Wetland Profiles of Oregon's Coastal Watersheds and Estuaries

Part 3 of a Hydrogeomorphic Guidebook

by

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1.0 Introduction

This is the third part in a series of five products that together comprise the "Oregon Tidal Wetland Guidebook" series:

1. *A Rapid Assessment Method for Tidal Wetlands of the Oregon Coast*	a method that may be applied during a single visit to assess indicators of the functions and condition of a particular tidal wetland relative to others of its subclass
2. *Science Review and Data Analysis for Tidal Wetlands of the Oregon Coast*	a detailed synopsis of literature and data upon which the rapid assessment method is partially based, with emphasis on research from the Pacific Northwest, including statistical analyses of new field data collected for calibrating the rapid assessment method listed above
3. *Wetland Profiles of Oregon's Coastal Watersheds* and *Estuaries*	tabular and narrative summaries and interpretations – by watershed and estuary -- of the distribution, properties, and geomorphic settings of wetlands (not just tidal wetlands) as derived from GIS analyses of available spatial data layers
4. *Software and Database for Selected Tidal Wetlands of the Oregon Coast*	a CD-ROM containing (a) a spreadsheet that automatically calculates scores for functions and condition, (b) a database of raw data collected from 120 tidal wetlands of the Oregon coast, (c) photographs of sites on public lands
5. *Revised Maps of Tidal Wetlands of the Oregon Coast*	a DVD containing refinements of the National Wetland Inventory maps, specifically: (a) increased detail in boundaries of intertidal emergent and intertidal forested wetlands based on enlarged May 2002 color infrared aerial photographs (1:24,000 original scale), field observations, and other data sources, (b) labeling of these wetlands to conform with a hydrogeomorphic classification, (c) labeling of some nontidal wetlands as "Restoration Consideration Area" if they might have geotechnical potential for restoration of tidal circulation, (d) improved depiction of tidal creeks within some wetlands. The DVD also includes spatial data on other themes pertinent to assessing condition and function of Oregon tidal wetlands. Some of this information may also be available at: http://www.coastalatlas.net

This part is not directly connected to the HGM rapid assessment method that is provided in part 1 and documented in part 2 of the guidebook series. Rather, its main purpose is to address the most fundamental question: How much coastal wetland acreage does Oregon still have (Table 1), where is it located, and what are its general characteristics? The answers provided in this volume should not be considered definitive, but rather treated as "best available data," partly because wetlands have not been mapped comprehensively for all coastal watersheds in Oregon. Much of the data presented here were compiled using Geographic Information Systems (GIS) and thus reflect both the limitations of the digital data sources and the processing limitations of this technology. Details concerning the sources and methods used to compile tidal wetland data are provided by Scranton (2004). In addition, a thesis by Larsen (2005) describes and compiles data at a landscape scale for nontidal wetlands of the Oregon Coast.

This part begins with a general overview of hydrogeomorphic processes that create and sustain Oregon's tidal wetlands (2.1.1), then discusses how human activities have directly and indirectly altered these wetlands (2.1.2), and describes how Oregon's tidal wetlands may differ from those of neighboring Pacific states (2.1.3). Some general characteristics of Oregon's tidal wetlands are summarized from available spatial data (3.1). Then, the volume proceeds with brief characterizations of each coastal watershed. When available, this includes compiled spatial data on nontidal as well as tidal wetlands. Within the discussion of each watershed are brief descriptions of the tidal wetlands surveyed by the HGM project during summer 2003. Additional information on these sites is provided in part 2 and in data files of the accompanying electronic media.

Table 1. Acres of tidal marsh in estuaries of the Oregon Coast according to three sources

	ODFW (Cortright et al.)	% of All	NWI 2002	% of All	Scranton 2004 (from newer NWI)	% of All
Alsea Bay/River	941	6	531	6	696	6
Beaver Creek	*	*	102	1	97	1
Big Creek	*	*	19	0	*	*
Chetco River	4	0	13	0	6	0
Coos Bay/River	1840	12	1800	21	1959	17
Coquille River	256	2	312	4	424	4
Ecola Creek	*	*	5	0	8	0
Elk River	*	*	5	0	18	0
Euchre Creek	*	*	5	0	6	0
Fourmile Creek	*	*	4	0	*	*
Necanicum Estuary	117	1	70	1	170	1
Nehalem Bay/River	846	6	612	7	707	6
Nestucca Bay/River	428	3	208	2	221	2
Netarts Bay	233	2	677	8	621	5
New River	*	*	137	2	210	2
Pistol River	*	*	4	0	4	0
Rogue River	134	1	36	0	39	0
Salmon River	804	5	283	3	595	5
Sand Lake	443	3	607	7	269	2
Siletz Bay/River	610	4	394	5	627	5
Siltcoos River	*	*	19	0	18	0
Siuslaw River	1673	11	755	9	1367	12
Sixes River	*	*	5	0	9	0
Tenmile Creek	*	*	8	0	85	1
Tillamook Bay	4001	26	913	10	1166	10
Twomile Creek	*	*	3	0	6	0
Umpqua River	1543	10	771	9	1546	13
Winchuck River	*	*	4	0	3	0
Yaquina Bay/River	1445	9	400	5	943	8
TOTAL	15318		8700		11824	

* acreage probably was added to that of an adjoining estuary

2.0 Overview: Tidal Wetlands of the Oregon Coast

2.1 Processes Influencing Oregon's Tidal Wetlands

Managing Oregon's tidal wetlands wisely requires an understanding of the fundamental processes that have influenced their extent and quality over the centuries. These can be categorized as natural or human-related. Although mostly describing processes affecting Oregon's beaches, a report by Dicken et al. (1961) provides some of the best local information on some of these processes, as does the thesis by Eilers (1975)

2.1.1 Natural Hydrogeomorphic Processes

Undoubtedly one of the greatest single natural events influencing the distribution of Oregon's tidal wetlands was the enormous **tsunami** that occurred in January 1700. As evidenced by still-visible peat deposits buried by layers of sand, the tsunami caused land along much of the coast to subside almost immediately by about 1 meter. Coarse marine sediments and seawater also were forced many miles upriver, in some cases creating shallows where none existed previously. As the marine waters receded torrentially, other areas were dramatically eroded. Most of today's tidal marshes along the Oregon Coast thus reflect 305 years of sediment accretion and plant community development. A much less powerful tsunami, originating from an earthquake in Alaska, struck the coast in 1964 and scoured some tidal channels, piling masses of woody debris in channels and along marsh surfaces.

Less dramatic but nonetheless influential have been **river floods** in some of Oregon's estuaries. During years of heavy rainfall and runoff, the resulting flooding forces freshwater farther downriver into estuaries. This can affect plant communities adapted to saline conditions, as well as introduce quantities of wood into the estuary and cause reversals of major biogeochemical processes in marsh sediments (see part 2, section 3.2.2). Conversely, prolonged **drought** allows incursion of saltwater farther upriver, potentially causing shifts in tidal wetland plant communities from woody and salt-intolerant species to herbaceous and salt-adapted species. This can also occur when marshes receive no direct precipitation for long periods, and freshwater seeps and springs that otherwise ameliorate the soil salinity within marshes dry up. Flood and drought together can influence the creation and disappearance of hydrologic connections between estuaries and adjoining waters, such as interdunal wetlands and riverine sloughs. River flooding can cause either an increase or decrease in the tidal range at a particular point in an estuary, depending on the estuary's configuration.

The natural processes of **sediment erosion, transport, and deposition** are closely correlated with tidal and river flooding, and profoundly influence the establishment. deterioration, and redistribution of tidal marshes. Marsh "age" -- the time elapsed since vegetation began growing on a mudflat, causing additional sediment to be deposited and converting the mudflat to marsh -- is strongly correlated with marsh elevation and inundation frequency, and thus is an important predictor of the plant species composition of tidal marshes (e.g., Jefferson 1975, Elliott 2004). Sediment accretion may be gradual, as a result of long-term weathering and transport into the wetland of upriver soils and sediments, or it may be sudden, as in the case of landslides that are common in the Oregon Coast Range. Most Oregon tidal marshes need a sustained supply of sediment to keep pace with rising sea level, but the exact quantities of sediment and net deposition rates needed to sustain a particular tidal marsh depend on local circumstances. Too much sediment can be detrimental to individual wetlands, as in the case of several small "pocket" tidal marshes that have been obliterated (or at least, lost their tidal connections) by drifting sand along coastal spits. Deposition and erosion of sediments near the mouths of some Oregon estuaries has caused some small estuaries and their wetlands to be cut off and reconnected to the ocean for short or long periods of time, with consequences for fish, salinity, and vegetation. Deposition of sediments alongside tidal channels is important because it creates banks that are elevated somewhat above the marsh surface and thus have different plant communities and soil textures. On the other hand, progressive erosion and downcutting of tidal channels within marshes potentially lowers the marsh water table, causing marsh soils to drain faster at ebb tide and potentially become more saline. Deposited sediments and the vegetation root systems that become established on them are responsible for the gradual conversion of low marshes to high marshes, with associated shifts in functions.

However, sedimentation is not the only factor that can cause a net rise in the marsh surface. The other is **coastal uplift**. Global climate change is causing sea levels worldwide to rise an average of about 2 mm per year. Although this hardly seems noticeable in the short term, even a small vertical increase in mean tidal height can potentially translate into a major upriver shift in the distribution of shallow estuarine habitats. Downriver marshes gradually will eventually disappear as they flood for longer daily durations, while upriver riparian areas will be tidally flooded more often and perhaps become tidal marshes where the terrain is suitable. Compared with other regions, Oregon is less vulnerable to rising sea levels because along most of the coast land surfaces are gradually rising as a result of continuing tectonic uplift. An exception is in the area between Newport and Tillamook, where an apparently lower uplift rate may currently be countering the rate of long-term sea level rise.

Other natural factors important to Oregon tidal marshes include wood, salmon, wildlife, and fire. The role of **wood** in estuaries is poorly understood, but accumulations of large woody debris obviously help support many marsh functions. They can provide shelter for estuarine fish and additional habitat space for invertebrates. Logs on the marsh surface that are pummeled by tides can diversify marsh topography and thus vegetation by causing local scouring and micro-depressions (pannes). "Nurse logs" provide a substrate elevated above the marsh surface, upon which seedling trees can take root above the hostile salinities of the tides. One can only imagine the vast quantities of large-diametered wood that must have been scattered along Oregon beaches and tidal marshes prior to the loss of much of the Coast Range's old growth forest (Gonor et al. 1988, Maser & Sedell 1994). Similarly, major spawning runs of **salmon** – now becoming something of the distant past – probably transferred significant quantities of ocean-derived elements into the headwaters of many estuaries. The functional role of **wildlife** in tidal marshes has seldom been studied in Oregon, but research elsewhere indicates a probable role of waterfowl and ungulates (e.g., elk) in nutrient transport and recycling, as well as altering plant species composition **Fires** caused by lightning, although relatively rare due to the wet climate of Oregon's Coast Range, have often resulted in erosion that has transported sediments and nutrients in a downriver, seaward direction. Fire frequency in the Oregon Coast Range prior to the arrival of European settlers has been the subject of several recent studies by the US Forest Service and Oregon State University. Between 1845 and 1902, major burns occurred throughout much of the coastal watersheds between the Nehalem and the Rogue, and major fires continued near Tillamook into the 1930s (Dicken et al. 1961).

2.1.2 Human-associated Changes to Oregon's Tidal Marshes

Conversion of tidal marshes to pastureland, through the construction of **dikes,** has been the largest human-caused change to Oregon's tidal wetlands (Boule and Bierly 1987). Estimates of the extent of this loss vary. Based on soil type, current land cover, and topography, between 20,000 (Good 2000) and 45,000 (Scranton 2004) acres may have been converted, excluding conversions in the Columbia Estuary[2] (Table 3). Thus, on a coastwide basis approximately two-thirds of the pre-1850s acreage of tidal marsh has been converted, mainly to agriculture. Conversions varied greatly among estuaries, with some estuaries losing over 90% of their original tidal marsh acreage and others losing essentially none. Most dikes that caused the conversions were constructed between 1870 and 1960. With economic declines of coastal agriculture in recent years, some dikes have not been maintained and during storms dike erosion has restored partial tidal circulation to some diked pastures. However, oftentimes the years of soil compaction by livestock, combined with volatilization of soil organic matter that gives soil its bulk, and years of being deprived of tidally-deposited sediments, had resulted in net **subsidence** (loss of marsh elevation relative to sea level) of former tidal marshes. As a result, many years of renewed input of marine sediments may be required before these marshes fully resemble their original condition (Frenkel & Morlan 1991). This may depend partly on whether dikes are breached or removed completely (Cornu and Sadro 2002). Presence of dikes also has profoundly hindered or eliminated fish access to tidal marshes, although different tidegate designs can mitigate this problem to varying degrees (Giannico & Souder 2004a, b).

Tidal wetland losses in Oregon also have been caused by **filling or excavation for transportation and commercial development**. Highway and railroad rights of way have resulted in partial fills of dozens of marshes. Perhaps most notable was the completion of Route 101, which connected all the major coastal communities and opened up many areas for commercial development and increased logging. Construction of roads and railroads often degraded larger areas of remaining tidal marsh when they (a) restricted tidal circulation to marshes adjoining the rights-of-way, and (b) provided greater marsh access to heavy equipment and livestock, making more profitable the conversion of abutting marshes to pasture or commercial enterprises. Harbor development and deposition of dredged material also resulted in the partial or complete filling or removal of some tidal marshes, and similarly spurred economic growth that facilitated filling or degradation of nearby marshes. Around parts of Coos Bay, surface mining of coal in the 1800s may have caused the destruction or degradation of some tidal marshes (Taylor 1980). In a few cases, waters near the heads-of-tide have been dammed to convert them to nontidal reservoirs or recreation lakes.

Beginning in the mid-1970s, most filling and diking of Oregon tidal marshes was curtailed or strongly limited by state and federal requirements for permits. The US Army Corps of Engineers (Portland District) has created a spatial database of wetland permit actions covering the more recent years. Estuarine mitigation requirements and their implementation in Oregon have been described by Gonor 1979, FES 1987, and Shaffer 1999. Over the past 50 years, tidal circulation has been restored partially or wholly to approximately 50 formerly-tidal wetlands on the Oregon Coast, either intentionally or as a result of unrepaired dike deterioration (R. Lowe, USFWS, *pers. comm.*; Simenstad & Feist 1996, Simenstad et al. 1999). Intentional restoration efforts by

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[2] Scranton did not claim all 45,000 acres were once tidal. The figure from his thesis is the acreage of nontidal wetlands within about 1 mile of tidal water, and at similar elevation, which he considered as Restoration Consideration Areas.

willing landowners increased substantially beginning in the mid-1970s. Yet, acreage gains accomplished by those efforts pale in comparison to losses over the past century. Several projects have sought to systematically prioritize individual Oregon tidal wetlands for restoration (Leibovitz 1992, Fuss 1999, Brophy 1999a, 2004, Brophy & So 2004, 2005b, 2005c). The Portland Office of the US Fish and Wildlife Service's National Wetland Inventory is currently conducting a project to map changes to Oregon's coastal wetlands that occurred during the 1980s and 1990s.

The foregoing paragraphs have mostly described outright loss of tidal marsh acreage, but less obvious is the insidious alteration—usually short of total loss—of the functions of tidal marshes due to a variety of other human-associated activities (Table 2) Watershed councils and other groups interested in conducting local inventories of such activities as they affect tidal marshes (e.g., to help prioritize restoration) may use the data form employed in our 2003 field assessment (part 2, Appendix B, Form D) and/or guidance provided by Brophy (2005). Many undiked tidal marshes, especially high marshes containing pannes, were **ditched** to facilitate their use by livestock and to control mosquitoes, although the latter purpose seems to have been less dominant than in tidal marshes of California and the Atlantic Coast. Little or no new ditching is occurring, and relatively few Oregon tidal marshes still show physical evidence of past ditching (43 of the 120 sites surveyed by this project found overt evidence of ditching). **Dredging** in waters that adjoin tidal marshes continues at least sporadically in several Oregon estuaries, and potentially can mobilize sediments, nutrients, and contaminants (Nightengale & Simenstad 2001). Especially when done near the mouths of estuaries in conjunction with placement of **jetties**, dredging can alter the penetration of tide and salinity into an estuary and thus alter flooding and salinity regimes in some tidal marshes. Upriver **water withdrawals** (for agriculture or other consumptive uses) can have similar results, at least during droughts. On the other hand, dredging has facilitated the creation of some of Oregon's tidal marshes. These first became established on dredged sediments intentionally or unintentionally deposited in shallow areas of estuaries, mostly prior to the 1980s. Widespread **planting of European beachgrass** (*Ammophila arenaria*), in misguided efforts to stabilize coastal sand dunes, interrupted normal processes of coastal sand erosion and redistribution (Dicken et al. 1961), perhaps disconnecting permanently some wetlands from tidal influence.

Table 2. Extent of potential stressors in or near 120 tidal marshes of the Oregon Coast

Cell numbers are the number of tidal wetlands (of 120) where evidence of the activity was noticed or reported. Rows cannot be summed meaningfully because "now" stressors were also counted as "historical" when they extended back more than 5 years. "Onsite" refers to activities or stressors within the current boundary of the tidal wetland; "offsite" includes other coastal areas within about 100 ft of the wetland. This tabulation is not necessarily representative. Some sites were selected intentionally because they were known to have potential stressors.

Potential Stressor/ Activity:	Extent	Onsite, Now	Onsite, Historical	Offsite, Now	Offsite, Historical
ATV intrusion	minor	8	5	11	7
	extensive	4	8	4	11
Bulldozing	minor	0	6	5	13
	extensive	2	5	2	3
Ditching/ Excavation	minor	10	22	11	15
	extensive	3	21	6	15
Dikes	minor	22	16	28	15
	extensive	7	26	21	44

Potential Stressor/ Activity:	Extent	Onsite, Now	Onsite, Historical	Offsite, Now	Offsite, Historical
Dredging	minor	0	0	5	12
	extensive	0	0	3	12
Erosion, accelerated	minor	7	6	9	11
	extensive	0	1	1	8
Facility, industrial	minor	0	0	3	6
	extensive	0	0	2	0
Fill (except from dikes)	minor	0	7	0	9
	extensive	0	9	4	18
Log Storage	minor	0	9	1	20
	extensive	0	2	0	8
Golf Course	minor	0	0	1	0
Gravel Mining	minor	1	3	0	0
	extensive	0	2	1	2
Grazing	minor	12	36	10	13
	extensive	7	28	5	27
Haying	minor	1	35	4	22
	extensive	0	7	1	9
Lawn	minor	0	1	8	3
	extensive	0	0	2	2
Logging, clearcut	minor	0	4	5	11
	extensive	0	1	2	6
Logging, other	minor	0	1	3	4
	extensive	0	0	1	1
Pilings	minor	17	10	23	16
	extensive	3	6	8	13
Pipes (stormwater or unknown)	minor	6	4	5	1
	extensive	0	0	5	4
Residence, sewered	minor	0	0	8	6
	extensive	0	0	4	2
Residences, septic	minor	3	0	13	12
	extensive	0	1	5	4
Riprap	minor	5	2	8	4
	extensive	2	1	7	3
Roads, dirt	minor	0	1	29	27
	extensive	0	0	4	5
Roads, paved	minor	0	0	26	25
	extensive	0	0	24	23
Utility, overhead	minor	9	7	21	15
	extensive	3	0	4	3
Utility, underground	minor	1	0	6	4

Logging has long dominated the economy of many Oregon coastal and near-coastal communities, and likely has had several effects on Oregon tidal wetlands. First, logging of trees (primarily Sitka spruce) directly from within tidal wetlands in fresher parts of estuaries probably had major impacts on salmon and wildlife using those wetlands. Because tree re-establishment is extremely slow in Oregon tidal wetlands, few such forested tidal wetlands remain.

Second, a diminished long-term supply of wood to coastal streams and estuaries (due to conversion of many riparian areas to agriculture) has presumably resulted in fewer “nurse logs” becoming available over the long term in coastal marshes. Such logs greatly facilitate the establishment of tidal forested wetlands.

Third, especially during the late 1800s and early 1900s, logging operations generated huge quantities of sediment which were deposited in downriver estuaries. This was especially the case when logging and roads on unstable slopes caused massive landslides, and when "splash-damming" was practiced on marsh tributaries. This involved piling logs in a tributary just upstream from a marsh, impounding water behind them, and allowing the pile to burst suddenly, sending logs downstream into the marsh and receiving channels, from which they were floated to lumber processing yards.

Logging-related sedimentation might have had both negative and positive effects on tidal marshes and their functions. By filling subtidal waters with new sediment, logging might have accelerated the re-establishment and expansion of tidal marshes, many of which had been obliterated by the tsunami of 1700. Widespread clearing of forests also increased peak flows in some estuaries, perhaps briefly altering the seasonal duration of flooding and freshwater intrusion into some tidal wetlands, and perhaps further facilitating the transport of sediment into tidal marshes.

Fourth, up until the 1970s many Oregon rivers were subjected to log drives (logged trees floated as a loose unit from headwaters to storage areas in the estuary, whereupon they were processed for shipment). In some places, the main river channels leading into estuaries were cleared of obstructions in order to allow for both boat navigation and unhindered floating of logs. Many of today's tidal marshes were blanketed almost totally with stored logs, often for many years. The current presence of pilings sometimes suggests the former presence of log storage areas; 24% of the surveyed marshes had such pilings nearby (Table 2). In some places log storage is suspected to have caused extensive erosion and lowering of marsh elevations. In others, the marsh substrates—shadowed by logs and covered by sawdust and log debris—became anoxic and inhospitable for most aquatic life. Recovery since the log drives that occurred long ago may be slow. Describing a tidal wetland in Washington, Hood (2002) attributed an inferred shift in dominant vegetation from sedges (*Carex lyngbyei* and *C. obnupta*) to spikerush (*Eleocharis palustris*) to the depression of marsh surfaces by log storage that had occurred many decades before. Log drives also provided a temporarily-expanded source of wood in tidal marshes, perhaps creating more fish habitat in tidal channels and nurse logs for tidal marsh tree recruitment. Fifth, wood processing facilities associated with log storage areas might sometimes have been sources of potentially toxic chemicals such as pentachlorophenols.

Finally, logging activities might have been at least partly to blame for massive fires that repeatedly swept through much of the Coast Range in the early-to-mid 1900s. The legacy of those fires was probably sedimentation of the estuaries more extreme than can be attributed to logging alone.

Although far less directly destructive, **grazing** by livestock and harvesting of tidal marsh grasses as **hay** may also have affected Oregon tidal marshes, depending on the intensity of grazing (number and type of animals, duration and season of use). Historically, most high marshes on the Oregon Coast that were accessible to livestock were grazed and/or hayed (Jefferson 1975) Currently few are, but where they adjoin pasture, some tidal marshes host a large component of pasture plant species along their upland edges and channel banks, especially if salinity is not excessive as is the case in upper portions of estuaries or where small tributaries come in. Among the more common of the pasture species are *Festuca arundinacea, Phalaris arundinacea, Lolium perenne, Dactylis glomerata, Trifolium repens,* and *Lotus pedunculatus* (Lundin 1996). The spread of the non-native grass, *Agrostis stolonifera*, may also have been facilitated by grazing. A European study found elevated plant richness on moderately grazed as compared to ungrazed tidal marshes, with increases in plant communities dominated by *Puccinellia maritima*, *Juncus gerardi* and *Festuca rubra* (Bos et al. 2002). Studies of tidal marshes elsewhere have demonstrated an expansion of area occupied by taller marsh plants after grazing was suspended (Esselink et al. 2002). Extreme grazing removes this shading canopy. Along with increased nutrient inputs (from manure), this supports the rapid growth of algae on the marsh surface and elevates soil salinity. This can increase the process of sulfate reduction as well as alter rates of chemical cycling in tidal marsh soils (Gribsholt & Kristensen 2002). One study (Levin et al. 2002) found that although horse-grazed tidal marshes had less vegetation and fish density in adjoining waters was reduced, they had a higher diversity of foraging birds and higher densities of crabs.

Studies elsewhere have suggested grazing animals foster the spread of particular **invasive plant species**, but firm evidence of a causal connection is lacking in Oregon tidal marshes. Surely the conversion of tidal marshes to pastureland, through diking and drainage and accompanying decreases in soil salinity, has accelerated the spread of many weedy non-native species. Botanical data collected from our surveyed wetlands indicate that grazed sites, including those with grazing only along their upland border, had significantly higher percent-cover of non-native plants. Of the 120 surveyed sites, 19 currently are grazed to some degree by livestock. Regardless of the influence of grazing, Oregon tidal marshes regularly host many non-native species. Most prevalent non-native plants at surveyed sites were colonial bentgrass (*Agrostis stolonifera*), reed canarygrass (*Phalaris arundinacea*), curly dock (*Rumex crispus*), and—mostly in low marshes—brass-buttons (*Cotula coronopifolia*) and saltmarsh spurry (*Spergularia salina*) (see section 4.2.6 of part 1 for further data). All these species were found commonly by Jefferson (1975) in her surveys of Oregon tidal marshes during the 1970's. Of potential concern because of their characteristic invasiveness have been purple loosestrife (*Lythrus salicaria*) and saltmeadow cordgrass, *Spartina patens*, which largely through aggressive control efforts has apparently not spread beyond an infestation on Cox Island in the Siuslaw Estuary. It is possible that other non-native plant species may have established small populations in some tidal marshes and were missed by our field effort, which was not intended to survey all tidal marshes comprehensively.

The possibility of Oregon tidal marshes containing harmful levels of **toxic pollutants** has not been investigated. Water and sediment sampling is typically done in open waters of estuaries or on mud flats, not in wetlands. Although compared with other estuaries in the United States there are relatively few point sources of industrial contaminants in Oregon estuaries, nonpoint runoff from logging, grazing, mining (at least historically), and residential septic systems has the potential to introduce **nutrients** and other substances at levels harmful to some tidal marsh species, and in the case of nutrient loading, beneficial to other species. Studies of New England marshes, where *Spartina* species dominate the plant community, have documented shifts in plant community composition and the ratio of above-to-belowground production in response to nitrogen enrichment (Wigand et al. 2003). The implications for other resources and functions could be either positive or negative, depending on many factors. In contrast, Oregon tidal wetlands are dominated by different plant species and there is no clear evidence of nitrogen limitation, so it probably is premature to extrapolate the New England findings to Oregon tidal wetlands. One finding of the New England research that may be applicable to Oregon is that tidal marshes that are adjoined on their upland border by nontidal freshwater wetlands (or hydric soils) tend to be spared the effects of nitrate enrichment (Wigand 2003).

Some of the available water quality data from non-wetland environments near our surveyed wetlands are compiled in tables in Appendix A.

Additional historical accounts of humans impacts to Oregon estuaries have been compiled by Gonor et al. 1988, Coulton et al. 1996, and Hennessey (2005), among others.

Table 3. Compilation of acreage by type (from Scranton 2004)

Note: These data have not been comprehensively field-verified.

MSL= Marine-sourced Low Marsh
MSH = Marine-sourced High Marsh
RS = River-sourced Tidal Wetland
Water = Subtidal and unvegetated intertidal estuarine water
PF = wooded nearshore areas that may be flooded by tides at least once annually
RCA= restoration consideration areas, i.e., nontidal wetlands at about the same elevation as tidal waters and which, in some cases, might have been tidal wetlands prior to blockage by dikes, roads, etc.
Fill = dikes, roads, buildings, and parking lots located on areas thought to have once been tidal wetlands

Estuary	MSL	MSH	RS	Water	PF	RCA	Fill	Total
Necanicum	89.44	80.54	0.39	291.19	35.30	101.61	0.23	598.69
Ecola	0.51	7.85	0.00	11.76	34.67	5.40	0.55	60.75
Nehalem	307.11	327.71	72.66	2245.05	516.57	2211.77	241.67	5922.54
Tillamook	687.80	444.09	33.65	8735.09	655.67	8801.08	894.75	20252.13
Netarts	462.02	150.02	8.99	502.22	57.60	74.26	8.27	1263.39
Sand Lake	135.92	129.86	3.05	2394.78	7.46	6.19	0.58	2677.85
Nestucca	149.56	63.68	7.78	1144.39	133.85	3139.18	52.10	4690.54
Salmon	302.59	215.41	76.66	275.73	57.14	214.52	35.67	1177.71
Siletz	215.97	379.84	31.65	1631.18	248.96	756.36	260.26	3524.23
Depoe Bay	0.00	0.21	0.00	10.76	1.34	0.71	6.46	19.49
Yaquina	386.62	232.71	323.69	4358.66	213.50	1416.32	651.01	7582.52
Beaver	2.20	94.68	0.00	32.08	19.89	187.26	0.52	336.63
Alsea	144.30	434.03	117.85	2448.31	128.86	394.75	146.79	3814.89
Siuslaw	919.95	259.44	187.66	2875.03	213.57	1892.86	584.28	6932.78
Umpqua	456.22	778.09	311.42	8006.85	592.02	3048.35	1278.01	14470.97
Siltcoos	0.72	13.87	3.40	31.98	0.00	9.08	0.05	59.10
Ten Mile	25.64	53.86	5.70	58.52	0.30	14.54	0.00	158.55
Coos Bay	1140.69	660.11	158.03	12672.67	326.92	6878.40	2475.31	24312.12
Coquille	145.39	201.41	77.60	2159.69	578.96	13560.98	701.24	17425.26
Two Mile	0.51	3.83	2.12	12.54	16.14	2.75	0.00	37.89
New River	67.80	138.27	4.19	302.59	100.69	1132.57	5.38	1751.51
Sixes	0.89	5.11	3.39	102.58	0.67	240.98	5.46	359.08
Elk	1.32	13.06	4.08	86.52	21.63	214.46	13.32	354.39
Euchre Cr.	6.18	0.00	0.19	25.74	2.19	19.08	20.89	74.27
Rogue	29.50	8.81	0.99	631.12	112.97	95.39	32.22	910.99
Pistol	0.00	4.30	0.00	33.81	19.16	20.23	9.42	86.93
Chetco	0.17	2.33	3.84	175.81	8.60	0.00	6.35	197.09
Winchuck	1.54	0.00	1.77	32.93	0.00	99.32	0.00	135.55
Total	5680.53	4703.13	1440.77	51289.58	4104.61	44538.41	7430.79	119187.82

2.2 How Oregon Tidal Wetlands May Differ from Those of Adjoining States

Although no studies have specifically compared Oregon's tidal wetlands (as a whole) with those in California or Washington, some inferences (Table 4) might be made from technical literature. This surely is not comprehensive.

