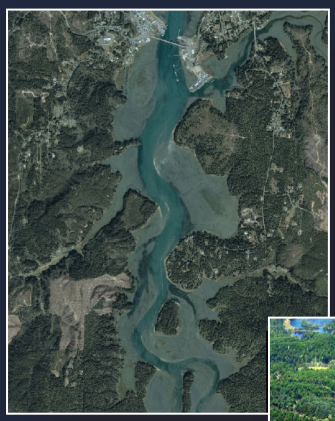
Geographic Features of the Coos Estuary and Lower Coos Watershed

CLW DATA SOURCE

Summary:

- *The Coos estuary is the second largest estuary in Oregon, and the sixth largest on the US west coast.*
- *Large expanses of intertidal sand and mud flats complement channels, eelgrass beds, vegetated marshes, and swamps to provide a diversity of estuarine habitats.*
- *After a century and a half of development about ten percent of the original tide lands remain.*



Steep forested hills of the South Slough (left), wetlands (below) and the expansive tide flats of the Coos River delta (below left) typify the variety of habitats found in the lower Coos watershed.

Figure 1. Coos estuary shoreline at Mean High Water (MHW). Data source: DLCD 2011

This data summary consists of three sections in which the geographic features of the Coos estuary and lower Coos watershed are briefly described. In the Current Features section, geographic features as they exist today are described. In the Historic Changes to the Coos Estuary section, several key differences between current geographic features and historic conditions are described. And in the Many Uses of the Coos Estuary section we discuss some of the estuary-dependant activities taking place in the project area.

Current Features

Coos Estuary

At latitude 43° 21' N, longitude 124° 20' W, the Coos estuary is the largest estuary completely within Oregon (second largest in Oregon after the Columbia River estuary), and the sixth largest on the US west coast (Rumrill 2006)(Table 1).

The surface area of the Coos estuary at Mean High Water (MHW) is approximately 50 km^2 (19 mi^2)(Figure 1), or approximately 34 km^2 (13 mi^2) at Mean Sea Level (MSL)(Hyde 2007). The average depth of the Coos estuary is 4 m (13 ft) and average volume is 0.14 km^3 (0.03 mi^3)(Hickey and Banas 2003). The estuarine drainage area (the part of the Coos watershed which empties into the estuary) is 1,500 km^2 (580 mi^2)(NOAA 1985).

The Coos estuary is composed of two tidal areas: the intertidal area, which is subject to daily tidal fluctuations, and the subtidal area, which is always flooded (i.e. deep channels). The intertidal comprises 47% of the MHW area (23.5 km^2 / 6 mi^2)(Percy et al. 1974 in Hickey and Banas 2003). Extensive filling and diking in the Coos estuary and its tributary sloughs for agricultural, industrial and urban development have reduced the intertidal area to about 10% of its pre-settlement extent (Roye 1979). It should be noted that these figures are over 30 years old and may have changed.

The Coos estuary's commercial shipping channel is routinely dredged by the US Army Corps of Engineers (USACE) to an average depth of 11.5 m (38 ft)(MLLW) and width of 300 m (984 ft)(Hyde 2007). USACE maintains

Tidal Datums

Tidal datums commonly used in this summary are described below:

***Mean Sea Level (MSL)** is based on hourly average water level at the local tide station in Charleston, OR.*

***Mean High Water (MHW)** is average height of all high tides.*

***Mean Lower Low Water (MLLW)** is the average of the lower of the two low tides each tidal cycle.*

Tidal datums are based on a 19-year period of water level averaging (called the National Tidal Datum Epoch) which is established by NOAA's National Ocean Service. The current epoch is based on tide level averages between 1983 and 2001.

