

**A Historical Reconstruction and Land Use History
of Six Tidal Wetlands in Oregon**

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Introduction

This Master's Degree project is intended to document historical ecological conditions and land use histories during the past 150 years for selected Oregon watersheds and tidal wetland sites. The sites are the subject of current research into the ability of tidal wetlands to provide rearing habitat and prey for juvenile salmonids. Six reference marshes were selected for an on-going study by Bottom, Jones, Simenstad, and others into the use of tidal wetlands by juvenile salmonids (Gray et al. 2002, Cornwell et al. 2001). Their project compares upper and lower estuary wetlands on three Oregon coastal river systems: the Alsea, the Siuslaw, and the Yaquina. These sites were chosen because they represent relatively undisturbed remaining tidal wetlands and are similar in vegetation and landscape position. In addition, the sites met the comparative and logistical needs for the study.

In order to manage vital resources such as estuaries, tidal wetlands, and watersheds, it is imperative to understand their history and how they may have changed over time. This Masters project attempts to provide data on the linkage between human induced changes to the physical characteristics of estuaries, tidal wetlands, and watersheds and the resulting impact on the functioning of tidal wetlands.

Estuaries represent unique and important ecosystems. They provide habitat for fish and wildlife, such as salmon, steelhead, and migrating waterfowl (Good 1999), and are home to a large number of endangered and threatened species. More than 70 species of juvenile fish are known to utilize Oregon estuaries for foraging (Restore 2002). Other important functions estuaries provide include pollution absorption, floodwater retention, slope stabilization, sediment trapping, and nutrient retention (Good 1999, Josselyn et al. 1990). They also provide recreational opportunities, aesthetic values, and functions that serve economic sectors such as fisheries.

There are several important habitats within estuaries in the Pacific Northwest including subtidal habitats, tidal wetlands (e.g. low and high salt marsh), tidal flats with eelgrass and algal beds, and tidal swamps (dominated by spruce, willow and alder) (Good 1999). Compared to other ecosystems throughout the world, tidal marshes are one of the most productive (Mitsch and Gosselink 2000, Restore 2002). By definition, tidal marshes¹ are inundated by tidal waters at least once a month. These unique ecosystems are subject to varying water and salinity levels on a daily basis, making them an area of environmental stress, as well as home to unique plant and habitat types. Tidal marshes provide a variety of important functions such as reduction of flood levels, retention of sediment, nutrient processing, wildlife habitat, and fish habitat (Brophy 1999). Specifically, wildlife such as waterfowl, shorebirds, a variety of fish species, and land mammals such as elk and beaver utilize tidal marsh habitat (Mitsch and Gosselink 2000).

Tidal marshes and their channels provide rearing habitat for coho and Chinook salmon (Simenstad et al. 2000, Gray et al. 2002, Restore 2002, Brophy 1999). The cultural, economic, and ecological importance of salmon has made its recovery critical in the Northwest. Recent research has found that salmon use not only mature marshes, but also those that have been recently restored. A study comparing salmonids in natural and created sloughs on the Chehalis River, Washington found no significant difference in growth rates or diet composition, but did find that fish residing in natural marshes had more food in their stomachs (Miller and Simenstad 1997). Work by Gray et al. (2000) in the Salmon River, Oregon found the highest densities of juvenile Chinook in the mature reference marsh and a trend of increasing fish abundance with increasing age of marsh recovery. However, the study also found a significant fish and invertebrate response in the first two to three years after restoration. According to the

¹ The terms "tidal wetland" and "tidal marsh" will be used interchangeably throughout this paper to encompass both low and high wetland habitats that are inundated by tidal waters roughly once per month.

researchers, this "pulse of productivity" indicates some early level of functionality returning and thus, also supports the "efficacy of restoring estuarine marshes for juvenile salmon habitat" (Gray et al. 2002).

Unfortunately tidal wetlands have been highly altered and degraded by Euro-American development. In Oregon, as in many other places a century ago, settlers viewed tidal marshes as wastelands that needed improvement (Robbins 1997). Thus, these areas were often diked, ditched, and drained for use as pasture or agriculture. Another popular use was filling for development or dredging for shipping. Population pressures in the Pacific Northwest over the past 50 years have exacerbated this habitat degradation. Between 1950 and 1990, the urban population in Tacoma-Seattle areas of Washington grew 85%, while Oregon's less urbanized population grew by just under 60% (Josselyn et al. 1990). As a result, more than 70 percent of tidal wetlands in the Puget Sound have been lost in the past century (Restore 2002). In general higher losses correspond to more dense populations. Yet along Oregon's coast, where populations are less dense, the Nestucca and Coquille have lost over 90 percent of their tidal wetlands (Good 1999); Tillamook Bay has lost 85 percent of marshlands to diking and draining; and South Slough National Research Reserve has less than 10 percent of original salt marsh remaining (Restore 2002).² Losses for the Oregon coastal estuaries covered by this project were estimated at 59 percent in the Alsea, 63 percent in the Siuslaw, and 71 percent in the Yaquina (Good 1999). Efforts by state and federal governments in the 1980s and early 1990s focused on mitigating damage from development under a "no-net-loss" policy for wetlands. However, recent attention in the Northwest has been directed towards reversing habitat degradation through restoration, rather than merely mitigating for additional losses (Good 1999; Restore 2002).

² Good's (1999) estimates for loss used the 1970 estimates for wetland area from the *Oregon Estuary Plan Book* (Cortright et al. 1987). Good derived the 1870 estimate of wetland area by adding the area of filled and diked land in the estuary to the 1970 estimates.

The aim of restoration is to restore functions such as biological productivity, sediment retention, and nutrient transformation (Gray et al. 2002). Brinson and Rheinhardt (1996) define restoration as "the return of a site to its pre-existing wetland condition." However, such "original conditions" are usually impossible to reach and not all functions can be returned. Yet, restoration is still a way to recover some important ecosystem functions in degraded habitats (Frenkel and Morlan 1991). For wetland habitats these ecosystem functions encompass the following categories: hydrologic, biogeochemical, plant community maintenance, and animal community maintenance (Brinson and Rheinhardt 1996, Brinson et al. 1994). Some researchers estimate recovery and return of functions can take anywhere from 10 to 50 years (Frenkel and Morlan 1991).

Special considerations are needed to improve salmon habitat in wetland restoration sites. According to Simenstad et al. (2000), if salmon recovery is a main goal of restoring a wetland site, then the following landscape structure and scales should be considered in planning and designing the restoration: 1) tidal marsh structure with large woody debris to provide prey resources and refugia, 2) migration corridors of tidal channels bordered with *Carex lyngbei* to provide food and protection, 3) prey resource concentration along with appropriate fish access, 4) detritus availability and seasonality to support secondary production, and 5) natural disturbance regimes that can change marsh structure. More important than considering design of one particular site is the total landscape "opportunity" for juvenile fish (Simenstad et al., 2000). Simenstad et al. (2000) recommend emphasizing "linkages among marshes" and diversity within the region to improve total habitat "opportunity" for fish.

While estuarine restoration is still considered a "young science," much has been learned from research over the past 20-30 years (Restore 1999). Restoration science requires specific

information throughout the process. During design and planning, contextual information should be gathered. Knowledge of historical, reference and existing conditions is an important first step (Good 1999; Restore 1999). Assessing historical conditions is also critical to determine what "reference" condition means in this project's marsh sites.

Other important information for restoration planning includes knowledge of the physical and biogeochemical processes and parameters, such as elevation, topography, soil types, salinity, tidal forces and heights, hydrology, and vegetation (Frenkel and Morlan 1991; Josselyn et al. 1990). In designing the restoration project all barriers to natural functioning should be removed (Restore 1999). This includes reestablishing former hydrological connections and matching hydrological conditions to the appropriate vegetation and habitat (Frenkel and Morlan 1991; Josselyn et al. 1990). In addition, site-specific constraints such as subsidence, poor substrate or excess sediment should be mitigated (Josselyn et al. 1990), while negative off-site impacts such as flooding and saltwater intrusion should be avoided (Restore 1999).

Unfortunately, in the past, monitoring of restored sites has been spotty and has lacked functionality assessments (Josselyn et al. 1990). Because of this, research and information regarding estuarine restoration has progressed slower than it would have with consistent and comprehensive monitoring. However, recent studies have begun to address functional equivalencies for monitoring progress of restored wetland sites (Morgan and Short 2002, Simenstad and Thom 1996). Work by Simenstad and Thom (1996) found only a few attributes out of sixteen tested suggested a possible path toward achieving functional equivalency. They warned that better understanding of natural variability and its sources is needed in reference wetlands before appropriate indicators of functional equivalency can be determined. More recently, Morgan and Short (2002) found that four of five indicators studied in constructed

wetlands fit a trajectory towards achieving similar functions as reference sites. However, these indicators varied in the length of time needed to achieve equivalency with reference sites. Some indicators, such as plant diversity and biomass actually exceeded reference conditions and later decreased to reference levels.

While recent research has increased knowledge of estuaries and restoration practices, the science of restoration still has a great deal of uncertainty. A broad spectrum of analytical tools is available to overcome this uncertainty including broad-scale comparative studies; site history (e.g., paleoecological, dendrochronological); historical time-for-space substitutions; focused experimentation; and application of statistical approaches used for environmental impact assessment (e.g., oil spills) (Michener 1997).

The use of reference sites is integral to providing a scientific basis for wetland management decisions. Yet, as mentioned above, very seldom do "reference" or original marshes exist. Some would argue there are no sites left today that exactly represent the habitats of pre-Euro-American development. Given this conundrum we are left with the question: What does "reference" mean? Brinson and Rheinhardt (1996) offer a definition:

Reference wetlands are defined as sites within a specified geographic region that are chosen, for the purposes of functional assessment, to encompass the known variation of a group or class of wetlands, including both natural and disturbance-mediated variations.

According to these researchers, reference wetlands must contain highly functioning and highly disturbed sites in order to determine the levels of possible functioning. From this set, reference standards can be determined; "*Reference standards* would represent the conditions exhibited by the subset of reference wetlands that correspond to the highest level of functioning of the ecosystem across a suite of functions" (Brinson and Rheinhardt 1996). Reference sites must also be selected carefully for similarities in wetland type, size, geomorphology, potential tidal range,

landscape position, water quality and adjacent land use (Neckles et al. 2002). The sites chosen for this project were carefully selected with these concerns in mind. However due to limited availability of appropriate sites, a few differences do exist between the sites that could result in functional differences. This project will analyze historical conditions in order to determine the following: Are these sites “references”? How have the sites differed historically? And finally, have historical changes likely affected contemporary salmon usage of tidal marshes?

Most researchers rely on studying wetland structures that correspond to various functions (for examples see work by Morgan and Short 2002, Simenstad and Thom 1996, and Adamus et al. 1987). According to Brinson and Rheinhardt (1996) this structure-function argument assumes that 1) “structure reliably indicates corresponding functions,” and 2) structure of highly functioning wetlands corresponds to sustainable functions within the constraints of the watershed, instead of a maximum level of functioning. Some problems with these assumptions include limited testing of the premise that wetland landscape determines function and little evaluation of spatial structure of wetlands in relationship to their watershed (Simenstad and Thom 1996).

Brinson and Rheinhardt’s (1996) definition of “reference” wetlands uses the wetlands of today in their context of a changed landscape as a starting point. The least disturbed wetland is likely the best functioning wetland across a range of functions (Brinson and Rheinhardt 1996). This method provides a practical way to approach the question of reference wetlands and reference standards for major ecosystem functions. But which functions (and therefore which standards) are important would vary depending on the perspective of the researcher. A scientist looking at water quality would be more concerned about a wetland’s ability to process nutrients than habitat structure for birds. This definition also fails if the available reference wetlands are

all highly disturbed. By focusing solely on current conditions, this definition also ignores the importance of historical changes to wetlands over time. Human impacts have changed the functioning of wetland sites over time. The extent, permanency and nature of these impacts create the current conditions on which this definition of "reference" relies. It is also important to understand whether certain past functions can be restored. Further confounding this is the fact that, "not all functions are affected equally by impacts...nor are all functions recoverable at the same rate and to the same degree over similar periods of time (Golet 1986, Larson and Neill 1987, PERL 1990)" (Brinson and Rheinhardt 1996). The field of historical ecology yields a way to begin answering some of these questions.

The emerging field of historical ecology relies on multiple disciplines. Its importance to contemporary ecology and resource management cannot be understated. As Swetnam et al. (1999) state:

Rather than a direct use of history for prediction, most historical ecologists emphasize the importance of knowing history, because it informs us about what is possible within the context of certain locations and times, and it places current conditions into this context.

Indeed, it is this historical context that provides a basis for resource management (Kettle et al. 2000, Swetnam et al. 1999). Because it is impossible to duplicate the effects of past influences Russell (1997) outlines three consequences of excluding historical ecology in contemporary ecological studies: 1) "If those past interactions have left a residual impact, study of current conditions alone cannot detect its cause"; 2) historical human influences accumulate over time and superimpose upon each other; and 3) human impacts are nearly universal making it very difficult to find systems that are lacking human influence. For example, a study of land-use history of prairie-forest habitats found that within restoration treatments there were differences associated with land-use history and landscape position that persisted in these communities

despite 40 years of restoration (Kettle et al. 2000). Thus, an important reason for historical reconstructions is that the effects of historic impacts persist (Kettle et al. 2000).

Historical reconstructions also provide important guidance for developing conservation or restoration goals. Management based on present-day conditions alone may actually reinforce present indicators of ecosystem decline. For example, current research may show abundance linked to habitats available today, but which are actually a result of historic habitat losses. For this reason, essential restoration and conservation needs might involve absent or rare types of habitats and populations, instead of the most prevalent. These needs would be underestimated by utilizing only current ecological information.

Ecosystems have a “range of natural variability” and thus, historical reconstructions cannot use a single fixed point in the past (Swetnam et al. 1999). Understanding both disturbance history and vegetation change patterns is critical to developing an ecosystem’s “range of natural variability” (Kettle et al. 2000). A good example is the role of fires and vegetation patterns in western U.S. forests. Only through research of fire scars and historical ecology did resource managers understand the importance of fire in maintaining some forest ecosystems (Kettle et al. 2000). As Russell argues, ecosystems are “never static and the present conditions are merely stages in a continually changing mosaic” (Russell 1997). Thus, this reconstruction will also attempt to identify the range of natural variability and human impacts influencing tidal marshes in pre-European times. Yet, it is important to remember that not all human interactions are stable. Even when discussing native cultures it is possible that “we may overlook the evidence from many cultures – even pre-industrial ones – that human groups often have significantly unstable interactions with their environments” (Cronon 1983).

Utilizing these lessons from historical ecologists, this historical reconstruction will examine the time period from the 1880s to present day focusing on the land use histories of six tidal marshes and their associated watersheds. These sites will be analyzed for pre-European condition and their historic human-induced land-use disturbances. Native American uses will also be examined in order to reconstruct what these areas might have been like before whites came to the region. As historian William Cronon acknowledges in *Changes in the Land: Indians, Colonists and the Ecology of New England*, "The choice is not between two landscapes, one with and one without human influence; it is between two human ways of living, two ways of belonging to an ecosystem" (Cronon 1983). Additionally, this paper will examine how these changes may have affected the functionality of these sites both at the site and landscape level. Historic reconstruction provides a better understanding of how the ecosystem functioned with native people in pre-European times, how it has changed, and how it may function in the future. Thus, this paper will attempt to provide a somewhat, uniform treatment for the three estuaries and six sites in question in order to understand both their historical and current conditions. Given the nature of historical records, however, some resources are used which are unavailable for all of the sites, but enhance the understanding of those particular areas. By focusing on prior uses and conditions versus those after the 1880s, the reconstruction will reveal the extent to which differing land uses impacted the landscape of these tidal marshes.

A few historical reconstructions have been compiled for Oregon, which include tidal marsh areas. In particular, Benner's analyses of Tillamook Bay (Coulton and Williams 1996) and the Coquille River estuary (Benner 1991) employ detailed methods for reconstructing past landscapes. Her reconstructed landscapes used a combination of data sources such as General Land Office original survey notes; Donation Land Claims; U.S. Geological Surveys; soil

surveys; flood insurance maps and records; U.S. Army Corps of Engineers reports on navigation improvements (such as jetties and dredging); drainage and diking districts; 1939 U.S. Army Corps of Engineers aerial photographs; and analysis of other impacts such as log jams, fires, and splash dams. As a result, detailed maps of past vegetation and ecosystem classes were developed.

Another review of historical disturbances was completed by Brophy (1999) who relied primarily on historical aerial photography, land ownership and some field observations for the purpose of prioritizing tidal marshes for restoration and protection in the Alsea and Yaquina basins. However, any research or discussion of pre-European conditions of tidal marshes is notably lacking. This report provided some important background and confirmation data for some of the sites in this study, but lacked detailed field observations for many of the sites and did not cover the Siuslaw River.

In *Landscapes of Promise*, environmental historian William Robbins writes, "a material understanding of the world, the physicality of modern life, is central to comprehending the human relationship with the natural world" (Robbins 1997). In order to understand the tidal wetlands of today, this paper will examine the changing human relationships to the material and natural world through time.

Methodology

The following are some of the research questions this paper will address and attempt to answer:

- What is a "reference" marsh? Can these sites be considered "reference"?
- How did the marshes look and function in pre-Euro-American times?
- What kinds of human influences might have impacted these tidal marshes from Euro-American settlement to present day? How do these impacts differ among the three estuaries?
- How might these influences have changed these tidal marshes from their pre-European functioning and, in particular, use by salmon?

In order to answer these questions and meet the overall goal of the project, the primary objective is to assess historical land use and historical ecological condition of the wetlands and their watershed.

ASSESS HISTORICAL LAND USE AND ECOLOGICAL CONDITION

Given the increased interest in restoring tidal wetlands and need for better information on historical conditions, Gupta (2000) developed suggestions for data and methods to provide a standardized, yet comprehensive approach for historical reconstructions.³ After analyzing available data types for quality, coverage, ease of use, utility and applicability, Gupta developed a series of recommended data sources based on the purpose of the historical reconstruction. For example, her "best available data" protocol provided a series of data sources to use, if one wanted the most complete and best quality data available. Her "state standard" protocol was a way to provide a uniform protocol and data sources, because multiple previous studies had discrepancies between data sources and methodologies. Gupta's (2000) "best available data" protocol was chosen as a base for my initial research rather than the "state standard" protocol. The goal of this project is not to conform to a standard historical reconstruction method, but

³ Both Brophy (1999) and Benner's (draft, and in Coulton and Williams 1996) were developed prior to Gupta's (2000) suggestions and thus, neither approach completely follows her suggested methodology.

rather to provide the most complete information based on the data available. This involved using data sources that were available for comparison across the estuaries and sites of interest and in some cases sources that were not highly recommended by Gupta due to difficulty of use. The resulting methodology used many of the data sources suggested under the “best available data protocol” by Gupta (2000) and by Benner's methods (1991, and in Coulton and Williams 1996) for historical reconstruction of tidal marshes. Specifically, the data sources are a combination of General Land Office Survey Notes, US Army Corps of Engineers Annual Reports, digital soil surveys, historical and current aerial photos, the Oregon Estuary Plan Book, National Wetland Inventory Maps, and Digital Elevation Models. In addition, searches were made for property ownership, interviews, and historical written accounts to provide a broader description of the land use history. Other sources of data included county surveyor's records and data from a variety of local historical societies. Unfortunately, Benner maps, the highest ranked data type for former vegetation by Gupta (2000), are not available for the estuaries in question. However, I used data sources and methods similar to those of Benner (1991) as well as a combination of other sources to fill this data gap. Using all of these data sources, the land use patterns, vegetation, and physical changes in the selected tidal marshes and their watersheds were analyzed and compared over time.

In addition to the above sources and based on other historical ecologists' work (see Cronon 1983, Robbins 1997, Russell 1997), I felt it also was important to analyze: 1) the historical context of resource use affecting each watershed, and 2) historical accounts, photographs, and field evidence of specific changes at each selected wetland site. As many historical ecologists have noted, human impacts are visible at various scales. By only analyzing a small parcel and not the larger landscape and resource use context, one can miss important

influences on the functioning of a natural system. Thus, by including both landscape- and site-level impacts, this project allowed a simultaneous analysis of these scales; how they influenced each other; and how this resulted in changes to wetland and watershed functioning.

With so many data sources, organization and clarity for the writer and reader can be difficult. Thus, this report has consolidated the results and discussion into one section for each watershed. Each watershed utilized a standard format to present the various sources of data (see table of contents). Since much of the data is visual, the maps and photos have been scanned into digital format. These visual references are contained in the Appendices, which have been burned onto a few CDs. The following is a detailed description of each data source and the methods employed:

Data sources

Anthropological and Archaeological Sources – Various primary and secondary sources covering different Native American tribes and their historical use of tidal marshes in each watershed were reviewed. This included results of archaeological studies along the Oregon coast, which established the locations of some temporary and permanent villages. These data provided an indication of native impact on natural resources and tidal wetlands. These sources also provide a context for understanding human disturbances that have modified the landscape and how these changes have affected coastal ecosystems.