Table 4. Some comparisons of Oregon tidal wetlands with those of adjoining Pacific states

	Oregon	**Washington**	**California**
Estuarine flushing times	mostly short	many long-duration	mostly short
Forested tidal wetlands	rare	more numerous	rare
Proximity to major urban areas	mostly minor and/or distant	some major & close (e.g., Seattle)	many major & close (e.g., San Francisco)
Proximity to croplands	minor and/or distant	many near wetlands	common near wetlands
Tidal lagoon wetlands (periodically isolated from the ocean)	rare	uncommon	common
Commercial salt ponds in former tidal marsh	none	none	common
Invasive non-native plants (e.g., *Spartina* spp.)	a few, mostly localized	a few but some major infestations	several, extensive
Recognized T&E species & subspp. that are tidal-wetland-associated	very few (primarily salmonids)	very few (primarily salmonids)	several birds, plants, fish

3.0 Profiles by Watershed: Tidal and Non-tidal Wetlands

The following accounts are organized by estuary, proceeding from north to south. Most of the general statistics are from the following sources, which will not be cited repeatedly: Pearcy et al. 1974, Proctor et al. 1980, Hamilton 1984, Shirzad et al. 1988, and PNCERS 2003. Data on sediment and water quality are from Oregon DEQ's LASAR database and USEPA's STORET database. Considerably more chemical data from the vicinity of some of Oregon's tidal wetlands are available from EPA's EMAP project:

http://epa.gov/wed/pages/projects/soundsciencemonitoringgoal.htm#EMAP%20Western%20Coastal%20Pilot

as well as from other researchers, but time did not allow their compilation herein.

3.1 Necanicum-Neawanna

This unit includes the Neawanna, Neacoxie, and Necanicum Rivers, which join together to form the Necanicum Estuary shortly before reaching the ocean in the Seaside-Gearhart area. The Necanicum estuary covers approximately 451 acres and has a watershed of approximately 87 square miles. Head of tide is about 3 miles from the mouth. Tidal wetlands comprise about 37% of the estuary's area.

Considerable existing information and some new data on the estuary have been compiled by students at the Coastal Studies and Technology Center (CSTC) at Seaside High School. No comprehensive watershed assessment document exists. This estuary is designated as an Important Bird Area (IBA) by National Audubon Society. The Necanicum River estuary is designated as a Conservation estuary under the Oregon Estuary Classification system.

The lower estuary is one of the most urban of Oregon's estuaries. Development began in the late 1800s, and Seaside was incorporated in 1899. An initial inventory of the estuary's resources was done in 1979 (Maine 1979). A field survey in 2001 found 199 pipes (mainly stormwater) entering the estuary, and also inventoried tidal channels for submerged wood and riparian cover (CSTC 2001).

Five tidal wetlands were assessed in 2003 by this HGM project, totaling about 73 acres (about 43 % of the tidal wetland area of the estuary):

<u>Wetland 761</u> (6 acres, mainly on public land) is approximately 10% high marsh and 90% low marsh. It is located along the Gearhart shore of the estuary, at the confluence of the Neacoxie and Neawanna. Considerable shifting of the river's course and associated sediments has occurred in the channel here, especially during unusually high tide events in 1967 and 1998 (CSTC 2001). This followed attempts in the 1960s to fill much of the south spit of the Necanicum River. *Agrostis stolonifera* dominates the high marsh, and *Salicornia virginica* the low marsh. A non-tidal shrub wetland borders the north side, and most of the rest of the upland edge is bordered by dunegrass.

<u>Wetland 767</u> (19 acres, partly on public land) is approximately 1% high marsh and 99% low marsh. This is the former Stanley Lake, to which tidal circulation was restored very recently. Before restoration, a 17-acre portion of the eastern shore where Thompson Creek enters had been recontoured as a nontidal wetland mitigation site. *Agrostis stolonifera* dominates the high marsh,

Salicornia virginica the low marsh. Water data downriver from this wetland were reported as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
24326	Conductivity	‘mho	29	505	48300
24326	Salinity	ppth	27	3.4	32.1
24326	Total Suspended Solids	mg/L	27	5	27
24326	Turbidity	NTU	29	3	12

Wetland 773 (7 acres, mostly on public land), is approximately 75% high marsh and 25% low marsh. This site adjoins a sewage treatment plant and is mostly on public land. A small portion of the assessed area was excavated in 1991 and extended north in 1999 to establish elevations believed to be suitable for tidal wetland development. *Agrostis stolonifera* and *Argentina egedii* dominate the high marsh, *Carex lyngbyei* the low marsh.

Wetland 787 (33 acres, mostly on private land), is approximately 95% high marsh and 5% low marsh. Both sides of the channel were assessed. A small stormwater outfall pipe is located on the western edge, and another at the south end. A 1939 aerial photograph shows extensive ditching on this site. *Argentina egedii* dominates the high marsh, *Schoenoplectus americanus* the low marsh, and a large stand of *Schoenoplectus tabernaemontanii* also is present.

Wetland 791 (Mill Ponds, 7 acres, entirely on public land), is approximately 90% high marsh and 10% low marsh. *Argentina egedii* dominates the high marsh, *Carex lyngbyei* the low marsh. Much of the site was excavated sometime between 1939 and 1950 to establish a rock quarry, and subsequently the ponds supported wood storage for a planing mill and later a shingle mill until the 1960s. Recently a narrow tidal connection was established to the Necanicum River. A plant list and bird data for the site are at: http://home.pacifier.com/~neawanna/observatory/plants.html

3.2 Ecola-Elk Creek

This small estuary at Cannon Beach is comprised of about 42% tidal wetland. One tidal wetland (Wetland 832) was assessed in 2003, totaling 0.8 acres (about 10 % of the tidal wetland area of the Elk Creek estuaries). It is entirely on public land along the northeast shore of the estuary, and is about 90% high marsh and 10% low marsh. There is frequent traffic from horse and hikers along its northern edge. The estuary becomes temporarily isolated from the ocean during unusually low summer flows. *Argentina egedii* dominates the high marsh, *Carex lyngbyei* the low marsh.

3.3 Nehalem

The Nehalem estuary covers approximately 2749 acres and has a watershed of about 855 square miles. Tidal wetlands cover 24% of the estuary, which is river-dominated. Its watershed extends inland and encompasses approximately 860 square miles, with head of tide being about 13 miles from the mouth. The Nehalem has no major dams, but jetties have been in place since 1910 and 1916. About 16 acres (1%) of the estuary is classified as tidal fresh (<0.5 ppt), 1356 (88%) as mixed, and 170 (11%) as seawater. The estuary as a whole is classified as highly stratified during winter high flow and moderately stratified during summer low flow. Freshwater detention time within the estuary is estimated to be 1 day, and ratio of annual high to low flow averages 0.205. Mean estuarine depth is 7.3 ft, with an estuarine depth-width ratio of 0.004. Assessments have been completed for:

the watershed generally: http://web.pdx.edu/~maserj/project/project1/project1.htm
the lower watershed: USDI-BLM (1997c, 2000), Ferdun 2003
the upper watershed: ongoing, Oregon Department of Forestry

In addition, a prioritization of wetlands for tidal restoration was completed by Brophy & So (2005b).
Four tidal wetlands were assessed in 2003, totaling 205 acres or about 29 % of the tidal wetland area of the Nehalem Estuary.

Wetland 865 (6 acres, mostly on private land) is a River-sourced Tidal wetland. *Carex lyngbyei* dominates, with lesser amounts of *Argentina egedii*. It is likely that much of the site was exposed to commercial log drives during the early and mid 1900s, and a dock or pen structure is evident on the southeast shore in a 1939 aerial photograph. A sewage treatment plant currently is located nearby. Mean quarterly salinity at the closest monthly monitoring site, less than one hundred meters south, was reported as 4, 2, 15, and 1 ppt (March, June, September, December). DEQ water samples collected about 2 mi upriver showed the following (for details, see Oregon DEQ-LASAR web site):

Parameter	Units	Samples	Min	Max
Conductivity	‘mho	24	63	4720
Salinity	ppth	20	0.1	10.2
Total Suspended Solids	mg/L	22	1	22
Turbidity	NTU	24	2	10

Wetland 869N (5 acres, managed by the Lower Nehalem Watershed Council, is a River-sourced Tidal wetland resulting from a recent partial restoration of tidal circulation to a ditched pasture. It is dominated by *Distichlis spicata* and upland graminoids.

Wetland 883 (West Island, public land, 183 acres) is approximately 60% high marsh and 40% low marsh. *Argentina egedii* dominates the high marsh and *Carex lyngbyei* the high marsh. Along its western (low) edge, the island appears to have nearly tripled in size since 1875 as a result of sedimentation, but changes in recent decades have been minor. The site was studied in detail by Eilers (1975), who found the following species (not all of them intertidal) that were missed by our transects: *Angelica lucida*, *Barbarea orthoceras*, *Castilleja ambigua*, *Epilobium ciliatum, Galium trifidum*, *Glaux maritima*, *Heraclum lanatum*, *Holcus lanatus*, *Juncus hesperius*, *Lotus corniculatus*, *Lilaeopsis occidentalis*, *Poa pratensis*, *Plectritus congesta*, *Plantago maritima*, *Rumex occidentalis*, *Schoenoplectus (Scirpus) cernuus*, *Spergularia canadensis*, *Stellaria calycantha*, *Stellaria borealis*, *Trifolium wormskioldii*, *Vicia gigantea*, and *Zannichella palustris*. Mean quarterly salinity at the closest monthly monitoring site, a short distance south in mid-channel, was reported as 9, 14, 22, and 14 ppt (March, June, September, December).

Wetland 889 (10 acres, mainly on private land), is nearly 100% low marsh and dominated by *Carex lyngbyei*. A berm supporting railroad tracks separates the marsh from Nehalem Bay, but tidal exchange through a designed opening in the berm appears to be close to normal. Mean quarterly salinity at the closest monthly monitoring site, over one-half mile upriver to the east, was reported as 9, 14, 22, and 14 ppt (March, June, September, December).

3.4 Tillamook

The Tillamook estuary comprises approximately 9216 acres and has a watershed of approximately 540 square miles. Tidal wetlands currently cover only about 12% of the estuary. Head of tide is about 17 miles from the mouth. Although some have classified the Tillamook estuary as river-dominated, compared with most other Oregon estuaries, river inputs of sediment and nutrients in much of this estuary have been small relative to ocean inputs.

The five rivers that feed Tillamook Bay have no major dams, but jetties have been in place since 1914. River flooding of the extensively diked lowlands is frequent and severe. About 339 acres (5%) of the estuary is classified as tidal fresh (<0.5 ppt), 4323 (60%) as mixed, and 2543 (35%) as seawater. The estuary as a whole is classified as highly stratified during summer low flow and vertically homogeneous during winter high flow. Freshwater detention time within the estuary is estimated to be 2 days, and ratio of annual high to low flow averages 0.068. Tidal range is 5.4 ft near Bay City. Mean estuarine depth is 6.0 ft, with an estuarine depth-width ratio of 0.001, making it one of the shallowest of Oregon's major estuaries. Despite its being fed by five rivers, the estuary's sandy sediments are mostly of marine origin.

Sediment influx has reduced the volume of the Bay by a factor of 20 from 1867 to the 1950s, but little measurable change has occurred overall since then, except during the 1952-56 Bayocean breach. During the period when logging and fires in the watershed were most extensive (1931-1954), sediment inputs potentially increased as much as 29% and river discharges by 13%, after accounting for differences in annual precipitation. Net removal of riverborne dissolved iron is associated with transport through the Tillamook estuary. Rivers that flow into the estuary have elevated levels of nitrogen due to agricultural and urban sources, but phosphorus in general is not elevated severely. Historically, logging and dairy farms have predominated mainly in the Tillamook River portion of the watershed whereas major fires have occurred mainly in the Kilchis River portion.

Sampling in 1999 (6 sediment samples at the Garibaldi boat basin) found no levels known to be biologically harmful with regard to heavy metals, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, or PAHs (COE 2002). An exception was fluoranthene, which in just one sample was higher than concern levels, and then only slightly. Among heavy metals, nickel was closest to potentially harmful levels, and its levels were the highest of any sampled Oregon Coast estuary.

Extensive analyses of the Tillamook watershed were conducted in the late 1990s and early 2000's (e.g., Nehlsen & Dewberry 1995, Miller & Garono 1995a, b, Strittholt & Frost 1995, Coulton et al. 1996, Houck et al. 1997, Komar 1997, McManus et al. 1998, Bernert & Sullivan 1998, Golden et al. 1998, Tillamook Bay National Estuary Project 1998, Strittholt et al. 2000, Rose 2000, Ford & Rose 2000). Restoration opportunities have been assessed partly by Simenstad et al. 1999, Charland 1998, Brophy 1999b, and the Corps of Engineers (http://usace.co.tillamook.or.us/default.html), the latter containing considerable analyses pertinent to tidal habitats of the estuary.

The importance of this estuary for migratory shorebirds is recognized by the Northern Pacific Coast Regional Shorebird Management Plan (Drut & Buchanan 2000) and it is designated as an

Important Bird Area (IBA) by National Audubon Society. The estuary also is listed by The Wetlands Conservancy as one of "Oregon's Greatest Wetlands."

Seven tidal wetlands were assessed in 2003, totaling 228 acres or about 20% of the tidal wetland area of the Tillamook Estuary.

Wetland 938 (3 acres) and wetland 941 (9 acres) are both on public land on the east (bay) side of Bayocean Spit. They are less than a half-mile apart and are both low marsh. From 1912 through the 1920s, a thriving community existed a few hundred feet away, but no traces remain. In 1952 a mile-long breach occurred in the spit and large amounts of sand were carried into Tillamook Bay. A dike was constructed in 1955-56 to seal the breach, and dunegrass planting began in 1958 (Dicken et al. 1961). Wetland 938 is dominated largely by *Schoenoplectus americanus* and *Juncus balticus*, whereas 941 (the southerly one) has a larger *Salicornia virginica* component and apparently has developed only since the 1952 breach. Mean quarterly salinity at the two closest monthly monitoring sites, in the Bay at least one hundred meters east, was reported as 22-27, 14-17, 29-30, and 21-22 ppt (March, June, September, December).

Wetland 964 (Wilson River restoration, public land, 4 acres) is a River-sourced Tidal wetland resulting from partial restoration of tidal circulation to a pasture confined on almost all sides by dikes. Dominant species are *Argentina egedii*, *Eleocharis palustris*, *Typha latifolia*, and *Oenanthe sarmentosa*, suggesting that current conditions remain brackish to fresh, with precipitation being the main freshwater input except during rare flood events when the Wilson River rises above the height of the dikes. Limited tidal exchange occurs through a narrow, heavily incised breach in the south dike. A few hundred feet upriver of the breach, a barrier (a cross-channel plug) completely blocks Blind Slough, a branch of the Wilson River. This barrier became evident in 1965 airphotos, and was not apparent in 1955 and 1939 aerial photographs. The diked area as shown in the 1939 airphoto had considerably more channel complexity and driftwood than presently, and conversion to predominantly upland and freshwater marsh apparently occurred as a result of peripheral diking between 1965 and 1980. The site was recently obtained by Tillamook County. Detailed modeling of tidal and river flooding in this area has been conducted by the Corps of Engineers. Sediment transport and geomorphic processes in the Wilson River have been analyzed (Pearson 2002). Historical changes in channels and infrastructure of this site were digitized from airphotos by Simenstad et al. (1999).

Wetland 964N (79 acres) and wetland 964S (120 acres) both are on mostly private land on a large depositional island, separated by less than a half-mile This island has accreted rapidly (Johannessen 1961) on its western edge: about 14 ft per year between 1867 and 1939, 9 ft per year between 1939 and 1961, and virtually none since. Adjoining upland pasture (and perhaps some of the upper portion of these wetlands) is regularly grazed. Ditches are present on the eastern margin of the island. A 1939 aerial photograph shows a possible dike along the margin of wetland 964S, and more driftwood than presently. No internal channels were visible in 964S at that time, and were very rudimentary in 964N. Both of the assessed wetlands are a mix of low marsh and high marsh. *Carex lyngbyei* and *Agrostis stolonifera* dominate. Mean quarterly salinity at the closest monthly monitoring site, in the Bay almost a mile to the northwest, was reported as 5, 7, 17, and 11 ppt (March, June, September, December).

Wetland 965 (8 acres, is about 60% high marsh and 40% low marsh. *Distichlis spicata* and *Carex lyngbyei* dominate the low marsh, while *Argentina egedii* dominates the high marsh. The site is mainly private land. Mean quarterly salinity at the two closest monthly monitoring sites, almost a mile north in the Bay, was reported as 17, 13-17, 25-28, and 15-19 ppt (March, June, September, December). DEQ sampling data from 2 locations, one (#20726) near wetland #965 and the other (#20738) near wetland #980 are as follows (for details, see Oregon DEQ-LASAR web site):

Stn #	Parameter	Units	Matrix	Samples	Min	Max
20726	Ammonia as Nitrogen	mg/L	water	1		0.2
20738	Ammonia as Nitrogen	mg/L	water	1		0.02
20726	Nitrate/nitrite as N	mg/L	water	1		0.0495
20738	Nitrate/nitrite as N	mg/L	water	2	0.22	0.231
20726	Orthophosphate as P	mg/L	water	1		0.035
20738	Orthophosphate as P	mg/L	water	2	0.019	0.02
20726	Total Organic Carbon	mg/L	sediment	1		12800
20738	Total Organic Carbon	mg/L	sediment	1		1510
20726	Total Suspended Solids	mg/L	water	1		230
20738	Total Suspended Solids	mg/L	water	2	6	7

Wetland 980 (5 acres, mainly on public land) is almost entirely low marsh, with *Carex lyngbyei* being the dominant plant. Several houses are situated immediately upslope of its western end. A small parking lot east of the wetland probably was once tidal marsh. Mean quarterly salinity at the closest monthly monitoring site, directly adjoining at mid-channel, was reported as 2, 3, 13, and 8 ppt (March, June, September, December).

3.5 Netarts

The Netarts Bay estuary covers approximately 2743 acres and has a watershed of approximately 14 square miles. This is one of only a few major Oregon estuaries that are not river-dominated. There are no dams, jetties, or dredging in the Netarts Estuary. Although 14 perennial creeks enter the bay, circulation is controlled mainly by tide and wind. The estuary is classified as vertically homogeneous during both winter high flow and summer low flow. Freshwater detention time within the estuary is estimated to be 2.5 - 4 days (Glanzman et al. 1972), and ratio of annual high to low flow averages 0.013. Further into the estuary at Whiskey Creek, a 2-week survey found tidal range was 75% of that found at the estuary mouth. Mean estuarine depth is 4.7 ft, with an estuarine depth-width ratio of 0.002, making it one of the shallower of Oregon's major estuaries. Only 12% of the estuary is subtidal, and tidal wetlands comprise about 55% of the estuary. Sedimentation as a result of major fires in the 1900s and intensified logging in the 1950s and 1960s is believed to have caused some filling in and a slight expansion of shallow areas in this estuary (Glanzman 1971). This estuary is designated as an Important Bird Area (IBA) by National Audubon Society, partly for its importance to Aleutian Canada goose and brant.

Pioneering environmental analysis was coordinated by Stout et al. (1976), resource data were summarized by Kreag (1979), and a watershed assessments have been completed more recently (USDI-BLM 1997d, Follansbee et al. 1999). Three tidal wetlands were assessed in 2003, totaling 168 acres (about 27% of the tidal wetland area of the Netarts Estuary).

Wetland 1048N (15 acres) and wetland 1048S (52 acres) are on public land (Cape Lookout State Park) on the east side of Netarts Spit, located within about 0.5 mile of each other. Both wetlands are about evenly split between high marsh and low marsh. *Jaumea carnosa*, *Salicornia virginica*, and *Distichlis spicata* dominate the low marsh, whereas *Argentina egedii* dominates the high marsh. The presence of *Schoenoplectus americanus* and *Carex obnupta* along their upland edge hints at significant freshwater seepage. The wide forested spit along this edge shelters these wetlands from ocean waves but has breached at various times in the past. A rare plant, *Cordylanthus maritimus* ssp *palustris* (salt-marsh bird's beak) is present. Dune grass was planted in the vicinity beginning around 1950. A 1939 aerial photograph shows many trails. Mean quarterly salinity at the closest monthly monitoring sites, several hundred meters directly east and closer to the east shore, was reported as 29, 30, 31, and 32 ppt (March, June, September, December). The Netarts Spit is recognized by ONHP as a Natural Heritage Conservation Area, and vegetation communities were studied by Liverman (1981), who also characterized marsh soil chemistry and structure as part of his thesis.

Wetland 1129 (101 acres, Jackson Creek marsh) is also on public land at Cape Lookout State Park, at the south end of Netarts Bay. The site is separated from Netarts Bay by a mostly-disintegrated dike. At some time prior to 1960, Jackson Creek (which currently feeds this marsh) did not enter the upland edge of the marsh, but rather flowed directly westward into the ocean (Dicken et al. 1961). Before flowing into this marsh, Jackson Creek traverses 20,350 ft of upland over a 2.5 sq mi drainage area. The area we assessed is about 95% high marsh and 5% low marsh. *Argentina egedii* and *Juncus balticus* dominate the high marsh, while *Carex lyngbyei* dominates the low marsh. The only species reported near here previously but not encountered by our transects are *Castilleja ambigua*, *Plantago maritima*, and *Puccinellia pumila*. Mean quarterly salinity at the closest monthly monitoring sites, several hundred meters north at mid-bay, was reported as 27, 29, 31, and 32 ppt (March, June, September, December).

3.6 Sand Lake

Sand Lake estuary covers approximately 897 acres and has a watershed of approximately 17 square miles. Tidal wetlands cover about 10% of the estuary. Head of tide is about 4.5 miles from the mouth. There are no jetties or dredging, and the estuary is similar to the preceding one in being classified as a Bar Built estuary Compared with most other Oregon estuaries, river inputs of sediment and nutrients in much of this estuary are expected to be small relative to ocean inputs. Sand Creek is the primary source of freshwater, and largely traverses dairy pastures. Three mostly-wooded streams enter the south end. The mean tide range is 5.7 ft. The estuary is included on the "Oregon's Greatest Wetlands." list of The Wetlands Conservancy. Resource data for the estuary were compiled by Kreag (1979). Additional data recently have been collected from the southern part of the estuary as part of an application for construction of a golf course. Three tidal wetlands were assessed in 2003, totaling 53 acres (about 20% of the tidal wetland area of the Sand Lake Estuary).

Wetland 1172 (Sand Lake beach, public land, 9 acres), is in the northwestern part of the estuary and is about 40% high marsh and 60% low marsh. *Juncus balticus* dominates the high marsh and *Distichlis spicata* the low marsh.

Wetland 1182 (southeast Whalen Island, public land, 36 acres) is about 70% high marsh and 30% low marsh. *Juncus balticus* dominates the high marsh, and is joined by *Distichlis spicata* in the low marsh. The current road to the island was originally a dike (date of replacement with bridge is unknown). Whalen Island is near one of the most productive bald eagle nests on the Oregon coast and peregrine falcons commonly feed in the area.

Wetland 1188 (7 acres, public land) consists entirely of two adjoining low marsh islands. The origin of these islands is uncertain, and is unlikely the result of dredging because this estuary is not dredged. *Salicornia virginica*, *Jaumea carnosa*, and *Distichlis spicata* are dominant.

3.7 Nestucca

The Nestucca estuary covers approximately 1176 acres and has a watershed of about 322 square miles. Undiked tidelands comprise about 578 acres (58%) of the estuary. Tidal marsh occupies about 16% of the estuary. Compared with most other Oregon estuaries, river inputs of sediment and nutrients in much of this estuary are expected to be small relative to ocean inputs. Head of tide is about 8.6 miles from the mouth. Mean tide range at the estuary mouth is 5.8 ft, with a spring tide range of 7.6 ft. The estuary is not dredged and there are no jetties. The estuary is designated as a Conservation estuary under the Oregon Estuary Classification system and was nominated as an Important Bird Area (IBA) by National Audubon Society.

Resources of the estuary were described generally by Starr (1979). Watershed assessments have been conducted by the USDI-BLM (1995, 1998), Nestucca-Neskowin Watersheds Council (Barczak 1998), and Portland State University (Johnson & Maser 1999); the latter can be viewed at: http://web.pdx.edu/~maserj/project/project1/contents.htm
An "Action Plan" was developed by the Council:
www.tcwrc.org/councils/nestucca/actionplan.html
The Oregon DEQ has prepared a TMDL document that identifies sedimentation, habitat modification, and flow modification as significant concerns:
http://www.deq.state.or.us/WQ/TMDLs/NorthCoastBasin/WilsonTraskNestucca/NestuccaBay/NestuccaBayOverview.pdf

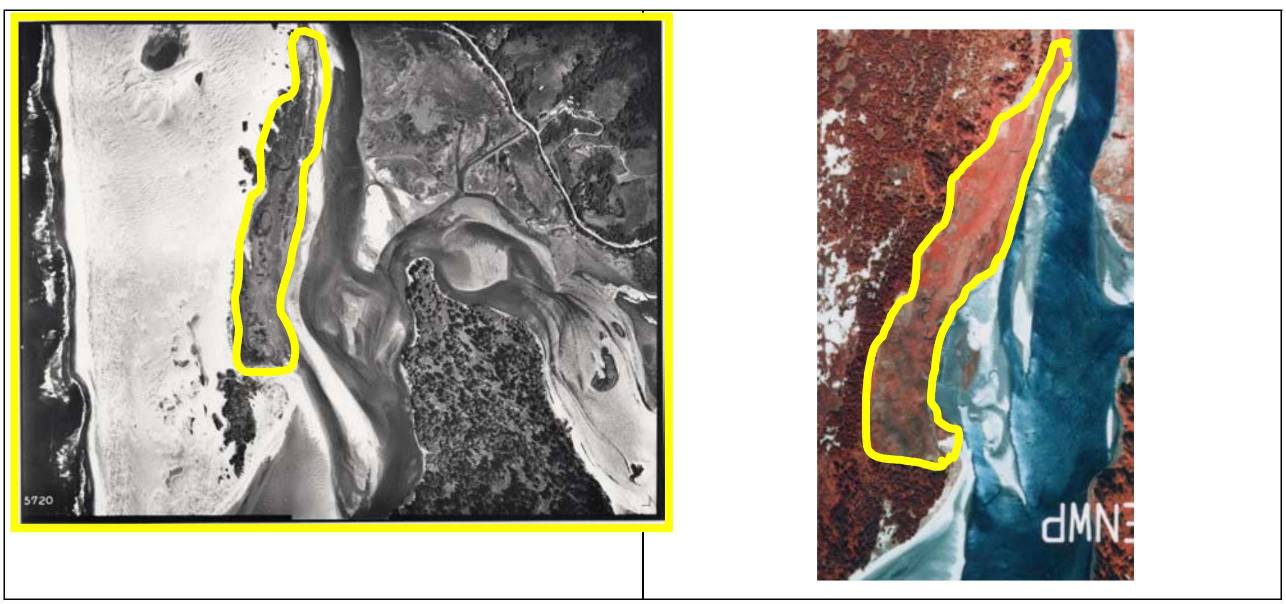

Figure 1. Aerial photographs of Straub State Park tidal wetland circa 1939 (left) and 2001 (right).

Although the wetland appears to have changed little, note the compete afforestation of the dunes adjoining to the west that occurred in the intervening period, possibly as a result of beachgrass planting and shore pine expansion.

Three tidal wetlands were assessed in 2003, totaling 137 acres (about 62% of the tidal wetland area of the estuary).

Wetland 1236 (Straub State Park, 30 acres, public land) is about 10% high marsh and 90% low marsh. *Deschampsia caespitosa* dominates the high marsh and *Salicornia virginica* the low marsh. The only species reported here previously but not encountered by our transects was *Festuca arundinacea*. A 1939 aerial photograph (Figure 1) shows remarkably little shore pine adjoining this site, as opposed to nearly complete cover at present. Mean quarterly salinity at the closest monthly monitoring site, due east at mid-channel, was reported in Hamilton (1984) as 11 and 12 ppt (April-June and July-September). However, recent DEQ data from nearby shows generally higher salinity, in the range of 31-34 ppt during those periods.

Wetland 1240N (Brooten, 68 acres, mostly public land (USFWS) is about 200m directly east of the above site, across Nestucca Bay. It is about 40% high marsh and 60% low marsh. A 1939 aerial photograph shows some ditching and perhaps a dike in the southern portion of the marsh. *Salicornia virginica*, *Carex lyngbyei*, and *Triglochin maritimum* dominate the low marsh. The only species reported here previously but not encountered by our transects were *Armerica pacifica* and *Conioselinum pacificum*. Mean quarterly salinity at the closest monthly monitoring site, due west at mid-channel, was reported as 11 and 12 ppt (June and September) but as noted above, recent DEQ data show higher salinity. The site is mostly on public land (US Fish and Wildlife Service, http://oregoncoast.fws.gov/nestuccabay/).

Wetland 1240W (USFWS west, 39 acres, public land) is about 20% high marsh and 80% low marsh. The site is bounded atypically on its *upland* border by a dike. A 1939 aerial photograph shows a somewhat smaller marsh, suggesting extensive sedimentation has occurred since then. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. Mean quarterly salinity at the closest monthly monitoring site, almost 1 mile north, was reported as 19 and 32 ppt (April-June and July-September). Closer to the site, the July-September salinity was 11 ppt and the October-December salinity was 6 ppt. The site is public land (US Fish and Wildlife Service, http://oregoncoast.fws.gov/nestuccabay/). DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Samples	Min	Max
20680	Little Nestucca River	Ammonia as Nitrogen	mg/L	1		0.09
26032	Upton Slough at Nestucca Bay Wildlife Refuge u/s tidegate (Nestucca)	Conductivity	‘mho	31	134	32490
20680	Little Nestucca River	Nitrate/nitrite as N	mg/L	1		0.105
20680	Little Nestucca River	Orthophosphate as P	mg/L	1		0.012
23243	Little Nestucca R. @ Hwy 101	Salinity	ppth	1		16.3
26032	Upton Slough at Nestucca Bay Wildlife Refuge u/s tidegate (Nestucca)	Salinity	ppth	30	0.1	20.4
20680	Little Nestucca River	Total Suspended Solids	mg/L	1		8
26032	Upton Slough at Nestucca Bay Wildlife Refuge u/s tidegate (Nestucca)	Turbidity	NTU	31	2	15

3.8 Salmon River

The Salmon River estuary covers approximately 438 acres and has a watershed of approximately 75 square miles. This estuary has proportionately more tidal marsh (68%) than any other Oregon estuary. Head of tide is about 4.3 miles from the mouth. Watershed data from headwater areas was compiled by USDI-BLM (1999a). Sediment accretion at a single point in the estuary, from the 1950s to the 1990s, averaged 0.3 cm/yr (Thom 1992). This estuary is designated as an Important Bird Area (IBA) by National Audubon Society. Along with the Yaquina and Coos Bay estuaries, it is one of the most-studied of Oregon's estuaries. A computer-based ecosystem model of the estuary has been developed and calibrated with extensive field data by Eldridge et al. (2004).

Three tidal wetlands were assessed, totaling 254 acres (about 43% of the tidal wetland area of the Salmon River Estuary). All are mainly on public land (USDA Forest Service) and some have been the subject of intensive study for over 20 years (e.g., Mitchell 1981, Morlan 1991, Frenkel & Morlan 1990, 1991, Cornwell et al. 2001, Gray et al. 2002, Buchner 2005).

