton americanus* (skunk cabbage), *Oenanthe sarmentosa* (water parsley), and *Potentilla anserina* (silverweed). Additional observations and plant collections would be required to determine whether the bur reed, *Sparganium*, is the native *S. eurycarpum* (broadfruit bur reed) or the introduced *S. emersum* (European bur reed). Also to be determined is whether the *Persicaria spp* (smartweed) is native, among 5-7 species in Curry County. From a distance, the pond lily (shown in the photo below) was tentatively identified as the invasive *Nuphar lutea*.

Also adjacent to the pond, *Stachys mexicana* (hedge-nettle) is a native facultative wetland species. Facultative species include the trees, *Alnus rubra* (red alder) and *Frangula purshiana* (cascara), as well as shrubs, *Rubus spectabilis* (salmonberry) and *Ribes spp* (gooseberry). On the hill, in the facultative upland, *Pteridium aquilinum* (bracken fern), and *Fragaria vesca* (woodland strawberry) are present. Genera containing unidentified species, *Rumex spp* and *Ranunculus spp*, have unknown moisture requirements. The only additional non-native species noted in this area was *Digitalis purpurea* (purple foxglove), a facultative upland type.

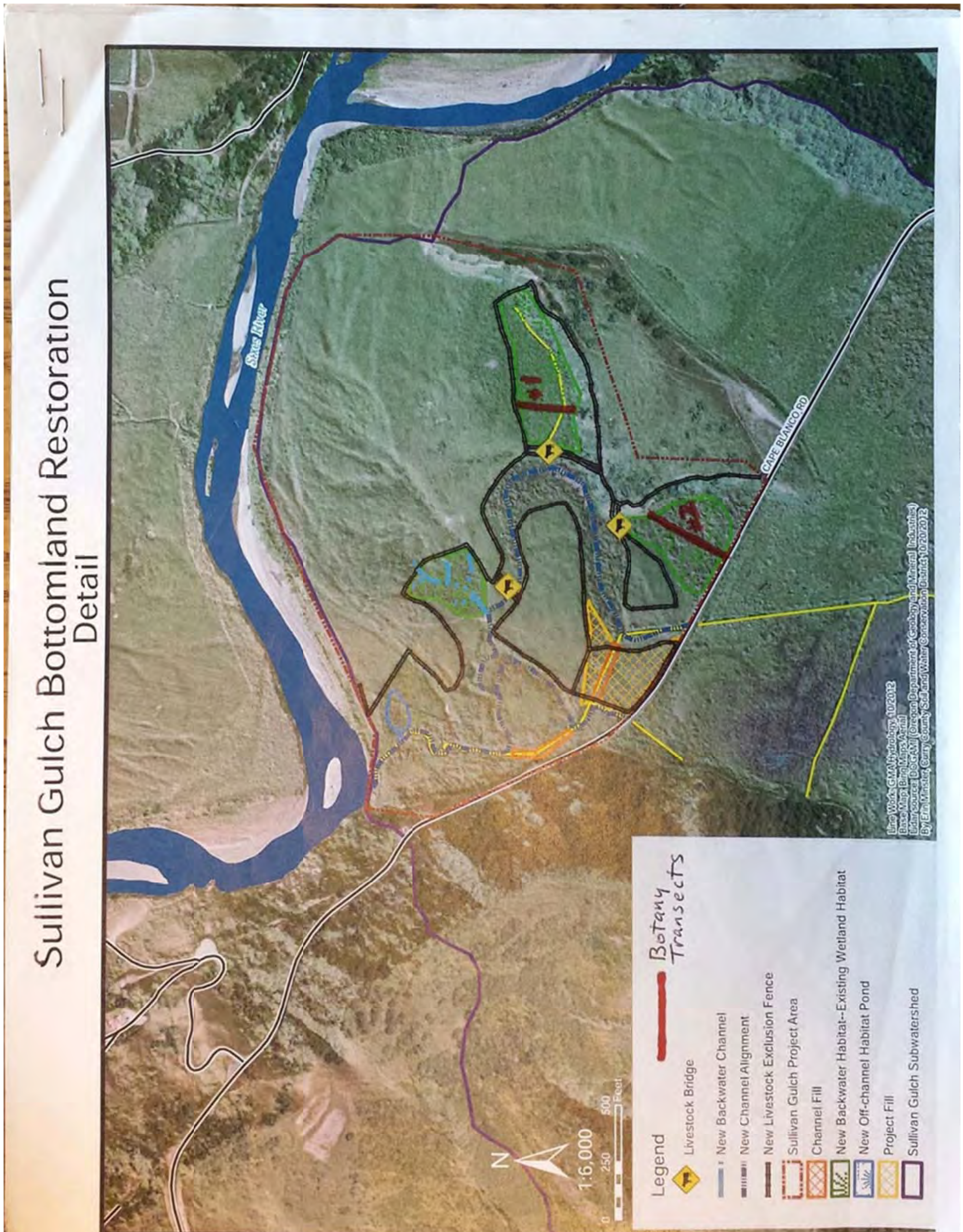
At the end of the second transect, species growing on the road fill were noted. These plants are among those that would colonize newly disturbed fill. Native species, from wetter to dryer include *Equisetum spp* (horsetail), *Symphyotrichum chilense* (aster), *Rubus ursinus* (blackberry), and *Polystichum munitum* (swordfern). Non-native species that could overtake the fill include *Agrostis stolonifera* (creeping bentgrass), *Rumex crispus* (curly dock), *Cirsium arvense* (thistle), and *Vinca major* (periwinkle).

Along the ditch at the margin of the wetland, a mix of wetland obligates and upland species were observed. Native wetland obligates include *Typha latifolia* (cattail) and *Scirpus microcarpus* (bulrush). *Phalaris arundinacea* (reed canarygrass) is a facultative wetland species, but is known as an aggressive colonizer, and once established, is difficult to control. Native facultative species include *Heracleum maximum* (cow-parsnip), *Lupinus rivularis* (river-bank lupine) and the tree *Frangula purshiana* (cascara). Native *Lupinus* may have value as a nitrogen-fixing cover for exposed soils. Moisture needs for the local *Salix spp* (willow) and a possible arnica species (leopardbane) are unknown. Non-native species include *Dipsacus fullonum* (teasel) and *Daucus carota* (wild carrot or Queen Anne's-lace).

Recommendations

Pre-project planning could include the following activities:

- Treat in advance, to control seed sources of *Cirsium arvense*, an Oregon "B" designated weed (Quarantine)
- Designate disposal area to isolate non-native and invasive plant materials (including rhizomes) during excavation
- Time excavation to avoid seed dispersal from non-native sources
- Establish plant cover on exposed soils as soon as possible
- Use extensive *Carex obnupta* meadows for root stock to plant excavated wetland areas
- Salvage *Juncus* and *Eleocharis* plants to promote diversity (except *J. capitatus*)
- Harvest native *Lupinus* seed to apply after construction
- Consider employing a botany consultant to delineate/stake critical areas prior to the project.


Sullivan Gulch Bottomland Restoration
Detail
Sixes River
CAPE BLANCO RD
Botany Transects
Legend
Livestock Bridge
New Backwater Channel
New Channel Alignment
New Livestock Exclusion Fence
Sullivan Gulch Project Area
Channel Fill
New Backwater Habitat--Existing Wetland Habitat
New Off-channel Habitat Pond
Project Fill
Sullivan Gulch Subwatershed
N
1:6,000
0 250 500
Feet

Data Gaps and Recommended Future Assessment

Verify extent of tidal inundation on floodplains when annual discharge and high tides coincide.

Locate groundwater seeps for enhancement opportunities by surveying Pistol River in the summer.

Research history of Crook Creek channel. Share wetland descriptions and CIR photos showing moisture and soils maps with landowner. Determine if moisture can be distributed better on the pasture through the growing season.

Literature Cited

Adamus, P.R. 2006. Hydrogeomorphic (HGM) Assessment Guidebook for Tidal Wetlands of the Oregon Coast, Part 1: Rapid Assessment Method, Produced for the Coos Watershed Association, Oregon Department of State Lands, and U.S. E.P.A.-Region 10. Charleston, OR: Coos Watershed Association.

Adamus, P.R. 2005. Science Review and Data Analysis for Tidal Wetlands of the Oregon Coast. Part 2 of a Hydrogeomorphic Guidebook. Report to Coos Watershed Association, US Environmental Protection Agency, and Oregon Dept. of State Lands, Salem.

Adamus, P.R., J. Larsen, and R. Scranton. 2005. Wetland Profiles of Oregon's Coastal Watersheds and Estuaries. Part 3 of a Hydrogeomorphic Guidebook. Report to Coos Watershed Association, US Environmental Protection Agency, and Oregon Dept. of State Lands, Salem.

Brophy, Laura S. 2003. Wetland Site Prioritization, Lower Elk and Sixes Rivers, Curry County, Oregon. Produced for Oregon Trout by Laura Brophy, Green Point Consulting, Corvallis, OR, www.GreenPointConsulting.com. 52 pp, plus 18 pp tables.

Brophy, L.S. (Green Point Consulting). 2007. Estuary Assessment: Component XII of the Oregon Watershed Assessment Manual. Prepared for the Oregon Department of Land Conservation and Development, Salem, OR and the Oregon Watershed Enhancement Board, Salem, OR.