Source: NGS 2015

Ranking of Major U.S. West Coast Estuaries*		
	Estuarine Surface Area**	
	km^2	mi^2
Puget Sound, WA	17,985	6,944
San Francisco Bay, CA	1,171	452
Willapa Bay, WA	238	92
Grays Harbor, WA	150	58
Humboldt Bay, CA	49	19
Coos Bay, OR	34	13

*The Columbia River estuary, with an area of 554 km^2 (214 mi^2), is generally not included in comparison with outer coast estuaries.

** Described in NOAA 1985 as mid-tide elevation. Using that source, Hickey and Banas (2003) report values as MSL.

Table 1. Sizes of the largest coastal estuaries on the west coast. Data source: NOAA 1985

a shallower, narrower channel to the Charleston marina at the mouth of South Slough, and to the shipyard just south of the Charleston bridge.

Discounting the dramatic change rendered by the shipping channel, the Coos estuary exhibits the typical features of a drowned river valley estuary type. It features a V-shaped cross section, a relatively shallow and gently sloping estuary bottom, and a fairly uniform increase in depth from the upper, river-dominated part of the estuary toward the mouth. For more detailed bathymetry information, see the Hydrology data summary in this chapter.

Two massive rock boulder jetties guard both sides of the Coos estuary mouth to help maintain a deep channel and ensure safe ship and boat passage across the bar to the ocean. An inner rock jetty helps protect the Charleston marina from winter storm surges and powerful waves that can pass through the mouth of the estuary. Two turning basins and an anchorage basin for commercial shipping traffic are located in the upper portion of the Coos estuary.

From the entrance, the lower bay runs nine miles northeast then swings to the south after the McCullough Bridge in North Bend and widens into the tide-flat dominated upper bay. The Coos River enters the upper bay near the confluence with Catching Slough, about 27.35 km (17 mi) from the mouth of the estuary (Roye 1979). Coos River empties through two channels. The north, unmarked Cooston Channel flows up the east side of the estuary and empties abreast of the city of North Bend. The Marshfield Channel, marked by lighted range markers and buoys, crosses the flats to the city of Coos Bay shoreline then turns north along the western side of the estuary.

Estuarine Regions

In the Oregon Estuary Plan Book, Cortright et al. (1987) describe four distinct regions in the Coos estuary – Marine, Bay, Slough and Riverine – each based on distinct physical features and bottom types, salinity gradients, habitats, and dominant species. There are no distinct boundaries between the regions, but each has distinctive features.

The highly energetic Marine region extends from the Coos estuary mouth up to about river mile (RM) 2.5. Although the estuary entrance is protected by jetties, powerful waves nevertheless propagate through the mouth during winter storms. Water quality and salinity are similar to the open ocean in this

region, but it is moderated by rain-fed river and stream flow during winter months.

The Bay region, divided into the Lower Bay and the Upper Bay, is characterized by broad, mostly unvegetated (except for intertidal eelgrass beds) tidal flats exposed at low tide and flooded by brackish water during higher tides. Tidal flats range from sandy to muddy throughout the bay, depending on currents and circulation. Sand may be either terrestrial (erosional) or carried into the lower bay from nearby ocean sources (Aagard et al. 1971, in Roye 1979).

The Lower Bay region begins above RM 2.5 and extends to about the railroad bridge at RM 9. Water salinity in this region is slightly fresher than in the ocean, whose influence gradually diminishes throughout this zone as the distance from the ocean increases.

The Upper Bay begins at the railroad bridge (RM 9) and extends to the southeastern corner of Bull Island at RM 17 (Figure 2c). Although the shoreline has been drastically altered over the past 150 years, the upper bay still includes extensive tidal flats, many acres of which are used for commercial oyster cultivation. The shipping channel runs along the western shore of the upper bay to access the shipping terminals located along the developed shorelines of the cities of North Bend and Coos Bay.

The Coos estuary includes multiple Slough regions. A half-dozen major sloughs and at least as many lesser sloughs feed the estuary. Most of the intertidal areas associated with the sloughs have been developed for various land uses through historic wetland filling, diking and draining activities. Eleven of the sloughs are described in more detail in 'Slough Subsystems' below.