Wetland 2935 (Mitchell marsh, 52 acres, public land). Dikes were removed in 1978 and 1987 and tidal exchange is now mostly unobstructed, although some subsidence has occurred. The assessed area is about 20% high marsh and 80% low marsh. *Carex lyngbyei*, *Salicornia virginica*, and *Distichlis spicata* dominate the low marsh, while *Argentina egedii* dominates the high marsh. Fine-scale maps of wetland plant community distribution and topography are available from several studies done here over the last 20 years. Marsh species found previously but not encountered by our transects (both because of our less intensive search and because of the major changes that have occurred since dikes were breached) include: *Glaux maritima*, *Alopecurus geniculatus, Holcus lanatus, Poa trivialis, Ranunculus repens, Trifolium repens*, *Trifolium wormskioldii*, *Galium aparine*, *Senecio jacobaea*, *Cotula coronopifolia*, *Puccinellia pumila*, *Spergularia salina, S. macrotheca*, *Plantago maritima*, *Rumex occidentalis*, *Schoenoplectus (Scirpus) cernuus*, *Carex obnupta*, *Oenanthe sarmentosa*, Vicia gigantea, SCMI, *Galium trifidum*, and *Juncus bufonius*. Mean quarterly springtime salinity at the closest monthly monitoring site, directly south in mid-channel, was reported as 22 and 25 ppt (June, September).

Wetland 2932W (44 acres, known to researchers as the "Y marsh", mostly public land) is about 1% high marsh and 99% low marsh. *Deschampsia caespitosa* dominates the high marsh and *Carex lyngbyei* the low marsh. Some dikes were removed as recently as 1996. See above for salinity measurements in the vicinity.

Wetland 2932E (145 acres, known to researchers as the "Reference marsh", mostly public land) is about 95% high marsh and 5% low marsh. *Argentina egedii* dominates the high marsh, and the small amount of low marsh is dominated by *Carex lyngbyei* and *Juncus balticus*. See above for salinity measurements in the vicinity. Other DEQ water quality data from the vicinity are as follows (for details, see Oregon DEQ-LASAR web site):

Parameter	Units	Samples	Max
Ammonia as Nitrogen	mg/L	1	0.27
Nitrate/nitrite as N	mg/L	1	0.131
Orthophosphate as P	mg/L	1	0.027
Total Suspended Solids	mg/L	1	14

3.9 Siletz

The Siletz estuary covers approximately 1461 acres and has a watershed of about 373 square miles. Tidelands comprise about 775 acres (65%) of the estuary. Tidal wetlands specifically cover about 28% of the estuary. The estuary of the Siletz is river-dominated. The Siletz has no major dams. Log rafting and storage were commonplace from the 1920s to the 1960s. Estuarine influence extends inland about 24 miles but fluctuates considerably due to the geomorphology of this watershed. About 339 acres (25%) of the estuary is classified as tidal fresh (<0.5 ppt), 848 (63%) as mixed, and 170 (12%) as seawater. The estuary as a whole is classified as moderately stratified during both winter high flow and summer low flow. Freshwater detention time within the estuary is estimated to be 2 days, and ratio of annual high to low flow averages 0.160. Tidal range is 4.6 ft near Kernville. Mean estuarine depth is 8.1 ft, with an estuarine depth-width ratio of 0.025. This estuary is designated as an Important Bird Area (IBA) by the National Audubon Society.

Initial reconnaissance of Siletz wetlands was conducted by HNTB (1976) for the Corps of Engineers and resource data were compiled by Starr (1979). Since then, watershed assessments have been conducted by the USDI-BLM (1996b, 1997b) and Garono & Brophy 2001). Information for the Rock Creek portion of the watershed has been compiled in more detail (Garono & Brophy 1999). Tidal wetland restoration opportunities were assessed and detailed mapping of plant communities was conducted by Brophy (2001). That study reported that the Siletz estuary currently contains a total of 623 acres of tidal and formerly tidal wetlands combined. Brophy reported that of the mapped wetland plant communities, about 334 acres had been disturbed by diking, tidegates, ditching, restrictive culverts, and other human activities, with the result that tidal influence is muted in these areas. Salinity and tidal patterns have been modeled by the Siletz Tribe, and ongoing studies are examining fish use of wood placed in tidal wetland channels, and nutrient limitation of estuarine algal productivity.

Six tidal wetlands were assessed in 2003, totaling 164 acres (about 26% of the tidal wetland area of the Siletz estuary).

<u>Wetland 542</u> (0.8 acres, private land) is a ditch that recently became tidal as a result of dike breaching. It traverses a pasture and is classified as River-sourced Tidal wetland, at least at its lower end. *Lilaeopsis occidentalis* and *Cotula coronopifolia* dominate on the river side of the dike breach, and *Argentina egedii* dominates on the landward side along the ditch. Mean quarterly salinity at the closest monthly monitoring site, about a mile upriver, was reported as 1, 2, 11, and 15 ppt (March, June, September, December).

<u>Wetland 543</u> (0.4 acres, private land) is a River-sourced Tidal wetland formed in the delta of a small stream and is mostly on private land. The site is in the delta of a forested tributary. Several beaver dams are located a short distance up this tributary. Extensive log rafting once occurred in this particular area, according to Corps of Engineers reports. *Phalaris arundinacea* dominates the high marsh, and a small amount of low marsh is dominated by *Lilaeopsis occidentalis*. Mean quarterly salinity at the closest monthly monitoring site, about a mile upriver, was reported as 0, 1, 6, and 5 ppt (March, June, September, December).

<u>Wetland 2938</u> (USFWS Drift Creek, 23 acres, mostly public land) is a pasture that was partly restored in 2000 by breaching a small opening in a dike. Within this pasture, in 2003 only a small corridor along a short internal channel extending from the breach point had clear botanical evidence of saltwater intrusion. The site was classified as River-sourced Tidal. A barrier is present across an arm of the channel a few meters upriver from this site but was not apparent in imagery from May 2002. *Argentina egedii* dominates the high marsh and *Carex lyngbyei* the low marsh.

Wetland 2940I (10 acres, public land) is an island marsh with about 90% high marsh and 10% low marsh. The 1939 aerial photograph (Figure 1) shows several buildings on the south end of this island, with a bridge spanning the short distance to the mainland and a large portion of the western side covered by logs. Currently there are no obvious signs this had ever been the case. The channel network appears mostly unchanged between the two time periods. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. The site is managed by the US Fish and Wildlife Service. Mean quarterly salinity at the closest monthly monitoring site, within a hundred meters to the southwest, was reported as 1, 8, 22, and 22 ppt (March, June, September, December).

Figure 2. Siletz island marsh in 1939

Wetland 2942W (Millport Slough west, 54 acres, public land) is about 85% high marsh and 15% low marsh. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. Portions of its upland edge may have been diked but most of the site has not been diked, although the adjoining channel has been extensively recontoured. The site is managed by the US Fish and Wildlife Service (http://oregoncoast.fws.gov/siletzbay). Mean quarterly salinity at the closest monthly monitoring site, almost a mile to the north in the Bay, was reported as 1, 8, 22, and 22 ppt (March, June, September, December).

Wetland 2942E (Millport Slough East, 76 acres, public land) is about 98% high marsh and 2% low marsh. Portions of its upland edge may have been diked. *Argentina egedii* and *Agrostis stolonifera* dominate the high marsh and *Carex lyngbyei* the low marsh. The site is managed by the US Fish and Wildlife Service (http://oregoncoast.fws.gov/siletzbay). During 2003 they placed large woody debris on the marsh surface to replicate conditions that might once have existed, and fish use is being studied.

3.10 Yaquina

The Yaquina estuary covers about 4329 acres and has a watershed of approximately 253 square miles. The tidal prism (distance to head of tide) ranges from 27 miles upstream during low flows to 20 miles upstream during high flows. About 84 acres (3%) of the estuary is classified as tidal fresh (<0.5 ppt), 1441 (45%) as mixed, and 1695 (53%) as seawater. The estuary as a whole is classified as moderately stratified during both winter high flow and summer low flow. It is river-dominated, yet compared with most other Oregon estuaries, river inputs of sediment and nutrients in much of this estuary are small relative to ocean inputs. During the summer and early fall, the volume of salt-water intrusion substantially exceeds the volume of fresh water discharged into the estuary from the river. Freshwater detention time within the estuary is estimated to be five days, but flushing from the upper estuary can take 13 days during low flow conditions (Goodwin et al. 1970, Zimmerman 1972). The ratio of annual high to low flow averages 0.026. Mean estuarine depth is 6.5 ft, with an estuarine depth-width ratio of 0.003, making it one of the shallowest of Oregon's major estuaries. Tidal wetlands comprise about 18% of the estuary's area. The tidal range increases from the mouth upstream to Elk City. Some of the tidal data have been compiled by Bayer (1996). The channel as far inland as Toledo has been dredged regularly for large boat traffic. The Yaquina has no major dams, but jetties have been in place since 1889 and 1891. Effects of bark deposits (from log drives) on estuarine invertebrate communities were studied by Walker (1974).

This estuary is designated as an Important Bird Area (IBA) by National Audubon Society. It also is included on the "Oregon's Greatest Wetlands." list of The Wetlands Conservancy. Sampling by the Corps of Engineers in 2000 just inside the estuary mouth and at the South Beach Marina (9 sediment samples total) found no levels known to be biologically harmful with regard to heavy metals, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, organotin, or PAHs (COE 2000). Among heavy metals, nickel was closest to potentially harmful levels.

Watershed assessments have been conducted (USDI-BLM 1995b, Garono & Brophy 2001) and tidal wetland restoration opportunities were assessed partly by Brophy (1999). She suggested as much as 1013 acres of wetland with muted tidal regimes might be restored, and prioritized those areas for restoration. The US EPA laboratory in Newport has studied the hydrodynamics, chemistry, eelgrass beds, and mudflat invertebrate fauna of the estuary, and an extensive bibliography for the estuary is on the internet at: http://osulibrary.oregonstate.edu/guin/yaqbib.htm

Six tidal wetlands were assessed in 2003, totaling 94 acres (about 10% of the tidal wetland area of the estuary). They are as follows.

Wetland 610 (16 acres, mostly on private land) is a River-sourced Tidal wetland. The site is mostly on private land and has been monitored by several biologists (plant communities, elevations, channel morphology, macroinvertebrates, salmonids). The site was diked in the 1930s and 1940s but tidal circulation was partially restored in 2001 and vegetation has changed rapidly since then, with species tolerant of brackish salinity replacing freshwater marsh species such as *Juncus effusus*. Much of the old dike still remains and the newly-excavated, steep-sloping outlet channel that we measured is becoming heavily incised. Brophy (1999a) reports that total length of tidal channel within this marsh has increased at least three-fold as a result of restoration. *Agrostis stolonifera* and *Deschampsia caespitosa* dominate much of the upper tidal portion of the site and *Cotula coronopifolia* dominates the limited areas with daily tidal inundation. Species reported here previously but not encountered by our transects include *Distichlis spicata*, *Angelica lucida*, *Grindelia stricta*, *Hordeum brachyantherum*, *Oenanthe sarmentosa*, and *Symphyotrichum (Aster) subspicatus*. The upper end grades gradually into a nontidal freshwater marsh. An excavated area along the upper edge (along the railroad tracks) remains full of water during all or most of the year. Mean quarterly salinity at the closest monthly monitoring site, at least a mile downriver, was reported as 1, 3, 13, and 4 ppt (March, June, September, December).

Wetland 620 (8 acres, mostly on private land) is a River-sourced Tidal wetland. The site has been monitored by Brophy (1999a) and the Oregon Sea Grant Salmonid Project. This site is a rare remnant of a tidal spruce swamp and apparently has changed little since 1939, the earliest available aerial photograph of the site. Shortly before that time, adjoining areas may have been logged (Brophy 1999a). The history of this site was documented in great detail by Fennessey (2005). *Phalaris arundinacea*, *Juncus balticus*, and *Argentina egedii* dominate most of the site and *Cotula coronopifolia* dominates the limited areas with daily tidal inundation. The only species reported here previously but not encountered by our transects were *Atriplex patula* and *Malus fuscus*. Mean quarterly salinity at the closest monthly monitoring site, at least a mile downriver, was reported as 1, 3, 13, and 4 ppt (March, June, September, December).

Wetland 2950 (HMSC, 7 acres, public land) is about 1% high marsh and 99% low marsh. The site is largely the result of fill and accretion that has occurred over the last 50 years (Brophy 1999a). Nearby portions of the main channel were dredged in 1949 and 1968. *Juncus balticus* dominates the high marsh and *Jaumea carnosa* the low marsh. Intertidal species reported here previously by Frenkel and Eilers (1976) but not encountered by our transects include *Argentia egedii, Agrostis stolonifera, ATPA, Castilleja ambigua, SPCA, Spergularia macrotheca, S. canadensis,, Symphyotrichon subspicatus, Triglochin concinnum,* and *Trifolium wormskjodii*. Those authors determined the elevation of the marsh external edge to be 0.82 to 0.98m above sea level, while the low-to-high marsh transition was at 1.61m above sea level. Elevation for the transition from low to high marsh at this location was determined by Frenkel et al. (1981) as 1.28m, and for the transition from high marsh to upland, 1.78m. Mean quarterly salinity at the closest monthly monitoring site, within a hundred meters to the northeast at mid-channel, was reported as 24, 28, 31, and 29 ppt (March, June, September, December).

Wetland 2963 (14 acres, mostly on private land) is about 50% high marsh and 50% low marsh. On the downgradient side, the connection to Yaquina Bay is interrupted by a road levee, but circulation under a bridge appears normal. *Jaumea carnosa* and *Agrostis stolonifera* dominate the high marsh and *Salicornia virginica* the low marsh. The upper end grades into a nontidal freshwater wetland. Comparison with a 1939 aerial photograph shows no obvious differences from the present condition. Mean quarterly salinity at the closest monthly monitoring site, about a half mile upriver, was reported as 9, 14, 27, and 22 ppt (March, June, September, December).

Wetland 2964 (25 acres, mostly on private land) is about 20% high marsh and 80% low marsh. Comparison with a 1939 aerial photograph shows no obvious differences from the present condition. The wetland adjoins an oyster culture operation, with future conservation anticipated through agreements with The Wetlands Conservancy and US Fish and Wildlife Service. *Juncus gerardii* is prevalent in the high marsh and *Distichlis spicata* and *Jaumea carnosa* the low marsh. Mean quarterly salinity at the closest monthly monitoring site, directly north at midchannel, was reported as 16, 19, 28, and 23 ppt (Jan-March, Apr-June, July-Sept, Oct-Dec).

Wetland 2994 (24 acres, mostly on public land) is about 97% high marsh and 3% low marsh. It also has been monitored by the Oregon Sea Grant Salmonid Project and by Brophy (1999a), who found 8-14 species on her transects. The site was considered by Jefferson (1975) to be one of best examples of "mature high marsh" on the Oregon Coast. However, surveyor notes indicate the site "was filled to a depth of 2 ft by hydraulic dredge in 1956." A 1939 aerial photograph shows no obvious difference from the current condition. The history of this site was documented in great detail by Fennessey (2005). *Salicornia virginica* dominates the limited area of low marsh, while *Juncus balticus* and *Deschampsia caespitosa* (joined in some areas by *Agrostis stolonifera* and *Grindelia stricta*) dominate the high marsh. In one study, summertime salinity in the adjoining channel was reported to range from 15 ppt (low tide) to 30 ppt (high tide), and wintertime salinity is 20 ppt at high tide (Goodwin et al. 1970). In another study, mean quarterly salinity at the closest monthly monitoring site, several hundred meters downriver, was reported as 9, 14, 27, and 22 ppt (March, June, September, December). DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Matrix	Samples	Max
20843	AL:_total	mg/L	sediment	1	11100
20843	Antimony	mg/L	sediment	1	10.7
20843	Arsenic	mg/L	sediment	1	463
20843	BA:_total	mg/L	sediment	1	2700
20843	Beryllium	mg/L	sediment	1	0.316
20843	CA:_total	mg/L	sediment	1	89000
20843	Cadmium	mg/L	sediment	1	14.4
20843	Chromium	mg/L	sediment	1	199
20843	Cobalt	mg/L	sediment	1	36.4
20843	CU:_total	mg/L	sediment	1	56500
20843	FE:_total	mg/L	sediment	1	124000
20843	K:_total	mg/L	sediment	1	1080
20843	K:_total recoverable	mg/L	sediment	1	1080
20843	Lanthanum:_dissolved	mg/L	sediment	1	7.4
20843	Lead:_total	mg/L	sediment	1	1190
20843	Lithium:_dissolved	mg/L	sediment	1	23.7

Stn	Parameter	Units	Matrix	Samples	Max
20843	MG:_total	mg/L	sediment	1	8250
20843	MN:_total	mg/L	sediment	1	605
20843	Molybdenum	mg/L	sediment	1	13.2
20843	NA:_total	mg/L	sediment	1	4540
20843	NI:_total	mg/L	sediment	1	142
20843	Silver:_total recoverable	mg/L	sediment	1	0.82
20843	V:_total	mg/L	sediment	1	9.4
20843	ZN:_total	mg/L	sediment	1	84.5

3.11 Beaver Creek

The Beaver Creek watershed contains extensive wetlands, nearly all of them nontidal, and 6.8 miles of stream classified as potential wintering habitat for coho salmon (Garono & Brophy 2001). The estuarine portion of the watershed is very limited and of this, tidal wetlands comprise about 75%. Head of tide is slightly above Rt.101 bridge and the extensive wetland is supported largely by natural tidal damming of winter outflows of Beaver Creek (Akins 1973). The watershed's only tidal wetland was assessed, totaling 58 acres (about 60% of the tidal wetland area of the 77-acre Beaver Creek marsh). Much of the site is owned by The Wetlands Conservancy. A 1939 aerial photograph shows several dirt roads or major livestock trails penetrating the marsh. *Argentina egedii* dominates the higher-elevation portions while *Carex lyngbyei* dominates lower areas. Salinity is highly variable in time and space, and only a small portion of the overall wetland can be classified as tidal. DEQ data salinity data from nearby show the following (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Samples	Min	Max
29331	Ona Beach at Beaver Creek	Salinity	ppth	26	0.2	32.9
30608	Beaver Creek mouth at Ona beach	Salinity	ppth	4	0.9	8

3.12 Alsea

The Alsea estuary is approximately 2516 acres in area and has a watershed of 474 square miles. The estuary has no major dams or jetties. Head of tide is about 15 miles from the mouth. About 84 acres (5%) is classified as tidal fresh (<0.5 ppt), 678 (28%) as mixed, and 848 (53%) as seawater. The estuary as a whole is classified as moderately stratified during both winter high flow and summer low flow. The estuary is river-dominated and freshwater detention time within the estuary is estimated to be one day, with a ratio of annual high to low flow averages 0.143. Tidal range is 5.8 ft near Waldport. Tidal dynamics were studied in detail by McKenzie (1975). Mean estuarine depth is 6.5 ft, with an estuarine depth-width ratio of 0.003, making it one of the shallowest of Oregon's major estuaries. Tidal wetlands comprise about 22% of the estuary's area. For the watershed as a whole, there are approximately 4.2 miles of road per square mile. During late summer, more freshwater stream inflow is legally allocated than is physically available (USDI-BLM 1999b).

Initial reconnaissance of Siletz wetlands was conducted by HNTB (1976) for the Corps of Engineers. A watershed assessment by BLM (1999) reported:

- 1019 acres of tidal wetland lost to dikes and fill;
- 7 acres lost to excavation;

- 229 acres of sloughs and tributaries where tidal influence has been impaired or eliminated;
- 471 acres of tidelands (marsh and mudflat) with impaired tidal influence; and
- 821 acres of intact tidelands.

Information on the Drift Creek portion of the watershed also has been compiled (USDI-BLM 1999b). Tidal wetland restoration opportunities have recently been assessed by Brophy (1999).

A study of tidal dynamics and sediments (McKenzie 1975) estimated that marine-derived sediments predominate from the mouth and through the throat of the estuary to around RM 1.6, and riverine sediments dominate from upstream down to around RM 2.5. McKenzie further speculated that net sediment deposition could be occurring in the north portion of the bay, facilitated by the damming of the north channel at that time. However, by evaluating early descriptions of the estuary, he concluded that the shallowness of Alsea Bay is natural and not the result of recent alterations. The bathymetry recorded in 1914 indicated that the northern channel was slightly deeper than the southern channel through most of its length (BLM 1999).

The Corps of Engineers (HNTB 1975) describes the flood tide as dampened between the mouth and RM 5.7, slightly amplified from RM 5.7 to the point where the shape of the estuary becomes more constant, and from there, gradually diminished by river flow and friction to the head of tide. At the time of that report (1976), flood flows were reportedly being deflected by shallow areas and tidelands toward the northeastern margin of the bay. Flows followed the margin of the bay and began filling the northern portion of the bay, including the north channel, before filling the southern channel. This differential filling resulted in an internal ebb flow from the north channel to the south channel that continued until the water levels in the two channels equalized. The water level in the north channel was reported at that time to exceed water level in the south channel by as much as a foot at the peak of this differential filling.

Eleven tidal wetlands were assessed in 2003, totaling 200 acres (about 29% of the tidal wetland area of the Alsea Estuary).

Wetland 675 (10 acres, mostly private land) is a River-sourced Tidal wetland. *Argentina egedii* and *Phalaris arundinacea* dominate the high marsh, grading into a nontidal wetland dominated by *Carex obnupta*, *Lysichiton americanus*, *Holcus lanatus*, *Phalaris arundinacea*, and Sitka spruce. *Carex lyngbyei* dominates in the low marsh. An adjoining area to the east has been altered by past diking, ditching, and grazing. The history of the site was documented in detail by Fennessey (2005). Mean quarterly salinity at the closest monthly monitoring site, almost adjacent at mid-channel, was reported as 1, 12, and 3 ppt (March, September, December). DEQ sampling data from about 2 miles downriver are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
20686	Ammonia as Nitrogen	mg/L	2	0.04	0.06
20686	Nitrate/nitrite as N	mg/L	2	0.066	0.0881
20686	Orthophosphate as P	mg/L	2	0.006	0.008
20686	Total Suspended Solids	mg/L	1		5

Wetland 692. (3 acres, private land) is a River-sourced Tidal wetland. *Phalaris arundinacea* and *Lonicera involucrata* dominate. The upper end is surrounded by forest (Sitka spruce, bigleaf maple), shrubs (alder and meadowsweet), and a residential neighborhood (new houses are still

being constructed). A tidegate reported by Brophy (1999) may have been removed recently; only a somewhat elevated culvert was apparent. Mean quarterly salinity at the closest monthly monitoring site, almost adjacent at mid-channel, was reported as 1, 7, and 1 ppt (March, September, December).

Wetland 1403 (<1 acre, private land) is about 5% high marsh and 95% low marsh. *Argentina egedii* dominates the high marsh and *Distichlis spicata* the low marsh. The site is comprised of a discontinuous array of narrow, steep-sloping tidal marshes that fringe a lagoon surrounded by an extensive housing development. The lagoon was excavated from sand dunes sometime after 1939 and until recently had restricted tidal inflow. Mean quarterly salinity at the closest monthly monitoring site, about a half mile upriver in the estuary, was reported as 4, 31, and 19 ppt (March, September, December).

Wetland 1410 (Eckman Outlet, 20 acres, public land) is entirely low marsh. *Triglochin maritimum* and *Distichlis spicata* dominate. Species reported near here previously but not detected by our transects include *Castilleja ambigua* and *Symphyotrichum (Aster) subspicatus*. This wetland is partly the result of gradual deposition of sediments following diking of Eckman Slough, located upgradient, in 1957. Most of the upland edge of this wetland is a paved road elevated on fill, with no tidal connection to Eckman Slough. Part of the area adjoining to the east is a filled former wetland. Mean quarterly salinity at the closest monthly monitoring site, a few hundred meters downriver, was reported as 2, 24, and 10 ppt (March, September, December).

Wetland 2976 (9 acres, public land) is about 10% high marsh and 90% low marsh. *Grindelia stricta* dominates the high marsh while *Distichlis spicata* and *Salicornia virginica* dominate the low marsh. Historical aerial photographs show this site extending to the west and possibly the east but those portions were filled sometime after 1939. Mean quarterly salinity at the closest monthly monitoring site, a few hundred meters downriver, was reported by Hamilton (1983) as 3, 27, and 16 ppt (March, September, December) but recent DEQ data show higher salinity (8-14 ppt) in March.

Wetland 2977 (4 acres, Lint Slough west, public land) is about 25% high marsh and 75% low marsh. *Distichlis spicata* and *Juncus balticus* dominate the high marsh while *Salicornia virginica* and *Jaumea carnosa* dominate the low marsh. Species reported here previously but not detected by our transects include *Juncus gerardii*, *Plantago maritima*, *Ruppia maritima*, and *Sagina decumbens*. Notable is the presence of *Limonium californicum*. The wetland was once much larger, extending across the road to the west where the high school and commercial buildings now exist. That part of the marsh was filled with dredged material early in the 1900s (Johannessen 1961). The slough itself has been extensively modified, with construction in 1963 of a tide-blocking earth dam just upriver of this site. The dam was removed in February 2000. Also, the stream that originally provided much of the freshwater input to the slough at its south end has mostly been disconnected from the slough and routed parallel to it in a channel that may receive treated wastewater. This site is mostly on public land. The site is on public land. Mean quarterly salinity at the closest monthly monitoring site, at the outer mouth of the slough, was reported as 3, 27, and 16 ppt (March, September, December).

Wetland 2981 (1 acre, mostly public land) is about 70% high marsh and 30% low marsh. It is a few hundred meters upstream of the above wetland, on the opposite side of Lint Slough, in the area that until recent restoration had no tidal circulation. *Agrostis stolonifera* and *Juncus balticus* dominate the high marsh and *Salicornia virginica* the low marsh.

Wetland 2987N (1 acre, mostly private land), is about 85% high marsh and 15% low marsh. *Juncus balticus* dominates the high marsh and *Distichlis spicata* the low marsh. Tidal circulation was restored to a wetland on the opposite side of the road which adjoins upslope. DEQ sampling data from bay waters nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Matrix	Samples	Max
25664	AL:_total	mg/K	sediment	1	65800
25664	Ammonia as Nitrogen	mg/L	water	1	0.04
25664	Arsenic	mg/K	sediment	1	3.7
25664	Cadmium	mg/K	sediment	1	0.118
25664	Chromium	mg/K	sediment	1	75.6
25664	CU:_total	mg/K	sediment	1	6.5
25664	FE:_total	mg/K	sediment	1	17700
25664	Lead:_total	mg/K	sediment	1	11.3
25664	Mercury	mg/K	sediment	1	0.0182
25664	MN:_total	mg/K	sediment	1	251
25664	NI:_total	mg/K	sediment	1	15.2
25664	Nitrate/nitrite as N	mg/L	water	1	0.0253
25664	Orthophosphate as P	mg/L	water	1	0.043
25664	pH	SU	water	1	8.1
25664	Salinity	ppth	water	1	31.6
25664	Silver:_total recoverable	mg/K	sediment	1	0.056
25664	Total Organic Carbon	mg/K	sediment	1	4000
25664	Total Suspended Solids	mg/L	water	1	48
25664	Turbidity	NTU	water	1	17
25664	ZN:_total	mg/K	sediment	1	34.6

Wetland 2980 (16 acres, Drift Creek, mostly public land) is about 97% high marsh and 3% low marsh. *Argentina egedii* and *Juncus balticus* dominate the high marsh and *Carex lyngbyei* the low marsh. The wetland has a deteriorating dike that is extensively breached and allows substantial tidal exchange The 1939 aerial photograph shows extensive logging directly adjacent to the site. The Drift Creek watershed was designated a key watershed by the Forest Ecosystem Management Assessment Team for the Northwest Forest Plan. Detailed tidal data may be available from a tide station located across the Alsea channel. The site is part of a complex included on the "Oregon's Greatest Wetlands." list of The Wetlands Conservancy. Mean quarterly salinity at the closest monthly monitoring site, where Drift Creek enters Alsea Bay, was reported as 1, 16, and 5 ppt (March, September, December).

Wetland 2987S (8 acres, mostly private land) is about 98% high marsh and 2% low marsh. *Agrostis stolonifera* dominates the high marsh and *Juncus balticus* the low marsh. Species reported here previously by Frenkel and Eilers (1976) but not detected by our transects include *Carex obnupta*, *Erectites glomerata*, *Galium aparine*, *Galium trifidum*, *Holcus lanatus*, LAPA, *Oenanthe sarmentosa*, *Phalaris arundinacea*, *Trifolium wormskioldii*, and *Vicia gigantea*. The site encompasses parts of Brophy's (1999) sites A27 and/or A29, and its history has been documented in detail by Hennessey (2005). Elevation and plant data from this site, labeled "Waldport North marsh" were reported by Frenkel and Eilers (1976). They determined the elevation of the marsh's steep external edge to be 0.98 to 1.05m above sea level, while the low-to-high marsh transition was at 1.283m above sea level. Detailed tidal data may be available from a tide station located across the Alsea channel. The channel west of this site was blocked during the early 1900s (see below). The site is part of a complex included on the "Oregon's Greatest Wetlands." list of The Wetlands Conservancy. Mean quarterly salinity at the closest monthly monitoring site, about a half mile upriver, was reported as 1, 16, and 5 ppt (March, September, December).

Wetland 2987I (122 acres, public land) is about 95% high marsh and 5% low marsh. *Deschampsia caespitosa* dominates the high marsh and *Salicornia virginica* the low marsh. The channel north of the islands and the narrow channels between the 3 islands were artificially blocked during the early 1900s in an attempt to redirect flow and deepen the main channel south of the islands, but nearly normal flow patterns have been restored since sometime after 1984 when the USGS topographic map was produced. The westernmost island has expanded somewhat downriver (northwestward) as a result of sediment deposition in the past 100 years. The 1939 aerial photograph shows much more extensive accumulations of drift logs, and about the same marsh configuration as presently. Detailed tidal data may be available from a tide station located on the south side of the Alsea channel. Mean quarterly salinity at the closest monthly monitoring site, a few hundred meters south, was reported by Hamilton (1983) as 2, 24, and 10 ppt (March, September, December). However, more recent DEQ data show salinity being 8-18, 20-30, and 11-26 ppt during these periods.

3.13 Siuslaw

Located on the Oregon coast at Florence, this estuary is approximately 3060 acres in area and has a watershed of 4560 square miles. The estuary of the Siuslaw River is river-dominated. Officially, the head of tide is about 23 miles from the mouth at Mapleton, but during winter tidal fluctuations may be noticeable only as far as about 6 miles inland (Siuslaw Basin Council & Ecotrust 2002). Tidal dynamics, water quality, and sediments were studied by Utt (1974) and Rauw (1974). About 254 acres (10%) of the estuary is classified as tidal fresh (<0.5 ppt), 1780 (72%) as mixed, and 424 (11%) as seawater. The estuary as a whole is classified as highly stratified during winter high flow, but vertically homogeneous during low summer flow. Freshwater detention time within the estuary is estimated to be two days, and ratio of annual high to low flow is 0.174. Tidal range is 5.4 ft near Florence. Mean estuarine depth is 9.0 ft, with an estuarine depth-width ratio of 0.017. Tidal wetlands comprise about 32% of the estuary's area.