Christy, J.A., E.R. Alverson, M.P. Dougherty, S.C. Kolar, C.W. Alton, S.M. Hawes, J.A. Hiebler, and E.M. Nielsen. 2001. Classification of historic vegetation in Oregon, as recorded by General Land Office surveyors. Oregon Natural Heritage Program, 9 May 2001.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service, Washington, D.C. FWS/OBS-79/31.

Evans, D. & Associates, 2002 (unpublished), Pistol River Watershed Analysis, prepared for USDA Forest Service Region 6, Siskiyou National Forest, Chetco Ranger District.

Jones, K.L, Wallick, J.R., O'Connor, J.E., Keith, M.K., Mangano, J.F., and Risley, J.C., 2011, Preliminary assess-ment of channel stability and bed-material transport along Hunter Creek, southwestern Oregon: U.S. Geological Survey Open-File Report 2011–1160, 41 p.

Jones, K.L., O'Connor, J.E., Keith, M.K., Mangano, J.F., and Wallick, J.R., 2012, Preliminary assessment of channel stability and bed-material transport in the Rogue River basin, southwestern Oregon: U.S. Geological Survey Open-File Report 2011–1280, 96 p.

Komar, P.D., 1997, The Pacific Northwest coast—Living with the shores of Oregon and Washington: Durham, North Carolina, Duke University Press, p 195
Maguire, M., 2001, Chetco River Watershed Assessment: Prepared by South Coast Watershed Council. http://www.currywatersheds.org/chetco_river_huc10.aspx

Maguire, M., 2001, Pistol River Watershed Assessment: Prepared by South Coast Watershed Council. http://www.currywatersheds.org/pistol_river_huc10.aspx

Maguire, M., 2001, Winchuck River Watershed Assessment: Prepared by South Coast Watershed Council. http://www.currywatersheds.org/winchuck_river_huc10.aspx

Maguire, M., 2001, Hunter Creek Watershed Assessment: Prepared by South Coast Watershed Council. http://www.currywatersheds.org/hunter_creek_huc10.aspx

Reimers, Paul E., 1973, The length of residence of juvenile fall Chinook salmon in Sixes River, Oregon: Research Report of the Fish Commission, Vol..4, no.2.

Ratti, F.D., and Kraeg, R.A., 1979, Natural resources of the Chetco River estuary: Oregon Department of Fish and Wildlife for Oregon Land Conservation and Development Commission, Estuary inventory report, v. 2, no. 9, https://ir.library.oregonstate.edu/xmlui/handle/1957/3183

Russell, P., 1994. Sediment production and delivery in Pistol River, Oregon, and its effect on pool morphology. Masters of Science thesis submitted for M. S degree. Oregon State University. 100 pp.

Scranton, R., 2004, The application of Geographic Information Systems for delineation and classification of tidal wetlands for resource management of Oregon's coastal watersheds: Thesis, Marine Resource Management Program, Oregon State Univ., Corvallis.

van Staveren, J. and P. Farrell, 2001, City of Gold Beach: Local Wetlands and Riparian Inventories: Pacific Habitat Services, Inc. prepared for City of Gold Beach, PHS Project #2316.

Wallick, J.R., Anderson, S.W., Cannon, Charles, and O'Connor, J.E., 2009, Channel change and bed-material transport in the lower Chetco River, Oregon: U.S. Geological Survey Open-File Report 2009–1163, 83 p.

Yocum, Charles F., 1951, Waterfowl and their food plants in Washington: University of Washington Press, 272 pp.

Table 1: South Coast Tidal Wetland Ecological Prioritization

Wetland Sites	Size, acres	Size Score	Tidal Ch Condition	Connect NWI Ac	Connect Score	Salmon Stocks	Salmon Score	Swamp Score	NWI Veg Types	Veg Div Score	Total Score	Ecol Priority	Rest Rank	Cons Rank
Pistol Pasture channel and swamp	25.5	5.0	3.0	1581	5.0	4	5.0	1.0	EM FO	3	25.0	High	1	
Pistol marsh and swamp	12.5	2.9	4.3	663	2.7	4	5.0	1.0	EM SS	3	23.2	High		1
Winchuck Reference	0.9	1.0	5.0	9	1.0	4	5.0	1.0	EM	1	19.0	High		2
Pistol ODOT overflow	6.8	2.0	3.7	333	1.8	4	5.0	1.0	SS	1	18.1	Mod-High		3
Chetco at Ferry Creek	12.8	2.9	2.3	141	1.3	4	5.0	1.0	EM FO	3	17.9	Mod-High	2	
Chetco at Joe Hall	9.4	2.4	3.7	75	1.2	4	5.0	1.0	SS	1	17.9	Mod-High	3	
Winchuck Johnson South (W)	11.2	2.7	2.3	179	1.4	4	5.0	1.0	EM SS	3	17.8	Mod-High		4
Chetco upstream of 101, east bank	4.5	1.6	3.0	50	1.1	4	5.0	1.0	EM SS	3	17.7	Mod		5
Hunter North	14.6	3.2	3.0	131	1.3	4	5.0	1.0	EM	1	17.5	Mod	4	
Hunter Turner pasture	25.5	5.0	1.7	459	2.1	4	5.0	1.0	EM	1	17.5	Mod	5	
Winchuck Johnson North (E)	7.2	2.0	3.0	108	1.3	4	5.0	1.0	EM	1	16.3	Low-Mod	6	
Chetco at Chetco RV	10.9	2.6	2.3	131	1.3	4	5.0	1.0	EM	1	15.6	Low-Mod	7	
Winchuck Wayside	0.9	1.0	3.0	8	1.0	4	5.0	1.0	EM	1	15.0	Low-Mod	8	
Hunter Turtle Rock	3.0	1.3	2.3	48	1.1	4	5.0	1.0	SS	1	14.1	Low	9	
Chetco upstream of 101, west bank	13.7	3.1	1.0	164	1.4	4	5.0	1.0	EM	1	13.5	Low	10	

Table 2: Wetland Function Scores, HGM Rapid Assessment Method	Hunter North	Pistol ODOT	Winchuck Wayside	Winchuck Reference	Winchuck Ranch S
Risk Assessment - Existing Risks to Wetland Integrity	0.36	0.33	0.43	0.27	0.28
Wetland Integrity (average botanical indicators, diff from predicted)	0.50	0.72	0.40	0.47	0.72

	Function Capacity compared to theoretical high score for function				
Function	**Hunter North**	**Pistol ODOT**	**Winchuck Wayside**	**Winchuck Reference**	**Winchuck Ranch S**
Produce Aboveground Organic Matter	0.41	0.34	0.41	0.34	0.31
Export Aboveground Plant & Animal Production	0.49	0.30	0.42	0.42	0.26
Maintain Element Cycling Rates & Pollutant Processing; Stabilize Sediment	0.62	0.38	0.41	0.55	0.21
Maintain Habitat for Native Invertebrates	0.50	0.48	0.54	0.56	0.50
Maintain Habitat for Anadromous Fish	0.17	0.16	0.17	0.53	0.22
Maintain Habitat for Visiting Marine Fish	0.18	0.16	0.19	0.31	0.23
Maintain Habitat for Other Visiting & Resident Fish	0.10	0.08	0.05	0.35	0.25
Maintain Habitat for Nekton-feeding Wildlife	0.27	0.31	0.15	0.37	0.21
Maintain Habitat for Ducks and Geese	0.36	0.38	0.22	0.41	0.27
Maintain Habitat for Shorebirds	0.51	0.50	0.39	0.51	0.41
Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators	0.44	0.46	0.54	0.39	0.37
Maintain Natural Botanical Conditions	0.85	0.90	0.85	0.75	0.90

	Function Capacity compared to best reference tidal wetland				
Function	**Hunter North**	**Pistol ODOT**	**Winchuck Wayside**	**Winchuck Reference**	**Winchuck Ranch S**
Produce Aboveground Organic Matter	0.61	0.37	0.59	0.36	0.27
Export Aboveground Plant & Animal Production	0.55	0.27	0.44	0.45	0.21
Maintain Element Cycling Rates & Pollutant Processing; Stabilize Sediment	0.61	0.27	0.31	0.51	0.01
Maintain Habitat for Native Invertebrates	0.44	0.38	0.53	0.59	0.44
Maintain Habitat for Anadromous Fish	0.22	0.21	0.21	0.72	0.28
Maintain Habitat for Visiting Marine Fish	0.17	0.14	0.19	0.35	0.24
Maintain Habitat for Other Visiting & Resident Fish	0.11	0.09	0.05	0.38	0.27
Maintain Habitat for Nekton-feeding Wildlife	0.20	0.25	0.03	0.35	0.12
Maintain Habitat for Ducks and Geese	0.43	0.46	0.22	0.51	0.28
Maintain Habitat for Shorebirds	0.38	0.36	0.17	0.38	0.22
Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators	0.42	0.46	0.60	0.33	0.28
Maintain Natural Botanical Conditions	0.35	0.40	0.35	0.25	0.40

