Chapter 9: Water Quality in the Coos Estuary and Lower Coos Watershed

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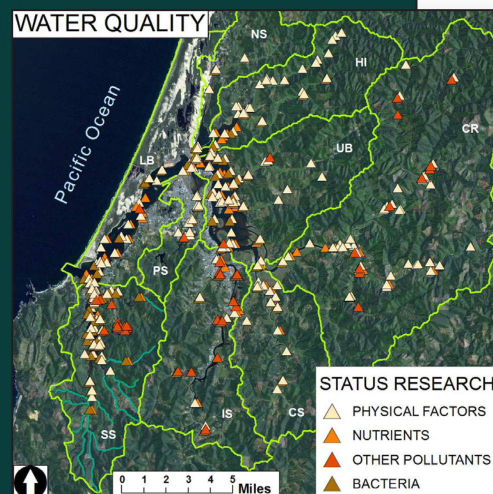
Physical Factors: *Multiple waterways in the project area are considered water quality-limited under the Clean Water Act for high temperatures and low dissolved oxygen.*

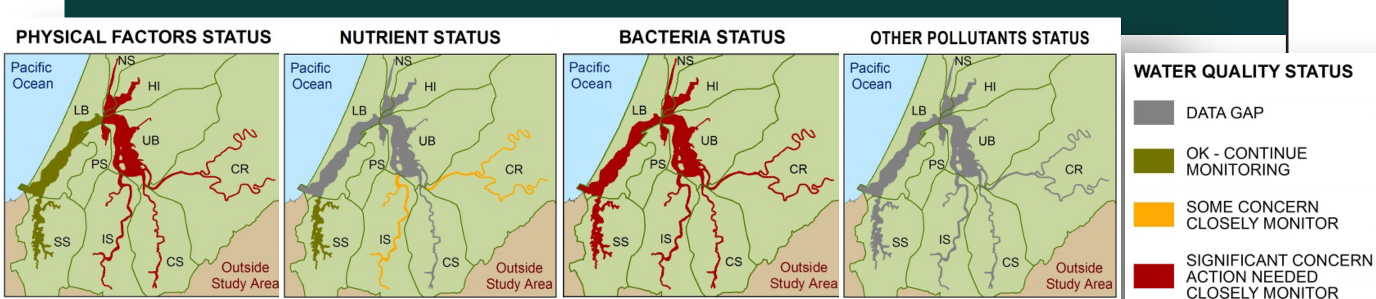
Nutrients: *Phosphorous levels are higher near the mouth and nitrogen levels are higher after precipitation events; however, nutrient levels appear to be generally healthy.*

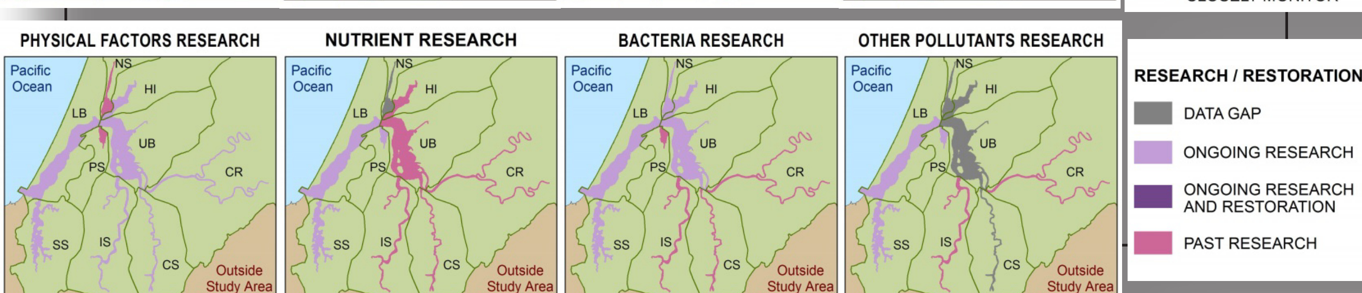
Bacteria: *Approximately 20% of monitored sites have maximum bacteria levels exceeding state bacteria criteria for fish and shellfish.*