A watershed assessment document is available (Siuslaw Basin Council & Ecotrust 2002). The Siuslaw River has no major dams, but jetties are present at its mouth (constructed in 1892 and 1910, repaired in 1957). Very high levels of dissolved lead have been noted at least as far downriver as Mapleton. The levels regularly exceed those for chronic toxicity to aquatic life, and occasionally exceed the acute toxicity threshold (Siuslaw Basin Council & Ecotrust 2002). The source is unknown. From sampling of Siuslaw sediments in 2001, the COE reported detectable levels of pesticides, PAHs, and heavy metals (including mercury) in sediments, but none were above the specified "screening level." No organotin, DDT, or PCBx were detected. Zinc was the metal found in highest concentration.

This estuary is designated as an Important Bird Area (IBA) by the National Audubon Society. The North Fork of the Siuslaw estuary is included on the "Oregon's Greatest Wetlands" list of The Wetlands Conservancy. Eight tidal wetlands were assessed in 2003, totaling 401 acres (about 29% of the tidal wetland area of this estuary).

Wetland 1462 (64 acres, mostly private land) is about 20% high marsh and 80% low marsh. A 1939 aerial photograph shows it as a diked pasture with relict channel scars, but recently the dike has been intentionally breached at 2-3 locations. *Deschampsia caespitosa* and *Agrostis stolonifera* dominate the high marsh, along with some *Typha latifolia* and *Schoenoplectus tabernaemontanii*, while *Carex lyngbyei* dominates the low marsh. Mean quarterly salinity at the closest monthly monitoring site, about 2 miles downriver, was reported as 7, 16, 16, and 10 ppt (March, June, September, December).

Wetland 1465 (1 acre, public land) is a River-sourced Tidal wetland, mostly enclosed by forest. *Carex obnupta* and *Phalaris arundinacea* dominate most of the site. Comparison with a 1939 aerial photograph indicates little obvious change. Mean quarterly salinity at the closest monthly monitoring site, almost adjacent at midchannel, was reported as 0, 1, 8, and 1 ppt (March, June, September, December). DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
20690	Ammonia as Nitrogen	mg/L	2	0.03	0.04
20690	Nitrate/nitrite as N	mg/L	3	0.031	0.0333
20690	Orthophosphate as P	mg/L	1		0.005
20690	Total Suspended Solids	mg/L	2	2	3

Wetland 1474L (99 acres, mostly private) is about 30% high marsh and 70% low marsh. The site is part of a complex listed by The Wetlands Conservancy as one of "Oregon's Greatest Wetlands." Mean quarterly salinity at the closest monthly monitoring site, several hundred meters north and upriver, was reported as 6, 11, 18, and 6 ppt (March, June, September, December).

Wetland 1474U (37 acres, mostly private) is about 55% high marsh and 45% low marsh. *Schoenoplectus tabernaemontanii* and *Phalaris arundinacea* dominate the high marsh and *Carex lyngbyei* the low marsh. The site is part of a complex listed by The Wetlands Conservancy as one of "Oregon's Greatest Wetlands." Mean quarterly salinity at the closest monthly monitoring site, within about a hundred meters downriver, was reported as 2, 6, 15, and 6 ppt (March, June, September, December).

Wetland 1494 (26 acres, mostly private) is about 90% high marsh and 10% low marsh. *Deschampsia caespitosa* and *Agrostis stolonifera* dominate the high marsh while *Carex lyngbyei* and *Schoenoplectus tabernaemontanii* dominate the low marsh. Mean quarterly salinity at the closest monthly monitoring site, about 2 miles downriver, was reported as 7, 16, 16, and 10 ppt (March, June, September, December).

Wetland 1532 (172 acres, Cox Island, owned by The Nature Conservancy) is about 33% high marsh and 67% low marsh. *Juncus balticus* dominates the high marsh and *Distichlis spicata* the low marsh. Frenkel and Boss (1988) described the invasion of parts of this wetland by *Spartina patens*, native to East Coast salt marshes, which was detected in the estuary in 1977. The Nature Conservancy is attempting to control this plant using solarization (plastic tarps) and manual removal, because of the risk of its spreading to other tidal wetlands and diminishing their plant richness. It invades middle elevations of marshes. The only species reported here previously (Frenkel and Boss 1988) but not encountered by our transects are *Angelica lucida*, *Festuca arundinacea*, *Hordeum brachyantherum*, *Schoenoplectus (Scirpus) cernuus*, and *Symphyotrichum (Aster) subspicatus*. Mean quarterly salinity at the closest monthly monitoring site, several hundred meters downriver, was reported as 5, 17, 19, and 15 ppt (March, June, September, December).

Wetland 1545E (1acre, mostly private land) and 1545W (1 acre, mostly public land), are both about 5% high marsh and 95% low marsh. *Juncus balticus* and *Grindelia stricta* dominate the high marsh and *Salicornia virginica* and *Jaumea carnosa* the low marsh. A sewage treatment plant and residential development is nearby. The adjoining main channel was dredged in 1930 and 1968-69. Bird surveys were conducted in this vicinity by Bayer & Lowe 1988 ("Woolington area 6"). Mean quarterly salinity at the closest monthly monitoring site, upriver and within a few hundred meters, was reported as 12, 22, 24, and 18 ppt (March, June, September, December).

3.14 Umpqua

The Umpqua estuary comprises approximately 6544 acres and has a watershed of 605 square miles. Head of tide is about 28 miles inland, near Scottsburg. About 16% of the estuary contains tidal wetlands. This was one of the first estuaries in Oregon to be colonized by European settlers, with Gardiner being settled around 1850. Log rafting was once common. Ship traffic and periodic dredging occur between Reedsport and the estuary mouth. This estuary is designated as an Important Bird Area (IBA) by National Audubon Society. Resource data for the estuary were first compiled by Ratti (1979). Fish data for the estuary were compiled by Johnson et al. (1986). A watershed assessment of the Lower Umpqua was completed by the USDA Forest Service (1997). A prioritization of wetlands for tidal restoration was completed by Brophy & So (2005c), and for the Smith River portion specifically (Brophy & So 2004).

Limited sampling in 2002 near the estuary mouth (8 sediment samples) found no levels known to be biologically harmful with regard to heavy metals, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, tributyl tin, or PAHs (COE 2002). Exceptions occurred in single samples: benzoic acid and butyl benzyl phthalate. The highest level found for any metal was mercury, which in one sample was at a concentration 63% of the harmful level.

A total of 16 tidal wetlands were assessed in 2003, totaling 607 acres (about 39% of the tidal wetland area of the estuary).

Wetland 2238 (1 acre, mostly private land) is about 65% high marsh and 35% low marsh. *Agrostis stolonifera* dominates the high marsh while *Carex lyngbyei* and *Distichlis spicata* dominate the low marsh. This wetland may have originated at least partly from changes in circulation patterns and sedimentation related to construction of an adjoining road and harbor. Development of the harbor itself required removal of tidal marsh by dredging, and filling of about 80 acres of tidal marsh. Mean quarterly salinity at the closest monthly monitoring site, about a mile downriver, was reported as 8, 18, 29, and 32 ppt (March, June, September, December). DEQ sediment sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
20852	AL:_total	mg/L	2	6970	73700
20852	Antimony	mg/L	2	2.6	3.56
20852	Arsenic	mg/L	2	4.97	11.7
20852	BA:_total	mg/L	2	27	88.9
20852	Beryllium	mg/L	2	0.155	0.161
20852	CA:_total	mg/L	2	5020	6900

Stn	Parameter	Units	Samples	Min	Max
20852	Cadmium	mg/L	2	0.492	1.35
20852	Chromium	mg/L	2	124	371
20852	Cobalt	mg/L	2	10.7	23.2
20852	CU:_total	mg/L	2	261	2640
20852	FE:_total	mg/L	2	20900	25300
20852	K:_total	mg/L	2	890	924
20852	K:_total recoverable	mg/L	2	890	924
20852	Lanthanum:_dissolved	mg/L	2	7.59	7.8
20852	Lead:_total	mg/L	2	49.3	52.7
20852	Lithium:_dissolved	mg/L	2	8.86	10.1
20852	MG:_total	mg/L	2	6350	19100
20852	MN:_total	mg/L	2	193	254
20852	Molybdenum	mg/L	2	0.711	2.86
20852	NA:_total	mg/L	2	1100	1490
20852	NI:_total	mg/L	2	61.1	798
20852	Silver:_total recoverable	mg/L	1		0.071
20852	V:_total	mg/L	2	23.1	23.8
20852	ZN:_total	mg/L	2	115	531

Wetland 2158 (4 acres, public land) is about 99% high marsh and 1% low marsh. *Phalaris arundinacea* and *Carex obnupta* dominate the high marsh and *Distichlis spicata* dominates the low marsh. The site is mostly on public land. Mean quarterly salinity at the closest monthly monitoring site, about 1-2 miles upriver, was reported as 2, 10, 17, and 24 ppt (March, June, September, December).

Wetland 2105 (10 acres, public land) is about 35% high marsh and 65% low marsh. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. See #2158 for salinity data.

Wetland 2094 (3 acres, public land) is about 40% high marsh and 60% low marsh. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. See #2158 for salinity data.

Wetland 2195 (1 acre, private land) is about 50% high marsh and 50% low marsh. *Carex obnupta* dominates the high marsh and *Carex lyngbyei* the low marsh. The wetland has developed fairly recently. Mean quarterly salinity at the closest monthly monitoring site, about a half mile upriver, was reported as 2, 15, 21, and 30 ppt (March, June, September, December).

Wetland 2188 (1 acre, private land) is about 70% high marsh and 30% low marsh. *Deschampsia caespitosa* and *Agrostis stolonifera* dominate the high marsh and *Salicornia virginica*, *Jaumea carnosa*, and *Carex lyngbyei* dominate the low marsh. This wetland also has developed fairly recently. The site is mostly on private land and is within about 200m of site # 2195. See #2195 above for salinity data. DEQ sampling data from the general vicinity of both sites are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
25649	Umpqua River @ RM 5.4 near Barretts Landing	AL:_total	mg/K	S	1		63000
25675	Umpqua River @ RM 6 South of The Point	AL:_total	mg/K	S	1		66800
25649	Umpqua River @ RM 5.4 near Barretts Landing	Ammonia as Nitrogen	mg/L		3	0.03	0.13

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
25675	Umpqua River @ RM 6 South of The Point	Ammonia as Nitrogen	mg/L		1		0.08
25649	Umpqua River @ RM 5.4 near Barretts Landing	Arsenic	mg/K	S	1		4.7
25675	Umpqua River @ RM 6 South of The Point	Arsenic	mg/K	S	1		5.8
25649	Umpqua River @ RM 5.4 near Barretts Landing	Chromium	mg/K	S	1		79.2
25675	Umpqua River @ RM 6 South of The Point	Chromium	mg/K	S	1		83.7
25649	Umpqua River @ RM 5.4 near Barretts Landing	CU:_total	mg/K	S	1		8.5
25675	Umpqua River @ RM 6 South of The Point	CU:_total	mg/K	S	1		14.8
25649	Umpqua River @ RM 5.4 near Barretts Landing	FE:_total	mg/K	S	1		26100
25675	Umpqua River @ RM 6 South of The Point	FE:_total	mg/K	S	1		28300
25649	Umpqua River @ RM 5.4 near Barretts Landing	Lead:_total	mg/K	S	1		8.7
25675	Umpqua River @ RM 6 South of The Point	Lead:_total	mg/K	S	1		9.8
25649	Umpqua River @ RM 5.4 near Barretts Landing	Mercury	mg/K	S	1		0.0249
25675	Umpqua River @ RM 6 South of The Point	Mercury	mg/K	S	1		0.0294
25649	Umpqua River @ RM 5.4 near Barretts Landing	MN:_total	mg/K	S	1		387
25675	Umpqua River @ RM 6 South of The Point	MN:_total	mg/K	S	1		340
25649	Umpqua River @ RM 5.4 near Barretts Landing	NI:_total	mg/K	S	1		30.3
25675	Umpqua River @ RM 6 South of The Point	NI:_total	mg/K	S	1		37
25649	Umpqua River @ RM 5.4 near Barretts Landing	Nitrate/nitrite as N	mg/L		3	0.113	0.128
25675	Umpqua River @ RM 6 South of The Point	Nitrate/nitrite as N	mg/L		1		0.158
25649	Umpqua River @ RM 5.4 near Barretts Landing	Orthophosphate as P	mg/L		2	0.047	0.049
25675	Umpqua River @ RM 6 South of The Point	Orthophosphate as P	mg/L		1		0.044
25649	Umpqua River @ RM 5.4 near Barretts Landing	pH	SU		3	7.8	8
25675	Umpqua River @ RM 6 South of The Point	pH	SU		1		7.7
25649	Umpqua River @ RM 5.4 near Barretts Landing	Salinity	ppth		3	28.3	31.2
25675	Umpqua River @ RM 6 South of The Point	Salinity (August)	ppth		1		25.8
25649	Umpqua River @ RM 5.4 near Barretts Landing	Silver:_total recoverable	mg/K	S	1		0.03
25675	Umpqua River @ RM 6 South of The Point	Silver:_total recoverable	mg/K	S	1		0.038
25649	Umpqua River @ RM 5.4 near Barretts Landing	Total Organic Carbon	mg/K	S	1		770
25649	Umpqua River @ RM 5.4 near Barretts Landing	Total Suspended Solids	mg/L		2	11	20
25675	Umpqua River @ RM 6 South of The Point	Total Suspended Solids	mg/L		1		14
25649	Umpqua River @ RM 5.4 near Barretts Landing	Turbidity	NTU		3	1.2	3.8
25675	Umpqua River @ RM 6 South of The Point	Turbidity	NTU		1		6.8
25649	Umpqua River @ RM 5.4 near Barretts Landing	ZN:_total	mg/K	S	1		45.3
25675	Umpqua River @ RM 6 South of The Point	ZN:_total	mg/K	S	1		56.6

Wetland 2079 (300 acres, Steamboat Island, mostly public land) is about 60% high marsh and 40% low marsh. *Agrostis stolonifera* and *Argentina egedii* dominate the high marsh and *Carex lyngbyei* the low marsh. This island marsh is almost entirely the result of river sediment deposition and placement of dredged material (at its north end) occurring here since about 1885 (Johannessen 1961). A low trough running north-south through the center of the island was formerly a channel that separated east and west halves into two islands. Also, until the 1940s this wetland existed as an island separate from wetland 2105 but sedimentation has now joined the two. Mean quarterly salinity at the closest monthly monitoring site, at midchannel directly west, was reported as 1, 9, 12, and 19 ppt (March, June, September, December). DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
25651	Umpqua River @ RM 8.5 East shore near sawmill	Acenaphthene	‘g/K	S	1		88
25651	Umpqua River @ RM 8.5 East shore near sawmill	AL:_total	mg/K	S	1		67500
20695	Umpqua River	Ammonia as Nitrogen	mg/L		3	0.03	0.06
25651	Umpqua River @ RM 8.5 East shore near sawmill	Ammonia as Nitrogen	mg/L		3	0.07	0.11
25651	Umpqua River @ RM 8.5 East shore near sawmill	Anthracene	‘g/K	S	1		690
25651	Umpqua River @ RM 8.5 East shore near sawmill	Arsenic	mg/K	S	1		4.6
25651	Umpqua River @ RM 8.5 East shore near sawmill	Benzo[a]anthracene	‘g/K	S	1		210
25651	Umpqua River @ RM 8.5 East shore near sawmill	Benzo[a]pyrene	‘g/K	S	1		50
25651	Umpqua River @ RM 8.5 East shore near sawmill	Benzo[b]fluoranthene	‘g/K	S	1		230
25651	Umpqua River @ RM 8.5 East shore near sawmill	Cadmium	mg/K	S	1		0.116
25651	Umpqua River @ RM 8.5 East shore near sawmill	Chromium	mg/K	S	1		106
25651	Umpqua River @ RM 8.5 East shore near sawmill	Chrysene	‘g/K	S	1		170
26458	Umpqua River at Gardiner Boat Ramp	Conductivity	‘mho		5	150	1967
25651	Umpqua River @ RM 8.5 East shore near sawmill	CU:_total	mg/K	S	1		16.8
25651	Umpqua River @ RM 8.5 East shore near sawmill	FE:_total	mg/K	S	1		30400
25651	Umpqua River @ RM 8.5 East shore near sawmill	Fluoranthene	‘g/K	S	1		570
25651	Umpqua River @ RM 8.5 East shore near sawmill	Fluorene	‘g/K	S	1		72
25651	Umpqua River @ RM 8.5 East shore near sawmill	gamma-BHC (Lindane)	‘g/K	S	1		6.6
25651	Umpqua River @ RM 8.5 East shore near sawmill	Lead:_total	mg/K	S	1		10.9
25651	Umpqua River @ RM 8.5 East shore near sawmill	Mercury	mg/K	S	1		0.0467
25651	Umpqua River @ RM 8.5 East shore near sawmill	MN:_total	mg/K	S	1		373
25651	Umpqua River @ RM 8.5 East shore near	NI:_total	mg/K	S	1		36.4

	sawmill						
20695	Umpqua River	Nitrate/nitrite as N	mg/L		3	0.008	0.0083
25651	Umpqua River @ RM 8.5 East shore near sawmill	Nitrate/nitrite as N	mg/L		3	0.096	0.0976
20695	Umpqua River	Orthophosphate as P	mg/L		2	0.006	0.007
25651	Umpqua River @ RM 8.5 East shore near sawmill	Orthophosphate as P	mg/L		3	0.043	0.046
25651	Umpqua River @ RM 8.5 East shore near sawmill	pH	SU		2	7.4	7.5
25651	Umpqua River @ RM 8.5 East shore near sawmill	Pyrene	‘g/K	S	1		400
25651	Umpqua River @ RM 8.5 East shore near sawmill	Salinity (August)	ppth		3	18.8	22.1
26458	Umpqua River at Gardiner Boat Ramp	Salinity (November)	ppth		1		3.8
25651	Umpqua River @ RM 8.5 East shore near sawmill	Silver:_total recoverable	mg/K	S	1		0.048
25651	Umpqua River @ RM 8.5 East shore near sawmill	Total Organic Carbon	mg/K	S	1		9070
20695	Umpqua River	Total Suspended Solids	mg/L		3	6	21
25651	Umpqua River @ RM 8.5 East shore near sawmill	Total Suspended Solids	mg/L		3	12	17
26458	Umpqua River at Gardiner Boat Ramp	Total Suspended Solids	mg/L		6	6	45
25651	Umpqua River @ RM 8.5 East shore near sawmill	Turbidity	NTU		3	3.6	5.8
26458	Umpqua River at Gardiner Boat Ramp	Turbidity	NTU		5	10	27
25651	Umpqua River @ RM 8.5 East shore near sawmill	ZN:_total	mg/K	S	1		60.8

Wetland 2146 (<1 acre, mostly public) is about 70% high marsh and 30% low marsh. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. This marsh has developed in the last 60 years partly on dredged material that forms most of the western half of Bolon Island, and which obliterated a formerly adjoining marsh. The nearby highway was constructed in 1950 and the remainder of the island is zoned for industrial use. Mean quarterly salinity at the closest monthly monitoring site, on the opposite southern side of the island, was reported as 0, 6, 8, and 13 ppt (March, June, September, December).

Wetland 2149 (12 acres, East Gardiner, mostly public land). This island wetland is about 50% high marsh and 50% low marsh. *Juncus balticus* dominates the high marsh and *Carex lyngbyei* the low marsh. Comparison with 1885 nautical charts indicates expansion of this island marsh has occurred as a result of progressive sedimentation. A railroad track crosses the island. Mean quarterly salinity at the closest monthly monitoring site, less than a mile upriver, was reported as 0, 5, 7, and 11 ppt (March, June, September, December).

Wetland 2152 (40 acres, mostly public land) is about 50% high marsh and 50% low marsh. *Agrostis stolonifera*, *Argentina egedii*, and *Phalaris arundinacea* dominate the high marsh and *Carex lyngbyei* dominates the low marsh. Comparison with 1885 nautical charts indicates this island marsh has expanded considerably as a result of progressive sedimentation. Mean quarterly salinity at the closest monthly monitoring site, less than a mile upriver, was reported as 0, 5, 7, and 11 ppt (March, June, September, December).

Wetland 2157 (9 acres, mostly private land) is about 40% high marsh and 60% low marsh. *Deschampsia caespitosa* dominates the high marsh and *Carex lyngbyei* the low marsh. This area was an island until the mid-1900s, when dredged material was deposited and connected it to the mainland. The upland edge is bordered by a dike that confines a former tidal marsh. A sewage treatment plant is nearby. Mean quarterly salinity at the closest monthly monitoring site, within a hundred meters to the north, was reported as 0, 6, 8, and 13 ppt (March, June, September, December). By month, DEQ reports mean salinity (in ppt) as follows: 3, 5, 2, 12, 5, 5, 9, 12, 13, 11, 5, 4. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
20853	Umpqua River @ Fred Wahl Marine	AL:_total	mg/L	S	1		26400
20853	Umpqua River @ Fred Wahl Marine	Antimony	mg/L	S	1		10.2
20853	Umpqua River @ Fred Wahl Marine	Arsenic	mg/L	S	1		7.11
20853	Umpqua River @ Fred Wahl Marine	BA:_total	mg/L	S	1		77.6
20853	Umpqua River @ Fred Wahl Marine	Beryllium	mg/L	S	1		0.536
20853	Umpqua River @ Fred Wahl Marine	CA:_total	mg/L	S	1		13400
20853	Umpqua River @ Fred Wahl Marine	Cadmium	mg/L	S	1		1.58
20853	Umpqua River @ Fred Wahl Marine	Chromium	mg/L	S	1		906
20853	Umpqua River @ Fred Wahl Marine	Cobalt	mg/L	S	1		24.5
13707	Scholfield Slough at Mouth	Conductivity	‘mho		42	50	15800
20853	Umpqua River @ Fred Wahl Marine	CU:_total	mg/L	S	1		3340
20853	Umpqua River @ Fred Wahl Marine	FE:_total	mg/L	S	1		45400
20853	Umpqua River @ Fred Wahl Marine	K:_total	mg/L	S	1		2110
20853	Umpqua River @ Fred Wahl Marine	K:_total recoverable	mg/L	S	1		2110
20853	Umpqua River @ Fred Wahl Marine	Lanthanum:_dissolved	mg/L	S	1		12.7
20853	Umpqua River @ Fred Wahl Marine	Lead:_total	mg/L	S	1		17.2
20853	Umpqua River @ Fred Wahl Marine	Lithium:_dissolved	mg/L	S	1		20.3
20853	Umpqua River @ Fred Wahl Marine	MG:_total	mg/L	S	1		42700
20853	Umpqua River @ Fred Wahl Marine	MN:_total	mg/L	S	1		819
20853	Umpqua River @ Fred Wahl Marine	Molybdenum	mg/L	S	1		0.22
20853	Umpqua River @ Fred Wahl Marine	NA:_total	mg/L	S	1		1320
20853	Umpqua River @ Fred Wahl Marine	NI:_total	mg/L	S	1		496
13707	Scholfield Slough at Mouth	Salinity	ppth		94	0.1	30
20853	Umpqua River @ Fred Wahl Marine	Silver:_total recoverable	mg/L	S	1		0.169
13707	Scholfield Slough at Mouth	Total Suspended Solids	mg/L		6	6	40
13707	Scholfield Slough at Mouth	Turbidity	NTU		13	3	28
20853	Umpqua River @ Fred Wahl Marine	V:_total	mg/L	S	1		64.4
20853	Umpqua River @ Fred Wahl Marine	ZN:_total	mg/L	S	1		396

Wetland 2148W (133 acres, private land) is about 70% high marsh and 30% low marsh. *Agrostis stolonifera* and *Argentina egedii* dominate the high marsh and *Carex lyngbyei* dominates the low marsh. The adjoining channel was dredged and modified in 1940. Mean quarterly salinity at the closest monthly monitoring site, less than a mile to the north, was reported as 0, 5, 7, and 11 ppt (March, June, September, December). By month, DEQ reports salinity (ppt) as follows:

Jan	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	2	30	7	5	8	10	12	10	6	4

Other DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
13708	Conductivity	‘mho	32	40	1100
13708	Salinity	ppth	80	0.5	30
13708	Turbidity	NTU	8	3	7

Wetland 2148E (21 acres, private land) is a River-sourced Tidal wetland that drains a mostly undeveloped area of about 3300 acres. *Schoenoplectus tabernaemontanii*, *Phalaris arundinacea*, and JUEF dominate. Portions of its upland edge are currently grazed, some intensively.

Wetland 2203 (29 acres, public land) is about 50% high marsh and 50% low marsh. *Schoenoplectus tabernaemontanii* and *Phalaris arundinacea* dominate the high marsh and *Carex lyngbyei* and *Triglochin maritimum* dominate the low marsh. The site is almost entirely diked, and a1939 aerial photograph shows a dense stand of trees on the river side of the wetland. These are now virtually absent and internal channels have moved. Mean quarterly salinity at the closest monthly monitoring site, less than a mile downriver, was reported as 0, 3, 5, and 9 ppt (March, June, September, December).

Stn	DEQ Location Name	Parameter	Units	Samples	Min	Max
20695	Umpqua River	Ammonia as Nitrogen	mg/L	3	0.03	0.06
26460	Umpqua River at Dean Creek Elk Viewing Area	Conductivity	‘mho	6	112	175
20695	Umpqua River	Nitrate/nitrite as N	mg/L	3	0.008	0.0083
20695	Umpqua River	Orthophosphate as P	mg/L	2	0.006	0.007
20695	Umpqua River	Total Suspended Solids	mg/L	3	6	21
26460	Umpqua River at Dean Creek Elk Viewing Area	Total Suspended Solids	mg/L	6	5	34
26460	Umpqua River at Dean Creek Elk Viewing Area	Turbidity	NTU	5	14	29

Wetland 2089 (43 acres, public land) is a River-sourced Tidal wetland. *Schoenoplectus tabernaemontanii* dominates the high marsh and *Carex lyngbyei* the very limited low marsh. A dike restricts tidal circulation to much of the wetland, but was breached during a storm in 1997. Comparison with a 1939 aerial photograph shows little obvious change, except perhaps a slight decrease since then in tree and shrub cover. The adjoining channel was dredged in 1957. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
20692	Ammonia as Nitrogen	mg/L	1		0.03
20692	Nitrate/nitrite as N	mg/L	3	0.046	0.0495
20692	Orthophosphate as P	mg/L	2	0.006	0.007
20692	Total Suspended Solids	mg/L	2	3	4

3.15 Siltcoos

This estuary is about 36% tidal marsh, and has been designated as an Important Bird Area (IBA) by National Audubon Society. One tidal wetland (# Wetland 1723) was assessed, totaling 10 acres (about 55 % of the tidal wetland area of the estuary). This site is about 95% high marsh and 5% low marsh. *Deschampsia caespitosa* and JUEF dominate the high marsh while *Carex lyngbyei* and *Distichlis spicata* dominate the low marsh. The site is on public land. The creek adjoined by the study wetland drains from Siltcoos Lake and probably shifts direction occasionally in response to shifting sand dunes (Dicken et al. 1961).

3.16 Ten Mile

About 59% of this very small estuary is estimated to contain tidal wetlands. Three similar tidal wetlands, all within a few hundred of each other, were assessed. They total 37 acres (about 44% of the tidal wetland area of the estuary). All are on public land. The creek adjoined by these wetlands drains from Ten Mile Lake and has occasionally shifted direction in response to shifting sand dunes (Dicken et al. 1961).

Wetlands 2385D (21 acres) and 2385N (13 acres) are almost entirely high marsh and are dominated by *Argentina egedii*, *Carex obnupta*, and *Juncus balticus* A 1939 aerial photograph does not show either wetland, because they are the result of more recent northward shifts in the channel. Wetland 2385D is a depression among the dunes and is only barely connected to the tidal channel. Wetland 2585N, about 600m away, comprises much of a small recently-deposited island in the channel.

Wetland 2385S, about 300m away and 3 acres in size, is about 50% high marsh and 50% low marsh. It apparently is situated along the former path of the main channel. Since 1939 the wetland appears to have expanded slightly. *Argentina egedii* and *Agrostis stolonifera* dominate the high marsh while *Schoenoplectus americanus* and *Triglochin maritimum* dominate the low marsh. A nearby pond is recognized by the ONHP as habitat for the northwestern pond turtle. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Samples	Min	Max
29439	Tenmile Creek @ Spinreel Rd. Bridge	Ammonia as Nitrogen	mg/L	2	0.07	0.09
29439	Tenmile Creek @ Spinreel Rd. Bridge	Conductivity	‘mho	3	58.8	78.3
29439	Tenmile Creek @ Spinreel Rd. Bridge	Nitrate/nitrite as N	mg/L	2	0.064	0.18
29439	Tenmile Creek @ Spinreel Rd. Bridge	pH	SU	1		7
29439	Tenmile Creek @ Spinreel Rd. Bridge	Total Kjeldahl Nitroge	mg/L	1		2.5
29439	Tenmile Creek @ Spinreel Rd. Bridge	Total Suspended Solids	mg/L	2	1	40
29440	Tenmile Creek @ Spinreel Campground boat ramp	Ammonia as Nitrogen	mg/L	2	0.02	0.06
29440	Tenmile Creek @ Spinreel Campground boat ramp	Conductivity	‘mho	3	75.6	81
29440	Tenmile Creek @ Spinreel Campground boat ramp	Nitrate/nitrite as N	mg/L	2	0.07	0.0963
29440	Tenmile Creek @ Spinreel Campground boat ramp	pH	SU	1		6.8
29440	Tenmile Creek @ Spinreel Campground boat ramp	Total Kjeldahl Nitroge	mg/L	2	0.2	0.3
29440	Tenmile Creek @ Spinreel Campground boat ramp	Total Suspended Solids	mg/L	2	1	2

3.17 Coos

The Coos Bay estuary is about 13,348 acres in area and has a watershed of approximately 1058 square miles. Tideland comprises about 6200 acres (50%) of the estuary, and tidal wetlands cover 13% of the estuary. Head of tide is up to 34 miles from the mouth. Compared with most other Oregon estuaries, river inputs of sediment and nutrients in much of this estuary are small relative to ocean inputs. The mean tidal range at the entrance is 6.7 feet, the extreme high is 10.5 feet and the extreme low minus 3 feet. The tidal range increases upstream to the city of Coos Bay where the mean range is 6.9 feet. Flushing times have been estimated to range from 6.2 days (7 miles above the mouth, in December) to 48.5 days (27 miles above the mouth, in June). Tidal dynamics have been described by Blanton (1964), Arneson (1976), Butler (1978), and others. Some salinity and other water quality data were compiled by McAllister (1963) and Baptista (1989).