General Land Office (GLO) Survey Notes – These surveys conducted along the Oregon Coast from 1850-1880s indicated general vegetation and soil types, tidal influence, and marsh existence and extent. The detailed GLO notes were transcribed for the sites in question and for the general descriptions of the watershed area. These surveys were conducted to aid in settlement, and thus the surveyors' perspectives are colored by comments on the suitability for

agriculture and other settlement needs (Benner 1991). Despite this bias, the survey notes are thought to be generally accurate descriptions of the land at the time (Benner 1991).

As noted by other researchers, these notes are notoriously difficult to transcribe due to variation in the legibility of each surveyor's handwriting (Benner 1991). Survey notes described distance in chains and links (one link equivalent to 8 inches) and direction in degrees (north, south, east and west) (Benner 1991). Wetlands were identified by characteristic descriptions such as "wet bottomland"; "swampy"; "good bottomland"; "subject to overflow"; and "marshy bottom" (Benner 1991).⁴ Surveyors also used a mound and stake when no trees were available, another indication of potential wetland (Benner 1991). Finally, notes on survey corners listed species such as, spruce, crab apple, and willow, which were often indicators of a wetland.

US Army Corps of Engineers Annual Reports to Congress – General surveys from the late 1860s were originally intended to provide information on navigability, head of tide, and potential channel improvements. However, they also contain broader notes on the area, land uses, extent of settlement, and economic activities. Additionally, they indicate dredging, splash damming, jetty construction, and other hydrological impacts undertaken by the Corps, especially in later reports. In particular, these reports were used to provide historical conditions from the late 1800s and document early alterations to the watershed. While extensive volumes are available, only those up to the turn of the century were used due to time constraints. More contemporary US Army Corps reports, particularly Environmental Impact Statements, provided additional information on specific projects and impacts in each estuary.

Historical Aerial Photo Interpretation – Aerial photos are available from 1939 to present day. These photos were used to identify on-site and near-site human influences and impacts. The

⁴ In her draft on the Coquille watershed, Benner (draft) mentions many more of the typical phrases used by surveyors that indicate historical wetlands.

photos were carefully examined at the library and notes were taken. Then, they were scanned into digital form at high resolution (800 dpi) and examined again. A ranking and scoring system for persistence and severity of these impacts was developed to systematically determine the level of disturbance for each site. Persistence of alterations was measured by the presence of impacts in photos over time. For example, a disturbance present in an early photo but not in a later photo, would cause the disturbance score to decrease. However, each estuary has a different number of photos available. To solve this issue, photos were lumped to capture a snapshot of the alterations for each decade.⁵

The scoring method presented two other issues: 1) how to rank and scale various impacts and 2) where to draw the boundary area of the wetland and upland. For ranking impacts, a simple 1-3 scale for low, moderate, and severe, respectively was used to score disturbances in the photos. A similar ranking system was used by the U.S. Army Corps of Engineers (USACE 1976) in an analysis of Alsea area wetlands, which gave examples of types of impacts in these categories.⁶ The USACE ranking categories followed a generally understood division for severity of various impacts. Instead of using the USACE's four-tiered system, I altered the USACE system of impacts to a three-tiered ranking system for determining what types of alterations constituted each rank. As a result, the ranking system provided a realistic, objective, and relatively simple method for categorizing and scoring the aerial photos. For scaling my results, I assumed that onsite disturbances would likely have a higher impact and depend also on the area of the wetland disturbed. To account for these differences, I assigned a maximum

⁵ The final score for a decade was the average score for the photos available during that decade. For example, if three photos were available for the 1950s with the scores 20, 22, and 24, then the average score of 22 would be used as the final score for the 1950s.

⁶ Although the USACE system used a 4-tiered scale of degree of disturbance, it did associate various impacts with each level. For example, an old clearcut and recreational use were low impacts; agriculture, dikes, clearcuts were moderate impacts; development constituted a severe disturbance; and fill was considered very severe.

disturbance ranking of 3 for onsite disturbances and 2 for offsite disturbances. Percent of wetland length and the percent of wetland area affected were used as a basis for scoring disturbances due to their ease of measurement. Since all the sites vary in size, use of percent area meant that the alteration was adjusted relative to the size of wetland.

The table below outlines the definitions for the scoring method. The score for each disturbance was achieved by adding its intensity rank and scale factor together.⁷ Each disturbance was scored separately, and all disturbance scores were added together to yield a total disturbance score for each photo.

Table 1. Scoring Method for Historical Photos.

	1 – low	2 - moderate	3 - high
Rank - Intensity of disturbance	Dock, old clearcut, pilings, boardwalk	Dike, ditch, agriculture, clearcut, rural housing, log booming, dirt road	Fill, dense development, paved road, railroad
Scale – Onsite	Less than 10% of wetland area impacted	10-25% of area disturbed	Over 25% of area disturbed
Scale – Adjacent	Affects less than 50% of contiguous length	Affects over 50% of contiguous length	N/A
Scale – Upland	Less than 50% of relative size of wetland	Over 50% of relative size of wetland	N/A

To determine historic wetland and upland areas I used the 1939 photo (or oldest and best coverage available). Other factors for determining the site area included knowledge of present and past wetland extent, area of current study, deed information, and channel networks. For a couple of the sites, a smaller area was determined as the site, even though the wetland was part

⁷ While more complicated statistical scaling could have been done, this system of adding the two numbers still resulted in an estimated impact that included both area and intensity of disturbance.

of a larger complex of wetlands.⁸ In these cases, the deed information, drainage area, and channel networks served to set the boundaries. For determining the upland area, the immediate subbasin or local drainage area served to set the boundary. Digital elevation models, topographic maps, and orthophotos assisted in determining this area. For island or peninsula sites such as the Siuslaw, the adjacent upland and associated wetland areas were included.⁹

Field Observations - Personal field data and observations were collected, recorded, and analyzed. Each site visit included a thorough walk of the site and photo documentation when possible. Primarily data included vegetation composition, presence and extent of non-native species, and man-made structures or alterations (ditches, dikes, roads, timber cuts) to the site, immediate upland composition, and general vicinity land use. The field data were used to indicate historical land uses and combined with scientific literature to determine the potential residual impacts to wetland functioning.

2000 Infrared Aerial Photography – Interpretation of infrared aerial photos provided evidence of vegetation changes, current conditions of marshes, as well as past ditching or diking.

Metsker Maps – These maps supplied information on road and other networks (electrical and railroad lines) and land ownership for the mid-1900s (1940-1960s).

Hatcheries – Hatchery operations influence whether or not native stocks are able to compete for limited habitat. Thus, a historical inventory of hatchery operations and release of hatchery fish in each estuary was compiled to provide further information regarding differences between the estuaries and sites for wild salmon stocks.

Other – Searches were made for property ownership, interviews, and historical written accounts to provide a broader description of the historical land use. Additionally, a few primary and

⁸ This was primarily due to: lack of aerial photo coverage (lower Alsea and upper Siuslaw) and/or large wetland size accompanied by a break in property ownership, vegetation, or channel network.

⁹ These sites also included a portion of the river, or a buffer around the wetland into the water.

secondary sources were utilized to describe the broader historical development and resource uses for each estuary. Other sources of information included diking districts, county surveyor's records, and local historical societies. These sources were not readily available for every site but assisted in answering questions and provided a richer historical narrative.

Digital Data

Estuary Plan Book; Inventory of Filled Lands in Oregon; National Wetland Inventory; Digital Elevation Model – The *Oregon Estuary Plan Book* (Cortright et al., 1987) was consulted for information on current vegetation, head of tide, diking, substrate, hydric soils and fill data. The inventory of filled lands is produced by the Oregon Division of State Lands, which corroborated the location of filled areas and tide levels. The National Wetland Inventory and the Digital Elevation Model assisted in confirming the classification and potential level of inundation of these wetlands. The hydric soil data also were digitally available. All of these sources were available as data layers in a single digital geodatabase (Scranton 2004).

SOURCES OF ERROR

This Masters project attempts to cover multiple sites over a large time range for a historical reconstruction. Financial and time constraints necessarily limit the sources of data covered in this report. This, in turn, renders the report liable to error due to lack of complete data. This report combats this by using data sources that others have recommended in their research and by utilizing data that serves more than one function.

Additionally, as is the nature in historical research, some types of data are available for some areas and not others. As several historical ecologists have noted, “The most important limitation of historical ecology is that the record of the past is often brief, fragmentary, or simply unobtainable for the process or structure of interest” (Swetnam et al. 1999). Thus, this work

relies on common sources of data for early mapping, photographs, and general history. The baseline for comparison is the same for all of the estuaries and sites. However, data that yielded a better understanding of a particular site and a richer historical narrative were included even if similar information was unavailable for the other sites.

Error also arises due to interpretation of the biases of those collecting the data. Interpreting past biases is a critical process to understanding the data and includes knowing common perceptions of the time and the purpose of past surveys, which influences the data's coverage specificity (Russell 1997). This report utilizes a variety of experts and best professional judgment to determine the context of the historical data: the reasons for the records as well as attitudes and perceptions of the time.¹⁰ Yet, interpretation of biases is also a subjective process colored by current values. As such, it is a product of its time, which must be taken into account in interpreting the results.

Historical reconstructions usually rely on utilizing data for a purpose other than its original intended use. This introduces scale error issues in attempting to draw larger conclusions from narrow descriptions and vice versa. This report attempts to overcome the scale issues by describing both the larger landscape of the watershed and each specific marsh through the appropriate sources and a wide variety of data types.

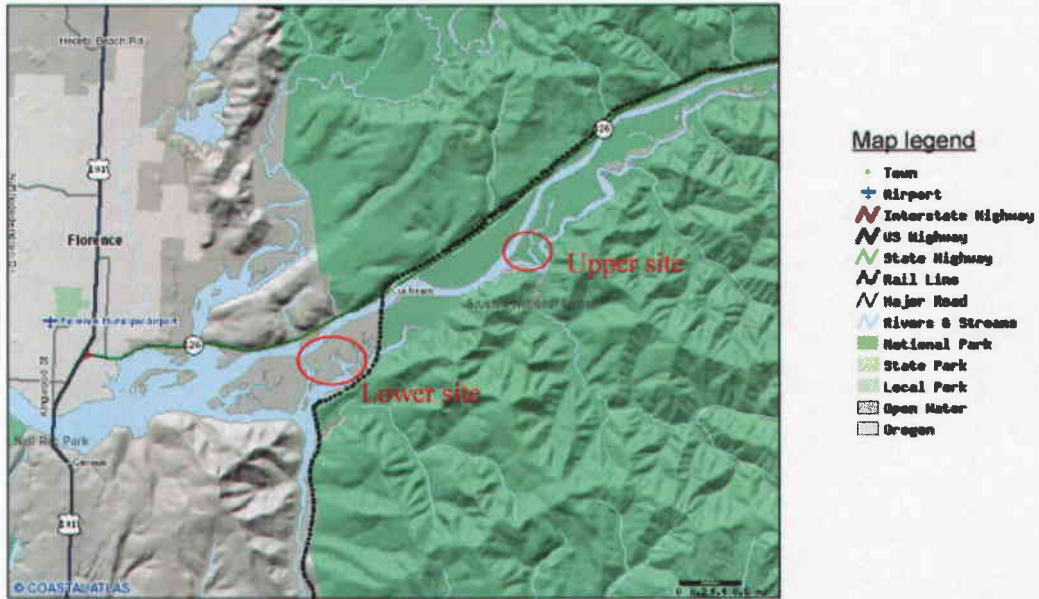
Interpreting landscape change is easier with the aid of aerial photography. However, interpretation can still present problems of scale and in determining vegetation classifications (Russell 1997).¹¹ The use of photographic interpretation involves many other potential errors. Interpretation relies on human observation of patterns, shading, shapes, and textures. Thus,

¹⁰ Russell (1997) further argues, "The attitudes and perceptions that prevailed when a document was composed necessarily color what was written."

¹¹ Russell (1997) also contends that one must not forget the human disturbances made prior to the available photographs for an area. This study combats this by using other data sources to elucidate the landscape history prior to the 1930s.

observation can lead to misread or missed objects. Since a photograph is a snapshot of one moment, it underreports some activities. Other activities, such as grazing may be difficult to detect at all. The photographs themselves are subject to errors from photographic equipment, film shrinkage or expansion and, in the case of the photos used for this project, resolution, and coverage vary depending on the area and age of the photo (Wolf and DeWitt 2000). In order to minimize human introduced errors, extensive practice in photogrammetric techniques and interpretation was gained by taking a graduate level photogrammetry course.

Siuslaw



The Coastal Atlas uses both public and private data sources, including the DynamicDisplay product. © GDT
The data and associated data files in this map are captured here "as is" without warranty to their performance, merchantable state, or fitness for any particular purpose. The entire risk associated with the results and performance of this map is assumed by the user. This map is not for navigational or legal purposes.
<http://www.coastalatlases.net> is a project of the Oregon Ocean-Coastal Management Program in collaboration with Oregon State University and EcoTrust. Funding for the effort has been provided by the National Science Foundation, the NOAA Coastal Services Center and the Federal Geographic Data Commission

Figure 1. Location of upper and lower tidal wetland sites in the Siuslaw River estuary.

Results and Discussion: Siuslaw Watershed and Sites

BACKGROUND

Table 2. General Statistics.

Estuary Area (acres)	3060
Watershed Area (square miles)	4560
Estuary Rank	8th
Geomorphology	Drowned River Mouth
Head of Tide (river mile from Department of State Lands)	22.8, above Mapleton

Sources: Oregon Coastal Atlas 2004; Percy 1974; Oregon DSL 2005; and Scranton 2004.

Site Locations

The tidal wetland sites on the Siuslaw River are located near present day Cushman on the main stem of the Siuslaw River, upstream from the town of Florence. Site locations are marked in red circles in Fig. 1 (see also Appendix A- Siuslaw, Folder: Site Locations, File: Siuslaw). The lower site is situated on a peninsula, which currently has a railroad running across the upper portion.¹² The upper site is on the southwestern most portion of Duncan Island, on the north side of Duncan Slough.

Table 3. Site Specifics.

	<u>Lower Site</u>	<u>Upper Site</u>
Location by River Mile from mouth (approximate) ¹³	7.3	9.6
Digital Elevation Model (ft. above Mean Low Tide)	0-3	0-10
Habitat Classification (from: Scranton 2004)	Mostly Marine Sourced Low with some Marine Sourced High Tidal	Mix of Marine Sourced Low and Marine Sourced High Wetland
Estuary Plan Book Classification	Tidal High	Tidal High
Hydric Soil	Yes	Yes
Soil Type	Brailer Muck	Brailer Muck
Mixing Regime (NOAA Salinity)	Mixing Zone	Mixing Zone
Upland Vegetation Type	Mostly broadleaf, some small, large & very large conifer, & open forest.	Similar to lower site but more patches of medium mixed, large & very large conifer.

Sources: Scranton 2004; Midcoast Watershed Council 1998.

¹² Both sites are part of larger island or peninsula complexes in the middle of the river. While only two to three miles separate the two sites, the lower site is subject to higher salinities than the upper site.

¹³ Source: ODFW, Trevan Cornwell, personal communication derived from USGS Topographic Maps.

HISTORICAL RECONSTRUCTION - LANDSCAPE LEVEL
Native Resource Use

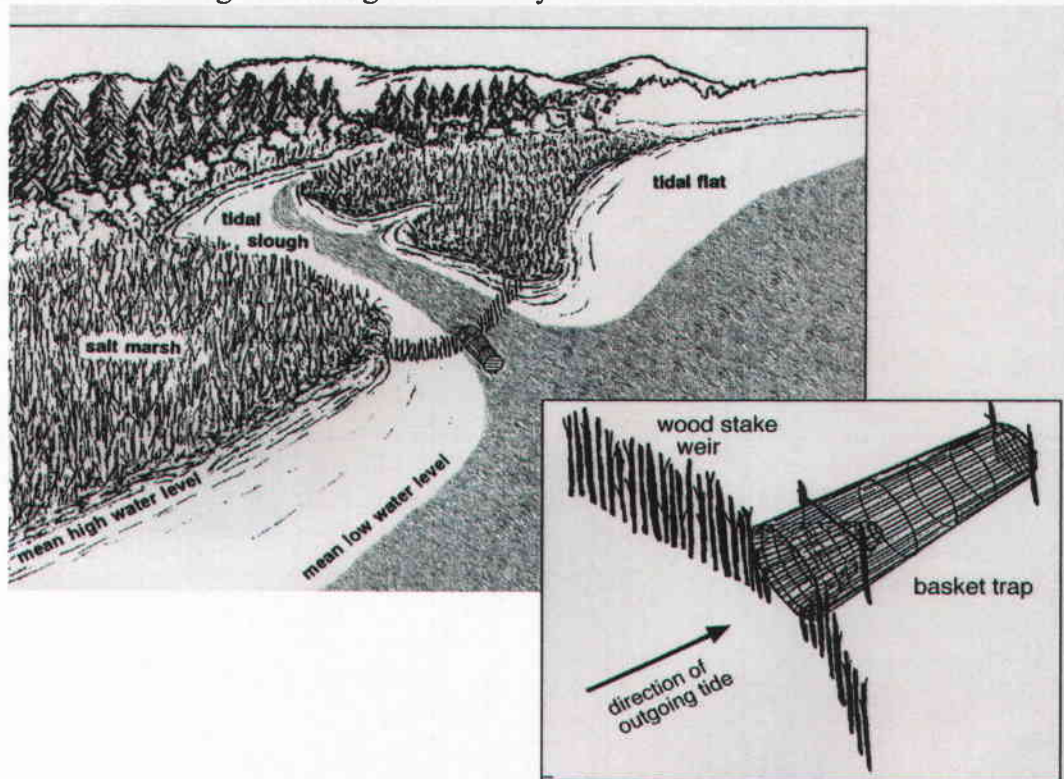
"Sit still and be quiet, and listen to this stream tell its story."
- Andrew Charles (Native Siuslawan)

Most tribes in Oregon were organized by watershed (Taylor 1996) and thus, these areas supplied their food, shelter and transportation. Indian tribes located in coastal and estuarine areas had access to ample supplies of food. They mainly fished, gathered and hunted such resources as clams, mussels, seals, berries, roots, and shellfish (Karnes et al. 1994). Salmon, in particular, played a large role in the diet and culture of many coastal natives (Taylor 1996). In *Making Salmon: an environmental history of the Northwest Fisheries crisis*, Joseph H. Taylor notes that coastal natives had a near constant supply of protein, especially salmon, due to overlapping runs and food storage resulting in less migration and denser populations for coastal natives (Taylor 1999). While a good food supply generally resulted in denser populations on the coast, this was not true for the Siuslaw tribe, which had a much smaller population than other tribes, roughly 900 individuals in 1806 (Taylor 1999; Karnes et al. 1994). White fur-trappers and traders were present in the Pacific Northwest prior to this time and there is evidence of diseases reaching some Indian populations in the Puget Sound by the 1780s (Crosby 1986). Given their isolated location, it is less likely that diseases had reached or impacted the Siuslaw tribe prior to the early 1800s.

The Siuslawans had their main camps in the lower portions of the estuary close to food resources and possibly on or near tidal marshes (Karnes et al. 1994; Taylor 1999). A historical atlas of the area indicated 34 villages along the lower Siuslaw River and adjacent coast, yet no specific locations have been determined for these sites (USACE 1975). More recent archaeological investigations have uncovered a 500 to 1000 year-old camp buried in the dunes

on the south side of the Siuslaw River near river mile 4 (Minor et al. 2000). Preserved at this site were remains of food resources used by the Native Americans inhabiting this particular camp primarily herring, sculpin, flatfish, tomcod, mussels, barnacles and a few birds and mammals (Minor et al. 2000). Most coastal Indians "established temporary camps at opportune fishing sites like waterfalls and riffles" (Taylor 1999). In the Coquille, archaeologists discovered that Native Americans placed extensive fishing weirs across mouths of tidal channels (Fig. 2) and used areas near the river for villages and camps (Byram and Witter 2000; Hall 1995). The river provided transportation upstream via canoes during salmon runs or for other important hunting, but winters were mostly spent in the lower estuary (Karnes et al. 1994).

Figure 2. Reconstruction of Native American Fishing Weirs. This figure depicts a wood stake weir and basket trap at the mouth of a tidal slough. The reconstruction is based on ethnographic accounts and archaeological findings. Source: Byram and Witter 2000.