Table 3: Wetland Indicator Values, HGM Rapid Assessment Method

Ind #	Indicator Abbrev	Indicator Description	Hunter N	Pistol Ch	Winchuck Wayside	Winchuck Reference	Winchuck Johnson S
1	BuffAlt	Relative buffer between the wetland & upland areas	0.20	0.20	0.40	0.40	0.10
2	ChemIn	Max risk of the wetland being exposed to chemical pollutants (excl nutrients)	0.33	0.01	0.33	0.33	0.01
3	NutrIn	Max risk of nutrient overload in the wetland	0.66	0.33	0.85	0.33	0.66
4	SedShed	Incoming fine-sediment overload	0.75	0.50	0.50	0.01	0.50
5	SoilX	Onsite soil disturbance	0.30	0.40	0.30	0.01	0.10
6	DikeDry	Degree the area that is still wetland becomes drier as result of ditches, dikes, culverts, or artificial constrictions	0.33	0.66	0.01	0.01	0.01
7	DikeWet	Degree the wetland/channels become wetter as a result of ditches, dikes, culverts & artificial constrictions or excavations (inc. substrate compaction & subsidence)	0.01	0.33	0.01	0.01	0.01
8	FootVis	Extent and frequency of wetland visitation	0.01	0.01	0.66	0.01	0.33
9	Boats	How frequent and close is boat traffic (all types)?	0.40	0.01	0.60	0.60	0.50
10	HomeDis	Proximity (ft) to nearest inhabited structure	0.75	0.75	0.75	1.00	0.75
11	RoadX	Proximity (ft) to the nearest paved area	0.20	0.01	0.20	0.01	0.20
12	Invas	Presence or potential for invasive exotic species	0.01	0.01	0.01	0.01	0.01
13	Instabil	Possible instability of the wetland	0.40	0.70	0.50	0.20	0.20
14	RatioC	Channel proportions	0.20	1.00		0.20	
15	SpPerQd	Number of wetland species per quadrat (mean)	0.60	0.30	0.60	0.10	0.20
16	SpDeficit		0.75	0.75	0.25	1.00	0.01
17	All90PC	Proportion of quadrats that contain plant species with a % cover of 90 or greater	1.00	0.60	1.00	0.60	1.00
18	DomDef		0.75	1.00	0.50	1.00	0.01
19	NN20PC	Proportion of quadrats that contain non-native species with a % cover of 20 or greater	0.10	0.50	0.10	0.40	0.40
20	Nndef		0.25	0.75	0.50	0.75	1.00
21	AnnSp	Proportion of quadrats that contain annuals	0.01	0.01	0.01	0.01	1.00
22	TapSp	Mean percent-cover of tap-rooted wetland species among all quadrats	1.00	1.00	1.00	1.00	1.00
23	StolSp	Mean percent-cover of stoloniferous species among all quadrats	1.00	1.00	1.00	1.00	1.00
24	TuftSp	Mean percent-cover of tuft-rooted wetland species among all quadrats	0.01	0.50	0.01	1.00	0.01
25	Flood	% of wetland area accessible to young anadromous fish	0.30	0.20	0.50	0.70	0.50
26	Shade	% of the entire wetland's vegetated area that is shaded by trees or topography	0.01	0.50	0.50	1.00	1.00
27	ShadeLM	% of low marsh shaded by trees or topography	0.01	0.01	0.01	0.50	0.01

28	Bare	Area of bare substrate, including pannes, shallow pools, & tideflats wider than 2m and located *within* the wetland	0.01	0.01	0.01	0.01	0.01
29	Pannes	Area of pannes and shallow isolated pools (not tideflats)	0.01	0.01	0.01	0.01	0.01
30	TranAng	Transition angle along most of the wetland external edge	0.01	0.01	0.01	0.50	0.01
31	UpEdge	Percent of the wetland's entire perimeter that is upland, i.e. neither water, non-tidal wetland, nor tideflat	0.75	0.25	0.75	0.75	0.01
32	LWDchan	# of piecesof large wood in wetland's tidal channel network	0.01	0.01	0.01	1.00	0.01
33	LWDmarsh	Number of large wood pieces projecting at least 1 m abv the wetland surface	0.01	0.01	0.50	0.25	0.25
34	LWDline	Driftwood line as % of wetland's upland edge length	0.25	0.25	1.00	0.01	0.25
35	TribL	Cumulative length of fish-accessible non-tidal tributary channels that feed into the wetland	0.01	0.01	0.01	0.01	0.01
36	Fresh	Types of freshwater sources that feed the wetland internally	0.30	0.30	0.30	0.50	0.50
37	Width	Wetland's width at its widest part	0.20	0.10	0.01	0.01	0.01
38	MudW	Maximum width of largest tideflat that adjoins the wetland	0.10	0.15	0.01	0.01	0.01
39	Roost	Number of types of potential shorebird roosts within 1.5 mile of the center of the wetland	0.75	0.50	0.01	0.25	0.25
40	Island	Wetland comprises all or part of an uninhabited island	0.66	1.00	1.00	0.66	1.00
41	Fetch	Direction and distance of external edge's exposure to intense wave and/or river current action	0.30	0.60	0.80	0.50	0.40
42	Pform	# of easily-recognizable vegetation structures present w/in the wetland.	0.25	0.50	0.50	0.50	0.01
43	FormDiv	# of easily-recognizable vegetation forms within the wetland or directly adjoining its upland edge.	0.40	0.50	0.30	0.60	0.70
44	Alder	% of upland edge bounded (within 50 ft) by alder	0.66	0.33	0.66	0.33	0.33
45	Eelg	Presence of eelgrass (either species)	0.01	0.01	0.01	0.01	0.01
46	SoilFine	Predominant soil texture in most of the wetland	1.00	1.00	0.40	1.00	0.01
47	EstuSal	Tidal marsh acreage in this wetland's major estuary	0.33	0.33	0.33	0.33	0.33
48	SeaJoin	Estuary connection with the ocean	0.80	0.80	0.80	0.80	0.80
49	Estu%WL	Relative dominance of undiked tidal wetlands in this estuary	0.30	0.20	0.10	0.10	0.10
50	WetField%	% of land within 1.5 mi that appears to be ponds, lakes, nontidal marsh, sewage lagoons, cropland, or pasture in flat terrain	0.01	0.75	0.50	0.50	0.25
51	BuffCov	% of the area surrounding this wetland that appears to be developed or persistently bare	0.35	0.35	0.11	0.11	0.45
52	BlindL	Internal channel complexity	0.40	0.01	0.01	1.00	0.01
53	Exits	# of internal channel exits (where internal channels flow into unvegetated waters or tideflats outside of the wetland)	0.25	0.25	0.01	0.25	0.01
54	Jcts	# of internal channel junctions	0.50	0.01	0.01	0.01	0.01
55	FreshSpot	Internal freshwater	0.01	0.01	0.01	0.01	0.01

Table 4: Curry Waterfowl Food Species by Family

Fam_Scientific	Scientific Name	Common Name	Native?	Ann/Per	Other Distrib
Ceratophyllaceae	Ceratophyllum spp	coontail, hornwort	yes	P	
Cyperaceae	Carex aquatilis	Leafy Tussock Sedge	yes	P	OFP: Brookings, Port Orford, New River, Rogue Basin inc Snow Camp
Cyperaceae	Carex exsiccata	western inflated sedge	yes	P	OFP: Harbor, swamp nr Winchuck mo, Langlois, New R, Game Lk, Lawson, Snow Camp
Cyperaceae	Carex lyngbyei	Lyngbye's sedge	yes	P	
Cyperaceae	Carex obnupta	slough sedge	yes	P	
Cyperaceae	Cyperus bipartitus	Shining flatsedge	yes	A	OFP: Illinois R Oak Flat, Rogue R Cherry Flat N of Agness
Cyperaceae	Cyperus eragrostis	Tall flatsedge	yes	P	
Cyperaceae	Cyperus erythrorhizos	Red-Root flatsedge	yes	A/P	OFP: Along Rogue River
Cyperaceae	Cyperus squarrosus	Awned flatsedge	yes	A	
Cyperaceae	Cyperus strigosus	Straw-color flatsedge	yes	P	
Cyperaceae	Eleocharis acicularis	needle spikerush	yes	A/P	OFP: Gold Beach, Floras Lake
Cyperaceae	Eleocharis obtusa	Blunt Spike-Rush	yes	A/P	OFP: Rogue at Twomile Cr
Cyperaceae	Eleocharis ovata	ovate spikerush	yes	A	
Cyperaceae	Eleocharis palustris	common spikerush	yes	P	OFP: Curry coastal, Floras Lake, Brookings
Cyperaceae	Schoenoplectus acutus	Hard-Stem Club-Rush	yes	P	OFP Garrison Lake, New R, Jackson Co.
Cyperaceae	Schoenoplectus tabernaemontani	Soft-Stem Club-Rush	yes	P	OFP: Gold Beach, Rogue at Chery Flat, New River ACEC
Cyperaceae	Scirpus microcarpus	red-tinge bulrush, small-flowered bulrush, panicled bulrush	yes	P	OFP: Gold Beach, Port Orford, S end coast, Rogue Cherry Flat nr Agness
Equisetaceae	Equisetum spp	horsetail	yes	P	
Haloragaceae	Myriophyllum sibiricum	Siberian Water-Milfoil	yes	P	OFP: Gold Beach, Garrison Lake, Floras Lake
Hydrocharitaceae	Elodea canadensis	Canadian Waterweed	yes	P	
Juncaceae	Juncus balticus	baltic rush	yes	P	OFP: Kalmiospis wilderness, Croft Lake
Lentibularaceae	Utricularia vulgaris ssp macrohiza	common bladderwort	yes	P	OFP: Floras, Croft, Lost Lakes, Rogue Basin (Parsnip Lakes)
Nymphaeaceae	Nuphar polysepala	yellow pond-lily	yes	P	OFP: Garrison, Floras, Lost Lks, Lawson Cr, Rogue Basin
Plantaginaceae	Hippuris vulgaris	Common Mare's-Tail	yes	P	OFP: Lake o the Woods only
Poaceae	Distichlis spicata	saltgrass, coastal salt grass	yes	P	OFP: Harbor at beach, Otter Pt.,New R, none in Rogue Basin
Poaceae	Glyceria elata	Tall manna grass	yes	P	OFP: Bald Mtn Cr, Rogue Basin
Poaceae	Glyceria striata	Fowl mannagrass	yes	P	OFP: N of Port Orford, Hunter Cr Bog, Josephine Co. Found in Pistol
Poaceae	Leersia oryzoides	rice cut grass	yes	P	OFP: Jackson Co in Rogue Basin, Douglas Co., override USDA
Poaceae	Torreyochloa pallida	pale false mannagrass, weak mannagrass	yes	P	OFP: Brookings, lower Winchuck, Iron Mountain
Polygonaceae	Persicaria amphibia	Water smartweed, water persicaria	yes	P	OFP: Rogue R. nr Agness
Polygonaceae	Persicaria hydropiperoides	Swamp Smartweed, Water-Pepper	yes	P	OFP: Coos, Rogue nr Agness, override USDA, also CA: DelNorte
Polygonaceae	Persicaria lapathifolia	Dock-Leaf Smartweed	yes	A	OFP: Rogue nr Grants Pass
Polygonaceae	Persicaria punctata	Dotted Smartweed	yes	A/P	OFP: Winchuck
Potamogetonaceae	Potamogeton epihydrus	Ribbon-leaf pondweed	yes	P	
Potamogetonaceae	Potamogeton natans	Floating pondweed	yes	P	OFP: pond nr Port Orford, Floras Lake, none on Rogue R