An estuary-wide ecological survey was published by Hofnagle et al. (1976) and resource data were compiled by Roye (1979). Restoration opportunities were identified and rated by Fuss (1999), and Shaffer (1999) surveyed the flora and other characteristics of a series of wetland mitigation sites (mostly nontidal) throughout the estuary. Watershed assessments have been done for the Coos watershed overall as well as specifically for the urbanized Lower Pony Creek area and the Coos Bay lowlands. The importance of this estuary for migratory shorebirds is recognized by the Northern Pacific Coast Regional Shorebird Management Plan (Drut & Buchanan 2000) and it is designated as an Important Bird Area (IBA) by National Audubon Society.

Portions of the estuary are heavily urbanized, with several oil facilities, tank barges, cargo vessels, tugs, fishing vessels, and pleasure craft. Approximately 220 cargo vessels enter Coos Bay annually. Oil spills have been relatively frequent. Sediment sampling at various times and places has mostly not detected levels known to be biologically harmful with regard to heavy metals, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, or PAHs (COE 2002). An exception is tributyl tin, which in 1994 was found in mid-channel Isthmus Slough at 150 ppm. The level of concern is 30 ppm. Subsequent sampling indicated this was a localized occurrence.

Some 28 tidal wetlands were assessed by the HGM project in 2003, totaling 475 acres (about 24 % of the tidal wetland area of the estuary). These are described as follows.

Wetland 2536 (53 acres, North Slough, mostly public land) is about 70% high marsh and 30% low marsh. *Agrostis stolonifera* and *Deschampsia caespitosa* dominate the high marsh and *Carex lyngbyei* the low marsh. Vegetation of the tidal marsh here was surveyed by Frenkel et al. 1981 and Hoffnagle et al. 1976, as well as Jefferson 1975, who commented that these marshes provide "the most complete and diverse mosaic of salt marsh plant communities in all stages of succession and with ecotones to freshwater, forest, and sand dunes." The contributing watershed area is about 8190 acres. A tidegate has existed at the north end of North Slough, and a railroad elevated on a dike skirts the dunes on the west side; it has a localized breach at its southern end. Presence of extensive dikes farther upstream and the Jordan Cove Causeway downriver are theorized to be contributing sediment deposition at this site. In the mid-1970s stands of bulrush (*Schoenoplectus tabernaemontanii*) were extensive but were not encountered by our transects. Also, our transects encountered none of the *Boisduvalia densiflora* or the rare *Cordylanthus maritimus* reported by Hoffnagle et al. 1976. His midsummer west-to-east transect crossing the slough found salinity changed from 4 to 31 ppt. He commented on the very peaty texture of the marsh soil.

Wetland 2731 (1 acre, mostly private land) is about 70% high marsh and 30% low marsh. *Grindelia stricta* dominates the high marsh and *Carex lyngbyei* the low marsh. This tiny marsh appears to be a rather new one arising on sediment deposited outside the dikes of a much larger (100 acre) tidal marsh that was diked and converted to pasture in the early 1900s. A watershed assessment has been completed covering the 5364-acre area above this site. DEQ sampling data from nearby show salinity ranging from 2 ppt in January to 12 ppt in October, with no summer data.

Wetland 2829 (1 acre, mostly private land) is a small narrow island with about 30% high marsh and 70% low marsh. *Distichlis spicata* and *Carex obnupta* dominate the high marsh and *Jaumea carnosa* and *Salicornia virginica* dominate the low marsh. The marsh is not shown on the 1971 topographic map, suggesting recent origin as a result of sedimentation and/or deposition of dredged material. Major expansion of the marsh to the east was reported 1939-1961, but apparently that marsh has had few changes since then. As reported by Dicken et al. (1961): "Dikes were built many years ago along the upper portion of the slough. An extension of the dikes down the south margin of the slough and the construction of a bridge (with tide gate) and a road levee across the slough have changed the flow of stream and tide. A semi-fluid mud has been flocculated in the bay water and laid down in the barrow ditch dug in the mud flat during the construction of the levees. The old mud flat has been built up slightly and tidal marsh vegetation is rapidly invading." Salinity in the vicinity is reported to range from 3.0 to 33.7 ppt. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
13594	Conductivity	'mho	3	140	365
13594	Salinity	ppth	5	0.1	29
13594	Total Suspended Solids	mg/L	5	4	15
13594	Turbidity	NTU	1		44

The following three surveyed wetlands on the north spit of Coos Bay are within a few hundred feet of each other: All three are mostly on public land.

Wetland 2739 (4 acres) is about 40% high marsh and 60% low marsh. *Juncus gerardii* dominates the high marsh and *Salicornia virginica* the low marsh. This marsh colonized dredged material deposited in the early 1900s. Mean quarterly salinity at the closest monthly monitoring site, about a mile upriver, was reported as 22, 28, 32, and 29 ppt (March, June, September, December). This site is very close to sites 2766 and 2771.

Wetland 2766 (<1 acre) is about 10% high marsh and 90% low marsh. *Salicornia virginica* and *Jaumea carnosa* dominate the low marsh. Review of the 1939 aerial photograph indicates this marsh has developed entirely since that time. This site is very close to sites 2739 and 2771.

Wetland 2771 (3 acres) is about 30% high marsh and 70% low marsh. *Distichlis spicata* and *Salicornia virginica* dominate the marsh. Review of the 1939 aerial photograph indicates this marsh has developed entirely since that time. This site is very close to sites 2739 and 2766

Wetland 2772 (Pony Creek marsh, 27 acres) is an River-sourced Tidal wetland. *Typha latifolia* and *Eleocharis palustris* dominate. Portions of the marsh were filled during construction of roads and a school in the mid-1900s. The shopping center was constructed in 1958 on a filled tidal wetland. The east side of the remaining marsh apparently has become drier, with increased willow cover. Further upstream, the tributary feeding the marsh flows through a lake with a controlled outlet. The site is mostly on public land. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Samples	Min	Max
13598	Pony Creek South Of North Bend High School	Conductivity	'mho	7	53	2370

Stn	DEQ Location Name	Parameter	Units	Samples	Min	Max
25031	Pony Slough at Coca Cola bottling plant (Coos Bay)	Conductivity	‘mho	6	51	320
13598	Pony Creek South Of North Bend High School	Salinity	ppth	11	1.2	12.6
13599	Pony Creek at Virginia Blvd (North Bend)	Salinity	ppth	10	0.2	14.3
13598	Pony Creek South Of North Bend High School	Total Suspended Solids	mg/L	5	2	39
25031	Pony Slough at Coca Cola bottling plant (Coos Bay)	Total Suspended Solids	mg/L	5	3	30
13599	Pony Creek at Virginia Blvd (North Bend)	Turbidity	NTU	1		10

Wetland 2783 (<1 acre, private land) is an River-sourced Tidal wetland. *Phalaris arundinacea* dominates with some *Carex lyngbyei* in lower areas. The site has been regularly grazed.

Wetland 2787 (North Spit island, 6 acres, public land), is about 20% high marsh and 80% low marsh. *Salicornia virginica* dominates the low marsh. The marsh has developed mainly on the west side of an island created in the early 1900s from dredged material. Mean quarterly salinity at the closest monthly monitoring site, less than a mile downriver, was reported as 24, 29, 32, and 31 ppt (March, June, September, December). Other DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
25665	Coos Bay West shore off North spit	AL:_total	mg/K	S	1		57000
25665	Coos Bay West shore off North spit	Aldrin	‘g/K	S	1		3.3
25665	Coos Bay West shore off North spit	Ammonia as Nitrogen	mg/L		2	0.03	0.04
25665	Coos Bay West shore off North spit	Arsenic	mg/K	S	1		5.4
25665	Coos Bay West shore off North spit	Cadmium	mg/K	S	1		0.439
25665	Coos Bay West shore off North spit	Chromium	mg/K	S	1		89
25665	Coos Bay West shore off North spit	CU:_total	mg/K	S	1		12.4
25665	Coos Bay West shore off North spit	FE:_total	mg/K	S	1		21200
25665	Coos Bay West shore off North spit	Lead:_total	mg/K	S	1		10.4
25665	Coos Bay West shore off North spit	Mercury	mg/K	S	1		0.0336
25665	Coos Bay West shore off North spit	MN:_total	mg/K	S	1		196
25665	Coos Bay West shore off North spit	NI:_total	mg/K	S	1		44.6
25665	Coos Bay West shore off North spit	Nitrate/nitrite as N	mg/L		2	0.093	0.105
25665	Coos Bay West shore off North spit	Orthophosphate as P	mg/L		2	0.04	0.045
25665	Coos Bay West shore off North spit	pH	SU		1		8
25665	Coos Bay West shore off North spit	Salinity (August)	ppth		1		32.3
25665	Coos Bay West shore off North spit	Selenium	mg/K	S	1		0.34
25665	Coos Bay West shore off North spit	Silver:_total recoverable	mg/K	S	1		0.058
13635	Coos Bay at Coos Bay STP #2 Outfall Mudflat	Total Organic Carbon	mg/L		1		18180
25665	Coos Bay West shore off North spit	Total Suspended Solids	mg/L		2	21	29
25665	Coos Bay West shore off North spit	Turbidity	NTU		2	2.3	7.5
25665	Coos Bay West shore off North spit	ZN:_total	mg/K	S	1		48.9

Wetland 2792 (133 acres, Bull/ Cooston Island, mostly public land) is about 40% high marsh and 60% low marsh. *Juncus balticus* dominates the high marsh and *Carex lyngbyei* the low marsh. Species reported on the mainland east of this island but not encountered by our transects include *Hordeum brachyantherum* and *Rumex occidentalis* (Hoffnagle et al. 1976). The island has more than doubled in size since around 1890, mostly along its western margin (Johannessen 1961). From 1944 to at least 1970 the adjoining channel was relatively stable and not subject to extreme erosion (Aagard et al. 1971), while the marsh expanded rapidly onto former mudflats. At least part of the island is recognized by ONHP as a Natural Heritage Conservation Area. The site is relatively unaltered. Mean quarterly salinity at the closest monthly monitoring site, about a half-mile south, was reported as 8, 13, 26, and 18 ppt (March, June, September, December). More recent DEQ data show salinity as high as 31 ppt in August-October. Other DEQ data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
13623	Marshfield Channel 200 Yds N Of Coos River Rd	AL:_total	mg/L		2	0.2	6000
20705	Coos River	Ammonia as Nitrogen	mg/L		2	0.02	0.03
13623	Marshfield Channel 200 Yds N Of Coos River Rd	BA:_total	mg/L		1		34
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Benzo[a]anthracene	mg/K	S	1		0.06
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Benzo[a]pyrene	mg/K	S	1		0.07
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Benzo[b]fluoranthene	mg/K	S	1		0.07
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Benzo[k]fluoranthene	mg/K	S	1		0.11
13623	Marshfield Channel 200 Yds N Of Coos River Rd	CA:_total	mg/L		2	180	1400
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Chromium	mg/K	S	1		42
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Chrysene	mg/K	S	1		0.07
13623	Marshfield Channel 200 Yds N Of Coos River Rd	CU:_total	mg/L		1		21
13623	Marshfield Channel 200 Yds N Of Coos River Rd	FE:_total	mg/L		2	0.24	7000
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Fluoranthene	mg/K	S	1		0.12
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Hardness as CaCO3:_dissolved	mg/L		5	2838	26557
13623	Marshfield Channel 200 Yds N Of Coos River Rd	K:_total recoverable	mg/L		2	180	1500
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Lead:_total	mg/K	S	1		10
13623	Marshfield Channel 200 Yds N Of Coos River Rd	MG:_total	mg/L		2	580	5600
13623	Marshfield Channel 200 Yds N Of Coos River Rd	MN:_total	mg/L		2	0.02	80
13623	Marshfield Channel 200 Yds N Of Coos River Rd	NA:_total	mg/L		2	3500	5000
13623	Marshfield Channel 200 Yds N Of Coos River Rd	NI:_total	mg/L		1		22
20705	Coos River	Nitrate/nitrite as N	mg/L		2	0.047	0.0504
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Phenanthrene	mg/K	S	1		0.12
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Pyrene	mg/K	S	1		0.12
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Retene	mg/K	S	1		0.1
13623	Marshfield Channel 200 Yds N Of Coos	Salinity	ppth		1		14.5

Stn	DEQ Location Name	Parameter	Units	Matrix	Samples	Min	Max
	River Rd						
13671	Coos Bay North Of Crawford Point	Salinity	ppth		60	1.8	32
13623	Marshfield Channel 200 Yds N Of Coos River Rd	Total Organic Carbon	mg/L		2	2	15600
20705	Coos River	Total Organic Carbon	mg/L	S	1		658
20705	Coos River	Total Suspended Solids	mg/L		3	8	12
13623	Marshfield Channel 200 Yds N Of Coos River Rd	V:_total	mg/L		1		21
13623	Marshfield Channel 200 Yds N Of Coos River Rd	ZN:_total	mg/L		2	0.02	54

Wetland 2801 (16 acres, mostly public land) is about 50% high marsh and 50% low marsh. *Argentina egedii* dominates the high marsh and *Salicornia virginica* the low marsh. The marsh has developed along the shores of an island created in the early 1900s from dredged material. Mean quarterly salinity at the closest monthly monitoring site, within a few hundred meters, was reported as 14, 19, 29, and 22 ppt (March, June, September, December).

Wetland 2838 (45 acres, Millicoma tidal marsh, public land) is about 20% high marsh and 80% low marsh. *Carex obnupta* dominates the high marsh and *Salicornia virginica* and *Carex lyngbyei* dominate the low marsh. In winter, 5000-10,000 shorebirds and a large variety of landbirds use the tidal marsh and/or adjoining mudflats and freshwater wetlands. The marsh is a remnant of a much larger tidal marsh that once extended southward and westward. Some of the upland now adjoining this marsh to the south was created in the early 1900s from dredge spoil placed behind the dike that now comprises the upland border of the tidal marsh. As much as 25 vertical feet of dredged material was placed in some areas. A sewage treatment plant borders the main tributary to the marsh. The site is mostly on public land. Mean quarterly salinity at the closest monthly monitoring site, within about a hundred meters north, was reported as 8, 13, 26, and 18 ppt (March, June, September, December).

Wetland 2904 (15 acres, mostly private land) is about 1% high marsh and 99% low marsh. *Distichlis spicata* dominates the limited high marsh while *Triglochin maritimum* and *Eleocharis parvula* dominate the low marsh. Historically, this area was a major storage area for logs. Mean quarterly salinity at the closest monthly monitoring site, almost adjacent at midchannel, was reported as 10, 14, 26, and 18 ppt (March, June, September, December). Other DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Matrix	Samples	Min	Max
13630	AL:_total	mg/L		2	0.5	2000
13630	BA:_total	mg/L		1		40
13630	CA:_total	mg/L		2	230	3200
13630	Chromium	mg/K	S	1		57
13630	Chromium	mg/L		1		57
13630	Cobalt	mg/L		1		10
13630	CU:_total	mg/L		1		22
13630	FE:_total	mg/L		2	0.42	9000
13630	Hardness as CaCO3:_dissolved	mg/L		5	3620	49170
13630	K:_total	mg/L		2	230	3500
13630	K:_total recoverable	mg/L		2	230	3500
13630	MG:_total	mg/L		2	740	10000
13630	MN:_total	mg/L		2	0.02	90
13630	NA:_total	mg/L		2	1000	6500

Stn	Parameter	Units	Matrix	Samples	Min	Max
13630	Naphthalene	mg/K	S	1		0.07
13630	NI:_total	mg/L		1		34
13630	Phenanthrene	mg/K	S	1		0.06
13630	Pyrene	mg/K	S	1		0.1
13630	Salinity (February)	ppth		1		20.5
13630	Total Organic Carbon	mg/L		1		83200
13630	V:_total	mg/L		1		45
13630	ZN:_total	mg/L		1		91

Wetland 3128E (12 acres, mostly private land) is about 10% high marsh and 90% low marsh. *Agrostis stolonifera* and *Schoenoplectus tabernaemontanii* dominate the high marsh while *Carex lyngbyei* dominates the low marsh. Mean quarterly salinity at the closest monthly monitoring site, about a mile north, was reported as 5, 9, 23, and 15 ppt (March, June, September, December).

Wetland 3128N (17 acres, mostly private land) is about 99% high marsh and 1% low marsh. *Carex obnupta* and *Agrostis stolonifera* dominate the high marsh and *Agrostis stolonifera* also dominates the very limited low marsh. See also #3128E for salinity data. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Samples	Min	Max
25998	Conductivity	‘mho	4	124	35900
25997	Conductivity	‘mho	2	3047	44400
25998	Salinity (August)	ppth	2	13	22.5
25997	Salinity (October)	ppth	4	1.8	28.3
25998	Total Suspended Solids	mg/L	4	15	44
25997	Total Suspended Solids	mg/L	3	27	70

Wetland 3033E (16 acres, mostly private land) is about 45% high marsh and 55% low marsh. *Distichlis spicata* is the dominant plant. The site is almost contiguous with site # 3033W. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Matrix	Samples	Min	Max
25655	AL:_total	mg/K	S	1		71700
25655	Ammonia as Nitrogen	mg/L		3	0.08	0.13
25655	Arsenic	mg/K	S	1		9.7
25655	Cadmium	mg/K	S	1		0.248
25655	Chromium	mg/K	S	1		102
25655	CU:_total	mg/K	S	1		18
25655	FE:_total	mg/K	S	1		34800
25655	Lead:_total	mg/K	S	1		12.9
25655	Mercury	mg/K	S	1		0.0482
25655	MN:_total	mg/K	S	1		267
25655	NI:_total	mg/K	S	1		44.1
25655	Nitrate/nitrite as N	mg/L		3	0.081	0.084
25655	Orthophosphate as P	mg/L		3	0.029	0.031
25655	pH	SU		1		7.3
25655	Salinity (August)	ppth		2	27.7	27.8
25655	Selenium	mg/K	S	1		0.53
25655	Silver:_total recoverable	mg/K	S	1		0.09

Stn	Parameter	Units	Matrix	Samples	Min	Max
25655	Total Suspended Solids	mg/L		2	20	21
25655	Turbidity	NTU		3	11.1	13.1
25655	ZN:_total	mg/K	S	1		74.6

Wetland 3033W (11 acres, mostly private land) is about 60% high marsh and 40% low marsh. *Agrostis stolonifera* dominates the high marsh and *Carex lyngbyei* the low marsh. The only species reported here previously (Shaffer 1999) but not encountered by our transects are *Cotula coronopifolia*, *Schoenoplectus (Scirpus) cernuus*, and SCMA, probably because survey areas may not have overlapped exactly. The site is almost contiguous with site # 3033E. Mean quarterly salinity at the closest monthly monitoring site, about a mile north, was reported as 2, 9, 25, and 12 ppt (March, June, September, December).

Wetland 3170 (9 acres, mostly private land) is about 45% high marsh and 55% low marsh. *Agrostis stolonifera* and *Schoenoplectus tabernaemontanii* dominate the high marsh and *Carex lyngbyei* the low marsh. DEQ sampling data from nearby are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Matrix	Samples	Min	Max
20708	Ammonia as Nitrogen	mg/L		2	0.03	0.05
20708	Nitrate/nitrite as N	mg/L		3	0.078	0.0839
20708	Total Organic Carbon	mg/L	S	1		264
20708	Total Suspended Solids	mg/L		2	8	9

The following wetlands are all in the **South Slough** part of the Coos Estuary. All are part of the South Slough National Estuarine Research Reserve (SSNERR). In this part of the Coos estuary much of the diking and draining of tidal marshes occurred before 1900, and was abandoned mainly in the 1930s, with many dikes failing in the 1960s. Localized grazing of diked marshes occurred until the early 1990s, and still occurs in upper reaches of Winchester Creek which feeds the south end of South Slough. In Charleston, at the mouth of South Slough, the maximum recorded high tide is 3.81m and the minimum recorded low tide is –0.6m. Inputs of wastewater are estimated to contribute 34% of the nitrogen load to the South Slough estuary (Fry et al. 2001, 2003, Cole et al. 2004). Numerous studies of estuarine physical, chemical, and biological relationships in South Slough have been published. In 2003 the HGM project assessed the following wetlands:

Wetland 3060 (Valino Island East, 2 acres) is about 85% high marsh and 15% low marsh. *Deschampsia caespitosa* dominates the high marsh while *Salicornia virginica* and *Distichlis spicata* dominate the low marsh.

Wetland 3070 (Rhodes, 7 acres) is about 20% high marsh and 80% low marsh. A dike was installed sometime after 1939 but is now mostly gone. ATPA and *Argentina egedii* dominate the high marsh while *Salicornia virginica* and *Triglochin maritimum* dominate the low marsh.

Wetland 3086 (Hidden Creek north, 12 acres) is about 25% high marsh and 75% low marsh. A dike was installed sometime after 1939 and subsequently was breached. *Carex obnupta* dominates the high marsh while *Salicornia virginica* and *Triglochin maritimum* dominate the low marsh.

Wetland 3113 (Hidden Creek south, 10 acres) is about 65% high marsh and 35% low marsh. *Deschampsia caespitosa* dominates the high marsh and *Jaumea carnosa* and *Triglochin maritimum* the low marsh. Some sandy dredged material may have been placed here in the early 1990s (Ewing and Seebacher 1997). However, the marsh has never been diked so is relatively unaltered. Ewing and Seebacher (1997) estimated accretion rates of 0.264 to 1.67 cm/yr within this marsh. Plant data are available from S. Simenstad (University of Washington) and from the report by Ewing and Seebacher.

Wetland 3103 (Eliot Creek, 18 acres) is about 95% high marsh and 5% low marsh. A dike was installed sometime before 1939 and subsequently was breached. One marsh transect was done upstream of this breach and the other was downstream. *Carex obnupta* dominates the high marsh and *Carex lyngbyei* the low marsh.

Wetland 3140 (Lattin Marsh, 3 acres) is about 35% high marsh and 65% low marsh. The site was diked in the early 1900s but the dike has been breached since the 1940s. Despite this marsh being open to tidal circulation, tidal marsh plants have been slow to colonize and mudflats currently occupy close to 70% of the intertidal zone. The lower limit of the dominant plants in this marsh was reported as 1.35m above sea level NAVD by Ewing and Seebacher (1997), who also estimated accretion rates of 0.8 (high marsh) to 1.33 (mudflat) cm/yr. *Carex obnupta* dominates the high marsh while *Carex lyngbyei* and *Triglochin maritimum* dominate the low marsh. Plant data are available from S. Simenstad (University of Washington) and from the report by Ewing and Seebacher. The only species reported here previously but not encountered by our transects are *Glaux maritima* and *Hordeum brachyantherum*. Soil salinity during summer was reported as 30-45 ppt by Ewing and Seebacher.

Wetland 3141H (Kunz High Marsh, 2 acres), is about 95% high marsh and 5% low marsh. *Carex obnupta* dominates the high marsh and *Triglochin maritimum* the low marsh. In 1996 part of a dike was intentionally removed and its soil, along with stockpiled topsoil, was spread to raise the elevation of some of the marsh that had subsided by at least 0.8m behind the former dike. An elevation of 2.35m above sea level NAVD was established in 1996. The mean daily duration of tidal flooding was determined to be 0.18 and 0.84 hours in January and August 1999, respectively. . Species reported here previously but not encountered by our transects include *Alopecurus aequalis*, ATPA, *Holcus lanatus*, JUEF, *Lotus corniculatus*, LODE, *Oenanthe sarmentosa*, *Phalaris arundinacea*, and SCMI.

Wetland 3141P (Kunz Passive Marsh, 2 acres), is about 35% high marsh and 55% low marsh. *Eleocharis parvula* and *Triglochin maritimum* currently dominate this marsh, which adjoins the above site, being part of the same restoration project and currently being physically separated from the adjoining marsh by a geotextile sediment barrier. In contrast to the above site, partial removal of a dike was not followed by spreading of sediment to raise its elevation. Its current elevation is 1.5m above sea level NAVD, and passive vertical accretion of sediment is averaging 0.19 cm/yr (Cornu and Sadro 2002). Salinity is reported to range from near 0 ppt during winter floods to 32 ppt during summer low flow. Species reported here previously but not encountered by our transects include *Agrostis stolonifera*, RUMA, ATPA, *Schoenoplectus (Scirpus) cernuus*, *Typha latifolia*.

Wetland 3145 (Wasson-Fredrickson, 12 acres), is about 98% high marsh and 2% low marsh. *Agrostis stolonifera* and *Argentina egedii* dominate the high marsh while *Carex lyngbyei* dominates the low marsh. Species reported here previously but not encountered by our transects include ATPA, *Cotula coronopifolia*, *Distichlis spicata*, JUBU, *Lotus corniculatus*.

Wetland 3149 (Dalton, 16 acres) is about 95% high marsh and 5% low marsh. This marsh is relatively undisturbed, following removal of a dike and partial restoration of natural channel patterns. Fish use is reported by Miller and Sadro (2002). *Carex obnupta* dominates the high marsh and *Carex lyngbyei* the low marsh.

Wetland 3154 (Anderson Creek, 16 acres) is a River-sourced Tidal wetland, with *Carex obnupta* being the dominant plant. The site is immediately at and below the South Slough's head of tide. Channel restoration work was completed recently just above this wetland.

3.18 Coquille

The Coquille estuary covers approximately 1082 acres and has a watershed of 1058 square miles. Head of tide is about 41 miles from the mouth, the farthest inland of any of Oregon's coastal estuaries. The Coquille also is one of the most-diked estuaries of the Oregon coast, with most diking having occurred in the 1870s. The remaining tidal wetlands occupy just 16% of the estuary's area. The lower Coquille River valley is the most important wintering area for waterfowl on the Oregon coast, supporting up to 57,000 ducks and geese. The lower Coquille estuary is listed by The Wetlands Conservancy as one of "Oregon's Greatest Wetlands."

Sampling in 2002 just inside the estuary mouth (6 sediment samples) found no levels known to be biologically harmful with regard to heavy metals, pesticides, PCBs, phenols, phthalates, miscellaneous extractables, or PAHs (COE 2002). Among heavy metals, nickel and silver were closest to potentially harmful levels.

Three tidal wetlands were assessed in 2003, totaling 123 acres (about 29% of the tidal wetland area of the estuary). They are as follows.

Wetland 3425 (Bandon National Wildlife Refuge, 94 acres) is about 80% high marsh and 20% low marsh. *Deschampsia caespitosa* and *Agrostis stolonifera* dominate the high marsh and *Carex lyngbyei*, *Juncus balticus* the low marsh. Species reported here previously but not encountered by our transects include *Castilleja ambigua*, *Carex obnupta*, *Erechtites glomerata*, *Galium triflorum*, *Hordeum brachyantherum*, *Lilaeopsis occidentalis*, PLLA, RUMA, *Schoenoplectus (Scirpus) cernuus*, *Schoenoplectus tabernaemontanii*, and *Trifolium wormskioldii* (Hodder and Graybill 1984, Frenkel and Eilers 1976). The latter authors determined the elevation of the marsh's external edge to be 0.15 to 0.56m above sea level, and the low-to-high marsh transition to be at 1.33m above sea level. Trees were present at 1.39m above sea level. The wetland is managed by the US Fish and Wildlife Service (http://refuges.fws.gov/profiles/index.cfm?id=13596). The town of Bandon, with a small-boat harbor and sewage treatment plant, is located about 1 mile downriver. Early maps indicate this marsh barely existed prior to 1895, and since that time has grown due to rapid sediment accretion and minor dumping of dredge spoil along its external edge. The marsh expanded laterally at a rate of about 70 ft per year between 1887 and 1916, and 5 ft per year between then and 1939 (Johannessen 1961). Most of that expansion occurred along the southern edge. However, comparison of a 2002 aerial photograph with the USGS topographic maps printed in 1970 suggests the marsh might have eroded somewhat at the southerly (seaward) end, perhaps as a result of erosion and/or excavation. The importance of this wetland for migratory shorebirds is recognized by the Northern Pacific Coast Regional Shorebird Management Plan (Drut & Buchanan 2000) and it is designated as an Important Bird Area (IBA) by National Audubon Society. Bird and mammal data from fall, winter, and spring transect surveys in 1983-1984 document use by over 1000 shorebirds per month, with a maximum of about 4000 (Hodder and Graybill 1984). Frenkel believed the adjoining upland spruce forest, situated on a relict dune complex, might be gradually advancing into the high marsh, and he further noted the presence of freshwater seeps. He also measured elevation ranges of four tidal marsh plant communities at this site. Mean quarterly salinity at the closest monthly monitoring site, about a mile upriver, was reported as 1, 14, and 30 ppt (March, June, September).

Wetland 3451 (12 acres, mostly public land) is about 90% high marsh and 10% low marsh. ATPA dominates the high marsh and *Salicornia virginica* the low marsh. Over time the wetland has alternately been a nontidal interdunal wetland, and a tidally connected wetland. Tidal connections have been periodically lost as a result of log accumulations and windblown sand obstructing the outlet channel. By the late 1990s the wetland was 5% of its apparent size in 1861 (M. Scalici, pers. comm.). Aerial photographs from 1939 show it being tidally connected, but it lost its tidal connection at some time after that. The connection was restored in 1999 by excavating the channel blockage. Detailed tidal data have been collected. Mean quarterly salinity at the closest monthly monitoring site, about a hundred meters east at midchannel, was reported as 8, 22, and 31 ppt (March, June, September). DEQ salinity data, by month, are: 10, 11, 19, 16, 29, 28, 31, 31, 33, 33, 26, and 13 ppt.

Wetland 3250 (17 acres, private land) is a River-sourced Tidal wetland. *Phalaris arundinacea* dominates this site.

3.19 Two Mile

Tidal wetlands comprise about 34% of this tiny estuary's area. One tidal wetland (# Wetland 3729) was assessed in 2003, totaling 37 acres, or about 13% of the tidal wetland area of the estuary. It is comprised of about 80% high marsh and 20% low marsh. *Carex obnupta* dominates the high marsh and *Eleocharis palustris* the low marsh. A 1939 aerial photograph shows it being slightly more extensive; drifting sand has apparently reduced its size somewhat. The site is on public land.

3.20 New River

Tidal wetlands comprise about 41% of the area of this geologically-dynamic backdune estuary. BLM has designated its land in the estuary an "Area of Critical Environmental Concern." The importance of this estuary for migratory shorebirds is recognized by the Northern Pacific Coast Regional Shorebird Management Plan (Drut & Buchanan 2000) and it is designated as an Important Bird Area (IBA) by National Audubon Society. Up to 15,000 Aleutian Canada geese use the New River estuary and adjacent pasturelands as a last major stopover area in the spring.

One tidal wetland was assessed in 2003, totaling 12 acres. It is about 35% high marsh and 65% low marsh. *Carex obnupta* dominates the high marsh and *Eleocharis palustris* the low marsh. The site is on public land (BLM).

3.21 Sixes River

The Sixes River estuary is approximately 330 acres in area and has a watershed of approximately 129 square miles. Head of tide is about 2.5 miles from the mouth. The estuary is designated as a Natural estuary under the Oregon Estuary Classification system, and it is listed by The Wetlands Conservancy as one of "Oregon's Greatest Wetlands." Opportunities for wetland restoration have been identified and ranked by Brophy (2004). No tidal wetlands in this estuary were assessed in 2003.