About 30 tributaries enter the Coos estuary from the lower portions of the Coos watershed's 605 mi^2 drainage area, most entering by way of various sloughs. Several form riverine estuarine subsystems above the sloughs.

The Coos estuary includes multiple Riverine regions, the Lower Coos River being the main one. It forms at the confluence of the Millicoma River and the South Fork Coos River. From the mouth of the estuary, the head of tide is located approximately 51.5 km (32 mi) up the South Fork Coos River and 54.72 km (34 mi) up the Millicoma River (Wilsey and Ham Inc. 1974 in Roye 1979). See the Hydrology summary in this chapter for more information about heads of tide.

Slough Subsystems

The following major slough subsystems are described in more detail: South Slough, Pony Slough, North Slough, Haynes Inlet (detailing Palouse and Larson Sloughs within), Isthmus Slough, and Catching Slough (Figure 2a-c). The much smaller Kentuck and Willanch Sloughs and Echo Creek in the upper bay are also described. The Coos Watershed Association (CoosWA), having completed habitat assessments in many of these sloughs to identify opportunities for habitat restoration, provided the foundation for much of the information in this section.

Estuarine Surface Area (MHW)		
Subsystem	**km^2**	**mile^2**
Catching Slough	0.70	0.27
Coos River	2.50	0.97
Haynes Inlet	3.16	1.22
Isthmus Slough	3.39	1.31
Lower Bay	15.75	6.08
North Slough	1.92	0.74
Pony Slough	1.15	0.45
South Slough	5.46	2.11
Upper Bay	16.01	6.18
All Coos Estuary	**50.04**	**19.32**

Table 2. Wetted estuarine surface area at Mean High Water (MHW) for the Coos estuary and each major subsystem. Derived from: DLCD 2011

South Slough: Oriented north/south near the mouth of the Coos estuary, the South Slough estuary surface area is approximately 5.46 km^2 (2.11 mi^2) at MHW, making it Coos estuary's largest slough (Table 2).

Over 225 km (140 mi) of freshwater streams flow into the estuary from the 7,935 ha (19,600 ac) South Slough watershed. Winchester Creek is the largest of the creeks, and it forms the head of South Slough's western Winchester Arm. The eastern Sengstacken Arm is fed by Elliot, Talbot, John B. and other smaller creeks. Joe Ney Creek, the northernmost arm of South Slough, forms a tributary slough (Rumrill 2006).

Pony Slough: Pony Slough is the most heavily developed slough. Commercial development began around the slough in 1917. Pony Slough was once a triangular embayment, but now it is a narrow channel about a mile long with a wide tide flat on both sides of its mouth. It currently has a wetted surface area of 1.15 km^2 (0.45 mi^2)(Table 2).

North Slough: The northernmost sub-basin of the Coos estuary, oriented northeast to southwest, has an estuary surface area of 1.92 km^2 (0.74 mi^2) at MHW (Table 2).

According to CoosWA (2006), North Slough watershed drains an approximately 2,995 ha (7,401 ac) watershed and includes 83.7 km (52 mi) of streams. The main stem of North Slough is approximately 2.41 km (1.5 mi) long from the tide gate at U.S. Highway 101 to the Bear Creek-North Slough Creek confluence. The main channels of Bear Creek and North Slough Creek are approximately 6.92 km and 7.40 km (4.6 mi and 4.3 mi) long, respectively. Elevation in the basin ranges up to 292.61 m (960 ft) above sea level (CoosWA 2006).

Haynes Inlet: Haynes Inlet extends about two and a half miles northeast from its confluence with the Coos estuary, just east of North Slough. The estuary surface area of Haynes Inlet at MHW is 3.16 km^2 (1.22 mi^2)(Table 2). It drains a 2,881 ha (7,120 ac) watershed, which includes two major salmon producing tributaries, Larson and Palouse creeks.