Fam_Scientific	Scientific Name	Common Name	Native?	Ann/Per	Other Distrib
Potamogetonaceae	Potamogeton richardsonii	Red-head pondweed, clasping-leaf pondweed	yes	P	OFP: Garrison Lagoon
Potamogetonaceae	Stuckenia pectinata	Sago false pondweed	yes	P	OFP: Garrison Lagoon
Ranunculaceae	Ranunculus aquatilis	White Water-Crowfoot	yes	P	OFP: Floras Lake, override USDA
Ruppiaceae	Ruppia maritima	widgeongrass, beaked ditch-grass	yes	P	OFP: mouth of Winchuck, Bandon Marsh, override USDA
Typhaceae	Sparganium eurycarpum	broadfruit bur reed	yes	P	OFP: Floras Lake; Grants Pass, override USDA
Typhaceae	Typha latifolia	broadleaf cattail	yes	P	
Zosteraceae	Phyllospadix scouleri	Scouler's Surf-Grass	yes	P	
Brassicaceae	Nasturtium officinale	Watercress	no	A/B	OFP: Lower Rogue, N Bank Pistol
Poaceae	Avena sativa	Oat	no	A	
Poaceae	Echinochloa crus-galli	barnyardgrass	no	A	OFP: Rogue at Jim Hunt, Langlois, New River/Fourmile
Poaceae	Setaria pumila	yellow bristlegrass, yellow foxtail	no	A	OFP: Harris Beach, Rogue Basin nr Grants Pass, override USDA
Poaceae	Setaria viridis	green bristlegrass, green foxtail	no	A	OFP: Chetco RM 6, Langlois, Rogue Basin nr Grants Pass
Polygonaceae	Persicaria hydropiper	Mild Water-Pepper	no	A	OFP: Coos, Rogue W Evans Cr
Polygonaceae	Persicaria maculosa	spotted lady's-thumb, heartweed	no	A/P	OFP: Rogue nr Grants Pass; Port Orford

Appendix A: South Coast Estuary Tidal Inundation: Water Levels and Salinity

This document is intended to summarize locations and magnitudes of tidal water level changes recorded during water studies, and salinity concentrations during different flow and tide conditions. Since 2002, the Water Quality Monitoring Program of the South Coast and Lower Rogue Watershed Councils has conducted a variety of estuary water quality studies, beginning with a 1998 study in the Rogue River Estuary.

Hunter Creek

The head of tidal influence is located at approximately river mile 1.35 (Jones and others, 2001). The upper limit of salinity was detected at river mile 0.8, following a 6.3 foot tide after the first storm of the season eroded the bar at the mouth (9/21/13).

During 8.3 foot King Tide observations on 12/12/12 (all tides are referenced to the Wedderburn, Rogue Station), no tidal exchange was observed between mainstem Hunter and Turner Creek (~RM 0.5) or the ditch draining the large pasture (~ RM 0.95). Tidal exchange was observed in the ditch draining the wetland on the north bank (~RM 0.0-0.2).

During the summer of 2003, no stratification was detected at stations located at RM 0.4, 0.2, or 0.0, during three sampling events. The mouth was sealed during the sampling, but overwash of the bar was observed at the highest tides. Mean specific conductivity increased from 155 to 189 µS through the summer sampling. During summer 2004, the mouth was open during the first and third sampling events. The deeper sampling stations were stratified, the surface one meter measuring less than 1 ppt, and the bottom saline layer measuring 14-31 ppt in early July, and 12-20 ppt in late August. In early August, when the mouth was closed, samples at RM 0.0 measured 232-274 µS. ODEQ found similar results in August 2008 at RM 0.0 (check ODEQ report for the condition of the mouth at that time).

In 2013, salinity profiles were measured at several stations approximately weekly from early July through the end of September. Salinity was first detected on 7/17/13, partially mixed at stations up to RM 0.2. On 7/24/13, salinity reached at least as far upstream as RM 0.45 (the uppermost sampling station) near LL tide following a 7.5’ HH tide. Mixing had occurred at all depths. A week later, all of the salinity except at depths of 9-10 feet had flushed out or been mixed with fresh water. After another week, mean conductivity had decreased further, but a wedge with a peak salinity of 5.1 ppt had entered the RM 0.0 station on a 5.7’ tide. The mouth was closed a week later, and all stations and depths were fresh, with little variation in conductivity. On 8/24/13, following a 6.8’ tide, salinity was mixing as far upstream as RM 0.2, and a peak salinity of 16.9 ppt was recorded at RM 0.0. On 9/24/13, during a minus tide, no salt was detected. On 9/11/13, 3-3.5 hours following a 6.6’ tide, mixing was seen at RM 0.0, with a peak of 14.9 ppt. After the bar eroded at the mouth, salinity moved into the estuary at least as far upstream at RM 0.45. At a relatively low tide (between 4.9 and 2.8 feet), the upstream station measured 25.2 ppt at depth, and at RM 0.0, measured 31.4 ppt. The discharge of 47 cfs caused a higher degree of stratification, with a difference of 20 ppt between surface and bottom layers.

Weekly to biweekly sampling in 2002-2003, followed by periodic sampling coincident with the ODEQ Ambient monitoring run, was conducted at the Hunter Creek county road bridge at RM

0.4. During the higher flow months of October-May, just 2 of 27 samples had been mixed with ocean water as shown below.

Date	Time	Salinity, ppt	Discharge, cfs (@Chetco gage)	Tide Height, feet	Tide Time
10/30/02	16:17	0.1	63		
12/4/02	14:47	7.4	289	"high"	

Pistol River

Although some sources locate the head of tide at approximately river mile 1.0 (Adamus, Larsen, and Scranton, 2005), currents observed during the 8.1' King Tide on 2/19/15, indicate that it is located at RM 1.55.

During the summer of 2003, grab samples were collected every 2-3 hours during daylight on 7/8/03 and 9/23/03, at estuary stations located at RM 1.2, 1.0, 0.4, and in the outlet channel (which had migrated to the north). No profiles were measured to detect stratification. At river mile 1.2, all samples were fresh in July, and all measured 0.5-0.7 ppt in September. The upstream extent of salinity intrusion above the bridge was not determined. In July, the mouth was evidently open, since samples varied from 3.5 to 31 ppt with the tides in the outlet channel. Peak salinity was 4.0 ppt at RM 1.0 and 0.4. In September, the mouth was evidently closed. Peak salinities from upstream to downstream measured 0.7, 0.2, 1.7, and 2.6 ppt. Salinity may have been higher at RM 1.2 than 1.0 due to the greater depth at the Pistol Loop Bridge.

ODEQ sampled during mid-August, 2008, using continuous recorders at RM 1.2 and 0.4. At RM 1.2, 63% of the samples were considered fresh, <200µS. Conductivity of the remaining samples measured up to 206µS. At RM 0.4, all samples ranged from 301-451 µS. Discharge was measured as 12.2 cfs, but the data indicates that the mouth was closed.

Weekly to biweekly sampling in 2002-2003, followed by periodic sampling coincident with the ODEQ Ambient monitoring run, was conducted at the Pistol Loop Bridge at RM 1.2. During the higher flow months of October-May, just 2 of 29 samples had been mixed with ocean water as shown below.

Date	Time	Salinity, ppt	Discharge, cfs (@Chetco gage)	Tide Height, feet	Tide Time
12/4/02	11:34	19	289	"high"	
11/3/05	14:44	2.1	3,010		

Chetco River

In the Chetco River Estuary, the head of tide is located at 3.5 miles inland near Tide Rock (Ratti and Kraeg, 1979; Adamus, Larsen, and Scranton, 2005). Seasonal variation in mixing ranges from highly stratified during high flow, to partially mixed in June and well mixed in September (Ratti and Kraeg, 1979, c.f. Slotta and Tang, 1976, location not cited).