3.22 Elk River

The Elk estuary, located on the Oregon coast at Port Orford, is approximately 290 acres in area and has a watershed of 94 square miles. Head of tide is about 1.5 miles from the mouth. During periods of seasonally low river flow, this estuary sometimes becomes isolated from the ocean. The location of the outlet of this estuary has changed periodically in recent years as a result of shifts in the course of the Elk River (Dicken et al. 1961). The estuary is designated as a Natural estuary under the Oregon Estuary Classification system, and opportunities for wetland restoration have been identified and ranked by Brophy (2004). This estuary's only tidal wetland was assessed in 2003, totaling 3 acres (about 18% of the estuary). It is about 70% high marsh and 30% low marsh. *Carex obnupta*, *Agrostis stolonifera*, and *Agrostis stolonifera* dominate the high marsh and *Carex lyngbyei* the low marsh. The site is mostly on private land.

3.23 Greggs Creek

This tiny estuary is lagoonal, that is, the surface connection to the ocean closes off as freshwater runoff decreases during the summer. A 1-acre wetland with occasional tidal inundation was assessed in 2003. *Argentina egedii*, SCMI, *Schoenoplectus americanus*, and *Eleocharis parvula* dominate. The site is mostly on public land and a rare plant, *Abronia umbellata* ssp. *breviflora,* has been reported to grow along the nearby beach but not in the wetland. The wetland borders Route 101 and may have been altered during highway construction decades ago.

3.24 Rogue

The Rogue River estuary is river-dominated. Its watershed extends far inland and encompasses approximately 5133 square miles, of which about 898 (17%) is estuarine. At its mouth, jetties were constructed in 1959-1960, and dredging since then has been frequent. The location of the outlet of this estuary has changed periodically as a result of shifts in the course of the Rogue River (Dicken et al. 1961). Estuarine influence extends inland about 6 miles, and head of tide is about 4.5 miles from the mouth. Farther upriver, the Rogue has been dammed since 1977, and this had limited upriver salinity penetration of lower reaches during summer. About 121 acres (21%) of the estuary are classified as tidal fresh (<0.5 ppt), 413 (72%) as mixed, and 42 (7%) as seawater. During winter high flow the estuary as a whole is classified as highly stratified, whereas during low summer flow it is classified as moderately stratified. Freshwater detention time within the estuary is estimated to be less than one day, and ratio of annual high to low flow averages 2.433. Tidal range is 4.8 ft near Wedderburn. Mean estuarine depth is 4.6 ft, with an estuarine depth-width ratio of 0.010. Tidal wetlands comprise just 6% of this estuary. Some resource data were compiled by Ratti (1979).

Nickel levels have historically been higher in Rogue River sediments than in other coastal estuaries of Oregon. An analysis in 2002 of Rogue sediments showed levels of nickel averaged 220 ug/kg, which exceeded the level of potential biological concern of 140 ug/kg (Corps of Engineers 2002). No levels known to be biologically harmful were noted for 8 other metals, pesticides, polychlorinated biphenyls (PCBs), phenols, phthalates, miscellaneous extractables, or polynuclear aromatic hydrocarbons (PAHs). USEPA (1991) sampling specifically of the Gold Beach boat basin found elevated levels of nickel (up to 278 ppm), chromium (up to 192 ppm), and cadmium (1 ppm). Levels of three PAH's (phenanthrene, pyrene, fluoranthene) also were of concern.

In 2003, three River-sourced Tidal wetlands were assessed, totaling 15 acres (about 38% of the tidal wetland area of the Rogue estuary).

<u>Wetland 380</u> (Rogue Island, 10 acres), is dominated by *Argentina egedii* and *Lotus corniculatus*, with some *Lilaeopsis occidentalis* and *Eleocharis palustris* in lower portions. At the time of our survey this marsh was an island, but it may connect to mainland during very low river flow. The 1986 topographic map shows it connected. Part of it may have been created on fill after 1990. Some LYSA is present.

<u>Wetland 388</u> (Rogue peninsula, 3 acres), is dominated by *Argentina egedii* and *Festuca arundinacea* A small marsh located nearby (as shown in a 1939 airphoto) was filled to support construction of the marina.

<u>Wetland 405</u> (Rogue Harbor west, 1 acre), is dominated by *Festuca arundinacea*, *Juncus balticus*, *Schoenoplectus americanus*, and *Eleocharis palustris* The site is well-sheltered on its upriver side and open on its downriver side.

Table 5. Water and sediment quality data in the vicinity of surveyed wetlands in the Rogue estuary, from the DEQ LASAR database

Stn	Parameter	Units	Matrix	Samples	Min	Max
25653	AL:_total	mg/K	S	2	47300	48100
20709	Ammonia as Nitrogen	mg/L		3	0.02	0.37
25653	Ammonia as Nitrogen	mg/L		2	0.06	0.08
25653	Anthracene	‘g/K	S	1		85
25653	Antimony	mg/K	S	1		1.2
25653	Arsenic	mg/K	S	2	7.4	8.3
25653	Cadmium	mg/K	S	2	0.246	0.285
25653	Chromium	mg/K	S	2	322	346
25653	CU:_total	mg/K	S	2	53.9	54.1
25653	FE:_total	mg/K	S	1		52500
25653	Fluoranthene	‘g/K	S	1		68
25653	gamma-BHC (Lindane)	‘g/K	S	2	4	4.2
25653	Lead:_total	mg/K	S	2	15.6	15.9
25653	Mercury	mg/K	S	2	0.0976	0.101
25653	MN:_total	mg/K	S	2	1250	1350
25653	NI:_total	mg/K	S	2	322	326
20709	Nitrate/nitrite as N	mg/L		3	0.0754	0.198
25653	Nitrate/nitrite as N	mg/L		2	0.136	0.161
20709	Orthophosphate as P	mg/L		3	0.017	0.032
25653	Orthophosphate as P	mg/L		2	0.049	0.054
25653	pH	SU		1		8.1
25653	Salinity (September)	ppth		1		6.9
25653	Selenium	mg/K	S	2	0.54	0.58
25653	Silver:_total recoverable	mg/K	S	2	0.162	0.182
20709	Total Organic Carbon	mg/L	S	1		13500
25653	Total Organic Carbon	mg/K	S	2	27600	29100
20709	Total Suspended Solids	mg/L		2	1	10
25653	Total Suspended Solids	mg/L		2	10	11
25653	Turbidity	NTU		2	7	7.2
25653	ZN:_total	mg/K	S	2	108	110

3.25 Pistol River

The Pistol River estuary covers approximately 230 acres and has a watershed of 106 square miles. During periods of seasonally low river flow, this estuary sometimes becomes isolated from the ocean at its mouth Head of tide is about 1 miles from the mouth, but there are few if any tidal wetlands, and none were surveyed in 2003.

3.26 Chetco

A relatively small (171 acre) estuary, the Chetco drains an area of 365 square miles. Its head of tide is located only 3.5 miles inland. Late summer river flows are very small and tidal wetlands occupy only 3% of the estuary. The location of the outlet of this estuary has changed occasionally as a result of shifts in the course of the Chetco River (Dicken et al. 1961). Construction of jetties was completed in 1958 and subsequent harbor development and periodic dredging eliminated a tidal wetland to the east of the river (Dicken et al. 1961). Dredging is done almost annually near the estuary mouth and harbor. Some channelization also was done in 1970. Tidal dynamics were described by Tang (1977), and resource data were compiled by Ratti & Kreag (1979), The USEPA (1991) reported detectable levels of pesticides, TBT, PAHs, PCBs, and heavy metals (including mercury) in sediments, but none were "unusually high." DEQ sampling data from the estuary are as follows (for details, see Oregon DEQ-LASAR web site):

Stn	Parameter	Units	Matrix	Samples	Max
25667	AL:_total	mg/K	S	1	65600
25667	Ammonia as Nitrogen	mg/L		1	0.19
25667	Antimony	mg/K	S	1	1
25667	Arsenic	mg/K	S	1	6.7
25667	Chromium	mg/K	S	1	165
25667	CU:_total	mg/K	S	1	35.9
25667	FE:_total	mg/K	S	1	38600
25667	Lead:_total	mg/K	S	1	9.2
25667	Mercury	mg/K	S	1	0.0697
25667	MN:_total	mg/K	S	1	571
25667	NI:_total	mg/K	S	1	85.6
25667	Nitrate/nitrite as N	mg/L		1	0.156
25667	Orthophosphate as P	mg/L		1	0.074
25667	pH	SU		1	7.8
25667	Salinity	ppth		1	19.7
25667	Silver:_total recoverable	mg/K	S	1	0.06
25667	Total Organic Carbon	mg/K	S	1	6510
25667	Total Suspended Solids	mg/L		1	11
25667	Turbidity	NTU		1	2.3
25667	ZN:_total	mg/K	S	1	78.1

In 2003 one tidal wetland (Wetland 488) was assessed, totaling 4 acres (about 60% of the tidal wetland area of the estuary). *Festuca* sp. and *Deschampsia caespitosa* dominated this River-sourced Tidal wetland. The site is mostly on private land.

3.27 Winchuck

Located on the Oregon-California border, the Winchuck estuary is approximately 130 acres in area and has a watershed of 70 square miles. Head of tide is about 1 mile from the mouth. Only 3% of the estuarine area is tidal wetland, and none of it was assessed in 2003.

4.0 Sources and Analysis Methods for the Spatial Data

This section describes the statistical profiles presented in Appendices B, C, and D.

Few previous attempts have been made to compile existing spatial data comprehensively on Oregon coastal wetlands. This has been the situation despite guidance recommending that wetland resources be given greater consideration in watershed assessments, e.g., *Oregon Watershed Assessment Manual* (Watershed Professionals Network 1999), *State of the Oregon Environment Report: Estuaries* (Good 2001). Individual watershed councils and government agencies in coastal Oregon have sometimes used GIS to compile data tables and maps on various environmental themes at particular estuaries or watersheds, but few have done so coastwide. Exceptions are two interrelated projects—Oregon DLCD's Estuary Plan Book and OSU's Oregon Coastal Atlas—but to date these have not had a data layer covering tidal marshes specifically and comprehensively.

For this project, the best spatial data available at the time of analysis were used. Nonetheless, some of the data had significant limitations. These limitations are often compounded when multiple digital layers are overlaid. Because of these limitations, results reported herein should be quoted and applied only with caution and with warnings to readers about the data limitations.

National Wetland Inventory (NWI) wetlands: The NWI wetland digital maps were downloaded in summer 2002 from wetlands.fws.gov/downloads.htm and were the basis for the queries shown in Appendix B. Following the completion of those queries and our field work during summer 2003, a more recent version of the maps became available from NWI. With partial support from this project, that version was edited based partly on our field observations, as the major part of Russell Scranton's master's thesis at Oregon State University. Only limited queries of that newer data set were conducted (i.e., no overlays with other themes were performed) and were the basis for Table 3.

No digital layer showing tidal wetlands is available for all or part of 12 of 63 quadrangles that include tidal waters in our project region (unavailable digitally: Tidewater, Eddyville, Elk City, Foley Peak, Soapstone Lake, Mowrey Landing, Tiernan, Kilchis River, Toledo North, Toledo South, Devil's Lake, Mapleton). All of these quads are located upriver of most of the tidal wetlands, and would be expected to include only a limited additional area of freshwater tidal wetlands. Elsewhere, NWI maps may fail to show many narrow marshes along the fringes of bays and rivers, being limited by the 1:58,000 scale of the black-and-white aerial photographs from which NWI identified the wetlands and then produced 1:24,000 scale maps. NWI also reports that polygons visible on hard-copy versions of the maps occasionally do not appear in the digital versions. The scale of the original photography limits the ability of the maps to represent comprehensively some site alterations ("modifiers"): diking, excavation, spoil placement, ditching, and beaver dams. In addition, NWI map accuracy is limited because the maps are based on early-1980's (and in some cases 1970's and earlier) imagery. It is likely that some number of Oregon coastal wetlands have since been converted to other uses. This is currently being determined by a project sponsored by NWI, USEPA, and Oregon DSL.

Separating tidal marshes from other wetlands on NWI maps is sometimes difficult, because some emergent (marsh) wetland polygons that border and are connected to tidal rivers are classified as "palustrine" rather than "estuarine," on account of NWI using salinity in addition to tidal influence to distinguish these systems. Usually, such palustrine wetlands are labeled with a modifier that denotes tidal influence, but we noted several instances where undiked wetlands were labeled as palustrine by despite being located along fringes of tidal rivers downriver from the head-of-tide. It was uncertain whether these polygons were mislabeled by NWI, or if the DSL determination of head-of-tide was inaccurate, or if what appeared to be a fringe wetland was actually located much higher than the adjoining channel, e.g., slope wetlands.

In addition, measurements of "edge" using NWI or other maps are limited by the scale of the map source. At coarser scales, finely convoluted edges will be depicted as straighter, more direct lines. Thus, statistics representing water-wetland edge and upland-wetland edge, for example, will substantially underestimate the true amount of edge if measured from NWI maps.

Oregon Department of Fish & Wildlife (ODFW) habitat (tidal marshes): Based on 1970's mapping, this layer is somewhat older than the NWI layer and has similar or more severe limitations with regard to scale and availability of digital maps for inland areas. For the same counties and watersheds, the total acreage of tidal marsh as depicted by these maps is substantially less than depicted by the NWI maps. We obtained the layer directly from the Oregon Estuary Plan Book web site during summer 2002: http://www.inforain.org/mapsatwork/oregonestuary/datasets.htm .

Watershed Boundaries: These boundaries were downloaded from the Oregon Geospatial Data Clearinghouse (www.sscgis.state.or.us/) during summer 2002 and mostly depict "fifth field" watersheds, although some finer divisions of watersheds were obtained for localized areas. The boundaries do not delimit precisely the upland areas that contribute runoff or channel flow to individual wetlands, nor do they delimit discrete estuaries Rather, the boundaries delimit broad runoff zones (entire river basins, in some cases) that contain multiple wetland polygons. For the study region, 36 watersheds are defined and labeled in the layer we obtained. The layer sometimes aggregates small "frontal" watersheds—those representing catchments of minor streams that flow directly into the ocean—with larger nearby watersheds with which the streams share no hydrologic connection other than the ocean.

Geology: This digital layer was downloaded from the Oregon Geospatial Data Clearinghouse (www.sscgis.state.or.us/) during summer 2002 and is based on mapping of geologic features at a coarse scale (1:100,000). The map was initially published as *Geologic Map of Oregon (Walker, G.W., and MacLeod, N.S., 1991,. U. S. Geological Survey, Portland, OR)*. Its limitations are unknown, but at such as coarse scale, the data provided should be interpreted only as describing a wetland polygon's general geologic setting – not the substrate within the confines of the polygon.

Soils: Known as the SUURGO layer, this is NRCS's digital rendition of county soil survey maps plotted at a scale of 1:24,000. This layer was not available for Tillamook County. The layer was downloaded from the NRCS web site during summer 2002. To characterize the edaphic settings of wetlands identified by NWI or ODFW, we overlaid this with the tidal marsh polygons. We also used the soils layer to map hydric soils in selected subregions, inferring hydric status from information in the supporting NRCS database.

Ownership: We downloaded digital data on land ownership that had been compiled by previous projects – CLAMS, covering the coast north of about Port Orford (www.fsl.orst.edu/clams/) and

Oregon Gap (www.sscgis.state.or.us/), used to fill in layer for areas south of Port Orford. The maps show only very large parcels (a total of just 120 owners are identified for the entire coast), and have not been updated for over a decade. Because of the coarse scale (1:126,720) of the original data, the layer is unsuitable for identifying landowners along the margins of individual wetlands. However, it provides a general characterization of the ownership in nearby areas, e.g., large timber company, municipal entity, state agency.

Elevations: Digital elevation model (DEM) data compiled by BLM, USGS, and the USFS were obtained from the CLAMS project (www.fsl.orst.edu/clams/). The data provide a fairly precise vertical resolution of 10 meters, and a less precise vertical resolution of 3 meters.

Land Cover: Two sources of land cover information were used. For areas north of Port Orford, 1996 vegetation data from the CLAMS project (www.fsl.orst.edu/clams/) were compiled, whereas south of there, early 1990's vegetation spatial data at a scale of 1:100,000 prepared by the Oregon Natural Heritage for the statewide "Gap" project were downloaded from the Oregon Geospatial Data Clearinghouse (www.sscgis.state.or.us/). The coarseness of these layers allows for only a general characterization of land cover types around individual wetlands. Also, in some sections of the coast substantial shifts in land cover types have probably occurred, largely as a result of development and forest fires, since the time these layers were interpreted from early-1990's aerial imagery.

Digital layers from the sources described above were tiled (joined together at their geographic edges) where necessary and reprojected to a scale of 1:24,000 in the Lambert Projection. ESRI's ArcMap and ArcCatalog software was used to manipulate the layers, and to generate shapefiles and accompanying database files. Additional variables were measured digitally or categorized visually from the above maps. These include marsh polygon maximum dimension, area, perimeter, geomorphic setting (e.g., fringe or pocket marsh), aspect, fetch (open water distance); and marsh distance to closest other tidal marsh, head-of-tide, and estuary mouth.

5.0 Nontidal Wetlands of Oregon Coastal Watersheds

Although not a primary focus of this guidebook, coastal nontidal wetlands and the functions they support are closely linked with those of tidal wetlands. For this reason, some initial profiling and statistical analyses were conducted of their distributional patterns and factors that may predict hydrogeomorphic type, size, and isolation. Comprehensive analysis was constrained severely by lack of any field-checking of NWI wetland map accuracy, and especially, the complete lack of digitized wetland maps in approximately 65% of the area covered by Oregon's coastal watersheds. Therefore, data were compiled using a dual approach: (a) five major watersheds ("basins") with complete coverage were profiled somewhat comprehensively and specific relationships were examined using an advanced statistical package (a decision-tree application that uses the algorithm, CHAID), and (b) separately, whatever digitized wetland spatial data were available for the remaining watersheds were compiled but not analyzed statistically. More details on the methods and results are provided by Larsen (2005); presented below are some examples of outputs from that work. Considerable opportunity remains for exploring these data further to elicit a better understanding of factors associated with occurrence and characteristics of coastal nontidal wetlands in Oregon. An enhanced understanding will, among many benefits, allow for improved prediction of the geotechnically best locations for creating and/or restoring wetlands.

The following summaries pertain only to areas mapped as palustrine wetlands by the National Wetlands Inventory (NWI). In most cases such wetlands are nontidal but there are exceptions, and not all nontidal wetlands are palustrine (although the majority are). These summaries are based on just the five major watersheds with complete NWI digital coverage: Coos, Coquille, Umpqua, Tenmile, and Siltcoos. The tables referenced are located in Appendix C of this part of the guidebook.

- By area, approximately 96% of the palustrine wetlands exist on soil map units classified as hydric (Table C2).

- About 19% of the soil units mapped as hydric do not have palustrine wetlands according to NWI maps.

- The most prevalent palustrine wetland vegetation type by area and number of polygons is Emergent (about one-third of the palustrine wetlands), followed by Scrub-shrub and Forested (Table C3).

- The most prevalent water regime in palustrine wetlands is seasonally flooded, followed by temporarily flooded and permanently flooded (Table C4).

- From aerial photographs, the NWI noticed alterations in about 12% of the palustrine polygons. The most common alteration is diking (9%), followed by excavation (2%) (Table C5).

- Nearly 61% of the palustrine wetlands are within 10 m of a mapped road.

- Between 21 and 27% of the palustrine wetlands (8-9% by area) may currently lack surface connections to other wetlands and streams (i.e., " isolated," depending on how this is defined). Such wetlands average smaller than palustrine wetlands generally (Table C6). About 54% (76% by area) of the palustrine wetlands are within the 100-year floodplain as defined by FEMA (Table C7).

- About 24% of the palustrine wetlands (11% by area) are farther than 20 m from a stream or river; about 20% (9% by area) are farther than 40 m (Table C6).

- The greatest number of palustrine wetlands are associated with mixed conifer forest (17%), coastal dunes (15%), and agriculture (11%) (Table C8). More are in the Coastal Lowlands ecoregion (50% by number, 61% by area), followed by the Mid-sedimentary ecoregion (23% and 14% respectively) (Table C9).

- As expected, most (52% by number, 80% by area) of the palustrine wetlands are on slopes less than 2.5%, but 9% (2% by area) are on slopes steeper than 12.5%. Isolated (as defined above) wetlands are more likely to be on steeper slopes and at higher elevation (Table C10).

By exploring these data statistically, more precise contingent rules and thresholds were defined. For example:

- If a palustrine wetland in these watersheds is classified as open water (e.g., PUSA or PUSC) and it is located within the Coastal Lowlands Ecoregion between elevations of 20 feet and 430 feet, then there is a 77.5% chance that the polygon is in the Isolated 'A' scenario. If a palustrine wetland in these watersheds is classified as open water and it is located within the Coastal Lowlands Ecoregion between elevations of 0 and 20 feet then there is a 22.4% chance that the polygon is in the Isolation 'A' scenario.

- If a palustrine wetland in these watersheds is classified as open water (e.g., PUSA or PUSC) and is located within the Coquille watershed with a flow accumulation between 0 to 33 units (a modeled variable derived using ArcHydro software), then there is an 80% chance that the polygon is in the Isolation 'A' scenario'. For palustrine wetlands in the Coquille watershed, polygons with a flow accumulation value of 546 or less have a greater probability of being isolated. Each of the 5 analyzed watersheds is associated with a different variable that is most predictive of isolated wetland presence.

- If a palustrine wetland is classified as Aquatic Bed or Emergent-Saturated) and is located on hydric soil, then there is a 48% chance that it is associated with Isolation Scenario 'A'; or if it is Emergent-Saturated and is located on *non*-hydric soil then there is an even greater chance (68%) it is associated with Isolation scenario 'A''. In contrast, for open-water palustrine wetlands, isolation is significantly related to the presence of hydric soils *within a particular elevation range*.

- Among all palustrine wetlands in these watersheds, soil units mapped as hydric were at lower elevations and on flatter slopes than non-hydric soils.

- Palustrine wetlands were significantly more likely to be on hydric soil if mean slope was less than 4.79 degrees, and if values of the "compound topographic index" calculated by the ArcHydro application were greater than 11.12. When slope was greater than 4.79 degrees, the association of palustrine wetlands with hydric soils tended to dissolve.

- Palustrine wetlands associated with Soil Group A[3] have a much lower probability of being Emergent palustrine wetlands if they occur at elevation higher than 70 feet, with one exception. If a palustrine wetland is mapped as Milbury-Bohannon-Umpcoos, Preacher-Bohannon, or Willanch fine silt loam and is located at elevations between 70 and 430 feet within the Coastal Lowlands or Coastal Uplands ecoregions, the chance of it being an emergent wetland is as high as 80%.

- If a palustrine wetland is located in the Tenmile watershed within the Coastal Uplands ecoregion and is located on soils not mapped as hydric, the chance of it being an emergent wetland is 77%. If the same wetland is located on soils mapped as hydric, there is a decreased probability (56%) that the wetland vegetation is classified as emergent – it probably is more likely to be forested, shrub, or some other type.

- Within the Coos watershed complex, palustrine emergent wetlands within the Coastal Lowlands ecoregion are most closely associated with soil type; within the Coastal

[3] Nehalem silt loam, Nestucca silt loam, Willanch fine silt loam, Templeton silt loam (<30% slope), Waldport dune complex (<30% slope), Milbury-Bohannon-Umpcoos association, Preacher-Bohannon association

Uplands ecoregion they are most closely associated with geologic type; and within the Mid-Coastal Sedimentary ecoregion they are most closely associated with elevation.

6.0 Literature Cited

See part 2 of this guidebook series.

Appendix A.

Statistical summaries of selected water quality parameters from parts of Oregon estuaries nearest the surveyed tidal marshes, as reported in existing government databases

Table A1. Salinity and pH of Oregon coastal tidal water samples, 1999-2004, as reported in the STORET database of the USEPA.

Note the small numbers of records (n). These should not be construed as representative because samples were from a wide variety of non-systematic dates, times, and depths. Values below the detectable limit are reported here as "0.0"

Estuary	Subunit	Station	Salinity (ppt)				pH			
			Max	Min	Mean	n	Max	Min	Mean	n
Alsea	Alsea River	OR99-0027	14.7	6.5	10.6	2	7.4	7.3	7.4	2
Coos	Catching Slough	OR99-0048	20.9	17.8	19.1	5	7.3	7.3	7.3	1
Coos	Catching Slough	OR99-0049	15.1	13.2	14.1	6	7.1	7.1	7.1	1
Coos	Coos Bay	OR99-0039	30.2	30.2	30.2	1	7.9	7.8	7.9	2
Coos	Coos Bay	OR99-0040	30.1	30.0	30.1	2	7.9	7.8	7.9	2
Coos	Coos Bay	OR99-0041	29.3	29.1	29.2	2	7.7	7.7	7.7	1
Coos	Coos Bay	OR99-0042	32.7	32.3	32.5	2	7.9	7.8	7.9	2
Coos	Coos Bay	OR99-0043	29.4	29.4	29.4	1	7.8	7.7	7.8	2
Coos	Coos Bay	OR99-0044	31.8	31.8	31.8	1	8.1	8.0	8.1	2
Coos	Coos River	OR99-0046	13.9	12.3	13.3	5	7.3	7.3	7.3	1
Coos	Coos River	OR99-0047	23.5	20.9	22.3	11	7.5	7.4	7.5	2
Coos	South Slough	OR99-0045	31.7	31.7	31.7	1	8.0	8.0	8.0	1
Nehalem	Nehalem River	OR99-0018	31.7	31.6	31.7	2	7.9	7.9	7.9	1
Nestucca	Little Nestucca River	OR99-0021	15.0	15.0	15.0	1	7.6	7.6	7.6	1
Nestucca	Nestucca River	OR99-0020	5.2	3.3	4.4	7	7.5	7.5	7.5	1
Netarts	Netarts Bay	OR99-0019	31.8	31.8	31.8	1	8.0	8.0	8.0	1
Rogue	Rogue River	OR99-0050	22.9	2.7	7.6	5	8.0	7.9	8.0	2
Salmon	Salmon River	OR99-0022	31.4	31.4	31.4	1	8.0	8.0	8.0	1
Siletz	Siletz Bay	OR99-0023	31.4	31.4	31.4	1	7.7	7.7	7.7	1
Siuslaw	Siuslaw River	OR99-0030	31.5	26.6	29.5	3	8.0	7.7	7.9	3
Siuslaw	Siuslaw River	OR99-0031	0.0	0.0	0.0	1	7.3	6.7	6.9	3
Tillamook	Tillamook Bay	OR99-0051	31.5	31.5	31.5	1	7.9	7.8	7.9	2
Tillamook	Tillamook Bay	OR99-0053	32.5	32.1	32.3	2	8.2	8.1	8.2	2
Tillamook	Tillamook Bay	OR99-0054	31.8	31.2	31.5	2	7.7	7.5	7.6	2
Umpqua	Scholfield Creek	OR99-0037	7.3	7.3	7.3	1	7.9	7.9	7.9	1
Umpqua	Smith River	OR99-0033	3.5	3.2	3.4	4	7.1	7.1	7.1	1
Umpqua	Umpqua River	OR99-0032	13.0	13.0	13.0	1	8.0	8.0	8.0	1
Umpqua	Umpqua River	OR99-0034	25.8	25.5	25.7	2	7.9	7.9	7.9	1
Umpqua	Umpqua River	OR99-0036	17.3	15.6	16.6	3	8.0	7.9	8.0	2
Umpqua	Umpqua River	OR99-0038	6.7	6.7	6.7	1	7.5	7.5	7.5	1
Yachats	Yachats River	OR99-0028	1.0	1.0	1.0	1	8.0	8.0	8.0	1
Yaquina	Yaquina Bay	OR99-0024	31.6	31.2	31.4	3	7.8	7.5	7.7	3
Yaquina	Yaquina River	OR99-0025	30.2	30.2	30.2	1	7.8	7.7	7.8	2
Yaquina	Yaquina River	OR99-0026	24.1	24.1	24.1	1	7.3	7.3	7.3	1

Table A2. Phosphorus and total suspended solids in Oregon coastal tidal water samples, 1999-2004, as reported in the STORET database of the USEPA.