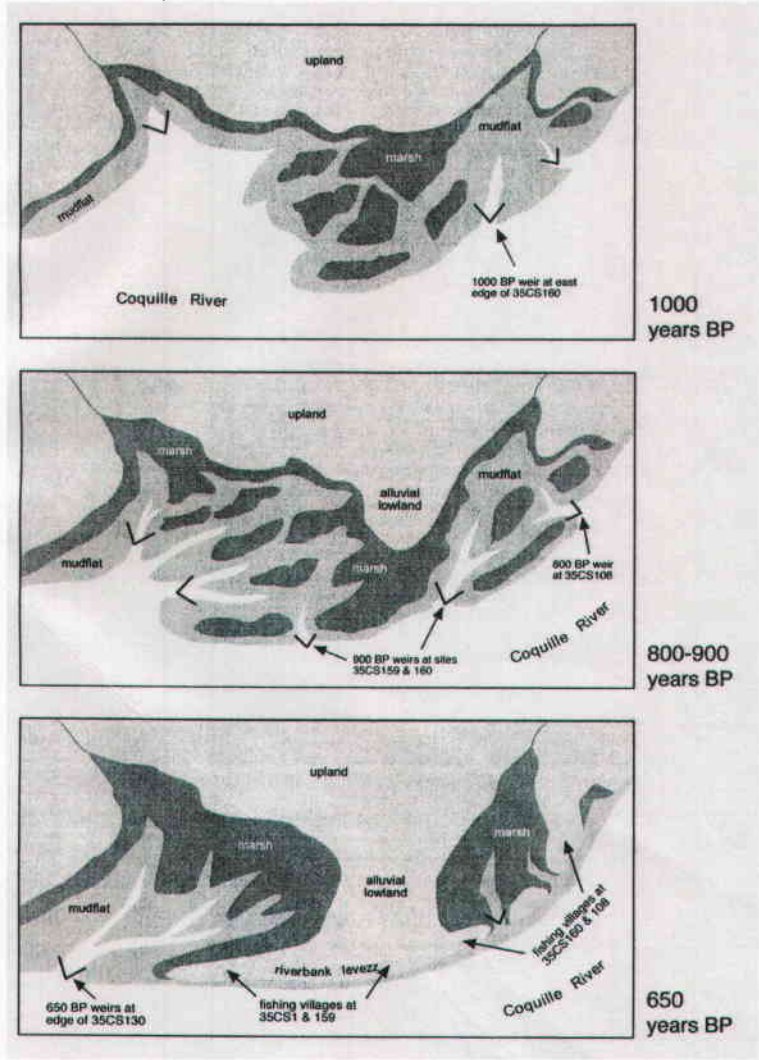


Up and down the Oregon Coast coastal tribes utilized similar fishing techniques, including fishing weirs, dip nets, gill nets, clubbing, and spearing (Hall 1995). Some researchers estimate coastal Indians, through their fishing efficiency and populations, exerted considerable pressure on salmon runs, yet "avoided permanent harm" (Taylor 1999). At the same time, some settlers in the Siuslaw viewed the Siuslawans as "conservationists" by allowing small fish through their traps and taking only what they needed (Karnes et al. 1994). But, Taylor aptly points out:

Oregon country Indians interacted with nature as cohabitants and consumers. Their complex environmental relationships defy simplistic caricatures. They were hardly preternatural beings exuding environmental wisdom.... Nor was their relationship timeless and uniform.... Culture and environment informed each other, both were ever changing. (Taylor 1999)

Considering their much smaller population in the early 1800s, it is possible the Siuslawans may have had a lower impact on fishery resources than other coastal tribes. However, environmental impacts associated with natural resource uses were not purely based on extraction rates. Fishing weirs left in tidal channels by the Coquille in their watershed are thought to have caused more rapid sedimentation in tidal marshes by slowing water flows around these structures (see Fig. 3, next page) (Byram and Witter 2000). The Siuslawans built a similar rock weir structure on the Yachats during reservation times (Lindsay 1995). This indicates they may have also used weirs prior to Euro-American settlement.

Figure 3. Model marsh accretion and weir placement. The model development of marsh emergence and alluvial development is based on strategic profiles and radiocarbon dates from archaeological sites in an area of the lower Coquille estuary. Arrows indicate locations of weir and midden features. Source: Byram and Witter 2000.



Plant matter was also critical to coastal tribes, not only for food, but for creating important materials such as fishing gear, baskets, and mats. Cedar bark and wood was particularly important for a variety of items from canoes to mats to clothing (Karnes et al. 1994). According to Taylor (1999), coastal tribes used iris, cedar bark, and silk grass to make fishing gear, but they also utilized Indian hemp and beargrass from trading with Plateau tribes. Many Northwest tribes were also known for using marsh vegetation for making baskets, mats, and

other items. They even cultivated certain marsh plants such as camas. In particular, camas was considered "a staple food in the Indian diet" which "grew in marshy areas subject to seasonal flooding" (Robbins 1997). While camas is more of a freshwater plant, it can grow in upstream and fresher tidal marshes. Although these practices have not been established in this research of the Siuslaw people, it is very likely they used marsh plants in a similar manner. By the 1850s, early settlers report that Siuslawan were cultivating gardens, with crops such as potatoes (Karnes et al. 1994). Gardening may have occurred on marshes, but no evidence was uncovered to substantiate the exact location of native gardens.

Many tribes in the Northwest practiced strategic burning of prairies and woods in order to attract game, assist hunting animals, maintain travel routes, promote certain types of food plants, and maintain herds of horses (Robbins 1997). In the 1880 General Land Office Map of the Township for the sites, the surveyor noted: "*The timber is very poor, the greater part having been destroyed by fire some years since.* The undergrowth is very dense – almost impenetrable" (University of Oregon, Map Library; emphasis added). The burned timber was probably the result of the fire of 1846, which covered approximately 500,000 acres between the Siuslaw and Nestucca Rivers (Taylor 1999), and was previously timbered land (Karnes et al. 1994). Especially since the GLO survey occurred 40 years later, a lack of more recent fires would result in dense undergrowth noted by the surveyor.¹⁴ However, it is unknown whether this was a case of Native American burning or was naturally caused. Conflicting reports attribute the fire to white settlers and Native Americans (Courtney 1989 and USACE 1975).¹⁵ Robbins relates another instance of native burning with stories of Umpqua women who would gather tar seeds by

¹⁴ It is difficult without additional research to pinpoint the year of the forest fire noted by the surveyor. Forest fires were set intentionally by Native Americans, but also occurred naturally. The fire of 1846 was the largest during this period and noted by many observers of the time due to the vast amount of land burned. However, other forest fires likely occurred between 1846 and 1880, the time of this survey.

¹⁵ See Yaquina section on Native Americans for more details on the 1846 fire.

first burning the valley fields in the fall and then, collect the seeds from the singed pods (Robbins 1997). While it is unknown whether the Siuslaw also practiced this method, the Umpquas were deemed "most like the Siuslaw" by the Siuslawans (Ruby and Brown 1992). Due to their acknowledged cultural similarities, it is very possible the Siuslaw people practiced these types of burning to assist in gathering food, as well. However, the Siuslaw River valley is narrower and shorter with fewer prairie areas than the Umpqua River valley. This geographical difference may have limited these activities.

In 1855, the Coast Reservation was established, which initially included areas of the Siuslaws' native lands. The Siuslaw tribe was initially under the Umpqua Subagency moved later to the Alsea Reservation and subsequently the Siletz. During the government's process of reducing reservation size and increasing land available for whites, the Siuslaws were allowed to stay on the land, but whites could file for claims of the same land and have the Siuslaws evicted (Karnes et al. 1994). In 1887, some land allotments were given in trust to Indians (the Indian Allotment or Dawes Act of 1887). However, it is unclear how many Siuslaws actually took allotments and many lost their allotted land due to inability to pay property taxes (Karnes et al. 1994). One study of the North Fork of the Siuslaw indicates two sizable Indian allotments present in 1912 (Karnes et al. 1994).

During the period from 1840 to 1880 the Siuslaw population, like all other tribes in the Northwest, shrank considerably due to illnesses such as smallpox contracted from the whites (Karnes et al. 1994, Robbins 1997). In 1863, reservation authorities listed their population at 129; by 1875 their numbers had dropped to 45 (Karnes et al. 1994). Illness affected more than sheer population size. According to Taylor (1999) a smaller Indian population meant fewer fires set purposefully to clear undergrowth and improve hunting resulting in less frequent and more

devastating fires and less open space. Reservations and population decline effectively ended the Siuslawans presence in the Siuslaw watershed and signaled the beginning of white settlement and influence.

Overall, the Siuslaw people had an impact on the watershed and tidal marshes. Their activities such as selective harvesting, promotion of certain plants species, and potentially intentional burning influenced the ecosystems in which they lived from the soil chemistry to species diversity. They utilized plants and animal resources to sustain themselves. Ultimately, the way in which they interacted with these resources differed immensely from the white settlers. The initial settlement by Euro-Americans in the area helps document the landscape condition at the time as well as early uses of the land.

General Land Office Surveys

The tidal marsh sites were both indicated as marsh vegetation through the sketches and early surveys done by the General Land Office (GLO) during the late 1800s (see Appendix A – Siuslaw, Folder: General Land Office Maps, Files: t18s11w_1880 and t18s12w_1879).¹⁶ The notes reveal general attitudes regarding the land and its suitability for resource development by white settlers. The descriptions even rank the resources accordingly from excellent to poor.

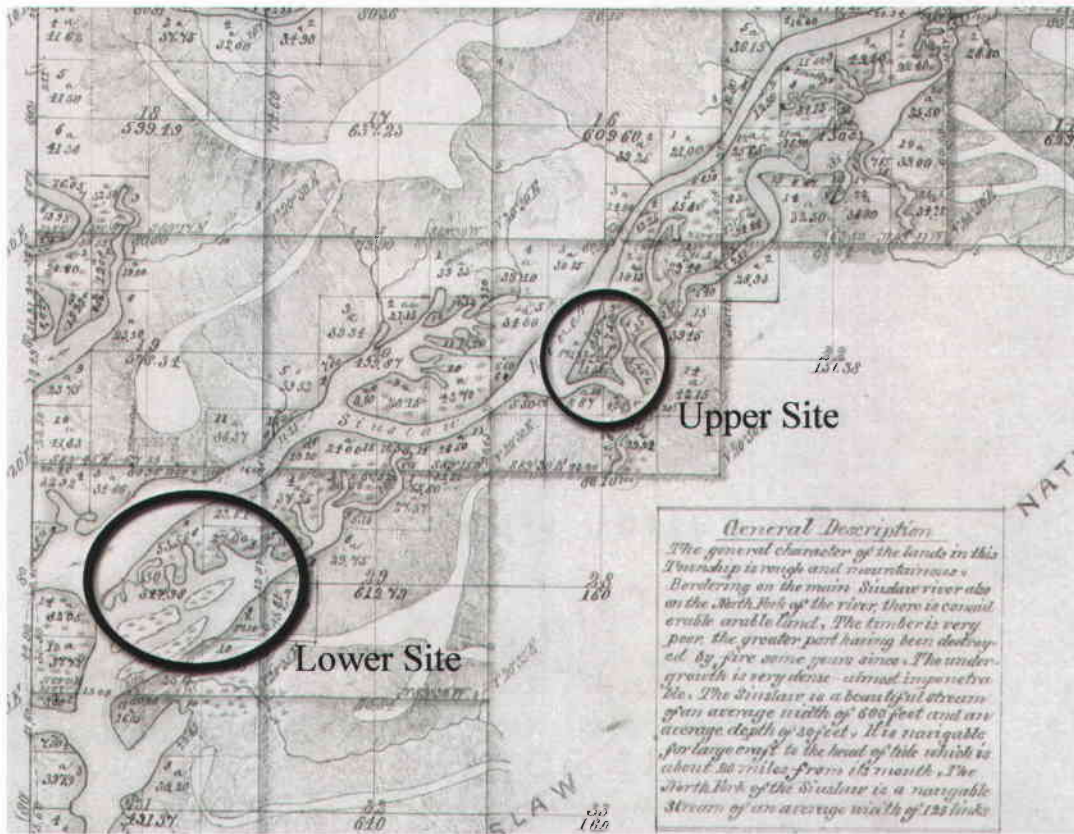
General Land Office Survey 1879 (Florence area)

The quality of the land in this township is about an average of land along the coast. *The bottoms, marshes and swamps along the rivers and creeks are 1st rate*; but the greater portion of the land is fair 2nd rate, and a small portion is poor. The portion immediately along the coast is formed of low hills; but as you recede from the Coast the hills become higher and steeper and even mountainous.

Timber [sic] chiefly Fir, Pine, Cedar, Spruce and hemlock, and is very equally distributed over the Township except on the south and near the mouth of the Siuslaw River. The Siuslaw river [sic] is a beautiful stream of a depth of 20 or 30 feet of water through the Township. (University of Oregon, Map Library; emphasis added)

¹⁶ These cadastral maps show a specific type of symbol to indicate marsh vegetation. This is similar to symbols used for marking marshes on maps today.

Figure 4. 1880 General Land Office Survey (circles and site text added).



General Land Office Survey of 1880

The general character of the lands in this Township is rough and mountainous and Bordering on the main Siuslaw river [sic] also on the North Fork of the river, there is considerable arable land. The timber is very poor, the greater part having been destroyed by fire some years since. The undergrowth is very dense – almost impenetrable. The Siuslaw is a beautiful stream of an average width of 600 feet. It is navigable for large craft to the head of tide which is about 20 miles from its mouth. (University of Oregon, Map Library; emphasis added)

Both of the GLO surveys indicate significant land for agriculture in the marsh areas.

Eventually many of these "1st rate swamps and marshes" would be used for such purposes. The surveyors also made note of the navigability of the stream, an important route for transportation for the area until other routes could be established. What is unclear from the notes is the specific

type of vegetation present on the tidal marshes at the time. Yet, some indications are given in the more detailed notes, excerpts of which follow.

Lower site (Section 30)

Nearby the lower site, the surveyor walked north between sections 29 and 30. He wrote:

In marsh...Leave marsh high tide mark...Set stake on left bank of Siuslaw river...ground corner to fractional sec.[section] 29x30 also witness corner to sec 19x20x29x30 from which; Fir 12 in[ch] diam[eter] bears N60°W14 lks[links] dist.[distance]; Crapapple 4 in[ch] diam[eter] bears S22°E58lks dist.[distance]; 86.23 Set stake 4 ft long 4 in[ch] diam[eter] 18 in[ch] ground corner to fractional sec 19x20 from which Fir 6 in[ch] diam[eter] bears N52°W152 lks [links] dist.[distance]; Fir 4 in[ch] diam[eter] bears N66°E220 lks[links] dist.[distance] I ascertain distance...is 10.62; *Country mostly marsh. Soil wet Timber scarce fir cedar and alder Undergrowth gooseberry salmon & thimble brush.* (University of Oregon Map Library, GLO Survey, 1879, emphasis added).

Upper site (Section 21)

The surveyor began at the corner of section 15, 16, 21 and 22, near but not exactly on the upper site. Heading south between sections 20 and 21 he noted: "In marsh; 7.30 North bank of slough; Set stake...to fractional sec[tion] 21x22 dug pits raised mound; 12.97 South bank of slough set stake...to fractional sec[tion] 21x22 from which Alder 4 in[ch] diam[eter] bears S66°W102 lks[links] dist.[distance]; Alder 4 in diam[eter] bears S 12 1/2 E 35 lks[links] dist[ance]" (University of Oregon Map Library, GLO Survey, 1879). Farther east of the upper site (on present day Duncan Island) the Kennedy house is marked. According to Siuslaw Pioneer Museum documents, Oscar Kennedy and his Native American wife had obtained a large Indian Grant of 146 acres (Larsen, 2000). This is the only house indicated near the upper site in 1880.

Thus, it appears that both areas were likely undeveloped tidal marshes in the 1880s with scarce tree coverage and wetland tolerant plants such as salmonberry, thimbleberry, gooseberry, crabapple and alders. Scarce tree coverage was also noted by the numerous instances of "dug pits

raised mound" for setting a stake rather than the preferred method of blazing trees for marking section corners.

U.S. Army Corps of Engineers Reports

According to the Rivers and Harbors Act passed in the 1800s, the U.S. Army Corps of Engineers (USACE) was required to furnish reports on navigability of U.S. waterways. The purpose of these studies was to determine if navigation improvements were needed based on the amount of development and settlement, as well as the characteristics of the river itself. Yet, these reports also reveal much about the landscape at the time. The first report on the Siuslaw River was completed in 1881. The following are excerpts from the initial two reports with emphasis added:

GENERAL: I have the honor to transmit herewith a chart of Siuslaw Bay, Oregon, together with the report of Mr. J.S. Polhemus, assistant engineer, and to submit the following report of an examination of that bay made under my direction, in compliance with the river and harbor act of June 14, 1880.... The land bordering the river near its mouth was embraced in an Indian reservation up to 1876, after which time it was thrown open to settlers. The public surveys under the direction of the Commissioner of the General Land Office were commenced about two years ago and now cover almost two townships, estimating eastward from the mouth of the river.

No survey of the river or bay has ever been made under the authority of the War Department to ascertain the resources of the country or the depth of water at the entrance, nor has any money ever been appropriated for any improvement. The portion of the river adapted to navigation by sea-going vessels extends from the falls to the outlet, a distance of about 20 miles, in which reach it is nowhere less than 100 feet wide and has a depth from 18 to 50 feet. Above the rapids the river has the usual characteristics of a mountain stream. The bar at the entrance is of pure sand, with 9 feet usually at low-tide, and as the harbor opens directly upon the ocean with a wide stretch of low, unbroken sand beach north and south, the channel across the bar shifts frequently to the northward or southward, according as the prevailing winds are from the southwest or northwest.

The country drained by the river is necessarily very thinly settled, and as the good bottom land is somewhat limited in extent, the principal resources of this special region in the near future will be restricted mainly to the yield of fir, cedar, and other valuable timbers, which abound along the slopes of the main stream and its several affluents. *In the course of time, when the rich land of the bottom and hillside is all taken up and properly cultivated, the valley will furnish a large yield of the grains which grow so abundantly in this climate, and will seek a market for its products in the large towns to the southward through the shipping which will be invited to the harbor.* [emphasis added]

...The cost of transporting to market the products of the upper part of the Willamette Valley by the long and circuitous route which leads out of the Columbia River, has led the parties interested to an examination of the country intervening to the coast to ascertain if an outlet to the sea could not be found which would be cheaper and nearer than the river route. It is stated that the examination has been successful, and that a narrow-gauge railroad is now projected to connect Eugene City with Siuslaw Harbor. It will be a short road, but it is thought its construction will be a great relief to the Willamette River Valley.

I do not think it proper to recommend the appropriation of any money for the commencement of an improvement at the entrance, but I would respectfully recommend that an appropriation be asked for a thorough survey of the harbor and outer bar, that the shipping public may learn officially the exact character of the harbor and the usual depth of water over the bar at low-tide.

.... There were no foreign imports or exports during the year.

Three small coasting vessels or steamers have visited the harbor during the year, chiefly for fuel. The harbor is not generally known to the public, as it is not mentioned in the Coast Pilot.

The commerce and navigation which will be benefited by the survey refer wholly to small coasting vessels, and to them the information acquired will be highly important.

G.L. GILLESPIE
Major of Engineers,
Bvt. Lieut. Colonel, U.S.A.
(USACE 1881)

United States Engineer Office
Portland, Oreg., November 16, 1880.

Colonel: I have the honor to submit the following report of the examination of the Siuslaw River, Oregon, made under your direction in October last.

.... The mouth of the Siuslaw River lies 62 miles to the north of the Coquille River, to reach which it was necessary to go to Empire City, on Coos Bay, *via* Beaver and Isthmus sloughs, thence by wagon along the sand beach to the mouth of the Umpqua River, and by wagon again 22 miles along the beach to Florence, the name of the post-office on the Siuslaw -- a small settlement of five houses and about a dozen inhabitants.

.... My personal examination extended from the mouth 20 miles up stream to the foot of a line of rapids and to the end of tidewater. At this point the river is a rapid, shallow stream, about 100 feet wide. After flowing a mile it widens to 200 feet, with a depth ranging from 18 to 50 feet. It widens as it approaches the sea, until the North Fork is reached, 5 miles from the mouth, where it is a half mile in width, after which it gradually contracts to 600 feet at the entrance at low-water.

From the rapids to the North Fork the river is inclosed on both sides by hills ranging in height from 300 to 500 feet, covered with burnt timber, brush, and fern. Between the hills there is usually a narrow strip of rich bottom land on alternate sides of the river. [emphasis added]

The average rise and fall of the tide in the entrance is about 7 feet, which decreases gradually to the foot of the rapids, where it is about 2 feet.

The depth of the river to quite near the rapids was nowhere found to be less than 16 feet at low-water, and usually from 20 to 30 feet.

Above the rapids, to its source, the river is described at a rapid mountain stream, obstructed by rocky shoals and bowlders. The Indians sometimes ascend in light canoes, but it is not navigable. Near the rapids the hills rise very abruptly from the banks, and are 600 to 700 feet high; *some distance up, I am told, they become lower, and some good bottom land is found on both the Siuslaw and Lake Creek. Much yellow-fir timber is also reported as growing along the banks....* [emphasis added]

THE ENTRANCE

The river enters the ocean in a westerly direction, through an entrance 600 feet wide and 24 feet depth at low-water, between sandy shores. *It has no headland on either side, and shifts from year to year north or south. Two years ago the mouth of the river was at least 1 mile north of its present position.* [emphasis added]

THE BAR

No suitable boats being available, I was not able to make a personal examination of the bar at the mouth of the river. It is of sand, however, unobstructed by rocks, extending across the river's mouth about a quarter of a mile from the entrance. One main channel only exists, which, although shifting, has a depth, from all accounts, of about 8 feet at low-water.