CoosWA's (2006) Larson and Palouse creek assessments describe those system as once supporting substantial tidal marsh area. Today the creeks are both restricted by major tide gates, one of which (Larson) was upgraded in 2001 to a fish-friendly style tide gate. The drainage area of Larson watershed is approx-

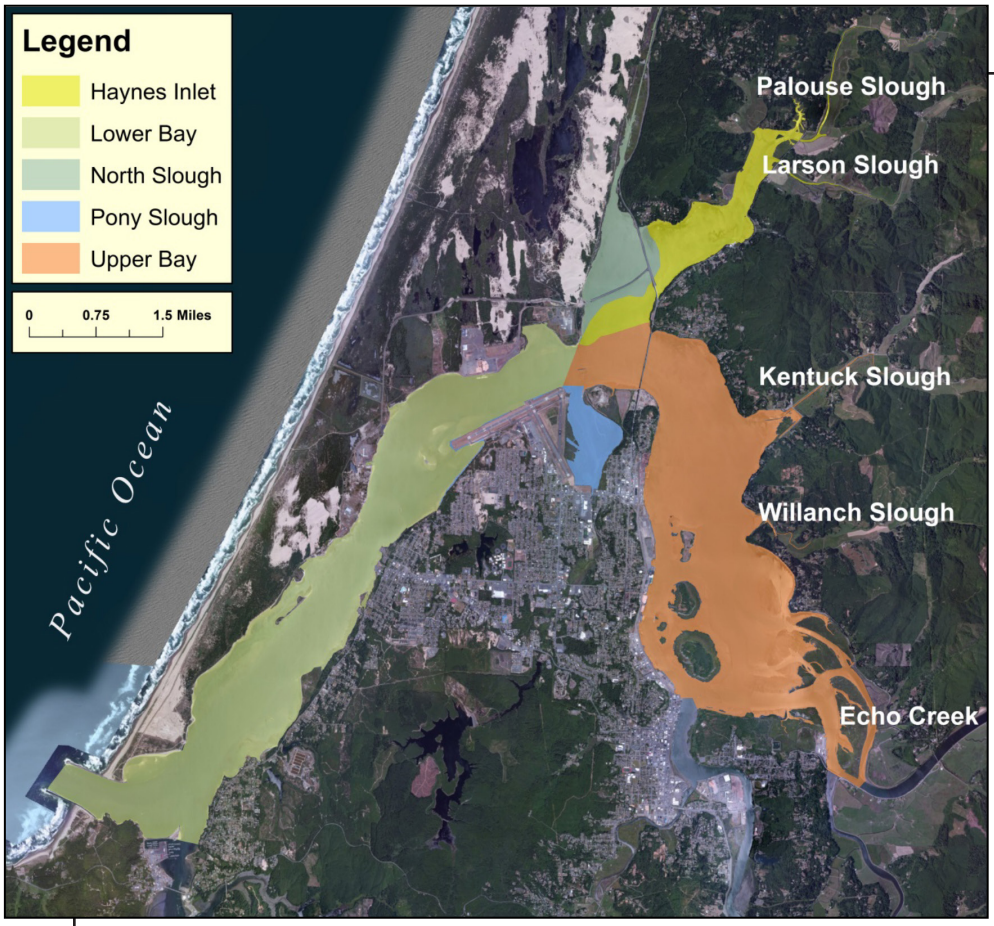


Figure 2a. Northern portion of the Coos estuary shoreline at Mean High Water (MHW) using 2011 vector shoreline data. Major subsystems are designated by color. Data source: DLCD 2011