Other Pollutants: *Previously operational point sources of pollution (e.g., former marina on Isthmus Slough) may still pose a threat to water quality. Remaining estuarine waters remain essentially unstudied.*



Subsystems: CR- Coos River, CS- Catching Slough, HI- Haynes Inlet, IS- Isthmus Slough, LB- Lower Bay, NS- North Slough, PS- Pony Slough, SS- South Slough, UB- Upper Bay





Chapter 9: Water Quality in the Coos Estuary and Lower Coos Watershed

*This chapter includes four data summaries: **Physical Factors, Nutrients, Bacteria, and Other Pollutants** – each describing the most current research on the status and trends (where the data allow) of water quality in the Coos Estuary.*

Physical Factors: The most comprehensive information for physical water quality parameters (dissolved oxygen, water temperature, pH, salinity, turbidity, depth) comes from long-term continuous water quality monitoring efforts (i.e., data recorded by automated data collectors every 15 to 30 minutes). South Slough National Estuarine Research Reserve (SSNERR) staff began continuous monitoring efforts in 1995 and now have five water quality data collection stations in the South Slough estuary (SWMP 2014).

Data from these stations have been analyzed previously (O'Higgins and Rumrill 2007; Cornu et al. 2012) and are reported here with the benefit of additional analyses of the most recent data.

In the fall 2013, SSNERR staff installed four additional continuous monitoring stations in the Coos estuary. Data from these new stations are also summarized for this inventory (SSNERR 2014).

The Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians (CTCLUSI) began almost identical continuous water quality monitoring in the lower Coos estuary in 2006. Their data are collected in annual reports which have been summarized in the Physical Factors section (CTCLUSI 2007, 2008, 2009, 2010, 2011, 2012, 2013).

In addition, the National Oceanic and Atmospheric Administration (NOAA) operates a meteorological and oceanographic station at the mouth of South Slough, which has been collecting water temperature data since 1993 (NOAA 2014). Hourly raw data were downloaded from NOAA and analyzed.

Short-term continuous data can also inform our understanding of water quality. Data used in this report include the following:

- A regional eelgrass study that collected water temperature data every hour from summer 1998 to fall 2001 at four sites in the Coos estuary (Thom et al. 2003); and

- Stream water quality data from summer 2011 monitoring at 15 sites in the South Slough watershed described in Cornu et al. (2012).

The description of the status of stream water quality was additionally informed by several short-term data collection efforts in the Coos River subsystem by ODEQ (ODEQ 2006b, 2006d, 2007a, 2009b).

Several datasets from long-term monitoring "grab" efforts (i.e., single, manually collected samples) were analyzed, including:

- Monthly sampling of salinity and temperature data taken by Oregon Department of Agriculture (ODA) as part of their ongoing fecal coliform sampling program (ODA 2011); and

- Daily data collection from 1966-1997 near the mouth of the Coos estuary collected for the Shore Station Program, a collaboration between the University of San Diego and various institutions across the Pacific Northwest, including the Oregon Institute of Marine Biology (OIMB) in Charleston, Oregon (Shore Stations Program 1997).

The remaining data discussed in this report come from studies which used data collected during very short-term data collector deployments or grab sampling, including the following: CoosWA 2002, 2006, 2008; Hayslip et al. 2006; Lee II and Brown 2009; Shanks et al. 2011; Sigmon et al. 2006; and Weybright 2011, along with the following unpublished sources: 1) Quality-checked data collected by ODEQ for various projects downloaded from their Laboratory Analytical Storage and Retrieval (LASAR) database and reviewed for this summary (ODEQ 2005b, 2005c, 2006a, 2006b, 2006c, 2007a, 2007c, 2009c); 2) Oregon Department of Fish and Wildlife's (ODFW's) annual fish monitoring seine program (ODFW 2013); and 3) A joint study from Marshfield High School and Oregon State University (Coastnet 1999).

<u>Nutrients</u>: The nutrient summary is partially based on an ODEQ report that assessed water quality in the Coos estuary and other Oregon estuaries (Sigmon et al. 2006). In addition, raw data collected during later years of the same project were analyzed in this section (ODEQ 1999, 2001a, 2004, 2005a, 2006a).