But two schooners have been in the river this year, the George Harley, for a supply of fuel, and the Ester Cobos, drawing 4 feet, that came to transport the machinery from Mr. Hume's cannery to the Rogue River. Captain Canghell, of the latter vessel, at my request, sounded over the bar on his departure, October 10, and reports the least depth found to be 9 feet, at which time the tide gauge at Yaquina Bay indicated 3 feet above mean low-water. The steamers Gussie Telfair, Whitelaw, and Duncan have all crossed the bar, sometimes drawing as much as 10 feet; also the steam-schooner Cordelia. They all report a very good bar, with as much as 16 feet of water at high tide.

All of the last-mentioned vessels visited the harbor within the last four years on business connected with the salmon canneries.

The country bordering on the Siuslaw River was an Indian reservation until 1876, when it was thrown open for settlement; consequently it is thinly settled, and its resources are as yet undeveloped.

There are at present about 20 settlers on the Siuslaw River to the end of tide water, engaged in agriculture and fishing. There were two salmon canneries built on the river three years ago but one has been removed and the other was not in operation this year. Salmon are very plentiful in the river, visiting it in large numbers about the last of August and staying until the middle of November.

I am told there are large forests of yellow fir and some cedar on the upper river. The upper river is well adapted for driving logs during freshets, when it rises from 10 to 20 feet.

There is considerable agricultural land distributed along the river and creek bottoms capable of producing excellent corn, vegetables, and wheat. [emphasis added]

There is a small variety store 4 miles from the mouth, and a post-office.

No vessels run regularly to the river, and all transportation is by means of wagons along the beach to the mouth of the Umpqua.

No survey has ever been made of the river or bar, nor is the harbor even mentioned in the Coast Pilot.

The people living on the river...think that no improvement is required; all they ask is that an accurate survey be made and the depth on the bar be officially declared.

When this is done and the entrance buoyed, it is thought small steamers and schooners can be induced to run into the river, and reasonable insurance can be obtained on their cargoes.

J.S. POLHEMUS,
Assistant Engineer. (USACE 1881)

In 1887, another survey was completed, this time on an initial proposal to survey the bar and entrance in order to provide more accurate charts for ships entering the Siuslaw Harbor. Excerpts indicate not only the major commerce of salmon, but also a growing population demanding improvements to the river:

The population is estimated at about 250. There is but one settlement on the river—Florence—with about 10 houses and a population of about 25. There are two other post-offices on the river, one at Acme, at the mouth of the North Fork, and the other at Neeley's, the head of tide. There is talk of building a railroad from Eugene City, but conditional to the improvement of the entrance.

Mails are brought tri-weekly from Gardiner, on the Umpqua, by beach-wagon, and once a week by carrier overland from Eugene City.

The only means of transportation in and out of the country is by these two routes and by means of an occasional visit from one of the small coasting vessels. The Coos Bay steamers Arcata and Coos Bay have been in the river, and the steam-schooners Kate and Anna and Mischief make irregular visits. Other coasters come in occasionally. Vessels will not visit the river unless guaranteed a cargo both in and out, and insurance and charters are very high on account of the lack of information with regard to the entrance, and on account of the channel not being buoyed. The people claim that if the entrance were surveyed, buoyed, so as to furnish an outlet for the products of the country, that capital would come in to develop it, and reasonable rates of insurance could be had on cargoes. They would expect only the class of vessels that visit other coast harbors, with a draught of 12 feet, *and think that these vessels could be induced to visit the river if the entrance were surveyed and buoyed, and if a jetty were built to hold the channel in one position.*

The salmon fishery is the principal industry of the country. The June run of salmon is small, but the fall run is very large. There are at present two small salteries and one small cannery on the river. The pack this season was about 1,500 cases and 2,200 barrels. [emphasis added] It is expected that next year the cannery will be enlarged and one of the salteries changed to a cannery.

There is not much timber in sight from the river, the country having been partially burnt over by the great fire of 1846. [emphasis added] I was told, however, of large quantities of fir and cedar timber on the headwaters and in gulches back from the river.

There is a small saw-mill at Acme, which supplies the local trade, and there is no outlet for any other.

The bottom and tide lands in the valley are capable of producing agricultural and dairy products.

.... the entrance has since changed to such an extent as to require a new survey. I think the entrance worthy of a survey, and suggest that it be so recommended. (USACE, 1887; emphasis added)

The resulting survey found the Siuslaw River and “worthy of improvement” and attached a letter from George A. Miller, a Florence resident and proponent of improving the Siuslaw.

Noting the increased usage by different vessels and the variability of the entrance channels,

Miller wrote:

We expect the Government to improve the entrance to the river by confining the channel by means of jetties or otherwise, to one place, so that it may wash deeper and be more easily followed by navigators. As the channel now is it drifts from one point to another over a distance of 1 ½ miles, and is often spread out or divided into several channels, none of which, may be deep enough for such vessels as desire to enter.... There are thirty townships of very fine timber on the waters of this bay that must be taken to market over this bar. There are over one thousand people who live here now, and whose best source of supply and market are through this channel within a few years or more this number will be doubled, and if commerce is encouraged by the Government improving the bar it is difficult to estimate the number that may find happy homes here. (USACE 1890)

These initial surveys reveal the landscape uses that would become major cornerstones of the Euro-American economy in the Siuslaw watershed: agriculture, fishing, and timber. The reports also indicate an attitude of unimproved land as wasteful and the potential for the land to be used by man. Already in 1880, settlers were moving to the area and demanding navigational improvements to help build a natural resource-based economy. The following general history follows Euro-American development of the area and its impacts on the land, particularly the tidal marshes.

General History of Resource Use

The difference between Native and European-American resource relationships has clearly impacted many landscapes, including tidal marshes. Robbins reflects on the impact of white settlement and attitudes toward the land:

... vast river systems were pooled and re-created into technical artifices; forest lands were harvested, replanted, and redesigned into monocultural, market-driven models under the rubric of forest science; *swamps and marshlands were diked, drained, surrounded with diversion canals, and turned into plots of industrial efficiency.* (Robbins 1997; emphasis added)

The initial contact and use of land by whites was by the trappers and explorers associated with the Hudson Bay Company from 1820 through the 1850s. By the 1870s, more American settlers were moving to the area via routes such as beaches, rivers, the ocean, and through the mountains (Karnes et al. 1994). In 1876, the isolated city of Florence was founded. During the late 1800s, the shift in population distribution was dramatic: "By 1900 the number of Oregon country Indians had fallen ninety-five percent, while non-Indians had increased from less than 800 in 1840 to more than 1.1 million" (Taylor 1999). Overall, the European-American settlement brought sweeping changes in land use focused on using resources such as fishing, timber, and agriculture as commodities. As Taylor explains, "Euroamericans also [like Native Americans] relied on nature for subsistence, but increasingly they harvested for external markets" (Taylor 1999).

Transportation

Transportation was the key to expanding the intensity and scale of resource extraction and land uses of the Euro-Americans. The Florence area, due to the rugged surrounding topography, was especially isolated from the first expansions of roads and railroads. Early on, products such as salmon and timber were delivered to distant markets such as San Francisco and

Astoria through boats (Karnes et al. 1994). Throughout the late 1800s and into the 1970s, the river itself was used to float logs downriver to other transportation points or sawmills. In 1916, a long-awaited railroad spur to and through Cushman was completed (Karnes et al. 1994). However, it bypassed Florence, instead cutting across one of the marsh sites for this study and heading south to the Umpqua basin. "In brief, railroads were vehicles for incorporating nature, for extending the awesome forces of the industrial world to distant and relatively unpopulated areas" (Robbins 1997). This allowed greater movement of greater quantities of resources, especially timber. Robbins further examines the impact of railroads:

Railroads provided access to timberlands a considerable distance from waterways, thereby linking abundant sources of raw materials with sawmilling settlements; they liberated the transportation of logs from the restrictions of natural geography, enabling operators to build roads into hitherto inaccessible terrain. (Robbins 1997)

While railroads greatly increased the movement of natural resource products and people, roads completed the picture. Existing trails eventually became roads (Karnes et al. 1994). In the 1920s, a road connecting Florence to Eugene was finally completed (Karnes et al. 1994). Heavy timber harvest in the 1950s and 60s encouraged the development of many miles of new roads on private and public lands.

Fishing

One of the first industries in the Florence area was salmon fishing and associated canneries. In 1876, the first cannery was in operation and by 1883 three were operating in the area (Karnes et al. 1994). While some of the fish were consumed locally, most of the canned salmon headed to markets in San Francisco. The change in attitude and type of use would ultimately cause the decline of salmon, "There were many causes for changes in the way humans consumed the resources of Oregon country, but capitalism was the guiding force behind the most significant activities affecting salmon" (Taylor 1999). Already by the mid-1890s, there were

significant declines in fish caught and processed. In 1896, processors had a 48 percent drop in Chinook and 72 percent drop in coho (Karnes et al. 1994). Fishing restrictions and management increased as concerns mounted regarding the number of fish returning. This was exemplified by the "Saturday night law", which prohibited fishing on Saturday nights and the start of the Mapleton hatchery (Karnes et al. 1994). However, many fishermen disregarded the restrictions (Karnes et al. 1994). It was not only the sheer volumes of salmon taken, but also the impact of other land uses by whites in the late 1800s that served as a double whammy for salmon populations:

Oregon country Indians had harvested massive quantities of salmon for many centuries before whites arrived, but their impact on the rest of the landscape was relatively benign. Salmon faced a far different world in the second half of the nineteenth century. Trappers, farmers, miners, irrigators, loggers, and boosters transformed the landscape in ways that made it less hospitable to salmon. The clear, cool, unimpeded streams of pre-contact gave way to rivers that were dirtier, warmer, and more often obstructed... This was the ecological context of the industrial fishery during the late-nineteenth century. (Taylor 1999)

By the 1940s, set nets were made illegal followed in the late 1950s by the prohibition of drift nets (Karnes et al. 1994). Due to the federal listing of several stocks of salmon as endangered under the Endangered Species Act, today salmon are primarily fished for local consumption or recreation. While the Chinook fishery remains open, recreational fishers can catch only hatchery coho (ODFW 2005).

Hatcheries

Some sources suggest a hatchery in Mapleton released fish during the late 1890s (Karnes et al. 1994). However, it is unclear how long this hatchery was in operation or the number of fish released. The Oregon Fish Commission began releasing coho and Chinook from the Alsea hatchery into the Siuslaw River in 1934 and continued sporadic releases through 1954 (Wallis 1963). Hatcheries have continued to release salmonid species into the Siuslaw Basin. According

to ODFW, between 1970 and 2003 over 12 million salmonid species (steelhead, coho, cutthroat, and Chinook) were released by public and private hatcheries into the Siuslaw Basin (ODFW 2004). Coho constituted over half of the total with 7.5 million released, while Chinook only registered a nominal ten thousand. Not only that, but the brood stock used for propagation often came from other coastal watersheds including the Alsea, Coos, and Coquille (ODFW 2004).

Agriculture

Agriculture was another important use of land by the white settlers. It was "the backbone of the economy" in the Siuslaw watershed and important for subsistence of many local families (Karnes et al. 1994). Tidal marshes in their "natural" and unused state were viewed as wastelands, but with work could be used for productive agriculture or pastureland. Thus, numerous tidal marshes in the Siuslaw River became site for homesteads and farms. Dave Newsom, an early Oregon farmer, reflected these attitudes in his writing, "The timber is excellent; vast coal mines abound; there are oyster, salmon and cod fisheries; *and upon the marsh or tide lands fine wild grasses for hay and grazing*" (in Robbins 1997; emphasis added). By the late 1800s one Umpqua farmer had even obtained a Marsh Harvester - a horse-drawn mower specifically designed for haying marshland vegetation for animal feed (Robbins 1997). In the Siuslaw, early settlers worked to clear tidal marshes of unproductive vegetation as well as drain the water off through extensive ditching, dredging, and diking. One local settler account recalls the work done in this manner:

The lower several miles of the now cleared agriculture land was tidal marsh.... Mud from the bottom of the river was dredged out and placed along the rivers' edge to contain the water within it's banks during high tide and/or high flows.... Tide boxes were also installed at the mouths of streams and other areas to restrict the inflow of water. (Karnes et al. 1994)

Early on, Lane County was important statewide for its agricultural production. In the censuses from 1860 through 1890, it ranked among the top three counties for number of improved acres in farms.¹⁷ Even the census divisions and emphasis on agricultural statistics indicated the attitudes toward improving the land for agriculture:

The census figures that differentiated between improved and unimproved places reflected well-known cultural practices that segmented, classified, and provided definitions for identifying landscapes...cultivating the soil, altering the course of rivers...were improvements to the natural order and indicated to the settler population advances in the state of civilization itself. (Robbins 1997)

In the 1950s, the government through the Soil Conservation Service (SCS) began sending engineers to the Siuslaw watershed to assist farmers in the activities of ditching and leveling land through a cost-share program (Karnes et al. 1994). Regarding the importance of tide gates to agriculture, the contemporary publication *North Fork of the Siuslaw Watershed Assessment* noted, "*These water control structures are still vital to agricultural use of these lands today*" (Karnes et al. 1994, emphasis added). Many former tidal marshes in the Siuslaw have been converted to agricultural and pasture lands and remain in use for these activities today. Others have been abandoned; the "once lush pastures [have] been neglected" and grown over with "rank sedge, blackberries and brush" (Karnes et al. 1994).

Timber

Despite the accounts of a massive forest fire in 1846, timber rapidly became an important resource to the white settlers in the Siuslaw watershed. In 1893 there were 4 to 5 large sawmills at the mouth of the river, and by 1900 the combined capacity could mill 200,000 board feet per day (Karnes et al. 1994). Log rafts or splash dams on the river transported most of these logs to the mills. Early on, the Siuslaw and Umpqua basins were considered among the most important

¹⁷ Lane County included portions of the southern Willamette valley and by 1853 extended out to the coast incorporating the Siuslaw watershed. While this may have impacted census numbers with higher numbers of farms located in the Willamette valley, the trend is clear that the entire area was important for agriculture.

milling locations in the Oregon Coast Range (Karnes et al. 1994). While some of this wood was used for local construction, again, most was shipped to San Francisco or Astoria and even points beyond (Karnes et al. 1994). Timber harvest methods were notoriously damaging to waterways, "Logging hewed close to streams in order to float logs to mills.... Concentrated harvesting reduced streamside cover, eroded banks, and increased sediment loads" (Taylor 1999). Pilings were placed in the river to catch and guide logs as they were floated downstream to mills. As will be discussed later, this particular activity had a large impact on the tidal marshes.

Throughout the 1900s, the timber industry found new and more efficient ways to log. Thus, more trees were felled. Timber harvest became particularly heavy in the Siuslaw after the end of World War II (Karnes et al.). Roads snaked through public and private land to access more timber (Karnes et al.). Often timber cuts took the form of clear-cuts with slash burning afterward. Logging fires burned hotter and were more catastrophic than Native burning (Taylor 1999). What replanting did occur was in the form of monoculture stands of Douglas fir (Robbins 1997). As a result between 1936 and 1996, the amount of large Douglas fir forests dramatically decreased, while small Douglas fir and hardwood forest types increased (Wimberly and Ohrmann 2004). Eventually, environmental concerns and subsequent lawsuits in the 1980s would shut much of the timber operations down (Karnes et al. 1994). Yet, timber remains an important resource to the Siuslaw watershed economy as evidenced by the mill still operating in Mapleton.

Other impacts: jetties, dredging etc.

Development of an economy based on natural resources increasingly relied on transporting the products to market. As discussed earlier, roads and railroads were a major part

of this development. Even earlier, navigational improvements such as jetties and dredging were used to spur ship-based transportation.

By 1891, USACE reports indicate an approval for planning the construction of a north and south jetty at the entrance of the Siuslaw. In 1892, a plan was adopted for a north jetty of 4,500 feet long and a south jetty of 3,200 feet, converging at an entrance 600 feet apart (USACE 1892). Over the next couple years, work began on the jetties including building a tramway and partially enrocking it, but without “producing any results of importance to the bar” (USACE 1893 and 1894). Storms and slides caused major damage to the project in 1894 halting progress during this year (USACE 1894). The project also eventually included deepening of the navigation channel to 12 feet deep; 250 feet wide from the jetty entrance to Florence and 150 feet wide to Cushman (USACE 1950). The Siuslaw jetties were completed in 1917 and the channel deepening was completed in 1929 (USACE 1950). In the 1950s and again in 1975 proposals were made for deepening the bar and river channel for larger vessels associated with lumber transport (USACE 1950). In 1958 and 1962 both jetties were rehabilitated and additional dredging was proposed to: add 600 feet to the north jetty; deepen the entrance channel to 18 feet and the channel to Florence to 16 feet; and to extend, widen and deepen a 12 foot channel from Florence to Mapleton (USACE 1975). In 1969, this extended dredging was completed (USACE 1975). The USACE Environmental Impact Statement (EIS) from 1975 indicates a continuing desire to maintain these navigation improvements through additional dredging and jetty repair (USACE 1975).

The navigational changes made to the Siuslaw River system impacted sedimentation and circulation patterns. According to historical analysis of the impacts of the jetties, researchers concluded that:

Construction of the jetties on the Siuslaw River produced a large embayment with the pre-jetty shoreline to the north side of the entrance. There resulted pronounced changes in the shoreline position following jetty construction. Comparisons with aerial photographs dating 1939, 1957, and 1963 indicate that little or no change in the shoreline position or configuration has occurred in the past 36 years.... The conclusion is that the shoreline changes produced by jetty construction on the Siuslaw River entrance were, like those at the entrance to Tillamook Bay, due to local readjustments with accretion near the jetties and erosion at greater distances north and south of the jetties. Again, on a larger scale the net transport in the areas is concluded to be zero. (Lizarraga-Arciniega and Komar 1975; for map see Appendix A – Siuslaw, Folder: Map of Jetty Accretion and Shoreline Changes).

The USACE Environmental Impact Statement (EIS) from the 1975 proposal indicated that, “circulation and sedimentation patterns within [the Siuslaw estuary] are modified periodically as a result of maintenance dredging. Dredging and associated turbidity will damage benthic organism habitats with secondary negative effects upon bottom-feeding fish. Dredge disposal on land will result in habitat loss as well as plant community alteration” (USACE 1975).

Additionally, the EIS reported other adverse impacts included: “potential decrease in fish stocks due to degradation of habitat, temporary turbidity during maintenance dredging and related water quality problems...and short-term alteration of currents and/or tidal prisms within estuaries, potential increased flood damage and intensified land use on or adjacent to land disposal areas” (USACE 1975).

These navigational modifications impacted marsh structure and fish habitat. Specifically, increased siltation could kill eelgrass or cover fish eggs (USACE 1975). Changes to current patterns and sedimentation would cause marshes to “be eroded or sedimentation in the marshes

would increase thus altering habitats, food sources and the extent of marshlands” (USACE 1975).

Human impacts such as timber harvest and grazing also increased erosion of the river’s stream banks. A state study on erosion found that the entire area around Cushman and near the sites (from the railroad east to the tip of Duncan Island) for this study had sustained “moderate” erosion of the stream banks (State Soil and Water Conservation Commission 1973).

The land uses of the Euro-Americans, especially using fish, timber, and agriculture as major commodities had enormous impacts on the landscape of the entire Siuslaw watershed. As will be seen in the analysis of the two tidal marshes, it also impacted the landscape of these smaller sites.