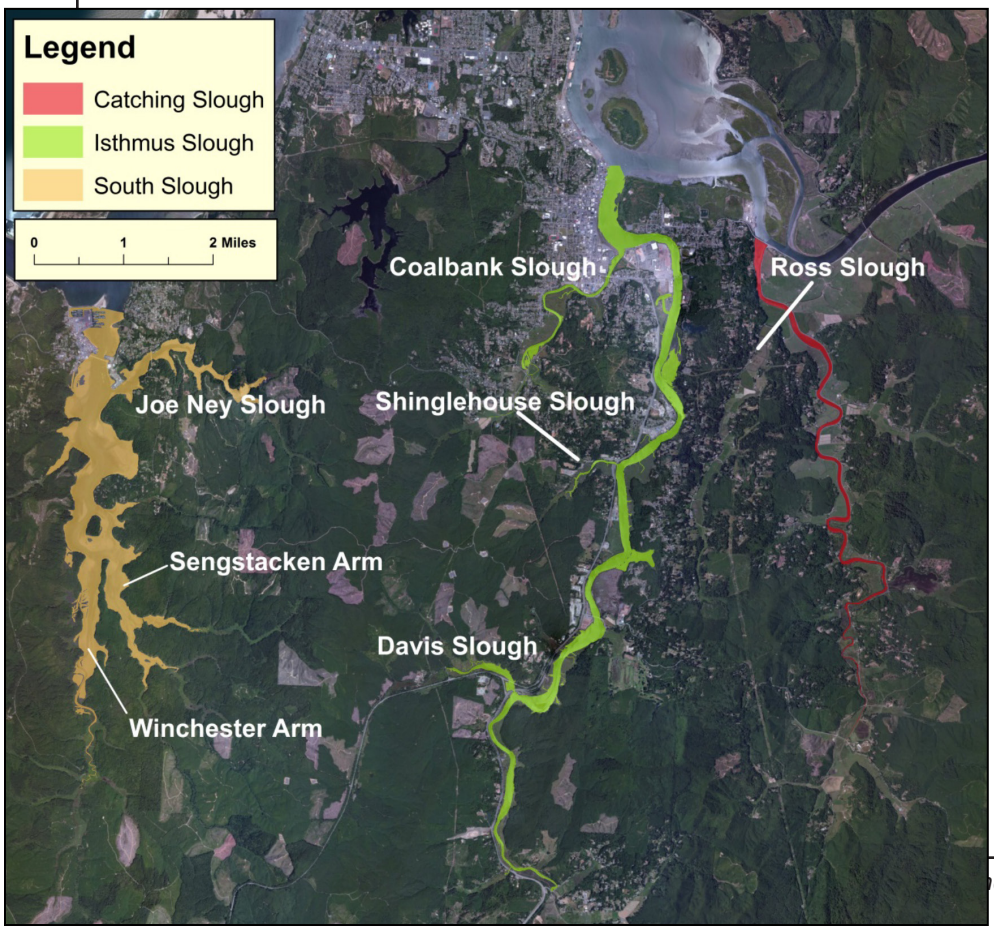


Figure 2b. Southern portion of the Coos estuary shoreline at Mean High Water (MHW) using 2011 vector shoreline data. Major subsystems are designated by color. Data source: DLCD 2011