Several raw datasets were analyzed and summarized for this inventory including monthly quality-checked nutrient sampling in the South Slough (SWMP 2012) and data from several ODEQ projects (ODEQ 2006d, 2007c, 2009c).

Annual reports from CTCLUSI provided information on two sites in the lower Coos estuary, and information on a single site in the upper estuary (CTCLUSI 2007, 2008, 2009, 2010, 2011, 2012, 2013).

Stream nutrients information was provided by a "State of the Watersheds" assessment of the South Slough watershed (Cornu et al. 2012).

<u>Bacteria</u>: The bacteria summary is based on several data sources including several ODEQ studies (ODEQ 2005a, 2007b).

ODA's monthly fecal coliform data from shellfish growing areas were analyzed and summarized for this inventory (ODA 2014).

Similarly, data from SSNERR's System-Wide Monitoring Program (SWMP) provided monthly *E. coli* and total coliforms bacteria information (SSNERR 2013).

Other reports on estuarine bacteria included here are: Souder 2003 and annual reports by CTCLUSI (CTCLUSI 2007, 2008, 2009, 2010, 2011, 2012, 2013).

Stream bacteria data in South Slough were also derived from Cornu et al. 2012.

Other Pollutants: Only relatively sparse data sets describing dissolved metal concentrations are available for the Pony Slough, Coos River, and Isthmus Slough subsystems (ODEQ 1995, 1998, 2002, 2006a, 2006c, 2006d, 2007c, 2007d, 2009a, 2009b; Water Board 2012).

More robust dissolved metal concentration data are available for South Slough from ODEQ's groundwater well monitoring program at the former site of Coos County's Joe Ney Landfill. The most recent data come from 2012.

ODEQ has monitored total organic carbon (TOC) in the South Slough, Isthmus Slough, and Coos River subsystems (ODEQ 2001b, 2007d, 2009a, 2009b) on a "sporadic" basis; the most recent data were collected in 2009.

Additionally, the Coos Bay/North Bend Water board monitored TOC from 2010-2012 in Pony Slough (Pony Creek and Merritt Lake) and Lower Bay (North Spit) subsystems as part of their drinking water program (Water Board 2012).

Data for assessing dissolved herbicides, pesticides, and other persistent organic pollutants (POPs) are sparse. The Coos Bay/ North Bend Water board monitors for eight POPs at Merritt Lake, all of which are internationally recognized for their high potential for environmental damage (Water Board 2012; Stockholm Convention 2008).

Data Gaps and Limitations

Physical Factors: Continuous water quality monitoring (automated data collection on a regular interval [e.g., 15 minutes]) provides the best characterization of physical water quality parameters. These continuously recorded data are most complete in the South Slough estuary and the lower bay. New stations recently installed in the upper bay by the Coquille Indian Tribe and SSNERR at McCullough Bridge, Isthmus Slough, Catching Slough and Coos River will provide a more complete picture of those parts of the Coos estuary in years to come.

Water temperature data from NOAA's Tides and Currents site in Charleston are raw data and have not been subjected to quality control or quality assurance procedures. NOAA states that these data "do not meet the criteria and standards of official National Ocean Service data. They are released for limited public use as preliminary data to be used only with appropriate caution".

Data from the Shore Stations Program were checked for key entry errors only and not analyzed for overall quality. We analyzed and reported on these data as-is.

Aside from the long-term monitoring efforts described above, most of the physical factors data used in this inventory come from short-term studies. Short term studies provide only a snapshot of water quality. Because most physical factors (e.g., turbidity) fluctuate widely relative to external factors (e.g., precipitation events), results vary drastically depending on when a sample was taken. The "snapshot" quality of these short-term data sets can sometimes limit our overall sense of the status of water quality in the Coos estuary. However, some short term data collection is still important because it can provide information about parameters under the most relevant conditions. For example, ODEQ's storm-related bacteria monitoring is collected during periods of high runoff and turbidity; the Coos Watershed Association's (CoosWA's) summertime-only monitoring is collected during the warmest months for stream temperature.