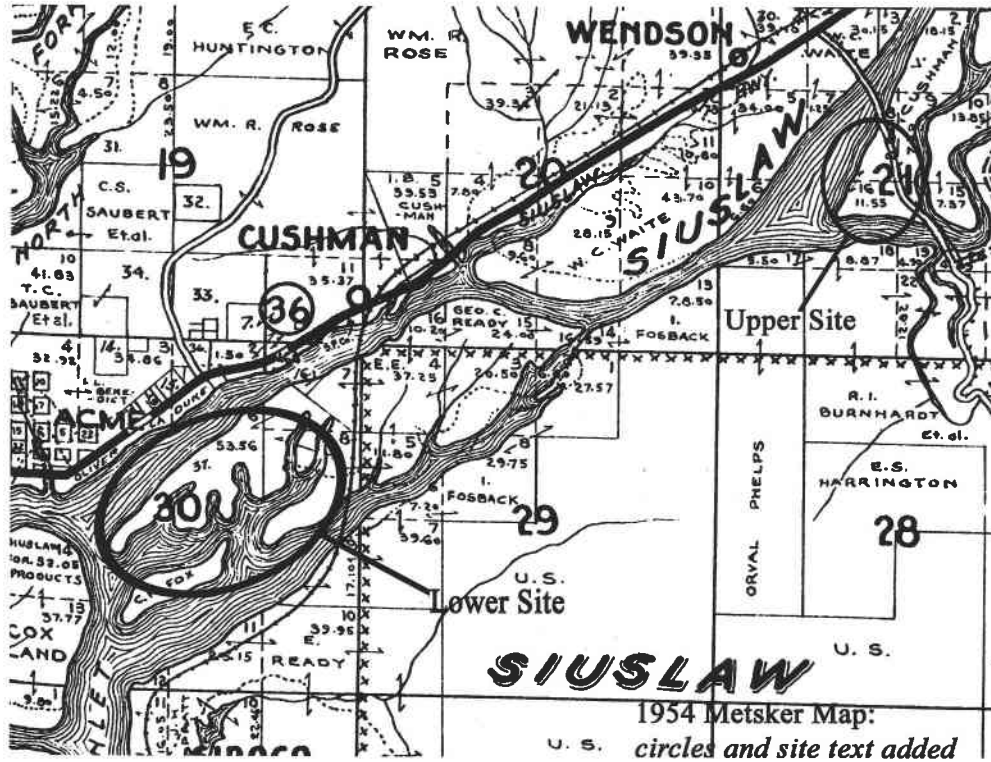
HISTORICAL RECONSTRUCTION - SITE LEVEL DATA

Metsker County Atlases

The Metsker County Atlases provide insight into land ownership, road development and other land uses. In particular, three were located for the years 1941, 1954, and 1968 for Lane County (see Appendix A – Siuslaw, Folder: Deed Data, SubFolder: Metsker Maps, Files: Metsker_1941, Metsker_1954 and Metsker_1968). The Metsker Atlas from 1941 shows the nearby towns of Acme and Cushman. The lower site (see Fig. 1 or Fig. 5) is owned by J.L. Sanborn, as is present-day Cox Island to the west of the site. As mentioned below, Sanborn was associated with the log booming business and used the properties to support his work. The upper portion of the lower site is crossed by the railroad completed in 1916. In this area, an owner of a private parcel within the Siuslaw National Forest boundary, E.E. Brattain is designated on the map. V. Cushman, the same name as the town on the opposite shore, owns the upper site at this time. This indicates ownership by a locally prominent family, which is substantiated by data

from the Siuslaw Pioneer Museum, covered later on in the site deed and historical account section. The land and channel extent of the tidal marsh sites appears similar to the GLO maps.

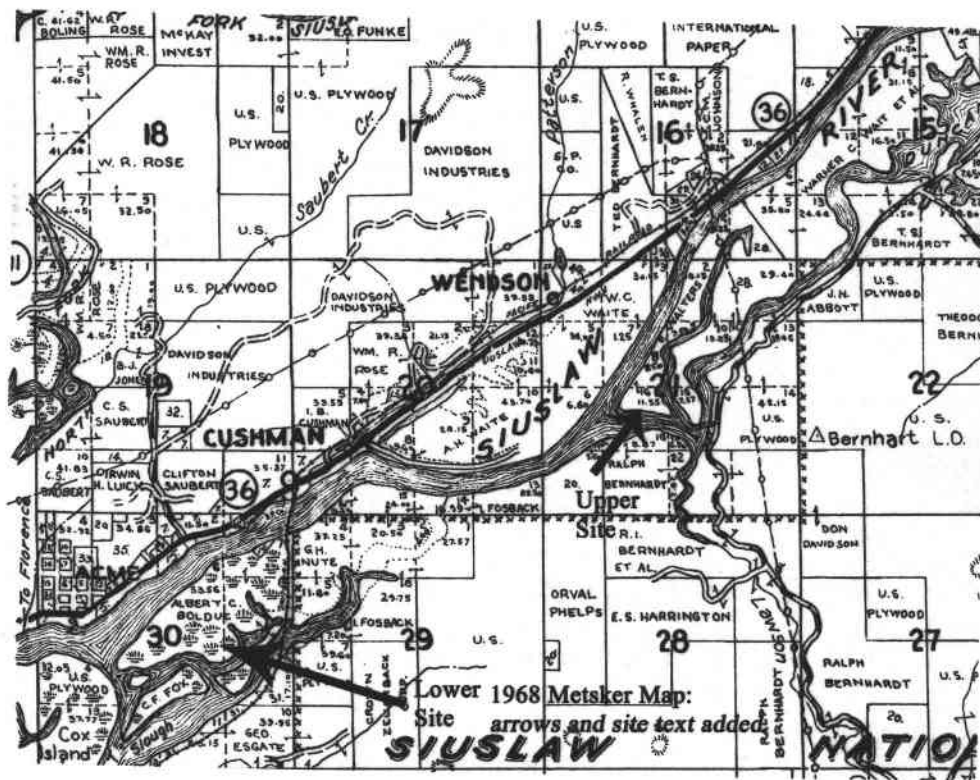
Figure 5. 1954 Metsker Atlas.



The Metsker Atlas of 1954 (Fig. 5) reveals some interesting changes in ownership and land use. The lower site now appears un-owned, while the upper portion of the area beyond the railroad, is owned by a private individual, Geo. C. Ready. Another portion of the island still remains in the Siuslaw National Forest. In 1954, a local timber company, Siuslaw Forest Products, now owns Cox Island. This indicates some use for timber extraction or processing. Likely this was due to the proximity of the railroad in Cushman. This was an important area for transporting logs and timber companies routinely floated logs down the river. Thus, Cox Island was an ideal place to locate for capturing and loading logs. Even more revealing is the upper site, still owned by V. Cushman, but across which an "unimproved" road appears that extends from one side of the river, across the marsh and to the other side. If a road did indeed cross this site, its

development and use would have greatly impacted the landscape. However, aerial photos from the early and late 1950s fail to confirm the road's existence. Lane County survey records show no record of the road either. It is unlikely a road that crossed such a major portion of the river would exist without a survey and financial backing of the county. Thus, as was common mapmaking practice at the time, this is probably an errant road put in by the mapmaker in order to mark it as the mapmaker's own work.

Figure 6. 1968 Metsker Atlas.



The Metsker Atlas of 1968 (Fig. 6) provides even more recent evidence of the changes to the landscape. The lower site appears to have accreted sediment, with a wider land mass; it was owned by Albert C. Boldue and marked for the first time in the Metsker Atlases with marsh symbols. Cox Island, along with many other properties in the area, is still held by timber interests, but has transferred ownership to U.S. Plywood. The upper site changed ownership as well, to E. Walters. The road from 1954 is absent in the 1968 map. Also absent are any symbols

marking marsh vegetation in the area. This reveals the possibility that agriculture or other vegetation was present; something other than what was traditionally considered tidal marsh. However, this is unlikely given the evidence from the historical aerial photos of this period that appear to indicate at least some marsh vegetation. Further up Duncan Island, a line of electrical transformers crosses the island.

Deed Information and Historical Accounts

Both Siuslaw sites are located near the Siuslaw National Forest. Yet, the sites have a history of ownership by private individuals.¹⁸

Upper Site

According to longtime resident, Melba “Jensen” Larsen, Duncan Island was home to a handful of farms and ranches, most of which operated primarily as small dairy farms throughout most of the 1900s (Larsen, 2000). The location of the upper site for this study is on Duncan Island. Its land use history follows a similar pattern.

In the 1870s Cyrus Cushman, his brother Irving and their wives moved to the Siuslaw valley in the town of Acme (Bauer 2000). Cyrus built a sawmill and Irving opened a general store (Bauer 2000). They soon became prominent businessmen in the area and the town of Acme changed to Cushman in 1914 when the railroad was completed.¹⁹ Cyrus owned property both near the sawmill and on Duncan Island. It is not clear who owned the island property prior to Cushman. But, by 1909 he was occupying the island land where the upper site is located. His son Vernon married Henrietta Fosback in 1925 and they moved to the island property a year later

¹⁸ The resource uses of nearby property owners and previous owners impact the landscape of these sites. Due to time and space constraints, the following will examine the property ownership for only the sites.

¹⁹ The railroad had another station named Acme already and needed a different name to avoid confusion (Bauer 2000).

(Bauer 2000). Their daughter, Barbara, provides a detailed account of the activities on the Duncan Island property:

Cyrus Cushman cleared about \$1,500 annually on his loganberries. He also ran beef cattle on the ranch and raised his own feed... While Vernon did most of the work on the ranch for his aging parents, he didn't share in the berry profits, so he purchased some dairy cows and a fish net so he could ship cream and fish to support his wife. (Bauer 2000)

She adds that after the depression hit, the market fell out for berries. In the large field to the east of the house, "They removed the berry vines and sowed hay then increased the dairy herd, which provided, in addition to milk and cream for their own use, income from selling the excess to the cheese factory in Cushman." During the depression years, the farm on Duncan Island provided for the family:

They raised their own beef, chickens, and pork for fresh and canned meat. They also cured their own ham and bacon. In addition, they had all the fish they could can, smoke, and eat fresh along with Dungeness crab and clams. They raised a large vegetable garden, had an orchard that provided an abundance of apples, prunes and pears, and a large berry patch with raspberries, strawberries, boysenberries and loganberries. (Bauer 2000)

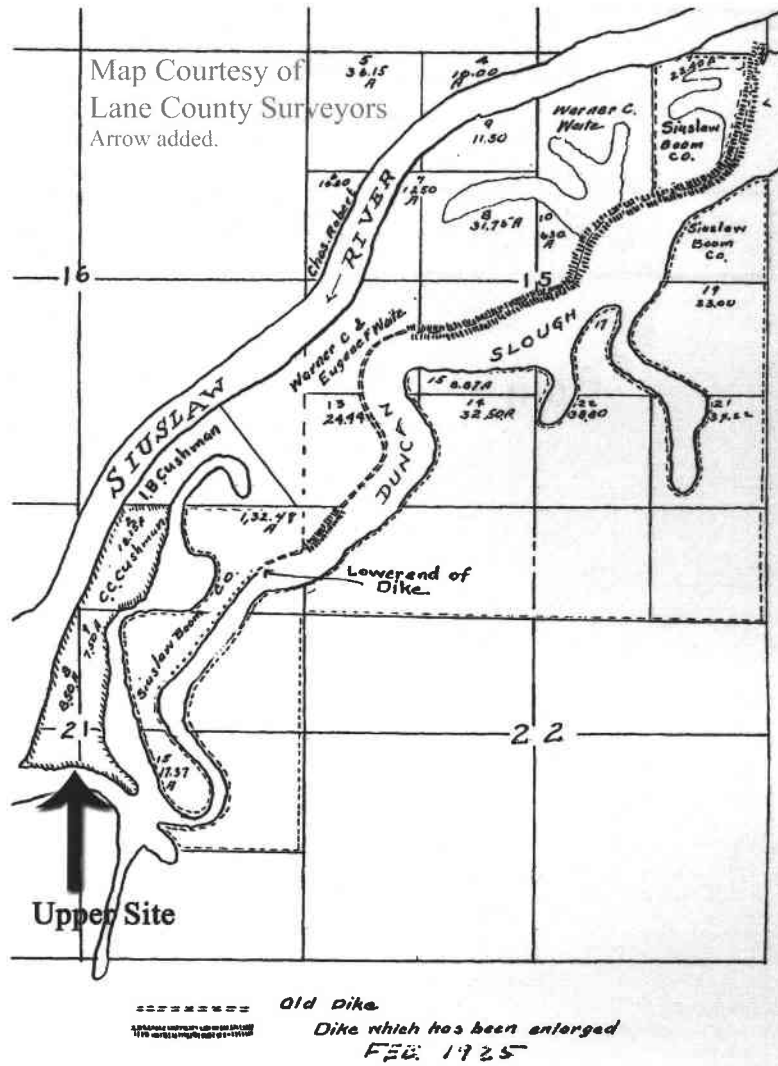
In 1944, Vernon Cushman moved his family to Eugene. The deed was officially transferred to Walter Powell and Frank Turner in 1962. Over the next couple years, the deed exchanged hands several times until the property was sold to Everett and Eleanor Walters in 1965. In a parent-child transfer, the Walters deeded the property to Sandra Ann Donaldson and her husband, who quit claimed to the property in 1999 (Lane County Assessment and Taxation Records). Sandra Ann Donaldson is still listed as the current owner with a California address.

The dike

Survey maps from Lane County indicate the location of the Duncan Island dike in 1909 (see Appendix A – Siuslaw, Folder: Dike Maps, Files: 1909 dike, 1925 dike). At this time it did not include the portion of land owned by the Cushman family. However, a later survey from

1925 (Fig. 7) shows both the “old dike” and the area of dike “which has been enlarged” (Lane County Surveyor’s Map Room). Included in this newer diked area, is the perimeter of the Cushman’s land.

Figure 7. 1925 Dike Survey.



Dikes were subjected to frequent breaches and breaks. On Duncan Island, property owners faced at least 7 major breaks between 1953 and 1992 (Larsen 2000). The Cushman property was no different. In 1934, the dike broke during a major storm. According to Barbara, “The resulting floodwater took away so much pasture they had to get rid of half of their cows”

(Bauer 2000). It cost 300 hundred dollars to repair the dike, but like many depression era exchanges, they paid by exchanging a boat and some raspberries (Bauer 2000).

Throughout the 1900s, it was common for timber companies to utilize the river for floating and storing logs. In order to have boorage rights on private property, timber companies would often lease land from landowners. On Duncan Island the east end had access for boorage by the Siuslaw Boom Company “to sheer saw logs in from the river to sort, boom, and store the log rafts along the slough banks....Rows of pilings were driven along the slough banks to secure the log rafts to” (Larsen 2000). In the case of the Cushman’s neighbors the Waites, the Siuslaw Timber company also offered to build a “good and substantial dyke suitable for reclaiming from overflow the lands” (Siuslaw Pioneer Museum: Legal deed; 1911). No such documents have been uncovered for the Cushman property.

After a major dike break in 1992, the U.S. Army Corps of Engineers did not want to spend money to repair the dike. Rather than rebuilding the dike the U.S. Fish and Wildlife Service and U.S. Army Corps of Engineers negotiated a transfer to natural wetland through a permanent easement with three affected property owners farther east on Duncan Island from the upper site for this project (*Register-Guard*, August 19, 1999).

Lower Site

According to the Metsker Atlas of 1941, the Sanborn’s owned property on what is now Cox Island and the land just upstream, the lower site for this study. According to historical accounts, Jesse Sanborn (1872-1942) was a contractor and worked booming logs from timber companies (Pellegrini 1980). He and his family “live longest in the island house, from about 1913 to 1939, and it soon became known as the Sanborn house, and the island as Sanborn

Island”²⁰ (Pellegrini 1980). At one time, he was the manager of the Siuslaw Boom Company (Pellegrini 1980). Since he was in the booming business, these property locations afforded proximity to boomage and the local mill in Cushman. As such, it is unlikely that any houses were erected on the lower site; the owners probably opted to utilize it primarily for boomage. This was certainly the case later, as evidenced by ownership by different timber companies and large stockpiles of logs on the lower site in aerial photos from the 1930s onward.

In 1956, Albert and Mary Boldue purchased the property from George and Lela Ready. The Boldue’s, in turn, sold portions of the land in 1975 and 1976 to Fern Greaves, Eileen Harrington and Josephine Hagle who then sold portions to Cliff, Allen and John McCarty. Fern, Eileen and Josephine created a tenancy in common in 1976, indicating that all three were occupying some portion of the land. Yet, records indicate that during this two-year period, the property was sold to Donald D. Wilbur, currently residing in Deadwood, OR, whose limited partnership still holds the property today.

Aerial photography narrative & quantitative scaling

Historical aerial photography obtained for the years 1939 to 1982 for these areas provides more detail of the land uses and their impacts on the tidal marsh sites (Appendix A – Siuslaw, Folder: Historical aerial photos, SubFolders: Lower site and Upper site). The narrative for the historical photos will be separated for each site in chronological order.

Lower site

The 1939 photo at first appears grainy and scratched. However, closer investigation reveals large piles of logs from timber operations piled on the marsh surface. Pilings are also present in the water cutting across the main marsh channel and entrance to the main stem of the

²⁰ Later owners of the island property would be the Cox family and the name of the island subsequently changed to that of its current name, Cox Island.

river. These pilings were used to navigate large log barges and to help catch stray logs from barges. The railroad clearly cuts across the eastern-most portion of the site. A dwelling, which appears residential in nature, with a pier is present on northeastern portion of the site, near the railroad. A major timber processing plant or sawmill is evident across the main stem of the Siuslaw, next to a road that today is Highway 126. Logging operations are seen in the nearby hillsides. The 1945 photo confirms a similar picture of land uses on and near the marsh as the 1939 photo.

In 1952, dikes and agriculture with crops appear on east side of the railroad, not directly on the site, but close by. The lower site itself still contains extensive log piles. Smoke from a fire is also caught in this picture. It appears to be an example of slash burning, because the area underneath the smoke has cleared vegetation like patches of clear-cut. Plus, the location is at the end of dirt road on hillside up from Highway 126, another indication of logging. In the 1953 photo, the log piles are especially evident next to the railroad, likely ready to be loaded and transported away. The lower site as a whole appears to be accreting sediment and increasing in size. The marsh accretion is even more noticeable in the 1963 photo. The accretion is likely due to increased sediment loading, as well as the presence of the pilings, which slow water flow and allow more rapid accretion. Most noticeably, the 1963 photo shows the beginning stages of logging the strip of forested upland on the lower site, next to the main stem of river. The dwellings are still present, but the piers are gone. Dikes are still present on the farm on east side of the railroad. By 1968, the land use appears similar with timber reduction on site; log piles on the marsh and farming opposite the railroad. However, there appears to be an increase in logging on the nearby hillsides.

By 1979, the photo indicates a significant reduction in the amount of timber onsite with only a few dozen trees remaining. The dwellings have disappeared. The final photo is color and was taken in 1982. Large piles of logs are still present on the marsh and huge swaths of clear-cuts with extensive road networks are clearly visible in the area.

Upper site

For the upper site, the historical aerial photos provide similar evidence of impacts and changing land use. The 1939 aerial photo indicates extensive farming occurring on Duncan Island, although further east of site. Nearby is a dwelling with pier, some dirt paths are evident leading towards the upper site. A look closer at the site yields an interesting discovery - the complete blockage of the main tidal channel on the site.

Figure 8. 1945 Historical Aerial Photo. Source: University of Oregon, Map Library.



By 1945 (Fig. 8), this channel appears unblocked, but bridged by several logs. These may have been stranded mid-channel or possibly placed by the landowner in order to easily access the other side of the marsh. There are other indications of increased land use including the

appearance of what looks like a straight ditch. The main vegetation still appears to be marsh vegetation, since the typically uniform crop look is not present on the site. However, the vegetation does appear somewhat disturbed likely from mowing or pasture use. Like the lower site, logs appear to be stranded on the marsh surface, but in much lower numbers. The dwelling with the pier is still apparent.

In 1953 the photos show large log barges in the nearby channels. Across the main slough a dike is present accompanied by a series of straight ditches. By 1962, the pier is gone, and the dwelling may have been abandoned. Farming across the main slough still continues. The site itself still contains more piles of logs. There is also an indication of bulrush vegetation (circular dark patches on marsh surface). In 1968, the dwelling is gone with only the building foundation remaining. The aerial photo continues to show many logs on the marsh surface and the straightened ditches from previous years.

Log barges are visible again in the nearby channels in the 1979 photo. Finally, the 1982 color photo, like the lower site, shows a large patchwork of area timber cuts clearly. On the upper site many patches of the marsh vegetation appeared dead or mowed over. Since this photograph was taken in May, it is unlikely the vegetation is dead. However, bulrush is a common vegetation type on this marsh currently. Its dead stems remain on the marsh surface and it has a later growing season. Another likely scenario is the use of these areas for pasture. In this case, the vegetation would be eaten before it could get very tall. The same straight ditch is distinguishable.

The table below provides the quantitative scores for each site by decade. As the data show, the upper site is more directly and indirectly disturbed than the lower site. It also yields

higher disturbances scores for both sites during the 1950s and 1960s with decreasing scores in more recent decades.

Table 4. Historical aerial photo scores for the upper and lower Siuslaw sites by decade.

Total Average Decadal Score								
Site	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Lower Siuslaw	20	16	19.6	22.3	20	16	N/A	10
Upper Siuslaw	50	52	58.6	56.3	40	38	N/A	26

The detailed data and spreadsheets for aerial photo scoring can be found in the attached appendices, excel file: Historical_Aerial_Photos.

The historical aerial photography available for the two sites from 1939 to 2000 generates some detailed evidence for impacts to the marshes primarily from resource uses such as timber and agriculture. The lower site has been disturbed primarily by the timber industry through log booming and storage and a nearby railroad. It also had a clearcut of its upland trees and some residential use. The upper site with one of the higher disturbance scores through the decades has been heavily impacted by agricultural use through dikes, ditches, crops, and grazing. The score and likewise these impacts have decreased in recent decades.

Field Observations

According to Emily Russell in *People and the Land through Time*, "Physical and biological remnants like cultivated plants and old ditches also reveal many details about what people did and where they did it, and this amplifies archaeological, historical, and geographical understanding" (Russell 1997). Current evidence is certainly critical to understanding both sites. Photo documentation can be found in Appendix E, Folder: Siuslaw Field Photos, Sub Folders: Lower Site and Upper Site (references will be to file names within these two folders).