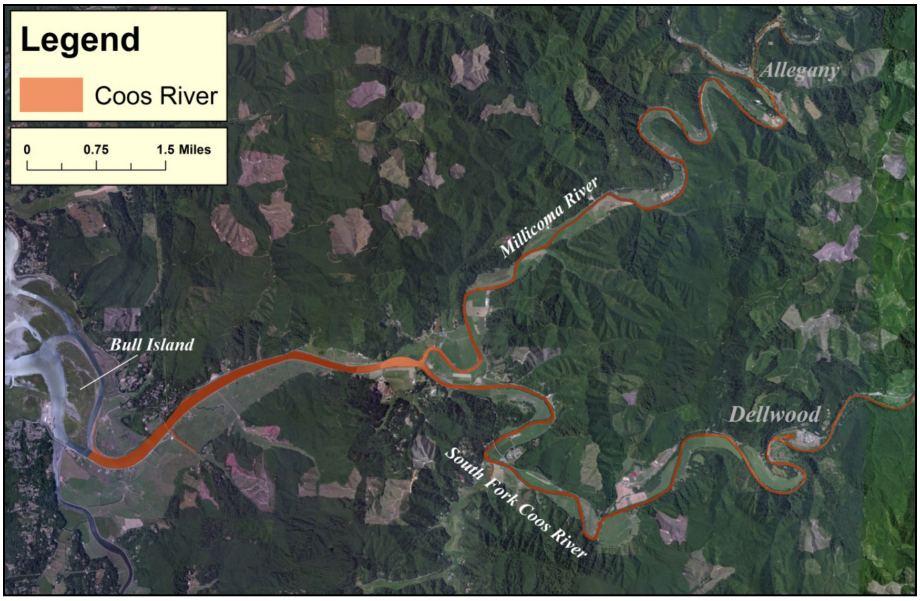


Figure 2c. Eastern portion of the Coos estuary shoreline (i.e., the Coos River subsystem) at Mean High Water (MHW) using 2011 vector shoreline data. Data source: DLCD 2011

imately 2,810.18 ha (6,944 ac) and includes approximately 75.96 km (47.2 mi) of streams. From the tide gate near the mouth, the Larson main stem is approximately 12.87 km (8.0 mi) long. The elevation in the basin ranges up to 421.54 m (1,383 ft) above sea level.

The Palouse watershed is approximately 2,814 ha (6,954 ac). There are approximately 78.05 km (8.5 mi) of streams within the Palouse watershed including very small intermittent headwater streams. From the tide gate at the mouth, the Palouse main stem is approximately 14.65 km (9.1 mi) long. The elevation in the basin ranges up to 463.30 m (1,520 ft) above sea level.

Isthmus Slough: The shoreline of Isthmus Slough, the second largest slough subsystem in the Coos estuary, is well developed. It includes the southern-most portion of the Coos estuary's commercial shipping channel. Coalbank Slough, Shinglehouse Slough, and Davis Slough are all tributary to Isthmus Slough which has a wetted surface area of 3.39 km^2 (1.31 mi^2) at MHW (Table 2). Isthmus Slough watershed covers 8,682 ha (21,456 ac), which is 5.4% of the entire Coos watershed (CoosWA 2011).

Catching Slough: Catching Slough enters the Coos estuary at the mouth of the Coos River. It is fed by several small streams, the largest of which is Ross Slough. Catching Slough is about 16.9 km^2 (10.5 mi^2) long and drains a 1,012 ha (2,500 ac) watershed (CoosWA 2008). It is the smallest of the major sloughs with an estuary surface area of 0.7 km (0.27 mi) at MHW (Table 2).

Kentuck Slough: The Kentuck sub-basin is oriented east to west, and is made up of two major tributaries, Kentuck and Mettman Creeks. These streams converge in the lowlands to form Kentuck Slough, which drains into the Coos estuary through a major tide gate (not yet fish-friendly). The drainage area of the watershed is approximately 4304.64 ha

(10,637 ac). There are approximately 95.40 km (59.28 mi) of streams within the drainage basin. From the tide gate at East Bay Drive, Kentuck main stem is approximately 13 km (8.1 mi) long, and Mettman Creek main stem is 5.47 km (3.4 mi) long. The elevation in the basin ranges up to 406.60 m (1,334 ft) above sea level.

Willanch Slough: The Willanch sub-basin is located south of Kentuck Slough and is also oriented east to west. It drains into the Coos estuary through a now fish-friendly tide gate. Willanch Creek's main tributary is Johnson Creek which converges from the south approximately 5.63 km (3.5 mi) upstream from the mouth. The drainage area of Willanch sub-basin is approximately 2,172.76 ha (5,369 ac). The total length of streams within the Willanch sub-basin is approximately 54.40 km (33.8 mi). The Willanch main stem is approximately 9.65 km (6 mi) in length. The elevation in the basin extends up to 368.5 m (1,209 ft) above sea level.