Subsystems lacking permanent water quality monitoring stations (e.g., North Slough; Pony Slough) have very little comprehensive information available to assess the status of physical water quality.

<u>Nutrients</u>: Much of the data used for this summary (e.g., ODEQ 1999, 2001a, 2004, 2005a, 2006a, 2006d, 2007c, 2009c) came from limited duration studies that sampled only during the dry season. For some parts of the estuary, our understanding of nitrogen, phosphorus and chlorophyll *a* levels during the wet season is therefore largely incomplete.

For several subsystems there exists little or no nutrients information (e.g., North Slough). Stream nutrient data included three sites in South Slough's upper watershed. All other subsystems are lacking in any stream (freshwater) nutrient information.

Silica data provided by ODEQ were frequently limited by the sensitivity of laboratory analysis techniques. Therefore, many of the silica data are listed as "below levels of detection" and provide little quantitative information.

<u>Bacteria</u>: There were limited data available to assess the Coos River, North Slough and Pony Slough subsystems.

Data sets were inconsistent based on sampling frequencies ranging from monthly to three times per year. Seasonal trends (e.g., wet vs. dry seasons) can be established for data sets with monthly sampling frequencies. However, there are limitations even with monthly sampling because many estuarine environmental water quality variables that influence bacteria are driven by tidal forces or precipitation events and can change multiple times in a day.

In addition, one state of Oregon standard for *E. coli* requires at least five samples over a 30 day period, which we were unable to fully assess in this report due to lack of data.

<u>Other Pollutants</u>: Large information gaps make it difficult to fully assess the status of dissolved pollutants in the Coos system. Information is only available in five of the nine subsystems. Available data are often collected at irregular intervals for a limited duration.

Additionally, the most recent dissolved pollutants data are from 2012.

The sensitivity of instruments used to collect and analyze the samples also presents a challenge. In many cases data values were below detectable limits, and United States Environmental Protection Agency (USEPA) water quality standards are close to many of these limits. To estimate the mean concentration of dissolved metals in the study area, we assumed "undetectable" observations were equal to the average of zero and the limit of detection. For example, an entry of "< 1.0 µg/L" was assigned the average value of 0.5 µg/L. If the true values of the undetectable observations differ from assumed values, then the true mean will differ from the estimated mean.

Evaluating the status of dissolved pollutants in the study area is further complicated by the uncertainty involved in applying appropriate water quality guidelines. Water quality standards for dissolved metals are often a function of site-specific parameters. For example, water "hardness," a measure of water's mineral content, may affect both acute and chronic criteria guidelines. In many cases, nationally recommended parameters that "can be effectively implemented on a broader level across any waters with roughly the same physical and chemical characteristics" have been adopted in order to facilitate analyses (USEPA 1993).

Exposure to dissolved metals adversely affects both aquatic life and human health. However, the exact effect of these toxins on aquatic life varies widely by species and environmental conditions (USEPA 1980). For example, USEPA explains that the toxicity of copper to aquatic life varies according to the species-specific biochemical receptors responding only to that metal (USEPA 2007).

They also note that copper toxicity is critically dependent on the characteristics of the water in which it is dissolved (e.g., temperature, dissolved organic compounds, pH, etc.). Due to the complexity of the physiological response to toxins in aquatic life, the Other Pollutants data summary focuses on the human health aspects of dissolved metals.

The mobility and availability of pollutants in estuaries are influenced by many factors, including chemical, geological and physical processes (oxidation, precipitation, sedimentation, tidal inundation, etc.)(Carroll et al. 2002, Bauer and Bianchi 2011, Williams et al. 1994). In addition to natural processes, pollutant cycling is affected by human land use activities, which can further complicate an already complex process (Bauer and Bianchi 2011). Because dissolved pollutants in the water column interact with sediment deposits on the estuary bottom, we suggest also examining the Contaminants data summary in "Chapter 10: Sediment in the Coos Estuary and the Lower Coos Watershed". Interpreting both together offers a more comprehensive indicator of the overall status of pollutants in the Coos estuary.

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