These should not be construed as representative because samples were from a wide variety of non-systematic dates, times, and depths. Also note the small numbers of samples (n). Values below the detectable limit are reported here as "0.0"

			Phosphorus (µg/L orthophosphate)				Total Suspended Solids (mg/L)			
Estuary	Subunit	Station	Max	Min	Mean	n	Max	Min	Mean	n
Alsea	Alsea River	OR99-0027	8.0	6.0	7.0	2	5.0	5.0	5.0	1
Coos	Catching Slough	OR99-0048	12.0	8.0	9.7	3	15.5	9.0	11.8	3
Coos	Catching Slough	OR99-0049	4.0	0.0	2.0	2	9.0	8.0	8.5	2
Coos	Coos Bay	OR99-0039	22.0	16.0	18.3	3	15.0	8.0	12.3	3
Coos	Coos Bay	OR99-0040	29.0	23.5	26.3	2	16.0	15.0	15.5	2
Coos	Coos Bay	OR99-0041	31.0	14.0	20.7	3	31.0	14.0	24.3	3
Coos	Coos Bay	OR99-0042	31.0	14.0	20.7	3	13.0	8.0	11.2	3
Coos	Coos Bay	OR99-0043	18.0	14.0	16.0	2	20.0	14.0	17.0	2
Coos	Coos Bay	OR99-0044	23.5	18.0	20.8	2	17.0	7.0	12.0	2
Coos	Coos River	OR99-0046	0.0	0.0	0.0	1	12.0	8.0	10.0	3
Coos	Coos River	OR99-0047	10.0	6.0	8.3	3	19.0	15.0	16.7	3
Coos	South Slough	OR99-0045	26.0	21.0	23.5	2	16.0	14.0	15.0	2
Nehalem	Nehalem River	OR99-0018	46.5	44.0	45.3	2	14.0	14.0	14.0	1
Nestucca	Little Nestucca R.	OR99-0021	12.0	12.0	12.0	1	8.0	8.0	8.0	1
Nestucca	Nestucca River	OR99-0020	24.5	20.0	21.8	3	13.0	2.0	6.3	3
Netarts	Netarts Bay	OR99-0019	44.5	44.5	44.5	1	16.0	9.0	12.5	2
Rogue	Rogue River	OR99-0050	32.0	16.5	24.3	2	10.0	1.0	5.5	2
Salmon	Salmon River	OR99-0022	27.0	27.0	27.0	1	14.0	14.0	14.0	1
Siletz	Siletz Bay	OR99-0023	57.0	57.0	57.0	1	11.0	11.0	11.0	1
Siuslaw	Siuslaw River	OR99-0030	18.0	2.0	12.0	3	14.0	8.0	11.0	2
Siuslaw	Siuslaw River	OR99-0031	5.0	0.0	2.5	2	3.0	2.0	2.5	2
Tillamook	Tillamook Bay	OR99-0051	38.0	36.0	37.0	2	15.0	8.0	12.0	3
Tillamook	Tillamook Bay	OR99-0052	28.0	27.0	27.5	2	18.0	15.0	16.5	2
Tillamook	Tillamook Bay	OR99-0053	31.7	14.0	20.9	3	29.5	6.0	15.8	3
Tillamook	Tillamook Bay	OR99-0054	40.5	31.0	35.8	2	50.0	10.0	30.0	2
Umpqua	Scholfield Creek	OR99-0037	7.0	7.0	7.0	1				
Umpqua	Smith River	OR99-0033	7.0	6.0	6.5	2	4.0	3.0	3.5	2
Umpqua	Umpqua River	OR99-0032	9.0	9.0	9.0	1	12.0	12.0	12.0	1
Umpqua	Umpqua River	OR99-0034	23.0	22.0	22.5	2	17.0	7.0	12.0	2
Umpqua	Umpqua River	OR99-0036	7.0	0.0	4.3	3	21.0	6.0	14.0	3
Umpqua	Umpqua River	OR99-0038	5.0	5.0	5.0	1	4.0	4.0	4.0	1
Yachats	Yachats River	OR99-0028	7.0	7.0	7.0	1	1.0	1.0	1.0	1
Yaquina	Yaquina Bay	OR99-0024	68.0	28.0	43.0	3	17.0	10.0	14.3	3
Yaquina	Yaquina River	OR99-0025	34.0	33.0	33.5	2	16.0	14.0	15.0	2
Yaquina	Yaquina River	OR99-0026	16.0	16.0	16.0	1	9.0	9.0	9.0	1

Table A3. Nitrate and ammonium in Oregon coastal tidal water samples, 1999-2004, as reported in the STORET database of the USEPA

These data should not be construed as representative because samples were from a wide variety of non-systematic dates, times, and depths. Also note the small numbers of samples (n). Values below the detectable limit are reported here as "0.0"

			Nitrate (NO3, µg/L)				Ammonium (NH4)			
Estuary	Subunit	Station	Max	Min	Mean	n	Max	Min	Mean	n
Alsea	Alsea River	OR99-0027	88.1	66.1	77.1	2	60.0	40.0	50.0	2
Coos	Catching Slough	OR99-0048	75.8	69.6	73.4	3	110.0	61.5	80.5	3
Coos	Catching Slough	OR99-0049	83.9	77.9	81.0	3	50.0	30.0	40.0	2
Coos	Coos Bay	OR99-0039	41.7	35.4	38.8	3	230.0	190.0	216.0	3
Coos	Coos Bay	OR99-0040	24.9	22.3	23.6	2	250.0	240.0	245.0	2
Coos	Coos Bay	OR99-0041	213.0	166.0	195.0	3	240.0	210.0	226.7	3
Coos	Coos Bay	OR99-0042	39.3	31.2	36.5	3	230.0	215.0	221.7	3
Coos	Coos Bay	OR99-0043	41.2	39.4	40.3	2	230.0	230.0	230.0	1
Coos	Coos Bay	OR99-0044	41.7	31.7	36.7	2	230.0	220.0	225.0	2
Coos	Coos River	OR99-0046	50.4	47.4	48.9	2	30.0	20.0	25.3	3
Coos	Coos River	OR99-0047	57.3	49.6	52.9	3	100.0	50.0	80.0	3
Coos	South Slough	OR99-0045	116.0	114.0	115.0	3	200.0	189.0	193.0	3
Nehalem	Nehalem River	OR99-0018	222.4	215.9	219.1	2	340.0	295.0	317.5	2
Nestucca	Little Nestucca R.	OR99-0021	105.0	105.0	105.0	1	90.0	90.0	90.0	1
Nestucca	Nestucca River	OR99-0020	235.0	215.0	222.7	3	40.0	0.0	20.0	3
Netarts	Netarts Bay	OR99-0019	148.8	137.1	142.9	2	433.5	380.0	406.8	2
Rogue	Rogue River	OR99-0050	198.0	75.4	117.5	3	370.0	20.0	140.0	3
Salmon	Salmon River	OR99-0022	131.1	131.1	131.1	1	268.0	268.0	268.0	1
Siletz	Siletz Bay	OR99-0023	298.0	298.0	298.0	1	580.0	580.0	580.0	1
Siuslaw	Siuslaw River	OR99-0030	99.0	10.2	56.3	3	240.0	150.0	202.0	3
Siuslaw	Siuslaw River	OR99-0031	33.3	30.6	32.0	3	41.0	30.0	37.0	3
Tillamook	Tillamook Bay	OR99-0051	160.0	146.0	152.3	3	250.0	230.0	240.0	3
Tillamook	Tillamook Bay	OR99-0052	96.1	75.6	82.8	3	259.0	240.0	248.7	3
Tillamook	Tillamook Bay	OR99-0053	147.8	31.2	70.5	3	260.0	200.0	225.6	3
Tillamook	Tillamook Bay	OR99-0054	206.1	171.0	188.5	2	220.0	219.0	219.5	2
Umpqua	Scholfield Creek	OR99-0037	18.5	18.5	18.5	1	50.0	50.0	50.0	1
Umpqua	Smith River	OR99-0033	49.5	45.7	47.8	3	30.0	0.0	15.0	2
Umpqua	Umpqua River	OR99-0032	10.6	10.6	10.6	1	30.0	30.0	30.0	1
Umpqua	Umpqua River	OR99-0034	101.0	88.9	95.0	2	144.5	140.0	142.3	2
Umpqua	Umpqua River	OR99-0036	8.3	7.5	7.9	3	161.5	30.0	83.8	3
Umpqua	Umpqua River	OR99-0038	5.3	5.3	5.3	1	32.5	32.5	32.5	1
Yachats	Yachats River	OR99-0028	109.0	109.0	109.0	1	30.0	30.0	30.0	1
Yaquina	Yaquina Bay	OR99-0024	44.0	30.9	38.3	3	300.0	290.0	295.0	2
Yaquina	Yaquina River	OR99-0025	56.2	56.0	56.1	2	310.0	185.0	247.5	2
Yaquina	Yaquina River	OR99-0026	124.0	124.0	124.0	1	130.0	130.0	130.0	1

APPENDIX B. Statistical profile of Oregon tidal wetlands, excluding those of the Columbia Estuary

Except where noted otherwise, the tables that follow are based on queries of the 2002 digital version of the NWI wetland maps, not the version included on the DVD (which was the source of Table 1 on p. 2). These are just a sampling of many queries that might be executed with this data set to better understand the characteristics and settings of Oregon's tidal marshes.

Table B1. Acreage of tidal wetlands on the Oregon Coast, by county

County	Acres
Clatsop	89
Coos	3465
Curry	218
Douglas	983
Lane	1078
Lincoln	2752
Tillamook	3316

Table B2. Acreage of tidal wetlands on the Oregon Coast, by estuarine position and salinity regime of adjoining waters

	Lower Estuary*	Mid Estuary*	Upper Estuary*
Marine	368	78	1308
Marine-Brackish	473	59	216
Brackish	1757	1000	685
Brackish-Fresh	709	1902	1925
Fresh	67	552	805

*

Table B3. Acreage of tidal wetlands on the Oregon Coast, by distance to nearest downstream tidal wetland and by salinity regime

	Distant (<350 ft)	Mid-distant (150-350 ft)	Near (<150 ft)
Marine	992	569	164
Marine-Brackish	464	247	29
Brackish	2264	455	586
Brackish-Fresh	2471	828	961
Fresh	1220	110	49

Table B4. Acreage of tidal wetlands on the Oregon Coast, by geomorphic setting

	Island Marsh	Shore Marsh	Pocket Marsh
Bay Fringe	199	1817	950
Channel Fringe	1581	4322	3031

("pocket marshes" are ones mostly surrounded by upland; "shore marshes" have a major portion of their perimeter along bays or channels; "island marshes" exist entirely as islands within rivers or bays)

Table B5. Acreage of tidal wetlands on the Oregon Coast, by fetch category and aspect

"Fetch" is open water distance from the wetland external edge. "Aspect" is the compass direction to which most of a wetland's water drains.

Aspect:	Large Fetch	Medium Fetch	Small Fetch	undeter-mined
N	564	512	282	232
NE	130	17	47	12
E	478	359	71	22
SE	1099	111	82	0
S	334	565	43	80
SW	881	107	51	9
W	1058	293	558	31
NW	838	499	44	2
X	0	25	583	35
I	1513	219	52	21
Q	15	0	29	0

X= no apparent aspect, I= island; Q= aspect undetermined

Table B6. Acreage of tidal wetlands on the Oregon Coast, by size category and adjoining geologic strata

	Small	Mid-sized	Large	undeter-mined
Jop	7	6	25	0
KJds	0	9	0	0
OW	106	168	3058	258
Qal	2013	72	1795	57
Qd	34	21	109	12
Qs	0	8	323	16
Qt	52	61	348	27
Ta	5	0	313	2
Tm	23	5	20	0
Tms	2	6	64	1
Tmsm	0	14	0	0
Tpb	2	2	0	0
Tsd	0	1	0	0
Tss	119	61	1197	2
Tt	678	32	564	111
Ttv	0	3	16	1
Tyq	63	6	0	0

Table B7. Acreage of tidal wetlands on the Oregon Coast, by adjoining land cover (CLAMS data) and soil series

Note: Due to the unavailability of digitized land cover and soils data for some portions of the coast, these data are not comprehensive

Soil Series:	V.Large Conifer Forest	Large Conifer Forest	Large Mixed Forest	Medium Conifer Forest	Medium Mixed Forest	Small Conifer Forest	Small Mixed Forest	Hard-wood Forest	Open Forest	Open Non-forest	Other Vege-tated	Water	Undeter-mined
Bagness-Pistol River complex; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	2	0	0
Bandon sandy loam; 0 to 7 % slopes	0	0	0	0	0	0	0	1	0	0	0	0	0
Beaches	0	2	0	0	0	0	0	0	0	0	1	0	0
Beaches; 1 to 3 % slopes	0	0	0	0	0	0	0	0	19	0	0	0	0
Bohannon gravelly loam; 50 to 90 % slopes	0	1	0	0	0	0	0	0	0	0	0	0	0
Bragton muck; 0 to 1 % slopes	0	0	0	0	0	32	0	0	0	64	64	0	0
Brallier muck; drained	0	0	0	0	0	7	0	0	0	0	0	0	0
Brallier mucky peat; 0 to 1 % slopes	0	0	0	0	0	102	0	0	0	0	0	0	0
Brallier variant muck	0	19	0	3	13	6	0	291	55	190	0	40	0
Brenner silt loam	0	0	0	0	0	0	0	0	0	0	25	0	0
Brenner silt loam; 0 to 2 % slopes	0	0	0	0	0	0	0	0	0	0	8	0	0
Brenner silt loam; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	5	0	0
Bullards sandy loam; 12 to 30 % slopes	0	0	0	0	0	0	0	0	0	4	0	0	0
Bullards sandy loam; 30 to 50 % slopes	0	0	0	0	0	0	0	0	0	8	4	0	0
Bullards sandy loam; 7 to 12 % slopes	0	0	0	0	0	0	0	0	0	1	0	0	0
Bullards-Ferrelo loams; 30 to 60 % slopes	0	0	0	0	0	0	0	2	0	0	2	0	0
Chetco silty clay loam	0	0	0	47	0	0	0	0	0	7	0	0	0
Clatsop mucky peat	0	0	0	0	0	0	0	155	0	299	260	0	0
Clatsop silty clay loam	0	0	0	11	105	255	0	88	9	8	87	0	0
Coquille silt loam	0	20	0	0	0	37	0	14	17	34	23	8	0
Coquille silt loam; 0 to 1 % slopes	226	205	68	230	1	199	0	89	15	401	104	10	35
Coquille silt loam; 0 to 1 % slopes; protected	0	0	0	0	0	1006	0	4	0	0	0	0	0
Coquille silt loam; protected; 0 to 1 % slopes	0	0	0	8	0	4	0	0	0	136	7	49	0
(data unavailable)	14	7	20	184	0	339	499	404	51	158	1412	36	0
Dune land	0	0	0	0	0	0	0	0	0	23	0	8	0
Fendall-templeton silt loams; 35 to	0	0	0	0	5	0	0	0	0	1	0	0	0

Soil Series:	V.Large Conifer Forest	Large Conifer Forest	Large Mixed Forest	Medium Conifer Forest	Medium Mixed Forest	Small Conifer Forest	Small Mixed Forest	Hard-wood Forest	Open Forest	Open Non-forest	Other Vege-tated	Water	Undeter-mined
60 % slopes													
Fluvaquents-histosols complex	0	0	3	0	0	0	0	450	0	88	139	0	0
Gauldy loam; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	106	0	15
Heceta fine sand	0	0	0	0	0	1	0	6	0	171	12	0	0
Heceta-Waldport fine sands; 0 to 7 % slopes	0	0	0	0	0	3	0	0	0	0	40	0	0
Klooqueh silty clay loam; 3 to 8 % slopes	0	0	0	0	0	0	0	0	0	0	4	0	0
Knappa silt loam; 3 to 8 % slopes	0	0	0	0	0	0	0	2	0	0	0	0	0
Langlois silty clay loam	0	0	0	0	0	456	0	17	0	76	0	0	0
Langlois silty clay loam; 0 to 3 % slopes	0	0	0	0	0	0	0	1	0	9	0	0	0
Lint silt loam; 0 to 12 % slopes	0	0	0	0	0	0	0	0	0	0	5	0	0
Lint silt loam; 0 to 7 % slopes	0	0	0	0	0	1	0	0	0	0	0	0	0
Lint silt loam; 5 to 25 % slopes	0	0	0	0	0	0	0	0	0	0	1	0	0
Logsden silt loam; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	2	0	0
Millicoma-Reedsport complex; 60 to 90 % slopes	0	0	0	0	0	0	0	5	0	0	0	0	0
Nehalem silt loam	0	0	0	0	0	0	0	0	0	21	0	0	0
Nekoma-fluvaquents complex; 0 to 3 % slopes	0	0	0	0	0	36	0	0	0	0	0	23	0
Nestucca silt loam	0	0	0	0	18	3	0	395	0	51	265	1	0
Nestucca silt loam; 0 to 3 % slopes	0	0	0	0	0	5	0	0	0	4	0	0	0
Preacher-Bohannon-Slickrock complex; 50 to 75 % slopes	0	0	0	0	0	0	0	0	2	0	3	0	0
riverwash	0	0	0	0	0	0	0	2	0	4	7	0	3
Rustybutte-Sebastian-rock outcrop complex; 30 to 60 % south slopes	0	0	0	0	0	0	0	0	0	0	0	0	1
Svensen-Millicoma-Reedsport complex; 35 to 75 % slopes	0	0	0	0	0	0	0	0	0	1	0	0	0
Templeton silt loam; 30 to 50 % slopes	0	0	0	0	0	0	0	0	0	2	0	0	0
Templeton silt loam; 7 to 30 % slopes	0	0	0	0	0	0	0	0	0	10	0	0	0
Templeton-Fendall silt loams; 5 to 35 % slopes	0	0	0	0	0	0	0	157	0	0	0	0	0
Tidal marsh	0	0	0	0	0	0	0	0	0	2	6	0	0
Udorthents; level	0	0	0	0	0	0	0	2	10	2	15	1	0

Soil Series:	V.Large Conifer Forest	Large Conifer Forest	Large Mixed Forest	Medium Conifer Forest	Medium Mixed Forest	Small Conifer Forest	Small Mixed Forest	Hard-wood Forest	Open Forest	Open Non-forest	Other Vege-tated	Water	Undeter-mined
Umpcoos-rock outcrop-Damewood complex; 60 to 90 % slopes	1	0	0	0	0	0	0	0	0	0	0	0	0
Urban land-Waldport complex; 0 to 12 % slopes	0	0	0	0	0	0	0	0	0	0	10	0	0
Waldport fine sand; 0 to 12 % slopes	0	0	0	0	0	0	0	0	0	0	0	2	0
Waldport fine sand; 0 to 30 % slopes	0	0	0	0	0	0	0	0	0	0	1	0	0
Waldport fine sand; 30 to 70 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Waldport fine sand; thin surface; 0 to 30 % slopes	0	0	0	0	0	15	0	0	0	5	0	0	0
Waldport-dune land complex; 12 to 30 % slopes	0	0	0	0	2	1	0	5	3	6	13	0	0
Waldport-dune land-heceta complex; 0 to 30 % slopes	0	0	1	0	0	0	0	0	0	0	0	0	0
Waldport-Heceta fine sands; 0 to 30 % slopes	0	0	0	0	0	0	0	0	0	5	4	0	0
water	1	2	10	7	1	41	49	114	9	187	135	27	9
Willanch fine sandy loam	0	0	0	0	0	0	0	0	33	0	110	0	0
Yachats very fine sandy loam; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	3	0	10
Yaquina loamy fine sand; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	1

Table B8. Acreage of tidal wetlands on the Oregon Coast, by adjoining land cover (GAP data) and soil series

Note: Due to the unavailability of digitized soils data for some portions of the coast, these data are not comprehensive. The land cover data are very low-resolution (minimum polygon size was about 100 acres)

	Urban/ Resi-dential	Coastal Ponds /Dunes	"Salt Marsh"	Tidal Flat	Open Water	Pasture	Conifer Forest: Doug-fir	Conifer Forest: spruce	Mixed Conifer Forest	Recent Cutover	Riparian Forest	Riparian/ wetland Shrub	Undeter-mined
Bagness-Pistol River complex; 0 to 3 % slopes	0	0	0	0	0	0	0	0	2	0	0	0	0
Bandon sandy loam; 0 to 7 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Beaches	0	1	1	0	0	0	0	2	0	0	0	0	0
Beaches; 1 to 3 % slopes	0	0	0	0	0	0	0	19	0	0	0	0	0
Bohannon gravelly loam; 50 to 90 % slopes	0	0	0	0	1	0	0	0	0	1	0	0	0
Bragton muck; 0 to 1 % slopes	17	6	6	0	0	0	0	0	108	0	0	0	0
Brallier muck; drained	0	0	0	0	0	0	0	0	7	0	0	0	0
Brallier mucky peat; 0 to 1 % slopes	0	0	0	0	0	0	0	102	0	0	0	0	0
Brallier variant muck	109	0	0	0	0	0	0	6	194	0	0	0	299
Brenner silt loam	0	0	0	0	0	0	0	25	0	0	0	0	0
Brenner silt loam; 0 to 2 % slopes	0	0	0	0	0	0	0	0	8	0	0	0	0
Brenner silt loam; 0 to 3 % slopes	0	0	0	0	0	5	0	0	0	0	0	0	0
Bullards sandy loam; 12 to 30 % slopes	0	0	0	0	0	0	0	0	4	0	0	0	0
Bullards sandy loam; 30 to 50 % slopes	0	0	0	0	0	0	0	0	2	0	0	0	0
Bullards sandy loam; 7 to 12 % slopes	0	0	0	0	0	0	0	0	1	0	0	0	0
Bullards-Ferrelo loams; 30 to 60 % slopes	0	0	0	0	0	0	0	4	0	0	0	0	0
Chetco silty clay loam	0	0	0	0	0	0	0	0	47	0	0	0	0
Clatsop mucky peat	106	0	0	0	15	0	0	0	387	15	0	0	0
Clatsop silty clay loam	8	0	0	74	0	0	74	0	76	0	0	0	205
Coquille silt loam	25	0	0	0	0	0	0	3	97	0	0	0	0
Coquille silt loam; 0 to 1 % slopes	20	0	0	56	37	0	56	397	645	37	0	0	286
Coquille silt loam;	0	0	0	0	0	0	0	4	0	0	0	0	0

	Urban/ Resi-dential	Coastal Ponds /Dunes	"Salt Marsh"	Tidal Flat	Open Water	Pasture	Conifer Forest: Doug-fir	Conifer Forest: spruce	Mixed Conifer Forest	Recent Cutover	Riparian Forest	Riparian/ wetland Shrub	Undeter-mined
0 to 1 % slopes; protected													
Coquille silt loam; protected; 0 to 1 % slopes	32	49	49	21	0	0	21	0	5	0	0	0	88
(data unavailable)	281	16	16	0	0	716	0	376	559	0	489	489	644
Dune land	5	6	6	0	0	0	0	0	0	0	0	0	19
Fendall-Templeton silt loams; 35 to 60 % slopes	0	0	0	0	0	0	0	1	0	0	0	0	0
Fluvaquents-histosols complex	93	0	0	0	6	0	0	0	438	6	0	0	117
Gauldy loam; 0 to 3 % slopes	0	0	0	0	0	0	0	0	15	0	0	0	106
Heceta fine sand	0	190	190	0	0	0	0	0	0	0	0	0	0
Heceta-Waldport fine sands; 0 to 7 % slopes	0	40	40	0	0	0	0	3	0	0	0	0	0
Klooqueh silty clay loam; 3 to 8 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Knappa silt loam; 3 to 8 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Langlois silty clay loam	0	0	0	0	0	0	0	39	49	0	0	0	0
Langlois silty clay loam; 0 to 3 % slopes	0	0	0	0	0	9	0	0	0	0	0	0	0
Lint silt loam; 0 to 12 % slopes	5	0	0	0	0	0	0	0	0	0	0	0	0
Lint silt loam; 0 to 7 % slopes	0	0	0	0	0	0	0	1	0	0	0	0	0
Lint silt loam; 5 to 25 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Logsden silt loam; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Millicoma-Reedsport complex; 60 to 90 % slopes	5	0	0	0	0	0	0	0	0	0	0	0	0
Nehalem silt loam	0	0	0	0	21	0	0	0	0	21	0	0	0
Nekoma-fluvaquents complex; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Nestucca silt loam	0	0	0	8	0	0	8	0	32	0	0	0	0
Nestucca silt loam; 0 to 3 % slopes	0	0	0	4	0	5	4	0	0	0	0	0	0
Preacher-Bohannon-Slickrock complex; 50 to 75 % slopes	0	0	0	0	0	0	0	3	2	0	0	0	0
riverwash	0	0	0	0	0	0	0	0	7	0	0	0	6
Rustybutte-Sebastian-rock outcrop complex; 30 to 60 % south slopes	0	0	0	0	0	1	0	0	0	0	0	0	0

	Urban/ Resi-dential	Coastal Ponds /Dunes	"Salt Marsh"	Tidal Flat	Open Water	Pasture	Conifer Forest: Doug-fir	Conifer Forest: spruce	Mixed Conifer Forest	Recent Cutover	Riparian Forest	Riparian/ wetland Shrub	Undeter-mined
Svensen-Millicoma-Reedsport complex; 35 to 75 % slopes	0	1	1	0	0	0	0	0	0	0	0	0	0
Templeton silt loam; 30 to 50 % slopes	0	0	0	0	0	0	0	0	2	0	0	0	0
Templeton silt loam; 7 to 30 % slopes	0	0	0	0	5	0	0	0	6	5	0	0	0
Templeton-Fendall silt loams; 5 to 35 % slopes	0	0	0	0	0	0	0	0	157	0	0	0	0
Tidal marsh	8	0	0	0	0	0	0	0	0	0	0	0	0
Udorthents; level	13	0	0	0	0	0	0	0	0	0	0	0	0
Umpcoos-rock outcrop-Damewood complex; 60 to 90 % slopes	0	0	0	0	1	0	0	0	0	1	0	0	0
Urban land-Waldport complex; 0 to 12 % slopes	10	0	0	0	0	0	0	0	0	0	0	0	0
Waldport fine sand; 0 to 12 % slopes	0	0	0	0	0	0	0	0	2	0	0	0	0
Waldport fine sand; 0 to 30 % slopes	0	0	0	0	0	0	0	1	0	0	0	0	0
Waldport fine sand; 30 to 70 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Waldport fine sand; thin surface; 0 to 30 % slopes	0	20	20	0	0	0	0	0	0	0	0	0	0
Waldport-dune land complex; 12 to 30 % slopes	0	30	30	0	0	0	0	0	0	0	0	0	0
Waldport-dune land-Heceta complex; 0 to 30 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0
Waldport-Heceta fine sands; 0 to 30 % slopes	0	5	5	0	0	4	0	0	0	0	0	0	0
water	79	132	132	0	15	7	0	11	151	15	0	0	167
Willanch fine sandy loam	0	0	0	33	0	0	33	0	110	0	0	0	0
Yachats very fine sandy loam; 0 to 3 % slopes	0	0	0	0	0	3	0	0	0	0	0	0	10
Yaquina loamy fine sand; 0 to 3 % slopes	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix C. Statistical profiles of palustrine (mostly nontidal) wetlands in coastal Oregon watersheds that have comprehensive wetland digital maps

The following basins are covered by Appendix C: Coos, Coquille, Umpqua, Siltcoos, and Tenmile. These are the only ones for which NWI coverage was comprehensive. Together, these watersheds contain 66% (63% by area) of the palustrine wetlands that have been mapped in Oregon coastal watersheds that have NWI wetland maps. In the tables below the data from all 5 of these watersheds have been combined, but tables for each watershed are available upon request from the author.

Table C1. Summary of watershed and ecoregion characteristics of the Coos, Coquille, Umpqua, Siltcoos, and Tenmile basins.

Total area covered (acres):	1,854,785
Number of wetland polygons mapped as palustrine by NWI:	16,941
Total palustrine wetland area (acres):	40,627

Ecoregions included:	Acres	% of area
Coastal Lowlands	187425.55	10.10
Coastal Uplands	208900.58	11.26
Mid-Coast Sedimentary	1262929.06	68.09
S. Oregon Coastal Mtns	83707.98	4.51
Coastal Siskiyous (KM)	1590.79	0.09
Inland Siskiyous (KM)	23006.45	1.24
Umpqua Interior Foothills (KM)	50648.54	2.73
Valley Foothills (WV)	7843.33	0.42

Table C2. Overlap between mapped hydric soils and palustrine wetlands in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds

HYDRIC SOIL OVERLAP	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean
NWI palustrine polygons intersected by hydric soil	39095.63	96.23	14219	83.93	503.4	2.74
not intersected	1531.06	3.77	2722	16.07	58.06	0.577
Hydric soil polygons not intersected by NWI palustrine wetlands	117735.66		3154	18.62%	1094.21	37.3

Table C3. Vegetation classes assigned by the NWI to palustrine wetlands in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds

	Acres	Number of Wetland Polygons
Open water/ unconsolidated bottom	905.15	1364
Aquatic bed	176.76	193
Emergent	29601.64	10409
Scrub-shrub	6435.65	2989
Forested	3502.73	1984

Table C4. Hydroperiod assigned by NWI to palustrine wetlands in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds

	Acres	Number of Wetland Polygons
Temporarily flooded	6994.05	3618
Saturated	1152.66	808
Seasonally flooded	29404.94	9690
Seasonally flooded or saturated	14.74	8
Semipermanently flooded	651.75	734
Intermittently exposed	3.07	5
Permanently flooded	1022.06	1235
Intermittently flooded	25.08	9
Artificially flooded	43.9	47
Seasonally flooded but tidally influenced	942.96	617
Temporarily flooded but tidally influenced	115.24	58
Semipermanently flooded but tidally influenced	238.13	99
Undetermined	13.35	11

Table C5. Alterations of palustrine wetlands noticed from by the NWI in aerial photographs in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds

	Acres	Number of Wetland Polygons
Beaver-impounded	96.77	98
Diked	5058.79	1578
Ditched	382.4	109
Excavated	177.48	306
NONE NOTICED	34905.27	14846

Table C6. Connectivity, isolation, stream proximity, and road proximity of mapped palustrine wetlands in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds

WETLAND CONNECTIVITY	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean
Isolation condition A: wetland not intersected by mapped stream and not within 10m horizontally of another mapped NWI polygon	3346.78	8.24	3624	21.39%	58.10	0.92
Isolation condition B: condition A is true, plus not intersected by hydric soil, water, or the FEMA floodplain	253.54	0.62	636	3.75%	6.74	0.4
Isolation condition C: condition B, plus not within 10m horizontally of a stream, *floodplain, or hydric soil*	165.06	0.41	370	2.18%	6.73	0.45
Isolation D: none of above (not isolated)	37279.90	91.76	13317	78.61%	503.42	2.8

STREAM PROXIMITY (CLAMS Project streams layer)	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean
Isolation C1: not within 40m of a stream	3797.00	9.35	3319	19.59%	89.61	1.11
Isolation C2: not within 20-40m	4264.34	10.50	3825	22.58%	89.61	1.11
Isolation C3: not within 10-20m	4499.17	11.07	4063	23.98%	89.61	1.11
Isolation C4: none of above	36127.51	88.93	12878	76.02%	503.42	2.8
STREAM PROXIMITY (other streams layer)	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean
Isolation S1: not within 40m	11463.34	28.22	7356	43.42%	503.40	1.55
Isolation S2: not within 20-40m	11951.00	29.42	7772	45.88%	503.40	1.54
Isolation S3: not within 20m	12142.28	29.89	7960	46.99%	503.4	1.52
ROAD PROXIMITY to Palustrine Wetlands						
Road isolation (X): wetland is not within 10m of road	8639.26	21.26	6630	39.14%	255.3	1.3
Road isolation (Y): within 10m of road	31987.43	78.74	10311	60.86%	503.4	3.1

Table C7. Extent, mean size, and isolation of palustrine wetland polygons in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds, by floodplain association.

Palustrine by location in **FLOODPLAIN**	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean	and Iso A	% A	and Iso B	% B	and Iso C	% C	and Iso D	% D
Zone A (FEMA 100-yr floodplain)	30722.02	75.62	9105	53.75%	454.62	3.37	1409.87	42.13	0	0.00	0	0.00	29312.14	78.63
Zones D, X500	30755.63	75.70	9134	53.92%	454.62	3.37	1434.89	42.87	0	0.00	0	0.00	29320.75	78.65

Table C8. Land cover classes associated with palustrine wetlands in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds

Palustrine by association with **LAND COVER CLASS** (very coarse)	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean
Agriculture	3145.44	7.74	1902	11.23%	162.09	1.65
Coastal Dunes	4811.84	11.84	2532	14.95%	190.88	1.9
Coastal Strand	2.06	0.01	2	0.01%	1.43	1.03
Douglas Fir - Mixed Conifer	194.62	0.48	157	0.93%	12.76	1.23
Douglas Fir - Mixed Deciduous	0.32	0.00	1	0.01%	0.351	0.351
Douglas Fir - Port Orford Cedar	66.85	0.16	85	0.50%	15.5	0.78
Douglas Fir-W. Hemlock-Red Cedar	2248.41	5.53	1696	10.01%	62.23	1.32
Douglas Fir-White Fir-Tanoak	31.27	0.08	56	0.33%	2.91	0.55
Grass/shrub or regeneration	2557.60	6.30	1408	8.31%	113.9	1.81
Mixed Conifer - Mixed Deciduous	5722.23	14.08	2934	17.32%	154.61	1.95
NWI Estuarine Emergent	1881.34	4.63	202	1.19%	503.41	9.31
NWI Palustrine Emergent	433.54	1.07	200	1.18%	32.51	2.16
NWI Palustrine Shrubland	11811.75	29.07	1911	11.28%	349.33	6.18
Open Water	4129.51	10.16	1649	9.73%	130.85	2.5
Red Alder forest	487.88	1.20	189	1.12%	24.31	2.58
Siskiyou Mtn. Mixed Deciduous	32.25	0.08	51	0.30%	3.35	0.63
Sitka Spruce-W Hemlock Maritime	1539.77	3.79	1133	6.69%	79.49	1.35
Urban	1424.38	3.51	706	4.17%	62.53	2.01

Table C9. Extent, mean size, and isolation of palustrine wetland polygons in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds, by component ecoregion.