Echo Creek: The Echo sub-basin is the smallest slough system, found in the southeastern portion of the bay. It consists of four streams that empty directly into the Coos estuary's Cooston Channel, which runs along the eastern side of the upper Coos estuary's mud flats (Upper Bay region). The Echo Creek sub-basin is bordered on the south by the South Fork Coos River, which converges with the bay at the southern tip of the sub-basin. The drainage area is approximately 479.14 ha (1184 ac). The sub-basin has approximately 17.1 km (10.6 mi) of streams, with Echo Creek main stem approximately 7.23 km (4.49 mi) in length. The elevation in the basin ranges up to 275.23 m (903 ft) above sea level.

Historic Changes to the Coos Estuary

According to Oberrecht (2001), when the first Euro-American immigrants began to settle in 1853, the Coos estuary's main channel was about 3 m (10 ft) deep and 61 m (200 ft) wide at the mouth. The channel deepened up the estuary in the Lower Bay region to about 3.5 m (11.5 ft). In the Upper Bay region, above North Bend, the main channel gradually decreased in width and depth until at Marshfield (current day Coos Bay) the channel was about 15 m (50 ft) wide by about 1.8 m (6 ft) deep, with numerous shoals.

In the mid-twentieth century the lower Coos River changed its course through the upper bay (Aagard et al. 1971, in Roye 1979). Formerly, the main channel of the Coos River flowed through the Cooston channel east of Bull Island. At the northern end of Bull Island the channel split into the west-flowing Marshfield Channel and the East Channel, which continued north along the eastern shoreline. Over time the effects of logging (e.g., splash-damming and log-rafting) and dredging widened the channel south of Bull Island, so that the main flow of the Lower Coos River and Catching Slough is now along the western shore of the estuary along the Coos Bay and North Bend waterfronts (Aagard et al. 1971, in Roye 1979). The tendency for channel migration remains, since changes in hydrographic conditions may have unpredicted effects on channels and shorelines.

Tidal marsh filling historically occurred along the Coos estuary's western shore (much of Coos Bay's business district is built atop filled marshes), south of the Marshfield Channel at Eastside, and on several tide flats, where dredged materials now form several forested spoil islands. In the decades before federal and state laws began to regulate the alteration and filling of wetlands, extensive wetland fills occurred when dredge spoils from the maintenance and deepening of commercial shipping channels and harbor areas were used to create develop-able land on the shores of the Coos estuary (Roye 1979).

Many Uses of the Coos Estuary

Bay and Riverine Regions

Socioeconomically, the Coos estuary is important for being the second-busiest maritime commerce center in Oregon, according to the Oregon International Port of Coos Bay (OIPCB 2014). The western portion of the Upper Bay, adjacent to the cities of Coos Bay and North Bend, contains deep draft shipping terminals where the main shipping channel hugs the west side of the Coos estuary.

Environmentally (and indirectly socioeconomically), the Coos estuary is important for a number of reasons. The Riverine regions provide important habitat for commercially, recreationally, and ecologically important fish. Adult Coho salmon, Chinook salmon, and Steelhead trout populate the Coos estuary in the spring and fall en route to spawning streams. The Coos system is a major freshwater rearing area for Chinook, especially during their first year. The Lower Bay region of the estuary is also used by starry flounder and staghorn sculpin. Prickly sculpin and shiner perch occur in the upper portions (Rumrill 2006).

The marshes of the Coos River delta islands constitute major tracts of salt and brackish marshes. The entire eastern side of the Upper Bay—from Jordan Point to Bull Island, and west to the shipping channel—is a vast complex of flats, marshes, and eelgrass beds, providing valuable habitat and a rich source of organic material for the entire estuary. The tidal flats of the Upper Bay are feeding and rearing habitats for many fish species. Extensive brackish marshes can also be found on the spoil islands east of the main shipping channel in the Upper Bay.