Lower site

Vegetation of the lower site consists primarily of the low marsh plants such as *Carex lyngebyei*, and some other high marsh plants such *Deschampsia casepisota* (Source Paul

Adamus, photo files: ls_caly; ls_south). The lower site has a higher salinity than the upper site and thus, no extensive reed canarygrass patches are present. Along the lower site, most of the impacts are visible along the edge of the marsh. Extensive rows of pilings sunk into the river and near main marsh channels are still present today (file: lower_entrance). These pilings were initially set to assist in floating and booming logs on their way to the mill at Cushman. Across the Siuslaw River is a marina, the former site of the Cushman sawmill (file: lower_marina). The upper site has a natural levee with trees growing on it (files: lower_east; lower_west; lower_north). As noted by the historical aerial photos and deed history, the presence of primarily pilings and no other historical indicators confirms the previous use of the lower site primarily as log storage for the timber industry.

Upper site

The upper site's vegetation consists mainly of *Scirpus acutus* (hardstem bulrush), *Carex lyngbyei*, and *Phalaris arundinacea* (reed canarygrass) (Source Paul Adamus, photo files: us_bulrush; us_caly; us_veg). Disturbance history is more evident in field and current sources for the upper site than the lower site. First, the current infrared aerial photos reveal the main ditch constructed on the upper site and present in the 1945 photo.²¹ Second, field studies conducted in the summer of 2003 uncovered large patches of reed canarygrass (*Phalaris arundinacea*) on the upper site (Source: Paul Adamus. See Fig. 9 or photo file: us_reedcanary).²² While reed canarygrass is found throughout the world, it is often regarded as an invasive pasture grass and aggressive colonizer (Brophy 1999). It prefers fresher wetlands, but can tolerate some salinity

²¹ The aerial color infrared photos were analyzed for color, patterns, and textures. Darker reds indicate high growth of vegetation; light pink is newer growth. While white or cyan indicates disturbed soil, bare soil, or some crops. Some of the blues on the marshes indicate bulrush vegetation. Copies of these photos were not included in the appendices due to file size, but can be obtained from the U.S. Army Corps of Engineers.

²² Field studies were conducted as a part of a Hydrogeomorphic Assessment Study for the Coos Watershed Association.

(Weinmann 1984). Most importantly reed canarygrass is an indication of disturbed land, especially past use as pasture and/or crops (Brophy 1999, Weinmann 1984). In fact, a caption from a newspaper article in 1956 shows Warner Waite, a nearby farmer, with tussock, or *Dechampsia caespitosa*, and planting reed canarygrass. The caption reads “Tussock – the common clump of reed-grass that torments coastal farmers – can be controlled by canary grass, says W.B Parker, extension agent in agriculture” (*Siuslaw Oar*, 4/20/1956).

Figure 9. Reed canarygrass on upper site. Photo by Paul Adamus, 2003.



Other evidence of impacts can be seen through the rest of the area. Along the edges of the marsh is an upland berm with shrubs and trees growing on it (Source Paul Adamus. See photo file: us_main_channel. Source Jennifer Hennessey. See photo file: upper_duncan2). This is the remnant dike and still influences the flow of tidal waters over the marsh. Cattle still graze nearby land (file: upper_duncan1) and the hills immediately adjacent have been recently clearcut (files: upper_landscape1; upper_duncan3). Finally, at low tide, the upper site also reveals a large

wooden structure sunk in the main entrance channel. This structure could have been an old bridge or even a tidegate.

All these forms of on-site evidence confirm historical narratives and evidence of use of the upper site for agricultural practices such as grazing at one time. The footprints of yesterday still impact the functioning of the marsh today.

SUMMARY OF SIUSLAW

As seen in this narrative, the Siuslaw watershed has a diverse land use history, which affects the current functioning of the estuary and wetland sites for this project. Before white settlers arrived, the Siuslaw tribe interacted with the resources. They burned forests, relied heavily on fish runs, shellfish, and plants for food, and likely lived along the estuary for much of the year. In particular, the burn of 1846 was noted by early surveyors and had influenced much of the surrounding forests: not much timber was present near the river and dense undergrowth had grown up in the thirty years since the fire. The Siuslaw tribe may have also increased marsh accretion by leaving fishing weirs in tidal channels. The Siuslaw was slower to receive Euro-American settlers than other coastal watersheds due to an Indian reservation, which was abolished in 1876. Early industries included canneries, a sawmill, and agriculture. By 1890, the area population had reached 1,000 and locals were clamoring for better transportation options. This included a jetty to secure the rapidly shifting mouth of the Siuslaw River and a railroad to transport goods such as timber and fish. In 1916 the railroad was completed. The following year work on the two jetties at the mouth of the river was finished.

Overall, the resource uses by the Euro-Americans were larger in intensity and scale than those by the Siuslaw tribe. Euro-Americans initially used resources for subsistence, but rapidly moved to commercial production transporting goods to regional, national and even international

markets. At the watershed level, timber production and transportation (log rafting and splash dams) methods influenced erosion and sedimentation, scoured riverbeds, and altered woody debris supply to rivers. Agricultural production increased erosion and compaction, filled, ditched, and diked tidal wetlands, decreased habitat opportunity for fish and wildlife, decreased water quality, and introduced non-native vegetation. Canneries sought to pack as much fish as possible, especially salmon. This resulted in the implementation of management measures such as fishing restrictions and hatcheries. Other alterations such as, dredging, jetties, and dikes changed water circulation, sedimentation, and flooding patterns. Improved transportation allowed both the population and resource extraction to increase rapidly. Throughout the 1900s, the Siuslaw was especially known for its large timber output. More recently the area's economy has come to rely more heavily on tourism and recreation than resource extraction.

While the sites for this project are considered some of the "best of what's left," their functioning has been altered by their land use history. The upper site was particularly influenced by agricultural production, the presence of a dike and ditches, and introduction of non-native species. The lower site was altered by the presence of a railroad across its eastern edge, extensive use for log booming and storage, and a clearcut. This site appears to have accreted sediment at a higher rate than other nearby tidal marshes.

Alsea



The Coastal Atlas uses both public and private data sources, including the DynamicDisplay product, ©GCT

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<http://www.coastalatlases.net> is a project of the Oregon Ocean Coastal Management Program in collaboration with Oregon State University, and EcoVet. Funding for the effort has been provided by the National Science Foundation, the NOAA Coastal Services Center and the Federal Geographic Data Commission.

Figure 10. Location of upper and lower tidal wetland sites in the Alsea River estuary.

Results and Discussion: Alsea Watershed and Sites

BACKGROUND

Table 5. General Statistics.

Estuary Area (acres)	2516
Watershed Area (square miles)	474
Estuary Rank	7 th
Geomorphology	Drowned River Mouth
Head of Tide (river mile from Department of State Lands)	11.5, near Tidewater

Sources: Oregon Coastal Atlas 2004; Percy 1974; Oregon DSL 2005; and Scranton 2004.

Site locations

The upper tidal wetland site is located in the Barclay Meadows area on the north side of the Alsea River, near the bend in the Alsea River and just northwest of the Highway 34 bridge crossing. The lower site is located on the east side of the entrance to Drift Creek and follows west along the main stem of the Alsea River. Site locations are marked in red circles in Fig. 10 (see also Appendix B - Alsea, Folder: Site Locations, File: Alsea).

Table 6. Site Specifics.

	Lower Site	Upper Site
Location by River Mile from mouth (approx.) ²³	5.0	7.2
Digital Elevation Model (ft. above Mean Low Tide)	7-20	10-13
Habitat Classification (from: Scranton 2004)	Marine Sourced High Wetland	River Sourced Tidal Wetland A small patch of "potential forested wetland"
Estuary Plan Book Classification	High Salt Marsh	Not Classified
Hydric Soil	Yes	Yes
Soil Type	N/A	N/A
Mixing Regime (NOAA Salinity)	Mixing Zone	Mixing Zone
Upland Vegetation Type	Forest upland is primarily medium conifer and broadleaf, some small conifers.	Small patches of very large conifer, large conifer and small conifer, some medium mixed forest.

Sources: Scranton 2004; Midcoast Watershed Council 1998.

²³ Source: ODFW, Trevan Cornwell, personal communication derived from USGS Topographic Maps.

HISTORICAL RECONSTRUCTION - LANDSCAPE SCALE

Native Resource Use

Radiocarbon dates from shell middens in the Seal Rock area indicate that native peoples have occupied the mid-coast for the past 1500 years, but most archaeologists agree that native peoples have inhabited the Oregon coast for the last 3,000 years and likely longer (Beckham et al. 1982, Minor et al. 1985, Bryam and Witter 1999). The Alsea ('So-see') tribe occupied the Alsea watershed and was closely related to the Yaquina ('Yaconan' or 'You-cone') tribe of the Yaquina watershed. They solely shared a language in the Alsean language family under the Penutian linguistic phylum (Beckham et al. 1982, Minor et al. 1985). Linguistic experts claim that the changes between the various languages of local tribes "indicate that Penutian speakers have inhabited the Oregon coast for at least several thousand years" (Minor et al. 1985). The geographic proximity and cultural similarities of the Alsea and Yaquina means that many of their resource uses and impacts on the land were similar. Beckham et al. (1982) describe the territory of the Alsea as between Beaver Creek south to Tenmile Creek and primarily near the coast, but extending inland as far as the crest of the Coast Range.

The Alsea people procured food resources when and where they were seasonally abundant. Minor et al. (1985) describe what is known about the Alsea tribe's food resources:

The Alsea-Yaquina were described by their chief ethnographer as 'fisher folk' [Drucker 1939:82]. They relied heavily on the rich marine and estuarine resources available along the Oregon coast, including fish, sea mammals and shellfish. The Alsea appear to have practiced a seasonal round of subsistence procurement activities as suggested by 'their seasonal migrations up and down their little valleys' (Drucker 1939:82)... Exploitation of seasonally available resources such as fish, berries and camas no doubt required that trips be made into interior valleys during certain times of the year. Salmon, which was of greatest importance in the Alsea diet, was caught in the rivers and streams and dried for winter storage... Crabs, clams, mussels, mollusks, and sea anemones were also collected by women along the coastal margins. Curved, crutch-handled digging sticks were used to pry mollusks off rocks and to dig for clams, as well as for camas digging.

Additionally, the Alsea occasionally hunted seals or sea lions and whales were only used when they opportunely washed onshore (Minor et al. 1985, Ruby and Brown 1992, Beckham 1982). Hunting of land mammals such as elk or deer was done infrequently in the fall to supplement the diet (Minor et al. 1985). As Drucker noted, 'the paucity of hunting and trapping devices in a region plentifully stocked with game serves to emphasize the lack of interest in any pursuit other than fishing' (Minor et al. 1985). Thus, like many other coastal tribes, the Alsea people heavily relied on the large salmon runs, which "included Chinook in midsummer and dog salmon in early fall, and steelhead in the late fall and winter" (Beckham et al. 1982).

Women were primarily responsible for gathering food such as roots, berries, greens, fruits and seeds. In particular, researchers (Minor et al. 1985, Lindsay 1995) reported the importance of camas root, which was dug by the Alsea in late summer and early fall particularly in the Alsea Valley. As noted in the discussion of the Siuslaw people, camas is more likely to occur in freshwater wetland meadows or wet prairies than wetlands with higher salinities (Guard 1995). Other research indicates some Oregon coastal tribes may have burned meadows to enhance Camas growth (Lindsay 1995).

The heavy reliance on the salmon runs, allowed the Alsea and the Yaquina to live in permanent "semi-subterranean plank houses in permanent villages sheltered in the estuaries of rivers" (Beckham et al. 1982). Unfortunately, despite a list of 20 village names for the Alsea people "most have no locational information. Specific mention is made only of Alsea villages near Seal Rock, Beaver Creek, and Yachats" (Minor et al 1985). Their seasonal procurement of various resources would require the Alsea to also establish temporary camps in the summer and fall. For temporary quarters, "A rectangular gabled framework of poles was erected and *covered*

with long grass or reed thatch at fishing camps" (Minor et al. 1985 citing Drucker 1939, emphasis added).

The Alsea people built a variety of tools and utilized many different plants and implements to support their way of life. Baskets for cooking, food collection, or fishing were made from alder, cedar, willow, and maple (Beckham et al. 1982). Many of these containers used marsh plants: "Berry baskets and deep, round 'water baskets' were closely twined of split spruce roots. *Flexible bags and coarse baskets of rushes and beach grasses were also woven*" (Beckham et al. 1982, emphasis added). Fishing hooks were often made from bone, stone, or wood. The Alsea tribe employed many fishing techniques, including one similar to gill netting whereby nets were strung between canoes and allowed to drift downstream (Lindsay 1995). They may have also utilized fishing weirs (Lindsay 1995). In addition to the other materials, homes usually required mats for walls (Beckham et al. 1982). Shredded bark and animal hides made up the few clothes they opted to wear (Beckham et al. 1985). Thus, in addition to directly consuming resources for food, the Alsea people utilized other resources, including marsh plants to provide shelter, clothing, and a wide array of utensils.

In 1788, Robert Gray's crew sailing off the coast near the Alsea River reported that the Alsea people presented, "themselves to him and his crew in warlike fashion, dressed in cuirasses and shaking spears" (Ruby and Brown 1992). By the 1820s, Alsea people were trading with crewmen of the Hudson's Bay Company along the coast (Ruby and Brown 1992). Like the other native people along Oregon's coast, Euro-American contact came with a heavy price. Most of the decline in population was attributable to disease outbreaks to which the native population had no immunity. Minor et al (1985) reported that, "the Alsea-Yaquina, together with the Siuslaw and Lower Umpqua to the south numbered approximately 6000 in 1780. Only 29 Indians were

listed under these groups in the census of 1910, and by 1930 that number had dropped to nine [Swanton 1952:453, Mooney 1928]”. After signing an unratified treaty in 1855 with Joel Palmer, Oregon Superintendent of Indian Affairs, the Alsea were located along the southern portion of the Alsea River in the Coast Reservation (Ruby and Brown 1992). An act of Congress in 1875 removed them to a different reservation along a southern portion of Yaquina Bay (Ruby and Brown 1992). However, the local sub-agency allowed the Indians who remained on the Alsea to stay until 1881, when the government set in motion their removal back to the Siletz reservation (Noah 1999).

General Land Office Surveys

The first General Land Office Survey Township 13S Range 11W, the area where the Alsea sites are located, was completed in May 1876.

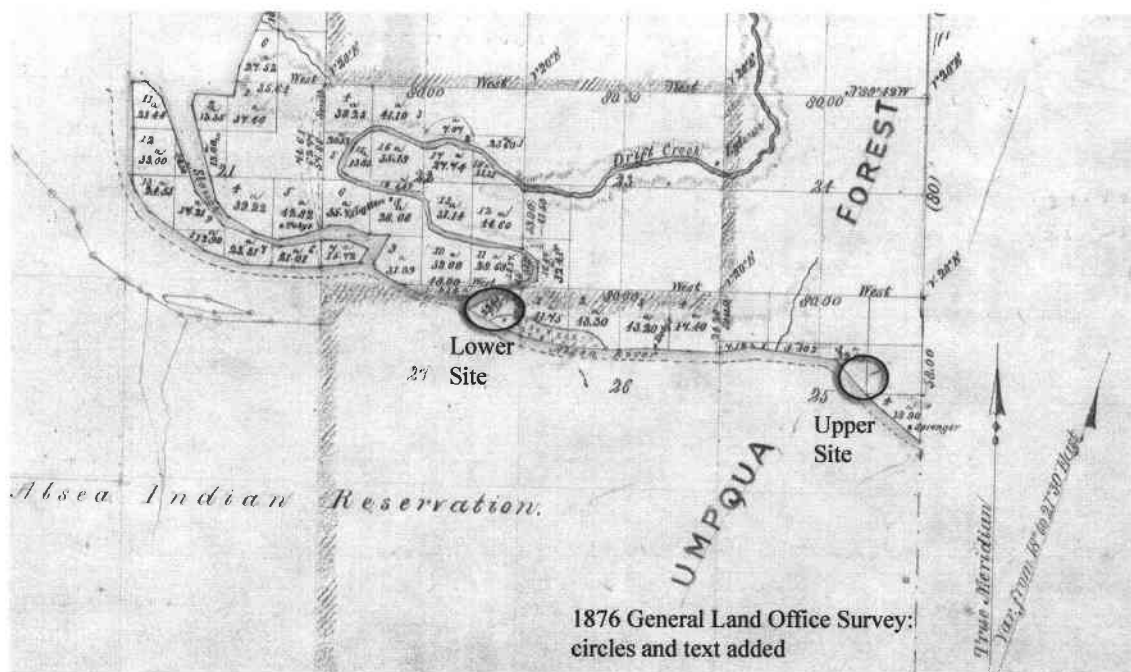
The general description reports: “The land of the above Township is mostly of good second rate quality. The surface is broken but there is level land along the Alsea river and the lower part of Drift Creek suitable for farming. Timber is mainly spruce and fir” (University of Oregon, Map Library, GLO 1876). Excerpts from the detailed field notes provide more specific information about both of the sites.

Lower site

“South between Sec 26 & 27...enter prairie bottom; marshy bears E-W...set post on right bank of Alsea for corner to fractional sec 26 & 27 from which a crabtree 6 in[ch] diam[eter] bears N66 E16 lks[links] dist and crabtree 6 in diam[eter] Bears S34 W14 Lks[links] dist[ance] Land hilly and level 2nd & 1st rate” (GLO 1876). The map indicates the closest house as the Doty’s, which was further east than the present day site location (see Appendix B, Folder: General Land Office Maps, File: 13s11w1876).

Not only was this lower site a marsh in the late 1800s, but there were tidal marshes in the surrounding area, too. Of the opposite side of the entrance to Drift Creek between Sections 22 and 27, the surveyor writes, “Land level wet soil 1st rate” (GLO 1876). Farther downstream near the Alsea Bay at the corner of Sections 21 and 22 the surveyor reported, “This island is tide land and covered with a heavy growth of grass. The Soil is first rate. The ordinary summer tides do not overflow it, but do occasionally in the winter” (GLO 1876). Thus, it appears that this particular nearby island was likely a high marsh. In 1879, after the Alsea Indian Reservation was eliminated, a second survey was completed in July of 1879 of the south side of the Alsea River. Across from the lower site the surveyor found more tidal marsh using spruce trees as the bearing trees he described the section, “land slopes gradually suitable for cultivation no timbers but some brush” (GLO 1879). The 1879 survey also characterizes the nature of extensive tide flats along the left bank in sections 26 & 27 as, “three fourths tide flat about 10,000 lks[links] in width good soil but quite brushy...brushy bank” (GLO 1879).

Figure 11. 1876 General Land Office Survey.



Upper site

The upper site, located in section 25, did not intersect with any corners for the survey, but information regarding the area can still be obtained. The map indicates the location of the Sprenger house on the Alsea just southwest of the area of interest (see Appendix B, Folder: General Land Office Maps, File: 13s11w1876). While mapping the meanders for the north side of the river, the surveyor headed from upstream towards downstream. He noted the Sprenger house and that the river bears north. His next note is the presence of "bottom" land right before a steep hill and the corner of fractional sections 25 & 26 (GLO 1876). This is the location of the area of interest and his notes indicate a likely tidal marsh.

The later 1879 survey near the site also indicated tidal marsh in this area. Using crab apple and willow trees for bearing trees, the surveyor describes the area north between sections 25 & 26 as, "Upland rough tide land produces good grass" (GLO 1879). Thus, another area of bottomland nearby had the appropriate vegetation for a tidal wetland.

U.S. Army Corps of Engineers (USACE) Surveys

In 1875, the USACE undertook the first surveys of the "Alsea River and Bar" in order to deem whether navigational improvements were required. The USACE concluded that the river did not require further navigational improvements, only a surveyed and buoyed entrance to facilitate safe vessel passage. The following excerpts (with emphasis added) from USACE letters and reports submitted from 1875-1878 indicate the nature of the landscape at the time.

United States Engineer Office
Portland, Oreg., December 27, 1875

SIR: Section 2 of "An act making appropriations for the repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes," directs that, among others, an examination be made of "Alsea River and Bar, Oregon, approved March 3, 1875;" and by your direction it has been accomplished.

...The mouth of the Alsea River is about 14 miles south of Yaquina Bay. The mouth of the river is very narrow, and a very short distance up it merges into a large bay at high-water. The deepest water is found in the mouth, near the south side, no bottom being found in some places with a seven-fathom sounding line. The bay at low water is almost bare except in the lower portion near the north shore, where the channel is then defined. It would be a difficult matter to get a vessel of any kind drawing 8 feet of water, more than 2 or 3 miles from the mouth. No worthy sea-boat was found able to go out on the bar during ordinary weather. But there was a large flat-bottom skiff which, after some repairing, was called into service. On very calm days this boat was taken out on the bar, one-half of a mile or more on the slack of the ebb-tide, but half an hour afterward the breakers of the coming flood-tide would hinder all further sounding. Ten feet was the least found on the bar at low water. The bar is almost similar to the one at Yaquina Bay. The preliminary survey and examination was completed, and the party returned to Portland on the 22nd of September.