Palustrine by **ECOREGIONS**	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean	and Iso A	% A	and Iso B	% B	and Iso C	% C	and Iso D	% D
Coastal Lowlands	24776.53	60.99	8465	49.97%	503.4	2.92	1854.65	55.42	58.02	22.88	33.40	20.24	22921.89	61.49
Coastal Uplands	7554.80	18.60	3190	18.83%	115.64	2.36	110.36	3.30	21.94	8.65	15.20	9.21	7444.44	19.97
Mid-Coast Sedimentary	5738.25	14.12	3824	22.57%	163.37	1.5	869.14	25.97	144.80	57.11	97.02	58.78	4869.11	13.06
S. Oregon Coastal Mtns	95.54	0.24	187	1.10%	11.18	0.5	38.64	1.15	16.64	6.56	13.27	8.04	56.91	0.15
Inland Siskiyous (KM)	18.86	0.05	18	0.11%	3.94	1.04	5.46	0.16	1.52	0.60	0.80	0.48	13.40	0.04
Umpqua Interior Foothills (KM)	1136.70	2.80	710	4.19%	162.09	1.6	202.78	6.06	8.00	3.16	4.67	2.83	933.91	2.51
Valley Foothills (WV)	30.72	0.08	41	0.24%	4.53	0.75	3.63	0.11	1.61	0.64	0.00	0.00	27.09	0.07

Table C10. Extent, mean size, and isolation of palustrine wetland polygons in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds, by slope, elevation zone, and precipitation.

Palustrine by **SLOPE class**	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean	and Iso A	% A	and Iso B	% B	and Iso C	% C	and Iso D	% D
<2.5%	32358.67	79.65	8728	51.52%	503.42	3.7	2623.16	78.38	62.23	24.54	34.00	20.60	29735.51	79.76
2.51-6.5 %	5992.00	14.75	4543	26.82%	113.93	1.32	508.29	15.19	87.27	34.42	55.41	33.57	5483.71	14.71
6.51-12.5 %	1507.57	3.71	2133	12.59%	16.46	0.71	161.12	4.81	74.89	29.54	53.61	32.48	1346.45	3.61
12.51-22.5 %	638.61	1.57	1133	6.69%	15.98	0.56	43.24	1.29	22.00	8.68	18.37	11.13	595.37	1.60
>22.5 %	129.84	0.32	404	2.38%	3.38	0.32	10.97	0.33	7.12	2.81	3.65	2.21	118.86	0.32

Palustrine by **ELEVATION ZONE**	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean	and Iso A	% A	and Iso B	% B	and Iso C	% C	and Iso D	% D
0-15 ft	14837.50	36.52	4376	25.83%	349.34	3.4	595.43	17.79	252.43	9.56	0.8	0.48	14242.07	38.20
16-35 ft	16245.94	39.99	5241	30.94%	503.41	3.09	1017.85	30.41	10.17	4.01	2.81	1.70	15228.08	40.85
36-170 ft	5831.93	14.35	4260	25.15%	113.93	1.36	962.47	28.76	73.33	28.92	34.6	20.96	4869.46	13.06
171-3800 ft	3711.32	9.14	3064	18.09%	162.09	1.2	771.03	23.04	167.85	66.20	126.84	76.84	2940.3	7.89

Palustine by Modeled **PRECIPITATION** (mean annual)	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean	and Iso A	% A	and Iso B	% B	and Iso C	% C	and Iso D	% D
900-1250 mm	1146.41	2.82	810	4.78%	162.09	1.41	218.28	6.52	7.47	2.95	4.55	2.76	928.13	2.49
1251-1500 mm	1101.29	2.71	1119	6.61%	35.25	0.98	327.17	9.78	44.03	17.37	23.34	14.14	774.12	2.08
1501-1750 mm	26198.74	64.49	9195	54.28%	454.61	2.85	2172	64.90	143.54	56.61	96.79	58.64	24026.75	64.45
1751-2250 mm	11927.49	29.36	5603	33.07%	503.4	2.13	597.65	17.86	43.74	17.25	26.82	16.25	11329.84	30.39
2251-3150 mm	252.75	0.62	214	1.26%	15.52	1.18	31.68	0.95	14.74	5.81	13.54	8.20	221.06	0.59

Table C11. Extent, mean size, and isolation of palustrine wetland polygons in the Coos, Coquille, Umpqua, Siltcoos, and Tenmile watersheds, by geologic strata in the vicinity.

Palustrine by associated **GEOLOGIC STRATA**	Acre Sum	%	# of polygons	%	Acre Max	Acre Mean	and Iso A	% A	and Iso B	% B	and Iso C	% C	and Iso D	% D
Js	5.50	0.01	15	0.09%	1.05	0.36	3.01	0.09	2.33	0.92	2.33	1.41	2.49	0.01
Ju	3.72	0.01	10	0.06%	0.61	0.37	1.43	0.04	0.72	0.28	0.24	0.15	2.28	0.01
KJds	51.21	0.13	99	0.58%	6.31	0.52	22.89	0.68	7.97	3.14	7.11	4.31	28.32	0.08
KJm	62.29	0.15	37	0.22%	6.12	1.68	11.11	0.33	0	0.00	0	0.00	51.2	0.14
OW	1709.93	4.21	778	4.59%	171.78	2.19	243.09	7.26	6.25	2.47	4.84	2.93	1466.85	3.93
Qal	7420.02	18.26	2069	12.21%	210.87	3.6	673.41	20.12	23.26	9.17	6.72	4.07	6746.61	18.10
Qd	6282.73	15.46	2275	13.43%	503.41	2.76	875.09	26.15	0	0.00	0	0.00	5407.65	14.51
Qls	7.11	0.02	7	0.04%	3.22	1.01	0.315	0.01	0.32	0.13	0.32	0.19	6.8	0.02
Qt	3962.83	9.75	1270	7.50%	303.83	3.12	335.32	10.02	17.46	6.89	7.73	4.68	3627.52	9.73
Ti	1.53	0.00	1	0.01%	1.53	1.53	1.53	0.05	1.53	0.60	1.53	0.93	0	0.00
Tm	65.56	0.16	54	0.32%	14.03	1.21	0.46	0.01	0	0.00	0	0.00	65.1	0.17
Tmsc	162.12	0.40	277	1.64%	13.44	0.58	57.35	1.71	9.52	3.75	6.7	4.06	104.77	0.28
Tmsm	1601.27	3.94	899	5.31%	154.61	1.78	222.78	6.66	43.37	17.11	22.49	13.63	1378.48	3.70
Tmss	477.88	1.18	220	1.30%	22.35	2.17	72.65	2.17	9.21	3.63	7.09	4.30	405.22	1.09
Tsr	71.51	0.18	85	0.50%	9.76	0.84	8.55	0.26	0.48	0.19	0.48	0.29	62.96	0.17
Tss	6592.95	16.23	2217	13.09%	349.33	2.97	204.92	6.12	34.51	13.61	31.79	19.26	6388.03	17.14
Tt	11510.23	28.33	6117	36.11%	121.2	1.88	513.95	15.36	83.56	32.96	54.87	33.24	10996.26	29.50
Ty	638.95	1.57	515	3.04%	32.51	1.24	98.87	2.95	13.02	5.14	10.8	6.54	539.37	1.45

Appendix D. Statistical profiles of palustrine (mostly nontidal) wetlands in all coastal Oregon watersheds, *including those with only partial NWI coverage*

Although the tables in this appendix appear similar to those in Appendix C, and include all the Appendix C data, they also include data from the remaining coastal watersheds. However, because those data are incomplete, any tabulations would present a distorted picture of what is actually present. Thus, they have been compiled separately, and this appendix is the result. By major basin, the approximate availability of digital NWI maps (excluding those is Appendix C that have complete coverage) is follows. These are merely "eyeball" estimates, not measurements using GIS. In all cases the portions that have digital coverage are the portions closest to the coast.

Watershed	Percent of Watershed Having Digital NWI Maps
Necanicum	30%
Nehalem	8%
Tillamook-Netarts-Sand Lake- Nestucca	30%
Siletz & Yaquina	15%
Alsea	30%
Siuslaw	15%
Rogue	5%
Chetco-Winchuck	90%

Table D1. Extent, mean size, slope, elevation, and stream connectivity of palustrine wetland polygons by watershed in all Oregon coastal areas having digital NWI wetland maps
(NOTE: comparisons are invalid because of differing extents of completed mapping).

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max
COASTWIDE	25511	64948.66	2.55	503.42	1367	3.92	50.33	159	3787	17588259	689	17927
by WATERSHED												
ALSEA	118	205.33	1.74	53.22	1100	4.42	23.30	49	454	38906	330	2159
BEAVER CREEK	524	1077.66	2.06	54.28	1292	3.39	31.99	41	295	435385	831	11251
COOS	4033	10197.26	2.53	196.74	1396	3.46	46.47	72	2746	4535817	1125	17927
COQUILLE	4552	14724.14	3.23	349.34	1512	3.32	36.44	257	3787	4271124	938	11590
ELK	294	631.05	2.15	52.01	1268	3.39	29.24	238	2678	40075	136	1499
NECANICUM	561	1190.77	2.12	80.01	1273	1.81	28.10	27	348	122192	218	3462
NEHALEM	109	651.59	5.98	119.36	2299	2.63	28.35	84	745	4862	45	1112
NESTUCCA	328	2404.66	7.33	177.72	2288	1.92	22.22	48	792	34197	104	2858
NETARTS	141	798.30	5.66	308.23	2174	2.40	17.17	59	908	9651	68	2638
NEW RIVER	2477	6442.09	2.60	336.33	1234	2.32	26.17	85	1906	1503854	607	11671
SALMON*	136	482.58	3.55	164.31	1611	2.87	15.75	28	750	61385	451	2437
SILETZ	104	181.52	1.75	35.14	1300	1.44	8.95	17	65	11998	115	1068
SILTCOOS	2576	5050.19	1.96	503.42	1362	5.40	39.25	41	681	1737614	675	13590
SIUSLAW	1622	3818.47	2.35	122.37	1421	4.34	36.30	209	1147	859531	530	5456
SIXES	511	1249.71	2.45	94.08	1250	2.58	25.10	143	2120	71890	141	2471
TILLAMOOK	472	3465.74	7.34	181.00	2405	1.64	14.33	43	874	87113	185	4337
UMPQUA	6901	12342.87	1.79	454.62	1180	5.20	50.33	244	2699	3761796	545	12099
YAQUINA*	52	34.74	0.67	5.86	736	4.40	25.23	39	213	868	17	335

* includes some of Siletz

Table D2. Annual and monthly precipitation (mm) at palustrine wetland polygons by watershed in Oregon coastal areas having digital NWI wetland maps

	AnnMin	AnnMax	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
COASTWIDE	917	4177	272	224	208	130	90	51	17	24	52	123	264	279
by WATERSHED														
ALSEA	1803	2135	288	240	219	142	106	69	23	28	67	144	298	323
BEAVER CREEK	1663	2058	269	227	207	133	99	72	26	28	66	135	285	303
COOS	1109	2069	263	218	209	132	89	47	13	23	47	119	264	276
COQUILLE	1152	3134	276	222	208	121	86	43	11	20	47	115	256	275
ELK	1945	4177	349	306	293	173	111	60	17	32	61	145	334	374
NECANICUM	1927	2443	282	261	229	153	104	79	41	36	81	164	314	315
NEHALEM	2002	3276	341	288	250	167	116	87	41	38	89	180	349	378
NESTUCCA	1865	2813	318	260	240	160	117	83	38	37	89	163	332	346
NETARTS	1968	2615	316	259	241	162	119	84	40	37	90	168	331	339
NEW RIVER	1631	2834	283	246	235	144	95	48	13	26	48	117	276	298
SALMON*	1928	2531	314	259	242	162	119	86	39	37	87	168	327	347
SILETZ	1885	2399	293	239	224	150	113	83	37	35	81	155	303	321
SILTCOOS	1679	2151	295	233	218	133	95	58	19	26	55	138	271	288
SIUSLAW	1251	2356	288	226	210	130	94	55	19	26	56	139	260	289
SIXES	1665	2943	323	283	270	164	106	54	17	30	56	133	312	346
TILLAMOOK	2050	2760	334	276	253	172	123	87	42	37	93	181	351	358
UMPQUA	917	2312	242	198	178	117	80	45	15	22	46	108	235	245
YAQUINA	1689	1902	259	219	199	125	92	70	26	26	62	130	270	287

* includes some of Siletz

Table D3. Extent, mean size, slope, elevation, and stream connectivity of palustrine wetland polygons in portions of Oregon coastal ecoregions having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max
Coastal Lowlands	13310	42036.54	3.16	503.42	1491	2.56	39.47	36	631	7537050	566	12099
Coastal Uplands	4341	10489.91	2.42	115.64	1467	5.12	42.20	42	874	6775700	1561	17927
Mid-Coastal Sedimentary	4449	6772.76	1.52	163.37	1122	6.37	50.33	419	3592	2371505	533	17927
S. Oregon Coastal Mountains	526	307.48	0.58	22.51	638	7.44	29.77	666	3787	48235	92	1762
Volcanics	43	78.94	1.84	21.60	1060	7.47	23.30	268	908	10136	236	1139
undetermined	2842	5263.04	1.85	191.16	1161	3.95	35.90	410	2539	845633	298	8721

Table D4. Annual and monthly precipitation (mm) at palustrine wetland polygons in portions of Oregon coastal ecoregions having digital NWI wetland maps

	AnnMin	AnnMax	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
Coastal Lowlands	1468	2760	280	230	218	135	94	53	17	25	53	126	271	288
Coastal Uplands	1447	3276	293	235	216	135	96	58	19	26	58	134	275	291
Mid-Coastal Sedimentary	1026	3131	274	224	202	126	85	45	14	23	50	120	259	277
S.Oregon Coastal Mountains	1453	4177	322	290	269	165	100	50	14	25	57	135	315	349
Volcanics	1974	2813	332	277	252	167	119	82	35	36	86	169	346	365
undetermined	917	2585	192	165	147	102	71	40	15	21	41	94	207	210

Table D5. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons relative to overlap with mapped hydric soils, in portions of the Oregon coastal area having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
on non-hydric soil	6862	3418.09	0.50	36	724	7.77	50	230	3592	8905432	1298	17927	1732	917	3131
on hydric soil	718	2579.07	3.59	87	1931	2.66	17	26	193	288781	402	12099	1808	1609	2399
on soil w. hydric inclusions	15090	49646.19	3.29	503	1600	2.53	50	148	3787	7453758	494	17927	1695	917	4177
indeterminable	1570	1583.28	1.01	34	1097	2.34	25	88	3786	733673	467	11671	1744	917	3551
no soil map available	1271	7722.03	6.08	308	2093	2.27	28	54	908	206616	163	5951	2174	1220	3276

Table D6 Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons located at different distances from channels in portions of Oregon coastal areas having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
not within 40m of channel	11356	16955.53	1.49	503	1042	3.83	45	226	3787	562575	50	10465	1707	917	4177
within 40 m of channel	567	631.32	1.11	20	972	4.46	27	254	3142	105067	185	3611	1709	960	3138
within 20m of channel	296	342.09	1.16	37	949	5.73	50	287	2430	77656	262	2437	1732	950	2838
within 10m of channel	13292	47019.72	3.54	349	1672	3.94	46	94	3271	16842961	1267	17927	1760	942	3031

Table D7. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons located in and out of the FEMA-mapped 100-yr floodplain in portions of Oregon coastal areas having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
Not within 100-yr floodplain	11634	15358.40	1.32	503	1004	4.85	50	292	3787	2195804	189	10465	1720	917	4177
Within 100-yr floodplain	13877	49590.25	3.57	455	1672	3.14	44	47	655	15392455	1109	17927	1747	917	2760

Table D8. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons by vegetation form in portions of Oregon coastal area having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
Aquatic Bed	366	319.22	0.87	17	878	3.35	30	271	3072	33593	92	2002	1730	960	3551
Emergent	14893	45823.41	3.08	349	1477	3.77	45	134	3592	15011933	1008	17927	1731	917	3972
Forested	3520	8203.58	2.33	308	1470	4.38	50	205	3163	1229989	349	7192	1752	917	4177
Open Water	16	18.74	1.17	3	868	12.23	39	1122	1494	1347	84	496	1468	1169	1866
Scrub-shrub	4422	8936.90	2.02	503	1305	3.88	46	131	3489	1028762	233	4737	1754	917	3138
Unconsolidated Bottom	1954	1313.20	0.67	34	659	4.59	33	305	3787	282092	144	4207	1699	917	3972
Unconsolidated Shore	340	333.61	0.98	31	926	2.55	26	85	1028	543	2	202	1728	942	2648

Table D9. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons by hydroperiod in portions of the Oregon coastal area having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
Temporarily Flooded	5588	15127.53	2.71	336	1499	3.81	50	132	2520	3823890	684	11671	1804	979	3972
Saturated	1690	2353.68	1.39	162	972	5.28	30	585	3592	190892	113	2143	1399	917	4177
Seasonally Flooded	13841	42721.72	3.09	503	1511	3.61	46	98	3140	12846632	928	17927	1750	917	3096
Seasonally Flooded or Saturated	8	14.74	1.84	6	1074	7.53	15	242	622	0	0	0	1660	1604	1786
Semipermanently Flooded	1233	1060.41	0.86	25	782	5.67	45	276	3500	141759	115	2184	1731	917	3551
Intermittently Exposed	5	3.07	0.61	1	681	4.01	15	515	2511	89	18	89	1903	1667	2837
Permanently Flooded	2021	1678.75	0.83	57	765	4.60	33	288	3787	360619	178	4207	1698	917	3972
Intermittently Flooded	13	29.32	2.26	10	1404	7.69	29	476	1067	17425	1340	2243	1365	1210	1688
Artificially Flooded	138	129.06	0.94	10	770	1.80	22	103	436	5101	37	653	1764	1140	2536
Regularly Flooded Tidal	9	12.86	1.43	6	1543	1.67	8	9	23	0	0	0	1722	1722	1722
Seasonally Flooded Tidal	790	1354.54	1.71	34	1265	3.42	27	13	71	131010	166	1964	1807	1603	2585
Temporarily Flooded Tidal	73	214.40	2.94	71	1833	2.41	17	8	35	6854	94	475	1785	1635	2186
Semipermanently Flooded Tidal	99	238.14	2.41	50	1515	3.09	18	13	34	63151	638	2173	1746	1669	1789
Permanently Flooded Tidal	1	9.97	9.97	10	9361	0.00	0	3	3	835	835	835	2258	2258	2258

Table D10. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons relative to alterations detected by NWI in aerial photographs, in portions of the Oregon coastal area having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
no alteration detected	22051	53498.81	2.43	503	1384	3.80	50	149	3787	16109887	731	17927	1739	917	4177
beaver dammed	190	157.35	0.83	10	838	7.46	35	218	2511	32846	173	1268	1811	1275	3096
partially drained/ditched	168	2264.25	13.48	181	2855	2.33	15	192	2199	49874	297	4337	1753	1157	3131
farmed	2	1.22	0.61	1	717	3.89	4	128	132	0	0	0	1584	1584	1584
diked/impounded	2385	8517.39	3.57	191	1363	5.24	45	229	3480	1319352	553	8721	1700	917	3096
diked/impounded & excavated	3	3.28	1.09	1	857	13.82	25	1146	1434	0	0	0	1527	1397	1786
excavated	677	435.65	0.64	34	635	2.81	39	180	2746	70357	104	4207	1715	917	2669
excavated & artificial substrate	32	58.08	1.81	10	997	1.12	9	160	436	4216	132	653	1626	1140	2536
dredge spoil deposit	3	12.64	4.21	10	3242	0.60	1	32	35	1727	576	576	1983	1982	1984

Table D11. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons relative to overlap with mapped land cover (coarse scale), in portions of the Oregon coastal area having digital NWI wetland maps

	Count	Acres Sum	Acres Avg	Acres Max	Perim Avg	StreamL sum	StreamL avg	StreamL max	Slope Avg	Slope Max	Elev Avg	Elev Max	Precip AnnAvg	Precip AnnMin	Precip AnnMax
Agriculture	3982	9195.79	2.31	195.73	1236	1243799	312	11671	2.84	25.42	213	1434	1534	917	2760
Coastal Dunes	3027	5544.58	1.83	190.89	1277	119170	39	8770	1.58	26.12	34	241	1724	1597	2136
Coastal Lodgepole Forest	7	7.35	1.05	3.17	1039	0	0	0	5.34	13.49	17	22	2075	1964	2135
Coastal Strand	2	2.07	1.03	1.44	979	0	0	0	1.26	1.29	124	136	1648	1648	1648
Douglas Fir Dominant-Mixed Conifer	159	195.11	1.23	12.76	1061	11374	72	978	5.79	36.44	2463	3787	2596	1169	3972
Douglas Fir-Mixed Deciduous Forest	6	4.20	0.70	2.18	676	586	98	529	7.47	13.81	469	794	1271	1245	1318
Douglas Fir-Port Orford Cedar Forest	141	94.70	0.67	15.53	757	19392	138	582	8.96	29.77	995	2304	2516	1502	3972
Douglas Fir-W. Hemlock-W. Red Cedar	2675	3533.73	1.32	62.23	1066	1324730	495	12099	7.13	50.33	448	2746	1581	1026	4177
Douglas Fir-White Fir/Tanoak-Madrone	55	32.59	0.59	2.92	665	1427	26	1213	8.16	28.58	1944	3472	2124	1115	2804
Douglas Fir/White Oak Forest	14	10.35	0.74	4.08	715	2143	153	2143	9.76	19.50	553	975	1185	1144	1206
Exposed Tidal Flat	32	101.41	3.17	42.03	1909	504	16	264	1.83	7.07	13	29	2088	2056	2137
Grass-shrub-sapling or Regeneration	1846	3584.64	1.94	113.93	1273	1672818	906	11251	5.72	38.96	145	3450	1765	960	2838
Mixed Conifer/Mixed Deciduous Forest	4505	9370.17	2.08	164.31	1248	4350785	966	17927	4.79	45.37	100	2120	1824	1265	3276
Modified Grassland	100	203.80	2.04	39.87	1210	42697	427	1762	5.59	14.47	294	1117	1953	1794	2407
NWI Estuarine Emergent	927	5473.52	5.90	503.42	2105	650362	702	11671	0.54	4.82	13	47	1799	1672	1925
NWI Palustrine Emergent	218	794.93	3.65	308.23	1689	67721	311	2638	3.25	28.48	371	499	1672	1298	2246
NWI Palustrine Forest	2	9.08	4.54	7.15	2868	0	0	0	0.50	0.61	19	21	2166	2136	2196
NWI Palustrine Shrubland	2561	16422.06	6.41	349.34	2260	5781710	2258	17927	2.74	37.30	28	427	1794	1104	2325
Open Water	1664	3990.30	2.40	130.85	1430	910686	547	12099	3.96	42.20	36	654	1706	942	2001
Red Alder Forest	191	489.32	2.56	24.31	1574	278646	1459	7515	7.47	34.50	94	927	1878	1406	1987
Siskiyou Mtns Mixed Deciduous Forest	64	37.80	0.59	3.36	711	3967	62	626	6.74	22.36	1381	3556	2136	1453	2943
Sitka Spruce-W. Hemlock Maritime	1824	2737.77	1.50	79.50	1122	733048	402	12099	4.97	38.50	63	715	1822	1612	3096
Urban	1406	3032.78	2.16	80.01	1257	340939	242	4664	2.32	28.10	37	436	1827	1140	2648
unclassified	103	80.63	0.78	10.19	981	31756	308	2277	2.30	23.34	4	35	1801	1662	2258

Table D12. Extent, size, slope, elevation, and annual precipitation of palustrine wetland polygons that likely are slope wetlands* (according to HGM classification), in portions of the Oregon coastal area having digital NWI wetland maps

* assumed if mean slope >1%, not intersected by stream, and water regime classified by NWI as A, B, C, D, or E (mostly non-permanent)

	Count	Acres Sum	Acres Avg	Acres Max	Perim Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	Ann Avg	Ann Min	Ann Max
COASTWIDE:	8590	11566.96	1.35	122.37	1028	5.21	46.47	219	3592	1705	917	4177
ALSEA	34	27.50	0.81	2.90	837	3.59	13.06	24	137	1932	1803	2029
BEAVER CREEK	111	128.16	1.15	11.90	970	5.14	31.99	46	295	1847	1663	2058
COOS	1119	1483.33	1.33	58.07	1004	4.68	46.47	82	1941	1694	1109	1976
COQUILLE	1565	1816.41	1.16	47.45	969	4.81	36.44	409	3592	1720	1157	3131
ELK	82	71.59	0.87	15.25	947	5.24	24.21	308	2678	2323	1945	4177
NECANICUM	193	266.93	1.38	13.67	1021	3.29	28.10	32	192	2060	1927	2443
NEHALEM	35	146.04	4.17	48.24	1940	2.61	7.39	90	715	2317	2002	3096
NESTUCCA	103	282.54	2.74	53.05	1561	3.51	22.22	50	792	2189	1865	2813
NETARTS	55	146.36	2.66	21.60	1388	2.85	13.49	67	908	2200	1968	2615
NEW RIVER	805	746.88	0.93	21.55	837	4.06	22.08	156	1805	1857	1631	2834
SALMON	25	43.11	1.72	7.77	1261	4.33	13.76	28	194	2226	1928	2531
SILETZ	20	20.68	1.03	5.22	1166	3.24	8.95	24	40	2040	1903	2399
SILTCOOS	835	1098.25	1.32	107.18	1069	6.03	35.34	41	255	1800	1679	2109
SIUSLAW	473	943.57	1.99	122.37	1355	4.97	33.96	213	1003	1777	1251	2356
SIXES	175	292.26	1.67	62.58	1047	4.97	25.10	181	1666	2127	1665	2943
TILLAMOOK	140	498.60	3.56	110.28	1807	2.73	14.33	67	874	2320	2056	2760
UMPQUA	2806	3534.55	1.26	115.64	984	6.22	42.20	285	1949	1465	917	2179
YAQUINA	14	20.20	1.44	5.86	1235	6.23	19.57	30	99	1765	1741	1807

Table D13. Extent, size, slope, elevation, stream connectivity, and annual precipitation of palustrine wetland polygons relative to overlap with mapped geologic strata, in portions of the Oregon coastal area having digital NWI wetland maps

Strata	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
JTRgd	4	1.21	0.30	1	425	16.58	29	691	1670	811	203	406	2874	2823	2925
Jop	81	226.98	2.80	73	1453	2.51	15	18	116	8296	102	665	1973	1942	1976
Js	35	16.38	0.47	2	578	7.57	18	1812	3078	323	9	150	2691	1868	3972
Ju	39	36.82	0.94	21	676	6.65	15	944	3787	10222	262	1575	2240	1858	3134
KJds	332	420.05	1.27	53	871	6.40	23	383	1833	95894	289	11671	1913	1453	2834
KJm	37	62.29	1.68	6	1280	3.92	18	2334	2514	5204	141	626	2808	2638	2961
Ks	83	36.53	0.44	2	659	5.88	28	349	1906	9721	117	793	2605	2100	4177
OW	889	1992.84	2.24	172	1314	3.56	42	36	403	97005	109	7015	1740	1026	2421
Qal	3343	14325.20	4.29	308	1800	1.88	30	118	2516	2049800	613	11590	1711	917	2898
Qd	2588	6761.73	2.61	503	1516	1.23	26	25	194	45454	18	4306	1719	1597	2073
Qls	28	24.39	0.87	4	796	5.86	20	525	1424	7073	253	999	1239	1176	1712
Qs	384	846.13	2.20	54	1471	1.30	11	69	152	3630	9	1068	1825	1741	2399
Qt	4039	12003.71	2.97	336	1337	2.07	28	51	1463	2379709	589	11671	1815	1471	2565
Ta	192	357.29	1.86	24	1278	3.64	32	33	97	108699	566	11251	1893	1699	2170
Tc	5	7.30	1.46	5	950	6.06	9	397	908	87	17	87	2396	2256	2615
Ti	8	5.43	0.68	2	834	11.59	20	1011	2699	417	52	208	2126	1821	2180
Tim	15	143.69	9.58	87	2835	2.80	7	33	305	2000	133	671	2164	2045	2366
Tm	54	65.56	1.21	14	1145	4.78	25	18	115	58645	1086	2464	1690	1680	1695
Tms	319	615.26	1.93	79	1263	2.95	23	48	874	56444	177	3462	2090	1694	2615
Tmsc	284	165.94	0.58	13	646	7.18	31	671	2604	23498	83	3018	1384	917	2605
Tmsm	1331	2311.95	1.74	155	1092	4.49	32	262	1117	567403	426	10941	1419	917	2103
Tmss	217	477.36	2.20	22	1352	4.20	30	1228	3142	78793	363	3097	1501	1130	3131
Tmst	26	68.25	2.62	13	1576	2.83	13	101	518	2121	82	1112	2432	2002	3276
Tpb	33	282.00	8.55	178	2096	4.39	16	84	750	10830	328	1673	2094	1974	2211
Tsd	132	480.80	3.64	47	1725	2.55	14	91	600	17894	136	2076	2312	1968	2536
Tsr	304	259.75	0.85	19	787	6.94	24	409	1811	68690	226	3060	1271	917	2531
Tss	2440	7592.56	3.11	349	1514	3.68	34	45	2316	4045597	1658	17927	1712	1526	3096
Tt	7618	14362.26	1.89	121	1260	6.37	50	208	3592	7704896	1011	17927	1747	1027	3035
Ttv	17	63.57	3.74	16	1768	2.71	8	45	245	2668	157	1387	2520	2378	2569
Ttvm	13	118.21	9.09	101	2431	4.46	22	62	256	1354	104	510	2250	2184	2375

Strata	Count	Acres Sum	Acres Avg	Acres Max	Perimeter Avg	Slope Avg	Slope Max	Elev Avg	Elev Max	StreamL sum	StreamL avg	StreamL max	AnnAvg Precip	AnnMin Precip	AnnMax Precip
Ty	577	781.82	1.35	33	990	5.55	33	470	2300	109446	190	2437	1587	1109	2813
Tyq	33	33.32	1.01	8	965	7.54	27	47	213	15563	472	3030	1808	1663	2120
cs	11	2.07	0.19	0	344	9.13	22	1252	2120	73	7	73	2521	2407	2713