Past episodes of salinity intrusion at former City of Brookings drinking water (DW) intake, resulted in relocating the intake from river mile 3.1 to 5.4 in 1989 (HGM, 2007 Water Systems Master Plan Update). During high tides in late summer, the upstream extent of salinity has penetrated as far upstream as the Harbor Water P.U.D. drinking water intake on the south bank at river mile 3.35 (shown at right). During the summers of 2014 and 2015, drinking water was periodically contaminated.

Samples collected from continuously recording multi-parameter sondes and grab samples provide a rough salinity profile during high tide. Higher flows were associated with less salinity at the upstream-most station at the former City of Brookings DW intake.

Date	Peak Tide (ft)	Chetco Gage Discharge (cfs)	Station Description (River Mile)	Peak Salinity (ppt)	Stratifi-cation?	Change in Depth (ft)
8/14/10	7.5	138	Chetco @former DW (3.1)	0.1		ND
			Chetco @Morris Hole (2.5)	32.7		1.6
			Chetco @Intertidal (1.7)	31.6		ND
9/10/10	7.8	96	Chetco @Harbor DW (3.35)	0.01		ND
			Chetco @former DW (3.1)	0.6[1]	0.6-8.8	ND
			Chetco @Morris Hole (2.5)	25.2		1.6
			Chetco @Intertidal (1.7)	32.9		ND
9/29/11	8.1	82	Chetco @former DW (3.1)	19.4	1.0-9.0[2]	1.6
			Chetco @Morris Hole (2.5)	26.3	3.0-24.4[2]	1.8
			Chetco @Intertidal (1.7)	30.9[1]	8.1-30.9[3]	ND

[1] grab samples near peak tide
[2] profiles on previous date, 2.0-2.5 hours after peak tide of 8.0 ft
[3] profile <1 hour following HL tide of 1.2 ft

In the Chetco River Estuary, incoming tides cooled all stations to some degree, even upstream of the salinity wedge. Temperatures at the head of the estuary were continuously warmer than the state standard for juvenile salmonid rearing for 34 days. Additional temperature, dissolved oxygen, and pH measurements were recorded at four sampling stations during three summer diurnal monitoring events (Myers, 2013). Results of Chetco boat basin profiles measured by the

Corps of Engineers in summer-fall 1999, and by the South Coast Watershed Council in 2002-2003, should be incorporated into this overview.

Salinity was measured during higher flows within the Chetco boat basin and in the mainstem upstream of the boat basin.

Date	Chetco Gage Discharge (cfs)	Station Description (River Mile)	Peak Salinity (ppt)	Stratification?
12/4/02	289	Commercial Boat Basin	19.3 @ 1.5 meters	ND
2/26/03	1,870	Chetco estuary upstream of Boat Basin at RM 0.6	0.3 at 2.0 meters	0.01-0.3 ppt
		Boat Basin Entrance at RM 0.3	4.0 at 2.5 meters	ND
		Sport Boat Basin North	5.4 at 2.2 meters [1]	ND
		Commercial Boat Basin South	5.0 at 1.75 meters [2]	ND
5/21/03	762	Chetco estuary upstream of Boat Basin at RM 0.6	0.6 at 1.0 meter	ND
		Boat Basin Entrance at RM 0.3	11.5 at 2.6 meters	ND
		Sport Boat Basin North	20.0 at 4.0 meters	4.0-11.2 ppt; 5.0-17.2 ppt varied tides
		Commercial Boat Basin South	20.6 at 2.0 meters	6.0-13.1 ppt; 20.0-20.6 ppt varied tides

[1] 10.6 ppt at 3.0 meters ~ 5 hours later

[2] 5.9 ppt at 2.7 meters ~ 5 hours later

To the right: mouth of Joe Hall Creek (RM 2.2) photographed on 12/14/12 after an 8.7 foot high King Tide. Discharge at the USGS Chetco River gage was 2,080 cfs.

Tidal exchange is also lacking at the mouth of Ferry Creek.

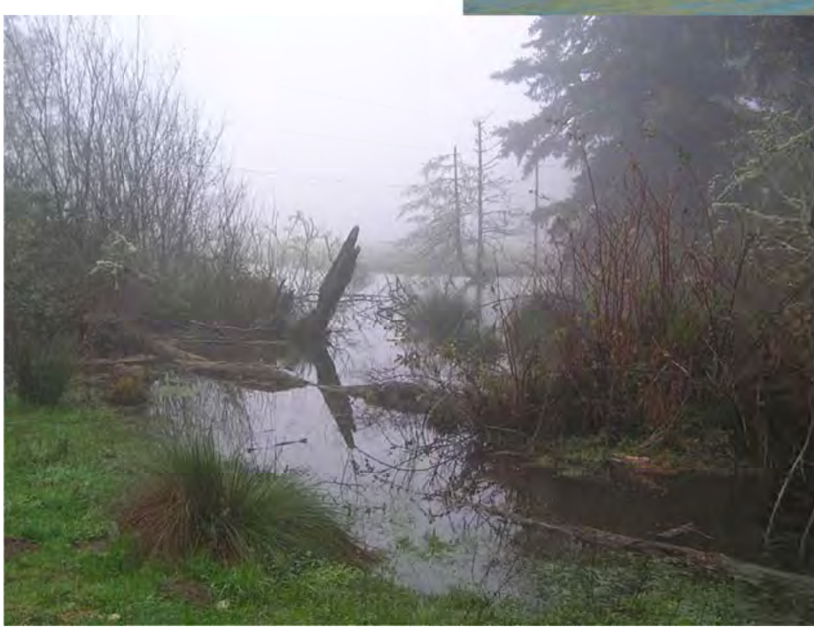
Winchuck River

Although some sources locate the head of tide at approximately river mile 1.0 (Adamus, Larsen, and Scranton, 2005), currents observed during the 8.8' King Tide on 12/13/12, indicate that it is located at RM 1.3 (figure 8).

During the summer of 2005, continuous and grab samples were collected during 7/20/04, 8/17/04, and 9/21/04, at estuary stations located at RM 1.0, 0.7, 0.3, and 0.0. At the upstream station, all samples except for several during a one-hour period at high tide were fresh water (locate the height of this tide). At RM 0.7, stratification was present in July with surface salinity at 0.2-0.6 ppt while deeper samples measured 25-26 ppt. In September, top samples measured 1 ppt while bottom samples were 19 ppt. Stratification was also detected at RM 0.3 in September, with a surface layer <1.0 ppt and bottom salinities of 22-23 ppt. Samples at the mouth ranged widely depending on the tides since the mouth was open all summer.

No high flow salinity data have been collected in the Winchuck estuary.

Tidal exchange with mouth of the tributary flowing on the east margin of Winchuck Wayside State Park (RM 0.27) was photographed on 12/13/12 after an 8.8 foot-high King Tide. Discharge at the USGS Chetco River gage was 2,330 cfs.



The extent of tidal inundation and the elevation of the annual flow on pastures of the Johnson/DeMartin Ranch remains to be mapped in detail. On the south side pasture, long-time residents observed that water covered the fields only during the tsunami (verbal communication, Carol DeMartin Johnson). On the downstream end of the south pasture, the mouth of the tributary (where the livestock bridge was later installed) was inundated when the photo above was taken on 12/4/2007, at a discharge of 17,200 cfs at the USGS Chetco River gage.

No information was collected for the north side pasture.

Myers, C. R., 2013 (unpublished), Water Quality for Summer Rearing and Sources of Nutrients: Elk River, Euchre Creek, Rogue River, and Chetco River Estuaries of the Southern Oregon Coast, 2010-2011: prepared for Curry Watersheds Partnership.

Hunter Creek Estuary - Tidal Inundation and Salinity Observations

		Fall-Winter-Spring		Summer		
WQ Project	**Estuary/Station(s)**	**Fresh <200µS**	**Brackish/Marine**	**Fresh <200µS**	**Brackish/Marine**	**Environmental Conditions/Notes**
Phase I & Ambient Supplement	Hunter Creek at low county bridge	25 samples	2 samples, 0.1 & 7.4 ppt (12/04/02, high tide, mouth open)	17 samples	2 samples, 1.0 & 1.7 ppt	10/30/02 16:17 62 cfs (daily discharge at Chetco gage; 12/4/02 10:47; 289 cfs (both low winter flows); tides xxxx
Diurnal 2003, three sampling events	Hunter Creek at low county bridge, Turtle Rock, & Hwy 101			52 samples, mean increased from 155 to 162 to 189µS		mouth sealed, overwash observed on highest tides
Nutrient source search	Hunter Creek at low county bridge	10/05/03: 1 sample				
Diurnal 2004, three sampling events	Hunter Creek at low county bridge, Turtle Rock, & Hwy 101				07/06/04: 16 samples stratified, (<1 ppt at <1 m depth, 14-31 ppt saline layer)	mouth is open; Turtle Rock station shallow, not stratified
				08/03/04: 13 samples, mean 181µS @ Turtle Rock and low county bridge	08/03/04: 7 samples 232-274 µS, Hwy 101 only	mouth closed
					08/31/04: 12 samples stratified, (<1 ppt at <1 m depth, 12-20 ppt saline layer)	mouth opened during swells during previous week, and migrated north
Hunter Nitrate Source Phase II	Hunter Creek at low county bridge			07/07/05: 1 sample	07/21/05: 1 sample, 12ppt	
Stormchasers 2004-2008	Hunter Creek at low county bridge	8 storm samples, 61-108µS				
ODEQ TMDL sampling	Hunter Creek at Hwy 101				Continuous 08/12/08-08/14/08: 100% of samples, 211-240µS	Discharge 3.5 cfs at Mateer Bridge. Check ODEQ report for condition of mouth (assume closed)
Hunter N isotopes	Hunter Creek at low county bridge, Turtle Rock, & Hwy 101, all sampled mid-depth			07/03/13: 3 samples, mean 139µS		
					07/24/13: 3 samples, 12-31 ppt	
				08/15/13: 3 samples, mean 165µS		
				09/04/13: 3 samples, mean 167µS		
					09/25/13: 3 samples, 15-31 ppt	