United States Engineer Office
Portland, Oreg., September 23, 1878

THE ALSEA RIVER

...From its source to a point about 15 miles from its mouth it is described as a mountain stream full of rapids and bowlders [sic], with abrupt falls at various points of from 3 to 5 feet, obstructed by rocks and with very little water. At this point the stream is 80 feet wide and from 3 to 6 feet deep at low-tide, and gradually widens and deepens until the mouth of Drift Creek, 9 miles below, is reached, where it is 300 feet wide; the depth in this section varies from 3 to 20 feet, with an uneven and occasionally rocky bottom; the river is inclosed [sic] on both sides by hills ranging from 300 to 600 feet high, covered with grass, fern, and young thickets. On the left bank the hills slope to the water's edge; on the right bank a strip of level bottom, several feet above high tide and from 200 to 600 feet wide, extends along the river, broken occasionally by projecting spurs from the ridge.

ALSEA BAY

About 3 1/2 miles from its mouth the river spreads out into Alsea Bay, which is from 2,000 to 7,000 feet wide at high tide, covered with mud flats bare at low-water, and through which are numerous shallow channels.

For a mile inside the mouth there is a channel and a perfectly protected anchorage with a depth of from 12 to 20 feet; immediately inside the bar is a hole 2,000 feet long and 300 feet wide at which no bottom was found at 6 fathoms. Near its mouth the bay is separated from the ocean by a sand-spit about 2/3 of a mile long and 1/3 of a mile wide; this spit narrows at its outer end, the outer 100 feet being covered at high tide the channel at the mouth of the bay is about 300 feet wide, with the depth as indicated in the deep hole described above.

THE BAR

Immediately in front of the mouth of the river, extending about 2,000 feet into the ocean, is a sand-bar, over which the least depth found at low-water was 8 feet. The law did not call for an examination of this bar, but it nevertheless would have been carefully made could it have been done without danger to life; but heavy fogs, rough seas, and bad weather, and the absence of any tug or safe boat at the time the survey party was there

prevented the examination. A line of soundings was afterward run on a calm day by some citizens, who reported that the distance across the bar was 1,800 feet, and the channel 1,200 feet wide, with 8 feet as the least depth.

TIDE

The tide rises about 8 feet at the mouth, and there is a rise of about 6 feet 8 miles above, the tidal influence being felt up to the foot of a line of rapids 15 miles from the mouth.

THE ALSEA VALLEY

The valley of the Upper Alsea is situated about 40 miles from the mouth, measured via the river, and covers an area of about 300 square miles; it is considered one of the finest portions of Oregon for agriculture, the flax and wheat being excellent. The wheat crop for the present year is estimated at 60,000 bushels; *great difficulty is, however, experienced in getting these products to market.* [emphasis added] In case the bar at the mouth of the river is found to be such as to admit vessels, it is proposed to build a good road from the settlement to the head of navigation.

OBJECT OF THE EXAMINATION

The act of June 18, 1878, directed an examination to be made of the "Alsea River and Bay, Oregon," and an estimate of the cost of improvements "proper to be made."

The result of the examination and of conversation with residents at the bay demonstrated the fact that no improvement of this river and bay was expected, and none is deemed "proper to be made." [emphasis added]

United States Engineer Office
Portland, Oreg., September 18, 1878

Colonel: After completing the survey at Cape Foulweather, I proceeded to make the examination of Alsea River and Bay, as directed by your letter of instructions.

...The principal tributaries are Fall Creek and Five Rivers, the former entering from the north, 29 miles by river from the sea, the latter 6 miles lower. Drift Creek, which flows into Alsea Bay at its head, is a tidal slough or lagoon navigable for small boats for 4 miles. It does not contribute to the volume of the river proper, although it is included in the same general drainage basin, which covers an area of 300 square miles.

The tide extends 12 miles, from the head of the bay to the foot of the line of rapids, where my personal examination ended. Here the stream is 80 feet wide and from 3 to 6 feet deep at low tide. Above it is a mountain stream navigated only by Indian canoes, with a swift current and rocky bed. Below it is a tidal channel with no perceptible river current, widening gradually down to the mouth of Drift Creek, where it is 300 feet across. The depths along this section at low tide vary from 4 to 20 feet, the bottom being very uneven, and in some places rocky.

The bay is 3 1/2 miles long and from 2,000 to 7,000 feet across at high tide. At low tide a large extent of mud flats is left bare, forming islands, between which the channels are so shallow as to admit only small boats and scows.

For a mile inside of the bar there is good anchorage, with a depth of from 12 to 20 feet at low-water, constituting a harbor of about 80 acres area, sheltered on all sides. Immediately inside of the bar is a deep hole 2,000 feet long and 300 feet wide, at the curve of 18 feet depth, in which no bottom was found at 36 feet.

The above data concerning the bay were obtained from the chart of the survey made in 1875 under the direction of your predecessor, Maj. N. Michler. At the head of the bay in the principal channel there is a bar half a mile long, on which I found only 3 feet at low-water. The point is not included in the limits of the survey.

Between the mouth of Drift Creek and the head of the tide-water, 12 miles, the river is inclosed on both sides by hills ranging from 300 to 600 feet in height, thickly covered with salal grass, fern and young thicket. On the left bank the slopes of the hills generally reach to the water's edge. *On the right bank a strip of level bottom, several feet above high-tide level and from 200 to 600 feet wide, extends throughout this section, broken at points by projecting spurs from the ridge. This strip is all taken up under the homestead and pre-emption laws, and a portion is under cultivation. It is all alluvial soil, producing excellent corn, vegetables, and fruit, and wheat equal to any that I have seen in Oregon.* [emphasis added]

The river is the northern boundary of the Alsea Indian Reservation.

For 30 miles from the coast inland, the greater portion of the large timber in the valley has been destroyed by fire. [emphasis added]

Forty miles from the bay, measured along the river, is the valley of Upper Alsea, covering an area of 300 square miles, in which some 50 families are settled. Its principal products are wheat, flax, oats, and cattle. The wheat crop of the present year is estimated at 60,000 bushels. A wagon-road is now being opened to connect with tide-water. At present there is no outlet from the upper valley save a wagon-trail, almost intransitable in summer and quite so in winter, across the Coast Range to Corvallis in the Willamette Valley. *Last year only about one-third of the wheat crop could be gotten to market before the trail was made impassable by the winter rains.*

The principal value of the Alsea country is in its forests of fir and cedar, which cover the country above the burnt district, the timber being of the best quality and of large size. [emphasis added]

Salmon visit the river in large numbers. The season commences between the 20th and 30th of August and lasts two months.

The information concerning the Upper Alsea country was furnished by Mr. Thomas Russell, an old resident and postmaster at Tidewater on the Lower Alsea.

It was not possible to make a personal examination of Alsea Bar, owing to the prevalence of heavy fog, rough seas, and bad weather generally, and the want of a suitable boat. I, however, engaged two of the residents of the vicinity to go out on the bar the first calm day and run a line of soundings across out to deep water. From them the following information has since been received: Least depth on bar in channel at low tide, 8 feet; width of entrance, 1,200 feet; distance across the bar, 1,800 feet.

No survey has ever been made of this bar, nor has any project for its improvement been suggested. All that the parties interested request from the government is that the depth of water be officially declared and the entrance buoyed, owners of steamers in San Francisco having assured them that when this is done they will send light-draught steamers to carry off the products of the valley. [emphasis added]

Up to the present time only one vessel, a small schooner built in Alsea Bay, has crossed the bar.

The survey report concluded that navigational improvement was not necessary due to the fairly navigable nature of the bar and harbor up to river mile two or three. However, transporting goods to market was a problem due to the Alsea's isolation from major roads²⁴ or railways. Thus, to enhance shipping residents requested a well buoyed and surveyed entrance to the Alsea as a result of the survey.

The USACE reports from 1875 and 1878 both yield important insights into the resources and land uses employed by the Euro-Americans settling in the Alsea. The surveyors specifically mention the importance of timber resources, especially fir and cedar, despite a great area having been burnt. The tidal wetlands were already all taken up by land claims and many were in use for agricultural production on the good alluvial soil. Abundant salmon runs were also mentioned in their report. These early reports foreshadowed the reliance on all these natural resources by Euro-Americans.

General History of Resource Use

The Alsea Watershed's natural resources were used by Euro-American settlers initially for survival, but later became more commercialized. The resources were similar to other watersheds in this study: fish, timber, and rich bottomland.²⁵ However, due to geology, geography and settlement patterns, the Alsea did not receive some of the alterations such as jetties or the same degree of development as the Yaquina and Siuslaw Watersheds. The following section outlines some of the important alterations made to the Alsea area by Euro-Americans and their impact on tidal wetlands and the landscape.

²⁴ Although a rough wagon road did run to Corvallis, it was impassible during much of the fall and winter due to heavy rains.

²⁵ In more recent times, tourism and recreation have become the main drivers of the local economy. A report by the USACE reflects the changing concerns for the landscape, "the river could conceivably end up with 700 private docks. The magnitude of proliferation is considered undesirable by many citizens locally. The effects of permit issuance would primarily be on esthetics, recreation, interference with navigation...and on riparian habitats" (USACE 1976).

Transportation

Transportation was important for increasing the number of settlers as well as selling products to outside markets. Thus, the economic and social viability of the Euro-American settlers was viewed as integrally linked to transportation. One such example is drawn from a letter regarding the railroad to Yaquina in the late 1880s, "The GAZETTE is eagerly sought after, for railroad news. I think we are about as much interested in the success of the Willamette Valley and Coast railroad as the people of Yaquina. Our interests are so intimately connected with Yaquina that we look upon her prosperity as our own" (*Corvallis Gazette* 1878). This passage also reflects the attitude of many Alsea residents who often felt their area was overlooked while nearby Yaquina River received more attention. However, the prosperity of nearby Yaquina in the 1880s with the construction of the railroad and jetties did transfer to the Alsea area. As historian Noah reports, Yaquina's prosperity, "created a market for vegetables, eggs, butter, and honey from the Alsea Bay area. The demand drove produce prices upward; beef shot up to five cents a pound" (Noah 1999).

The Alsea River was the first and primary transportation route for settlers in the mid to late 1800s. People utilized the river for barging goods and traveling up and down the river. Native American trails also served as transportation routes. As J.C. Barclay, an early Alsea resident, recalled, "I rode behind my mother on a horse over an old Indian trail. The settlers here hired the Indians to freight down the Alsea River on their canoes when the river was too low to run barges. They did a lot of freighting down the river by barges until 1918" (Barclay, Lincoln County Historical Society). Even the mail was delivered via boat.

Gradually dirt roads, railroads and bridges were developed. As J.C. Barclay notes, "Until 1888 we had to bring it [wheat] down river by boat, then a dirt road was finished through from

Alsea to Tidewater” (Barclay, Lincoln County Historical Society). Improvements to transportation routes were key to increased extraction of natural resources and residential development. In the early 1900s, “A railroad and wagon road are [sic] constructed to ease transport of logs to Toledo Mill. These transportation improvements permit the spread of residential development beyond the riverfront.... 1915-1917 A railroad is built through Waldport to transport logs to Toledo Mill.... 1919 The first wagon road along the Alsea, linking the towns of Alsea and Waldport, is completed. This eliminates the need to travel by raft from Tidewater to Waldport” (USACE 1975). Following on the wagon road, the Bureau of Public Road in 1919 began the task of finishing a rock road all the way from Corvallis to Waldport, which was completed in 1926 (Barclay, Lincoln County Historical Society). During the depression era, public works projects included finishing Highway 101 and the bridge over Alsea Bay (USACE 1975). At the same time, the Alsea Southern Railroad tracks were removed (USACE 1975). The Highway 34 bridge was completed in 1940 (USACE 1975). Roads were also built to facilitate timber removal. In Drift Creek, during the period of peak removal, the National Forest Service system had an average of three miles of road per square mile of watershed (USFS 1997).

Road building increased erosion and sediment loading to the watershed. It also decreased slope stability while increasing impervious surfaces. By the mid 1970s, a report by the USACE stated, “The Alsea has been heavily impacted by fill for housing and roads, particularly highway 101. The pressures for land emanate largely from tourists, recreationists and retirees” (USACE 1976). Thus, transportation and development in the area changed the landscape by increasing erosion and population size, but also by improving the ability for people to remove natural resources and alter the landscape.

Fishing

By all accounts, fish in the Alsea were plentiful in the 1800s. The first Euro-Americans utilized them primarily for subsistence. Many accounts from settlers relate the practice of catching and drying or salting enough fish to feed their family through the winter (Hays 1976). However, they quickly realized the economic potential of the salmon runs. One early settler family related their story of getting into the fishing industry, "In 1888 the family [Ludeman's] decided they could make some money in the fishing industry which was getting a good start on the Alsea; so they pooled all their resources and put up a building on piling[s] over the water near Green Point, ¼ mile east of Waldport" (Hays 1976).

Harrison, Freeman, and Dodge started the first cannery in 1886 (Hays 1976). According to local reports, "The first year the partners processed 1,100 cases of salmon. The following year they built a new, larger cannery at what was called Salmon Town (also known as Collins or Collinsville). Reputedly the new cannery processed 5,000 cases of salmon" (Noah 1999). The next year Nice and Polemus set up the "Lutgens Cannery" further up the bay. At one time as many as five different canneries operated on the Alsea River. During the 1880s and 1890s, the Bobell family recalls, "The Lutgens Cannery stood on piling across the bay from town and the Barnes Cannery out from old town. The Nye Cannery was upriver apiece and the Harrison enterprise was at Salmontown and the Bobell Ludeman Cannery upriver" (Hays 1976).

Most of these cannery operations were short-lived. By 1915, the almanac lists two canneries operating on the Alsea (USACE 1975). Nice sold to Elmore Canning Company in 1906, which subsequently burned in 1915 (Hays 1976). The Barnes cannery operated until it burned in the late 1930's (Hays 1976).

Canneries fostered wasteful fishing practices. Only a certain number of fish could be processed each day by the canneries and the rest were dumped (Hays 1976). Marjorie Hays recalls, "There was a race to catch the most fish. Bert Barclay and Oscar Hoover got 750 silvers and 27 Chinook one night; but Andy Kent and Albert Barclay beat them with 1100. It was said that one night there were 18,000 fish caught" (Hays 1976). She continues, lamenting the declining runs, "Gone are the days when we could, in September and October, go down the river to seine out, or catch the winter's supply of salmon. No more can the valley visitors camp on the coast, catch enough salmon to salt down a barrel for the winter, or bring in fruit from the valley to trade for fish" (Hays 1976).

Hatcheries

Given the large pressures of canneries on the Alsea salmon runs, hatcheries were started as an answer to sustaining salmon runs. Yet, their early practices in particular caused more harm than good. Not only that, but hatchery fish likely had a large negative influence on the survival of native salmon stocks (Independent Multidisciplinary Science Team 1998).

Hatchery operations on the Alsea began in 1902. Yet, hatcheries were moved frequently in the early years, due to operational problems. The following passage follows the chaotic attempts at establishing an Alsea hatchery:

The first hatchery on the Alsea River watershed was established in 1902 near the town of Alsea. It was abandoned after one year because large numbers of Chinook eggs could not be obtained. Another hatchery was established on Drift Creek, tributary to the Alsea River, in 1905. It was operated as a substation of the Yaquina Hatchery, and was closed after one year of operation. A third hatchery was established in 1907 on the Alsea River at the mouth of Rock Creek; this station was also closed after one year of operation. A fourth station was established on the Alsea River at Scott Creek in 1910 and was operated until 1913. In 1915 a hatchery was established near Tidewater and was operated continuously until 1952. (Wallis 1963)

Once established in Tidewater, the hatchery instituted a number of damaging practices.

The first was constructing a dam across the river:

In order to insure securing an adequate number of eggs for this station, a dam was constructed across the Alsea River near the hatchery which provided almost a total block to upstream migration of salmonids. This dam was constructed in 1916 and removed in 1929. (Wallis 1963)

The second was the practice of removing eggs for artificial propagation. In the words of one researcher:

Prior to 1948 it was the general policy to take all available eggs. It is presumed that in most years when no eggs were taken, it was because no effort was made to obtain them. During a period of several years after removal of the Tidewater dam in 1929, several million silver and Chinook eggs were transferred to the Alsea Hatchery from several other hatcheries for rearing and subsequent liberation in the Alsea River and tributaries. After 1938 silver salmon eggs were taken from Five Rivers each year until 1952, and fewer eggs were transferred in during most years. Chinook egg takes at Five Rivers were erratic and Chinook eggs were transferred in until 1953. (Wallis 1963, emphasis added)

These two practices significantly decreased the ability for native fish stocks to spawn naturally and increased competition by releasing millions of hatchery raised fish into the Alsea River.

Based on the reduced numbers of salmon caught during the dam's operation "the period of reduced landings [of coho] coincides exactly with the period during which the hatchery dam blocked the upper river runs"²⁶ and other hatchery practices researchers claimed, "it is felt the hatchery operation affected the bulk of the run into Alsea Bay" (Wallis 1963).

In recent times, hatcheries have continued to impact wild salmon runs in the Alsea River. According to ODFW statistical information, between 1970 and 2003 over 29 million salmonids (coho, cutthroat, Chinook, and steelhead) were released by private and public hatcheries into the Alsea Basin (ODFW 2004). Coho, released every year between 1978 and 1998, accounted for

²⁶ A detailed comparative analysis was done by the Oregon Fish Commission to determine the impacts of past hatchery management on run size. The fishing regulations and technology remained stable for coho during the time the dam was in place. Catch size increased after the dam was removed, a strong indicator of correlation between hatchery disturbance and run size. See Wallis (1963) for more details.

the majority with a total of 20 million. Chinook were also released every year during this period but totaled just 2.3 million. Primary release points were Fall Creek, Alsea River, Drift Creek, and North Fork Alsea River. Unlike other coastal systems, most of the brood stock used for propagation was from the Alsea system.

Hatchery fish interacted with wild salmon in several ways. At first, when almost all eggs were taken preventing natural spawning, the resulting runs were much smaller. Early problems with disease and propagation methods may have also reduced the number of juvenile fish in the system. Thus, fewer juvenile and adult fish may have interacted with natural habitats such as tidal wetlands. Hatchery-raised juveniles were also released at larger sizes and likely out-competed wild fish for resources. Life history and behavioral differences may have caused hatchery juveniles to utilize habitats throughout the watershed in different ways and for different periods of time. One example is the potential for some hatchery fish to have a quicker departure from the estuary to open ocean than wild salmon.

Agriculture

Settlers began arriving in the Alsea in the early 1850s, but settlement did not begin to increase until the 1870s and 1880s after additional lands were opened for settlement (USFS 1997). The first settlers took the most suitable land to build a living on, thus, "The more attractive agricultural lands close to Alsea Bay were claimed first" (USFS 1997). The settlers often wrote letters to the Corvallis Gazette newspaper encouraging additional settlement by touting the landscape and plentiful resources of the Alsea. In 1881, B.L. Arnold, a local settler, wrote, "The Alsea river is itself a source of trout and salmon, and the settlers (some at least,) take enough of the latter to supply themselves with dried fish during the year. Passing down the river from upper Alsea, one finds much fertile land on either side of the river, even to its mouth. This

land is suitable for grain, vegetables, butter, honey, and almost anything produced on the farm” (Arnold 1881). Martha French, another early settler, wrote in 1887, “You spoke of land for sale here. Well, there is a nice place on the river about four miles below here – 160 acres with bottom land a good orchard, a house, barn, hay meadow; nice fountain (spring) nearby. It is five miles from Waldport” (Hays 1976). Thus, early on many areas of tidal wetland were settled and utilized for farm activities such as raising cattle and growing crops.

These lands continued to be used for agriculture throughout the 1900s, especially the first half of the century. In 1933, a GLO resurvey of the area indicated the general use and conditions of the natural resources in the area:

Section 25 [the upper site] is entirely within the Siuslaw National forest. The land is mountainous, except for the narrow strip of bottom land along the Alsea River, part of which is subject to overflow....The soil of the mountainous portion of section 25 is a shallow, loose, sandy to rocky loam that is very fertile because of the rich mixture of vegetable mould. *The soil along the river is a fine, deep, sandy loam suitable to agricultural purposes where not subject to overflow....*The whole section is covered with a dense growth of vine maple, huckleberry, salmonberry, salal, and bracken. Fir is found throughout the section. Alder, hemlock, spruce, and cherry are found throughout the section in scattering patches. The timber is, for the most part, too small for successful logging operations, being suitable only for poles, piling, and rough lumber....*Settlers are living along the Alsea River. Their principal industry is commercial fishing. Dairying is the only agricultural industry of importance.* There is some demand for summer home sites due to the ideal summer, climate, fishing, and accessibility of this portion of the river. (GLO 1933, emphasis added)

This passage emphasizes the continued use of bottomland for agriculture, especially dairy operations through the 1930s. It also reinforces the importance of the fishing industry and resources to the area.

Both the diking of tidal wetlands and use for agriculture and pasture changed the vegetation composition, introduced non-native species, and altered soil chemistry (Brophy 1999, Cronon 1983, Portnoy 1999). Additionally, “Debris jams which flooded agricultural fields were removed, resulting in the loss of in-stream spawning and rearing habitat along with the loss of

high flow rearing habitat on flood plains” (USFS 1997). Agricultural use of tidal wetlands waned from the 1970s to present day. By 1974, “Only 25 percent of the land in the county which is suitable for agriculture is being farmed. Much of the floodplain supports recreational housing units” (USACE 1975).