Slough Subsystems

South Slough: South Slough was selected in 1974 as the site of the nation's first National Estuarine Research Reserve; as such, it conducts research and education programs focused on helping coastal communities effectively manage estuarine resources. South Slough contains about 1,000 acres of estuarine habitat including salt marshes, mudflats, and beds of eelgrass within its meandering, shallow channels, as well as about 5,000 acres of upland and riparian habitat. These areas all provide research, education and recreational opportunities for Reserve staff, visiting scientists and educators, and visitors.

The unincorporated town of Charleston is situated at the mouth of South Slough and includes stores, restaurants, a motel, a marina, fishing processing plants, and a shipyard. The University of Oregon's Institute of Marine Biology (OIMB) is located in Charleston and conducts research and educational programs for University students and visiting researchers.

North Slough: The North Slough has a 673 ha (1,664 ac) salt marsh below its tide gate. It has undergone several changes over the years, including the development of Highway 101 and historic dredging. It also provides key nursery habitats in the estuary for several important aquatic speices (e.g. salmon, trout) (CoosWA 2006).

Pony Slough: Pony Slough attracts many bird species, probably due to its sheltered location (Roye 1979). The most urban slough subsystem, Pony Slough is completely surrounded by the Southwest Oregon Regional Airport, Coast Guard air station, Pony Village Mall, and North Bend residential development.

Haynes Inlet: The tidal marshes associated with Palouse and Larson creek floodplains have been converted to agricultural uses through diking and construction of a system of tide gates (Roye 1979). In 2001, CoosWA facilitated the replacement of the main Larson Slough tide gate with an upgraded "fish-friendly" tide gate which allows fish to more easily pass between Larson Creek and Haynes Inlet (CoosWA 2006).

Isthmus Slough: Historically, many of the marshes in lsthmus Slough were eliminated by diking, filling, and log storage. In Coalbank Slough alone, marshes occupied 241.6 ha (597 ac) in 1892, but by 1979 only 23 ha (57 ac) remained (Hoffnagle and Olson 1974, in Roye 1979). On the western bank of the lower Isthmus Slough, multiple boat terminals and a marina can be accessed off the main shipping channel. A recreational boat launch can be found on the eastern shore.

Catching Slough: In the late 1800s, Catching Slough was an area of vast tidal marshes. Strong tidal flushing was responsible for maintaining main channel depths of 5.5-6.0 m (18 to 20 ft) at its confluence with the Marshfield Channel. By the 1940s diking of Catching Slough for agricultural purposes had decreased tidal transport and velocity through Marshfield Channel (Aagard et al. 1971, in Roye 1979).

Kentuck Slough: Today, Kentuck Slough features tidal marshes at its mouth outside the main tide gate. During the early part of the twentieth century the lower end of Kentuck Slough was straightened and confined to a rectangular box channel and the tide gate constructed near its confluence with the main part of the estuary. In 2006, CoosWA facilitated the replacement of the tide gate with a newer one designed to provide better passage for migrating fish (CoosWA 2006). Historically, the former tidal marshes on the south side of the channel were converted agricultural and then recreational uses (golf course). Plans are currently under way to restore tidal

flooding and marsh habitat at the golf course site as part of the compensatory mitigation required to replace the wetlands lost to planned development projects at Jordan Cove on the other side of the Coos estuary.

Willanch Slough and Echo Creek: Extensive salt marshes are found along the eastern side of the upper bay at the mouth of Willanch Inlet, although most of the marsh area has been lost through diking and reduced tidal inundation from the placement of a tide gate in 1947. Improved fish passage across the tide gate occurred in 2010 when it was replaced with a more fish friendly side-hinged version. Salt marsh habitat is abundant on the Coos River delta islands adjacent to Echo Creek and on the northeastern portion of the Eastside peninsula.

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