Pistol River Estuary - Tidal Inundation and Salinity Observations

		Fall-Winter-Spring		Summer		
WQ Project	Estuary/Station(s)	Fresh <200µS	Brackish/Marine	Fresh <200µS	Brackish/Marine	Environmental Conditions/Notes
Phase I & Ambient Split	Pistol River at Pistol Loop Bridge	27 samples, 53-176µS	12/4/02 11:34: 19 ppt 11/03/05 14:44: 2.1ppt	11 samples	6 samples, 0.1-16 ppt (peak on 7/11/02 16:07)	12/4/02 289 cfs (daily discharge at Chetco gage); tides xxxxx 11/3/05 14:44: x cfs; tides xxxx
Diurnal 2003, two sampling events	Pistol River at Pistol Loop Bridge, abv Crook Creek, at Hwy 101, and estuary outlet channel			07/08/03: 9 samples at Pistol Loop Bridge	7/08/03: 6 samples 0.1-4.0 ppt abv Crook Ck; 4 samples 1.2-4.0 ppt at Hwy 101; 4 samples 3.5-31 ppt at estuary outlet	mouth evidently open
					09/23/03: 6 samples 0.5-0.7 ppt at Pistol Loop Br; 5 samples 0.2 ppt abv Crook Cr; 6 samples 1.1-1.7 ppt at Hwy 101, 6 samples 1.0-2.6 ppt at estuary outlet	mouth evidently closed
Stormchasers 2004-2008	Pistol River at Pistol Loop Bridge	8 samples, 47-76µS				
ODEQ TMDL sampling	Pistol River at Pistol Loop Bridge and u/s of Hwy 101			Continuous 08/12/08-08/14/08: 63% of samples 175-200µS @ Pistol R Loop Rd	Continuous 08/12/08-08/14/08: 37% of samples 201-206µS @ Pistol R Loop Rd; 100% of samples 301-451µS u/s of Hwy 101	Discharge 12.2 cfs at ODOT

Chetco River Estuary - Tidal Inundation and Salinity Observations

		Fall-Winter-Spring (Oct-May)		Summer (June-Sept)		
WQ Project	**Estuary/Station(s)**	**Fresh <200µS**	**Brackish/Marine**	**Fresh <200µS**	**Brackish/Marine**	**Environmental Conditions/Notes**
Chetco Checkup long profile						
Chetco Boat Basin	Chetco River: Sport Boat Basin (SBB), Commercial Boat Basin (CBB), & upstream of Boat Basin (UBB)		10/17/02: 3 samples at 1.5-3.2 meters, 29-31 ppt, SBB & CBB		08/02/02: 4 samples at mid-depth, 18-19 ppt, SBB & UBB	8/2/02: 92 cfs. 10/17/02: 63 cfs, tides 16:10-17:23
			12/04/02: 1 sample at 1.5 m, 19 ppt, CBB		09/09/02: 13 samples well mixed at various depths, 23-28 ppt, SBB, CBB, & UBB	9/9/02: 69 cfs. 12/4/02: 289 cfs
		02/26/03: 1 sample at 1.2 m, 177µS, UBB	02/26/03: 1 sample at 2 m, 0.3 ppt, UBB; 7 samples at 1.5-2.7 m, 4.0-5.9 ppt, SBB & CBB (lowest at entrance to BB); 1 sample at 3 m, 10.6 ppt, SBB		06/12/03: 2 samples at 2.0 m, 25-26 ppt, SBB & CBB	2/26/03: 1,870 cfs, tides 16:58. 6/12/03: 331 cfs
			05/21/03: 1 sample at 1 m, 0.6 ppt, UBB; 10 samples: At ≤1.5 m, 4.0-7.5 ppt while at 1.5-4 m, 11-21 ppt, SBB & CBB			5/21/03: 762 cfs
Diurnal 2010	Chetco River: At former Brookings drinking water (DW) intake, at Morris Rock, Intertidal (d/s of Rivers Edge RV) , and at Hwy 101			08/14/10 3 samples at 1.0 m, 102-112µS at DW intake	08/14/10 2 samples at 1.0 m, 209-280µS, at DW intake. Continuous 08/13/10-08/14/10: 0.2-21 ppt at Morris Rock; 20-32 ppt at Intertidal. 08/14/10: 5 samples at 1 m, 25-32 ppt at Hwy 101	Discharge at Chetco gage =138 cfs. Sample timing optimized for peak tides during afternoons for profiling at head of tide. Profile at Hwy 101 had top 0.5 m as low as 16 ppt.
				09/10/10: 3 samples at 1.0 m, 111-135 µS, at DW intake	09/10/10: 3 samples at various depths, 0.3-8.4 ppt, at DW intake. Continuous 09/09/10-09/10/10: 1.0-25 ppt at Morris Rock; 6.7-33 ppt at Intertidal. 09/10/10: 5 samples at 1.0 m, 19-33 ppt, at Hwy 101	Discharge at Chetco gage =96 cfs. Profile at DW intake close to high high tide of 7.8 ft, ranged from 0.8 ppt at 0.5 m to 8.8 ppt at 2.5 m.
Diurnal 2011	Chetco River: At former Brookings drinking water intake, at Morris Rock, Intertidal (d/s of Rivers Edge RV) , and at Hwy 101			Continuous 09/28/11-09/29/11: 43% of samples at DW intake	Continuous 09/28/11-09/29/11: 57% of samples, up to 31 ppt at DW intake; 0.8-26 ppt, at Morris Rock. 09/29/11: 2 samples at middepth, 7.9-31 ppt, at Intertidal; 5 samples at middepth, 25-33 ppt, at Hwy 101.	Discharge at Chetco gage =82 cfs.
Inundation report Summer 2014	Harbor Drinking Water Intake (~RM 3.35)				Temporarily undrinkable sometime before 09/13/14	Brookings drinking water intake moved upstream from RM 3.1 to RM 5.4 in ~1989 (HGE, 2007 Water Systems Master Plan update)
Inundation report Summer 2015	Harbor Drinking Water Intake (~RM 3.35)				Harbor P.U.D. reported conductivity beginning 9/29/2015	

Winchuck River Estuary - Tidal Inundation and Salinity Observations

		Fall-Winter-Spring		Summer		
WQ Project	**Estuary/Station(s)**	**Fresh <200µS**	**Brackish/Marine**	**Fresh <200µS**	**Brackish/Marine**	**Environmental Conditions/Notes**
Diurnal 2004	Winchuck River: above salt at snags (, at red barn, at Hwy 101, at mouth			7/20/04: 3 samples 66-69µS, at abv salt at snags	07/20/04: 4 stratified samples at red barn, at <0.4 m, 0.2-0.6 ppt, while >0.8 m, 25-26 ppt; 5 middepth samples 26-29 ppt at Hwy 101; 8 middepth samples, 2.7-28 ppt, at mouth	2004 Tides needed. Chetco River discharge 133 cfs. Mouth is open, but bar is built up, so that flow is restricted
				08/16/04-08/17/04: Continuous, 50-166µS, at abv salt at snags	08/16/04-08/17/04: Continuous, 0.2-27 ppt at red barn; 08/17/04: 6 samples at 0.9 m, 28-30 ppt, at Hwy 101; 6 samples at 0.6 m, 28-30 ppt, at mouth	At abv salt at snags, salt affects conductivity briefly at 8/17/04 1:00 HH tide, x feet . Chetco River discharge 90 cfs. Mouth is open.
				09/20/04-09/21/04: Continuous, 69-87µS, at abv salt at snags	Continuous 09/20/04-09/21/04: 0.1-16 ppt , at red barn; 3 stratified samples, top 1 ppt, while bottom 19 ppt. 09/21/04: 4 stratified samples, top 0.4-0.8 ppt, while bottom 22-23 ppt, at Hwy 101; 4 samples 0.5-18 ppt, at mouth	No salt detected at abv salt at snags at 6.8 ft HH tide, 9/20/04 15:18. Chetco River discharge 153 cfs. Mouth is open.

APPENDIX B: Methods for OWEB Estuary Assessment

A Technical Advisory Committee was convened to guide the project and provide technical assistance (including guidance, training, and advice regarding prioritization criteria). Tidal wetland data compilation and prioritization followed Brophy (2007), except as noted. This project procured technical advice from the Institute for Applied Ecology, Estuary Technical Group (Laura Brophy, Director).

The OWEB Estuary Assessment, Component XII of the Oregon Watershed Assessment Manual, is designed to identify, characterize, and prioritize tidal wetlands within individual Oregon estuaries (Brophy, 2007). The method is intended for use within a single estuary, not for prioritizing wetlands across different estuaries. Tidal wetlands are defined as those wetlands that are periodically flooded by tidal waters, and do not include tidal flats or algal beds.

As described in Brophy (2007), this assessment uses existing data and generates new data to locate current and former tidal wetlands in the estuary. None of the current data sources provide a comprehensive map of current and former tidal wetlands, so several sources are used to identify the historic extent of tidal wetlands.

References and mapping included the Oregon Estuary Inventory Series, historic vegetation classification (Christy and others, 2001), levee/dike inventory (Mattison, 2011), National Wetland Inventory (NWI) classification maps, NRCS Soil Survey, 2008 LiDAR, and digital orthophoto quads and mosaics as described below. A Local Wetland Inventory of Gold Beach (van Staveren and Farrell, 2001), available as a set of paper maps and report, was examined for wetlands in Hunter Creek.

Aerial photos from 1940, 1951 (1952), 1965, 1970, 1986, 1992, and 2002 were procured from the University of Oregon Map and Aerial Photography Library (http://library.uoregon.edu/map/index.html) and georeferenced by Erin Minster, Curry SWCD. More recent NAIP orthophotomosaics (2005, 2009, and 2012) were obtained from the USGS Viewer – National Map at http://nationalmap.gov/viewer.html.

Images compared in the PowerPoint file, "SC_Estuaries_Tidal Wetlands_Flooplain Alterations.ppt", were created in ArcGIS, by exporting successive historic aerial photos at the same scale and view.

Previous delineations of South Coast tidal wetlands include NWI mapping, apparently using 1995 aerial photos, and Scranton (2004) mapping on 2001-2002 aerial photos.

King Tide observations of wetland inundation, currents, organic matter transport and wildlife were contributed by volunteers (Appendix D). Volunteers took photos and provided observations on Hunter Creek and Pistol River during King Tides on 12/12/12 and 12/30/13. In 2012, the author also kayaked for observations on Chetco River (12/15/12) and Winchuck River (12/14/12). An additional King Tide kayak trip to locate the head of tide on Pistol River was completed on 2/19/15.

Low flow inundation was also recorded during July-September, 2013 HGM field work, but these visits were not timed for maximum tidal exchange due to the competing objective of completing botanical surveys within a compressed flowering season for plant identification.

Alteration history was interpreted by inspection of successive historic aerial photos, and documented in a GIS table. Tidal wetland polygon subareas were split based on types and levels of alteration. Merging polygons having internally consistent degrees of alteration, resulted in 15 wetland sites.

GIS processing steps for the assessment, including evaluating the Ecological Prioritization criteria, were documented in a GIS process record.

APPENDIX C: METHODS FOR HYDROGEOMORPHIC (HGM) RAPID ASSESSMENT METHOD (RAM)

HGM RAM Wetland Selection

In order to facilitate the timely completion of HGM indicator monitoring, tidal wetlands were grouped into 13 areas, and given initial scores based on ecological value and social-economic factors that would preclude access or restoration (Table below). Although the OWEB assessment of Ecological Priorities was not yet completed, the importance of the "Social" factor, which dictated whether permission for access might be granted, based on land ownership (number, type, and established relationships) was clear.

Based on an apparent lack of alteration, the North Bank upstream of Hwy 101 area was included to serve as a least altered reference for comparison of HGM indicators.

Funding from a later OWEB Monitoring Grant, was used to survey additional wetlands north of Rogue River during 2014. Results from these surveys are not yet included in this report.

HGM Indicators

Components of the Watershed Assessments for Hunter Creek, Pistol River, Chetco River, and Winchuck River (Maguire, 2001) pertain to estuaries, including riparian/wetlands, sediment sources, hydrology and water use, channel modification, water quality, and watershed condition evaluation. More recent surveys and monitoring results have include road inventories, water quality, and riparian condition associated with restoration planting projects.

South Coast Tidal Wetlands, Prioritization for HGM Rapid Assessment Method								
Watershed	**Wetland Location**	**Ecological**	**Social**	**Economic**	**Ratings**	**Access**	**Calc**	**Field?**
Hunter	North Hunter	Connected ditch has tidal channel potl	Ongoing discussions		3	2.5	7.5	1
	Intertidal west bank strip	Possible hiding habitat, needs trees?	Adjacent to roadway		1.5	3	4.5	
	East Pasture & mouth of Turner Cr	Potl swamp or scrub/shrub, need connection		Expensive to develop connections; some value as livestock forage	2	2	4	
Pistol	North hillslope & mouth of Crook Cr	High marsh, outside bend erosion prevent low marsh development? Tidal connect w intact potl forested.	Landowner desires bank protection	Livestock operation	3	2.5	7.5	1
	Pasture u/s of Hwy 101, north side	Potl swamp or scrub/shrub, inc. cottonwoods, may need connection	Absent landowner	Property for sale, constriction at Loop Rd during floods - $$$ to fix. North Bank Rd fill, bridges	3	2	6	1
Chetco	Boat Basin	Small area available, but would be valuable for hiding and foraging	Decisions by Port District commissioners and manager	High value	2	2	4	
	East bank u/s of Hwy 101	Cottonwoods, flooding	Multiple landowners	Development potential on floodplain above wetland	3	2.5	7.5	1
	Snug Harbor	Tidal Forested in lower, River-sourced in upper	Development proposals ongoing		3	2.5	7.5	1
	Intertidal gravel bar	River-sourced, poor opportunity for upland connectivity. Any brackish vegetation? Stabilize w/ large wood?	Mitigation Site?		2	2	4	
Winchuck	Winchuck Wayside State Park	Low marsh, connect with adjacent high marsh, protect adjacent woodland?	Consider recreation impacts at Oregon State Parks	Good access for excavation, but width would be limited	3	3	9	1
	North bank u/s of Hwy 101	Reference site for low marsh						1
	Big bend river-sourced tidal & backwater	Plants brackish or freshwater? Measure tidal channel	Landowner worked with Curry SWCD for livestock exclusion fencing, access bridge, and large wood in off-channel habitat.	Livestock operation	3	3	9	1
	Mini-bank stabilizing tidal fresh	Veg stabilizing banks in small areas. Add species diversity for tidal swamp?	Recent project to exclude livestock		2	3	6	

Quality Control/Quality Assurance for HGM Indicators (excluding botanical)

Adamus, Larsen, and Scranton (2005) reported surveying one tidal wetland in the Chetco estuary during the development of the scoring models. Three additional wetlands were surveyed in the Rogue Estuary. Indicator scores obtained by Adamus may be compared with scores from these assessments to identify any systematic mis-interpretations of indicator definitions. Questions about how to best apply the HGM indicators to tidal wetlands on the South Coast are the basis for a request for assistance from Technical Advisory Committee (TAC) members. Reviews for reasonableness and completeness are to be undertaken by members of the TAC.

Scoring Models for Wetland Functions:

Produce Aboveground Organic Matter (AProd)
NutrIn + [(AVG: Fresh, FreshSpot) + Pform – Bare – SoilX – Shade

Export Aboveground Plant & Animal Production (XPT)
AProd + (AVG: BlindL, Jcts, Exits, Flood, TribL, (1- Width)]

Maintain Element Cycling Rates & Pollutant Processing; Stabilize Sediment (WQ)
AProd + (AVG: BlindL, Jcts, Exits, Flood) + Width + UpEdge + SoilFine -
[AVG: TranAng, RatioC, Fetch, SoilX]

Maintain Habitat for Native Invertebrates (Inv)
AProd + (AVG: BlindL, Jcts, Exits) + (AVG: Pform, FormDiv, SppPerQd) + (MAX: Eelg, Alder) + (AVG: Fetch, LWDchan, LWDline, Pannes, UpEdge) + (AVG: Fresh, FreshSpot, TribL) – Invas – ChemIn – SedShed – Instabil – (1-Island)

Maintain Habitat for Anadromous Fish (Afish)
(AVG: Flood, SeaJoin) * {AVG [Inv, Estu%WL, (AVG: BlindL, Jcts, Exits), (1-ChemIn)} + (MAX: Eelg, LWDchan) + (MAX: TribL, Fresh, FreshSpot) + EstuSal + ShadeLM

Maintain Habitat for Visiting Marine Fish (Mfish)
(AVG: Flood, SeaJoin) * {AVG [Inv, Eelg, (AVG: BlindL, Jcts, Exits), (1-ChemIn)] }

Maintain Habitat for Other Visiting & Resident Fish (Rfish)
Flood * + [(MAX: LWDchan, Eelg) + (MAX: TribL, Fresh, FreshSpot) + Pannes]

Maintain Habitat for Nekton-feeding Wildlife (NFW)
(MAX: Rfish, Afish, Mfish) + (AVG: TribL, BlindL, Exits, Jcts) + (MAX: Bare, MudW, Pannes) + (AVG: WetField%, Fresh, FreshSpot) + [AVG: BuffCov, (1-FootVis), (1-Boats)]

Maintain Habitat for Ducks and Geese (DG)
(AVG: BlindL, Exits, Jcts, Flood) + (AVG: Eelg, Bare, MudW, NutrIn, Pform) + (AVG: Fresh, FreshSpot, TribL) + WetField% + (1 - Fetch) + {[MAX: (Width, 1 - Island)] – [AVG: FootVis, Boats] }

Maintain Habitat for Shorebirds (SB)
Inv + (MAX: Bare, Pannes, Flood) + [(MAX: Roost, MudW, WetField%) – FootVis – (AVG: FormDiv, UpEdge) – (1-Width)

Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators (LBM)
[UpEdge + (AVG: Pform, BuffCov) + (AVG: SppPerQd, Inv) + (AVG: TribL, Fresh, FreshSpot) + (AVG: LWDmarsh, LWDline) –HomeDis – RoadX - Flood] * Island

Maintain Natural Botanical Conditions (BC)
SppPerQd + NNgt20

Scoring Model for Wetland Risk Assessment (RA):

Risk Assessment
Avg (BuffAlt, ChemIn, NutrIn, SedShed, SoilX, DikeDry, DikeWet, FootVis, Boats, HomeDis, RoadX, Invas, Instabil, (1-BuffCov))

Scoring Model for Wetland Integrity (WI):

Wetland Integrity
Avg (SpDeficit, DomDef, NNdef, AnnDef, TapPCdef, StolPCdef, TuftPCdef)

Botany Transects and Plant Identification

Botany transects were generally located as specified in Adamus (2006), except where the tidal fringe was particularly narrow. In these areas, multiple transects were located perpendicular to the river or slough, and selected to maximize wetland species diversity, based on potential locations observed during off-transect surveys. Plots (quadrats) were continued to the boundary of the wetland, typically a steep slope or the top of a floodplain surface where *Potentilla* was no longer present. Where transects were short due to the steepness of the slough bank, spacing between plots was decreased to detect the wetland zonation. Transects were located on aerial photographs in the field.

Percent cover of species within each meter-square plot was recorded on a form provided by Adamus (2006), and modified from landscape to portrait format to fit on two pages for each group of 10 plots. New species/taxa were added to the list as they were encountered. Estimates of bare soil exposure, algae mat cover, overhead shading, and shading from the south were added to the field form. Off-transect surveys noted presence of species (but not cover) and associated habitat.

Surveys were conducted during summer 2013. Although neither member of the crew is a professional botanist, both have relevant identification and taxonomic experience. Aaron Fitch conducted plant surveys on the Carrizo Plains in California, worked with local National Forest botanists, and performed weed surveys along Curry County roads and rivers. Aaron also possesses keen observation skills developed from his livelihood as a farmer. Cindy Myers' college coursework included plant taxonomy, paleobotany, and ethnobotany courses in California and Oregon, and her 13 years with the Rogue River-Siskiyou National Forest included interdisciplinary field work with botanists, soil scientists, and foresters. Prior to the field season, members of the Carex Working Group were engaged to deliver a sedge, rush, and grass workshop in Gold Beach, for eight hours of intensive lab and field identification.

Plant species that couldn't be readily identified in the field were collected for lab work, including microscopic examination of diagnostic structures and consultation of comprehensive taxonomic references. Samples were also collected of species to be pressed for future reference (primarily sedges, rushes, and grasses). Due to lack of flowers on the survey date, or time required to distinguish among multiple species, identification to species was generally not completed for these genera: *Artemisia, Baccharis, Callitriche, Ceratophyllum, Equisetum, Gallium, Gnaphalium, Hypochaeris, Lemna, Loliuum, Lupinus, Myriophyllum, Oxalis, Persicaria, Phacelia, Plantago (other than P. maritima), Poa, Polygonum, Ranunculus, Ribes, Rorripa, Rumex (other than R. acetocella, crispus, and conglomeratus), Salix, Spergularia/Stellaria, Stachys,* and *Vicia.*

To facilitate plant identification (focus on likely species based on geographic distribution) and vegetation data analysis, staff developed an Access database, tidalwetveg.accdb. Data fields include family, common name, synonyms, USDA symbol, National Wetland List wetland indicator type (western mountains ecoregion), native/introduced, perennial/annual, salinity tolerance, habitat, waterfowl food, inclusion in various lists, and geographic distribution (with data source). Oregon Flora Project Atlas was used for current taxonomic names, synonyms and distribution maps at http://www.oregonflora.org/atlas.php#. USDA Plants was used for images and additional distribution maps for coastal California species at http://plants.usda.gov/java/. The National Wetland Plant List (Lichvar, 2013) was the primary source for wetland indicator status. Lists of important plants consumed by waterfowl in Washington (Yocum, 1951), were checked for synonyms and cross-referenced with species in tidalwetveg.accdb.

Our approach to Quality Assurance/Quality Control for plant identification is based on multiple lines of evidence. This discussion is intended to illustrate the level of effort and skill of our botany crew. Of the 88 taxa identified in quadrats and off-transect observations in the South Coast wetlands, 12 specimens were sent to be verified or identified by Barbara Wilson, Carex Working Group, of Corvallis, Oregon. The collection included eight rushes, three grasses, and one forb. Of the rushes, two tentative identifications to *Juncus* species were verified, including one first Curry County record of *J. diffusissimus*, and one species typically found inland on ultramafic rocks, *J. exiguus*. One rush was mis-identified as the hybrid *J. lescurii*, but was most likely *J. breweri*. One rush was identified incorrectly as *J. nevadensis v. nevadensis*, but was another first Curry County record for *J. articulatus var. articulatus*. *J. balticus ssp. ater* was mis-identified as *J. mexicanus* because the long sheaths were mistaken for long leaf blades. J. effusus ssp. pacificus was mis-identified as *J. effusus var.*gracilis (synonym for *J. laccatus*) based on symmetry of upper sheath apices. One rush was actually the small sedge, *Isolepis cernua*.

One tentative grass identification was verified as *Agrostis stolonifera*, one tentative grass identification to genus was verified as *Glyceria*, but was the species *striata* rather than *elata*, and one grass was the "rare weed" *Cynosurus cristatus*. No identification had been attempted for the forb, the non-native *Chenopodium (Dysphania) ambrosiodes.*

Botany plot data were entered by wetland on worksheets in Excel, where species cover for the wetland and by transect were calculated. After linking the species with unique identifiers from tidalwetveg.accdb, the quad data were transposed to create separate records for each species and plot, and added to the database. Off-transect surveys were also entered in tidalwetveg.accdb.

Additional analyses were performed on the botany transects to better understand the characteristics of the 44 species that were not included in the list of 81 species used to calculate botany indicators. Percent cover was analyzed for taxa having attributes of wetland obligate species, native/introduced, native perennials, and waterfowl foods.

Taxonomic References

Cooke, Sarah S., 1997, *A Field Guide to the Common Wetland Plants of Western Washington and Northwestern Oregon*, Seattle Audubon Society.

Hickman, J.C., 1993, Jepson Manual, Higher Plants of California: University of California Press

Hitchcock and Cronquist, 1981, *Flora of the Pacific Northwest*, University of Washington Press

Lichvar, R.W., 2013, *The National Wetland Plant List: 2013 wetland ratings*, Phytoneuron 2013-49: 1-241.

Pojar, J. and A. Mackinnon, 1994, *Plants of the Pacific Northwest Coast, Washington, Oregon, British Colombia and Alaska*, Lone Pine Publishing.

Wilson, B.L., R.E. Brainerd, D. Lytjen, B. Newhouse, and N. Otting (Carex Working Group), 2008, *Field Guide to the Sedges of the Pacific Northwest*, Oregon State University Press, Corvallis.

Zika, P., received summer 2013, Key to Juncaceae of Oregon, Oregon Flora Project.

Carex Working Group, 7/10/13, Key to Genera of Oregon Sedges

Carex Working Group, 6/24/13 Draft, Key to the Grasses of Oregon and Washington

Appendix D: King Tide Observations Form

King Tide Observations Form

Goal/Objective: To identify the extent of tidal inundation in the Rogue, Hunter, Pistol, Chetco, and Winchuck Estuaries. We need photographs that show the peak elevation of the tide, at several different sites, particularly where the banks/floodplains are gently sloping. We are also interested in how the wetlands function during this annual tidal inundation (conditions differ from those during flooding).

Photographs: Please record the time that the photo was taken (in case the time doesn't download with the digital photo). Knowing the view direction is helpful, either using a compass or providing general description, such as "upstream" and/or "from south bank to north bank". Photo numbers can be filled in after they are downloaded/developed, as long as they are in sequence in the list. We'd like panoramic views as well as closeups of interesting features. Please note if zoom was used. Tips for taking photos of tides may be found at www.climateadaptationplanning.net/kingtides

Location: Please provide a detailed description of how you accessed the site (sketches are useful, and can be completed after the event is over). Maps will be available at the office to record the observation sites.

Observations: use as many lines on the form as you need

- Types/species of wildlife activity/behavior: fish, marine/freshwater mammals, birds, insects (for example, one great blue heron perched on a branch of a stump over a submerged wetland).
- Types of floating debris: branches, leaves, aquatic plants, foam (think about the food web)
- Strand lines: showing a wetted surface or litter that was left during a previous high tide or high flow event
- Sediment deposits, banks collapsing: size of area affected
- Flow patterns, especially near bridges, culverts, and channels: water backed up/stagnant, eddies, concentrated flow.
- Vegetation types, species if known (for example, the water submerged the willow thicket, but the spruce tree roots were still on dry ground)

King Tide Observations Form

Name(s) ____ Date __________________

Watershed ____________________________

Time	Photo #	View	Location/Observations