Timber

Despite the several forest fires, which swept over much of the area from 1840 to 1890, an account of the area during 1849 described Alsea Bay as “timbered down to the water’s edge” (USACE 1975). Spurred by demand from the fishing industry, the timber industry quickly became an important part of the early economy in the Alsea. In 1884, the Baldwin family built a sawmill near Waldport (Noah 1999). Another mill was set up in the area during the same time period. Prior to 1885, a mill ran up in the Tidewater area. Later, in the 1900s, Tidewater had a combined lumber and shingle operation.

Early logging was difficult work that required long hours of physical labor aided by oxen. Wet weather was a welcome sight, as mud served to grease the logs and ease transport down hills and to the rivers (Hays 1976). Many local people were employed in logging, which became easier with the advent of new technologies such as the “Steam Donkey” (Hays 1976). One account from a family in Yachats claimed they “chose only the best smaller old growth for knot-free lumber” (Hays 1976). As another long-time resident and historian claimed the, “old time logging wasted much of the timber – [sic] the supply of trees seemed endless. He chose only the best – [sic] old growth to go to the mills” and did not focus on replanting (Hays 1976). In 1908, much of the area was consolidated into the Siuslaw National Forest regardless of the condition of the forest (Hays 1976). This did not end forestry, but some claimed it created a better program for replanting stands after logging and conservation of timber resources (Hays 1976).

Like many other coastal watersheds, the Alsea River served as a main transport for logs. Early on a lack of roads and trucks meant the river served as a main transportation route. Often the logs closest to the river were cut first to clear the way for trees farther up the hills to be drug down the slope and into the river.

Initially, most of the lumber supply went to meet demand for local construction, barrels for shipping salmon, or boat building. However, World War I brought increased demand for Alsea Sitka spruce for aircraft construction (Hays 1976). In addition, the extension of the railroad from the Toledo Mill to Waldport, meant transportation of Alsea timber to a larger processing area. In Drift Creek, a sub-basin within the Alsea, large-scale commercial timber harvest began in the mid-1950s. During this time, Georgia-Pacific, an industrial timber company began acquiring more lands and by 1970s had “converted from 110-120 year old second growth timber to plantations” (USFS 1997).²⁷ In the 1960s, the Forest Service also dramatically increased harvest averaging 250 acres per year until the 1980s (USFS 1997). Harvest decreased during the 1980s, but increased to an average of 210 acres per year in the 1990s (USFS 1997). On industrial lands, timber harvest converted once diverse forests to monocultural, same-aged stands of Douglas fir that were “not as diverse as natural stands of a similar age class” (USFS 1997).

A study on forest cover change between 1936 and 1996 found that large Douglas fir forests in the Alsea had decreased, while small Douglas fir forests had increased (Wimberly and Ohrmann 2004). This same study found that hardwood forests established in the Alsea after historical fires had decreased as conifers or conifer plantations succeeded them (Wimberly and Ohrmann 2004).

In addition to changing vegetation patterns, timber harvest and associated road building in the Alsea: removed large woody debris from streams simplifying the stream channel;

²⁷ Some areas in Drift Creek were not logged and have since become designated wilderness areas.

increased landslide and erosion susceptibility; increased sediment supply to streams and rivers; and fragmented habitat more than historical disturbance regimes (USFS 1997).²⁸ Thus, throughout the 1900s the Alsea timber industry became increasingly connected to outside markets and wielded a heavy influence on the landscape and watershed functions. This impacted fish resources and tidal wetland functioning by altering the sedimentation, soil stability, and flow patterns in the Alsea River. Although tourism and recreation are currently considered larger contributors to the local economy than the timber industry, its effects are still felt on the landscape (USACE 1975, USACE 1976).

Other: splash damming, jetties, dredging and other river alterations

As noted earlier, the river was an important means of transportation; thus local settlers altered the river to increase its navigability. According to a local historian, "His [Johnnie Ludemann's] launches, the Nugget and Sea Gull, made regular trips across and up and down the river – a vital link for the settlers to town. The old river has a way of changing channels now and then. There were times, when he and Charlie Bobell would have to drag a farm harrow through the seine hole on out-going tide to develop a navigable channel so the mail boat could go upriver on low tide" (Hays 1976).

A 1950 report of the USACE summarized various modifications to rivers and harbors, including flood control projects, and indicated that no modifications had been made to the Alsea River or Bay (USACE 1950). While no jetties were built, as on the Siuslaw and Yaquina Rivers, other modifications did take place in the Alsea, as recorded by a later report on historic alterations and impacts to wetlands (USACE 1975).

²⁸ Research by Oregon Department of Fish and Wildlife also documented the effects of logging to aquatic resources including salmon by using control and treated (logged) stream comparisons (see Moring and Lantz 1975).

In 1895, the first of these modifications was proposed as an “improvement at the higher stages from the forks to the head of tide by the removal of rocks and other obstructions” (USACE 1895). As J.C. Barclay remembered, “In 1889 the army engineers had a crew of men working all summer shooting out a better channel down the river” (Barclay, Lincoln County Historical Society). Often this work also included removing brush along banks, wood in the stream, and rocks, resulting in higher flow and a more channelized stream (Benner 1991). During this early period of Euro-American settlement, docks and seawalls were built along the southern portion of Alsea Bay (USACE 1975). A large wooden groin was built upstream of Eckman Slough²⁹ in 1914 and extended two-thirds of the way across the bay (USACE 1975).

From 1941 to 1969, the natural resources of the Alsea watershed were subjected to increasing demands by larger markets. Thus, maintaining navigation was critical. During this period one report noted, “Numerous dredge and fill operations alter the shoreline. Some areas of the river are dammed, while attempts are made to blast open channels in other areas. Numerous docks and jetties are built” (USACE 1975). In particular, the following alterations were noted:

1946 Beginning in this year, and continuing through 1971, tideland areas around the mouth of Lint Slough are filled.... 1948 An attempt is made to blast a channel along the south side of the estuary near the city docks.... 1956 The Upstream end of the North Channel is dammed. This action...is intended to divert river flow through the South Channel.... 1963 A dam is completed one-half mile up Lint Slough to impound waters for the Oregon State Game Commission Fish Hatchery. The South Channel and several small boat channels are dredged.... 1968 A jetty parallel to the south shore of the bay is built on the east side of the mouth of Lint Slough to improve boat moorage at McKinley’s marina. (USACE 1975)

These alterations changed river flow patterns, decreased water quality, and increased sedimentation and erosion. A state report on erosion found that moderate stream bank erosion was occurring in Drift Creek, upstream from the lower site and near Tidewater (State Soil and

²⁹ Eckman Slough is located on the south side of the Alsea River, about two miles west of the entrance of Drift Creek and the lower Alsea site for this project.

Water Conservation Commission 1973). Agricultural uses such as grazing were common in this area, but the report only generally lists land uses that contribute to erosion and avoids singling-out causes in each particular area. While diking, filling and tidegating are thought to be the major causes of tidal wetland decline, Brophy (1999) provides evidence that erosion is one of the recent causes of decrease in the Alsea's tidal marsh area, even impacting areas considered "undisturbed." From the 1970s to present day, tourism and recreation became and remain more important drivers of the local economy and the rate of alteration by dredging; filling; and riverbank hardening has slowed (USACE 1975). The slower rate of change is also partially attributable to stronger environmental protections and Oregon's state estuary planning goal making it more difficult to fill wetlands and alter the shoreline. However, this does not erase the effects from previous alterations or continued land-use impacts farther upstream.

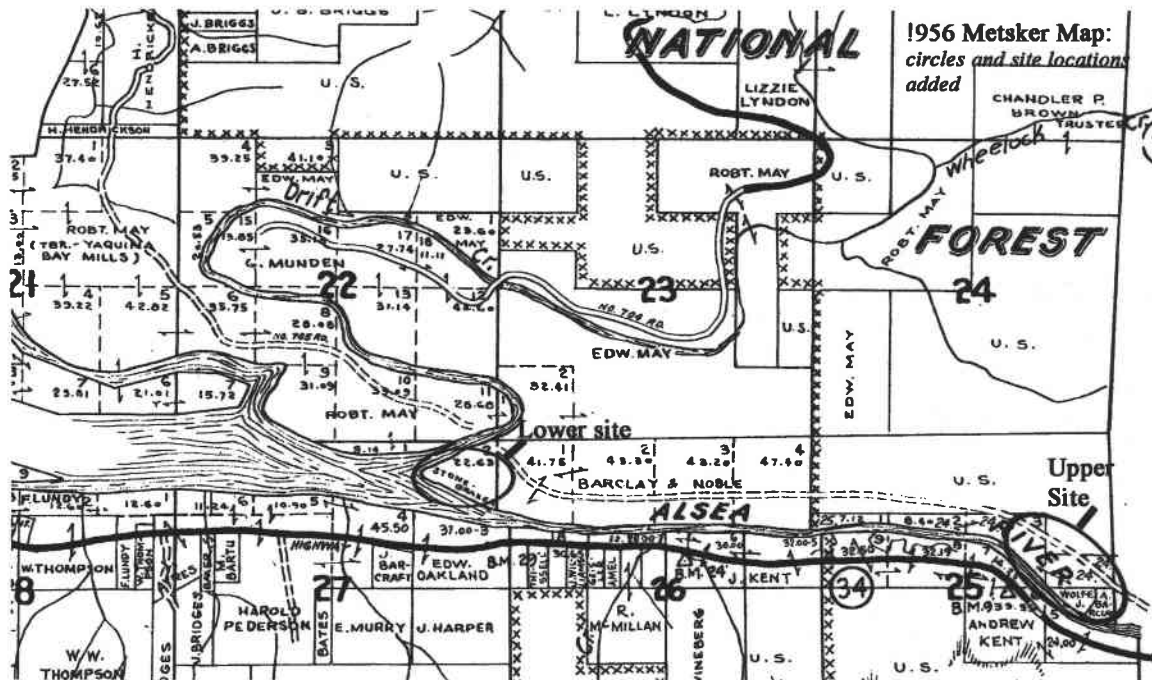
HISTORICAL RECONSTRUCTION - SITE LEVEL

Metsker County Atlases

Only two Metsker Atlases 1937 and 1956 were available for Lincoln County (see Appendix B, Folder: Deed Data, Folder: Metsker Maps).³⁰ In 1937, L.M Stonebreaker owned the lower site and a large tract of land around it and J. Wolfe owned the upper site. J. Wolfe's neighbor to the east was A. Barclay. By this time the Corvallis Alsea Highway, now known as Highway 34, had been completed and crossed the Alsea just east of the upper site. However, I found no evidence of major roads or trails near the Alsea wetland sites during this period. The federal government (the Siuslaw National Forest) owned large portions of the forested uplands in the area. The railroad spur to the Toledo mill crossed Alsea Bay to Waldport and the Highway 101 Bridge crossed the Alsea in Waldport.

³⁰ Locations checked included Oregon State University, University of Oregon, and Lincoln County Historical Society.

Figure 12. 1956 Metsker Atlas.



By 1956 the Metsker Atlas (Fig. 12) revealed increased development in the area compared with conditions depicted in the 1937 atlas. The Tidewater Road, marked as an “inferior road”, ran along the upland near the upper site and along the ridge above the lower site. More roads and landowners with smaller average lot sizes also appeared on the map. Private lumber companies constituted an increasing landowner class including the locally prominent Oregon Pulp & Paper Co. However, at the same time, the railroad spur across Alsea Bay was dismantled. The lower wetland site was still owned by Stonebraker (or Stonebreaker)³¹ in 1956 but the upland and eastern portion of his former large tract had been sold to Barclay & Noble. During the 1940s, Barclay and Noble were known as local suppliers of lumber to Marion Carey’s planning mill (Hays 1976). It is likely that they had already logged the upland forest near the lower wetland site by the 1950s. The upper site was still owned by J. Wolfe in 1956, but he had

³¹ An apparent misspelling occurred with the landowners name and caused a discrepancy between the two Metsker Atlases. The deed history information from the Lincoln County Assessors office indicates that “Stonebreaker” is the appropriate spelling.

split one lot to the east of the main site with A. Barclay, who also owned the eastern area almost to the junction with Highway 34. This area is generally known today as Barclay Meadows (Brophy 1999).

Deed & Land Ownership Information

While both Alsea sites (see Fig. 10 or 12) are located near large tracts of federally owned land, the sites have a history of ownership by private individuals. The resource uses of nearby property owners and previous owners impact the landscape of these sites. For the sake of brevity, the following examines property ownership for the two wetland sites only.

Lower Site

The earliest plat map for Lincoln County was a Surveyors Map from 1912. This survey indicated ownership, development, crops, dikes, and even distinguished “marsh lands” from “reclaimed lands”. The map only covers the lower site for the Alsea³² and indicates that this area was a state deed to James Doty in June 1887. He also owned the adjacent lots to the east along the Alsea. The 1912 map does not indicate the presence of any houses or dikes.³³ The next plat maps available are from 1915 (see Appendix B, Folder: Deed Data, SubFolder: Lincoln County Plat 1915). The lower site, including the upland areas, was owned by Augusta Day in 1915.

According to the Lincoln County Assessors records, I.A. Mcleary sold the lower site (as one tax lot) to Louis and Margaret Stonebreaker in August 1926 (see Appendix B, Folder: Deed Data, SubFolder: Tax Lots/LAlsea_Tax). Louis died in 1959 and his wife sold the property to Sarah Mayea in August of 1969. She shared ½ interest with Eugene and Dorothy Brown. In

³² The survey also included the lower Yaquina site, as covered in the Yaquina Results section. The survey did not go far enough upriver to include the upper site in each estuary.

³³ However, the Doty house does appear in the GLO map from 1876. It is located farther east along the river and not part of the lower site.

1979, they jointly sold the property to Robert and Elaine Cristler. Today, the property is still owned by Buster Kittle and Raymond Flerschinger, who bought the property in 1993.

Upper Site

In 1915, Martha Goin owned the upper site (see Appendix B, Folder: Deed Data, SubFolder: Lincoln County Plat 1915). Historical accounts indicate that Martha Goin was a teacher with the maiden name Kent who married the area school superintendent R.P. 'Tine' Goin in 1907 (Hays 1976). The Kent family owned land along Drift Creek and farmed a previously wooded and logged parcel of land (Hays 1976). The plat map also indicates Martha owned another piece of property on Drift Creek, but farther upstream. Since these properties were all in Martha's name, it is likely that she inherited them from the Kents.

The upper site has two properties of interest (tax lots 300 and 200; see Appendix B, Folder: Deed Data, SubFolder: Tax Lots/UpperSiteTaxLots). Since 1974, the Gangle family has owned both lots. According to the Lincoln County Assessors Office, the earliest record for Tax Lot 200, is May 1926 when Edward and Henrietta Davis and others³⁴ sued William Davis to sell the property to James Wolfe. As a result, James Wolfe obtained title to the property. In 1955, Ruth Wolfe, James' widow, and his heirs sold the property to Lawrence and Alice Gangle. For Tax Lot 300, the earliest Assessor's record showed the Battins (Leslie and Pauline) selling a portion of the property to R.E. Floweree, Ross Bowles, and the Alsea Lumber Company. Likely this portion was the timbered upland portion.³⁵ The Battins sold the remaining property in 1958 to George and Carrie Eilertsen. In August 1974, Carrie Eilertsen sold to Tillman and Booth, Inc, which a few months later sold to Lawrence and Octavia Gangle.

³⁴ Also, Nona Davis and Evelyn and Eugene Keenan were party to the suit on behalf of the plaintiffs.

³⁵ The deed information indicates that this was U.S. lot 2 and 3, west of the slough. Thus, it was more likely the timbered portion of the land. See tax map (see Appendix B, Folder: Deed Data, SubFolder: Tax Lots) for verification.

Historical Accounts

For the Alsea sites, the only historical accounts uncovered mentioning the previous property owners or sites have already been incorporated in the above deed and landscape histories.

Aerial photo narrative & quantitative scaling

Historical aerial photography obtained for the years 1939 to 1982 for these areas provides more detail of the land uses and their impacts on the tidal marsh sites (Appendix B – Alsea, Folder: Historical aerial photos, SubFolders: Lower site and Upper site). The narrative for the historical photos will be separated for each site in chronological order.

Lower Site

The 1939 photo does not effectively reveal the condition of the lower site. Only a small corner of the site is visible in the photo. One area, north of the site along Drift Creek was used for agriculture and perhaps pastureland as well. Large piles of logs had accumulated along the upland edge of the wetland across from the lower site. In 1945, the photo again cuts off a portion of the site. This time, the area along the Alsea River is cut off. However, the upland forest and wetland appear to have had little direct influence from human activities. On the other hand, the adjacent upland area of the wetland just upstream along Drift Creek appears in the photo as recently logged. The other wetland, which was previously used for agriculture, is still under cultivation.

In 1952, a large log raft appears next to the lower site. No roads or crop usage of the area is apparent. The wetland has a few spruce and evergreen trees along its western edge. The upland is a mixed forest of evergreen and deciduous trees; the age of the stand is unknown, but based on tree height, the average age is likely more than 40 years. In the photo, several docks and

residential homes can be seen on the opposite side of the Alsea River. A new road runs along the ridge across the entrance to Drift Creek and logging is taking place. By the 1958 and 1959 photos, this logging and the associated roads are more widespread on the western side of Drift Creek. Since most of the roads run down to one of the sloughs, which is blocked at the entrance, this is likely a point to transfer logs to the river.

Direct disturbances within the lower site appear minimal during the 1960s. The 1968 photo cuts off a portion of the eastern end of the lower site and much of the forested upland. Although logging, agriculture, a marina, and a few residential homes and docks continued to alter the general area, the lower site showed no signs of direct disturbance. The next available aerial photo is a color view from 1982. In the intervening years, logging near the site has become much more prominent. Many new logging roads and clearcuts are visible in the area. A recent clearcut is apparent in the upland above the site, but new vegetation has already begun to grow.

Upper site

In 1939, the upper site has two residences each with a cluster of buildings on the upland edge. These two residences have associated boardwalks leading down to the river and docks. Furthermore, near the water's edge (along the eastern edge), a crop of some sort has been planted, or grazing is taking place. A small area of forest has been cleared in the upland. Several spruce trees are visible on the wetland surface in clusters. The upland consists of a dense, tall, evergreen and deciduous mixed forest. Across the river and upstream, wetland areas are being used for agriculture and residential homes. By 1945, the same residences and associated impacts are present. The clearing is no longer visible. A fence line surrounding the crop/grazing area appears in the same area as before. One of the upland houses has logs piled around it, suggesting selective logging by the residents.

Lack of contrast in the 1952 photo makes it difficult to identify all objects. However, the same residences, docks, and boardwalks are still present. It is not clear whether the agricultural production or grazing were still occurring onsite. In the general area, logging and roads have increased, especially above the eastern portion of Barclay Meadows. By 1959, a dirt road has been built along the upland edge. While the residences are still present, the western dock and boardwalk have disappeared. A portion of the upland forest has been cleared.

In the 1982 photo, a large clearcut and logging road is visible in the drainage above the wetland. Another, smaller cut and associated roads are apparent closer to the wetland. At least one of the houses is still present, but docks are not. The general area still has many clearcuts, but there is now a proliferation of residential homes and docks along the river, especially in the eastern portion of Barclay Meadows.

Despite the fewer photos available and coverage issues for some decades, general trends in the quantitative scores for the photos can be detected (see Table 7). The data suggest minimal disturbance to the lower site and greater disturbance to the upper Alesia site.

Table 7. Historical aerial photo scores for the upper and lower Alesia sites by decade.

Total Average Decadal Score								
Site	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Lower Alesia	0	0	3	0	N/A	4	3	3
Upper Alesia	23	20	18	N/A	N/A	18	N/A	12

The detailed data and spreadsheets for the aerial photo scoring can be found in the attached appendices, excel file: Historical_Aerial_Photos.

The historical aerial photography available for the two sites from 1939 to 2000 generates some detailed evidence for impacts to the marshes primarily from resource uses such as timber and agriculture. However, the impacts appear to be less severe than to the upper Siuslaw site. The lower site appears to have very minimal disturbance, primarily from logging in the upland

and some log booming. According to the scoring, the upper site has greater disturbance than the lower site, primarily from residential houses, recreational use, and possibly agriculture.

Field Observation

I conducted field site visits to the Alsea wetland sites to identify vegetation and assess human disturbances. Photo documentation can be found in Appendix E, Folder: Alsea Field Photos, Sub Folders: Lower Site and Upper Site (references will be to file names within these two folders).

Lower Site

The only access to the lower site is from the water (File: Lower_landscape1). The nearest roads are dirt logging roads. Several houses and a marina occupy the south bank of the river, directly across from the site (File: Lower_landscape2). A small, electricity transmission line runs along the upland edge of the site (File: Lower_upland). A natural levee with shrubs and trees runs along part of the river's edge (File: Lower_levee). Two posts were found on the site (Files: Lower_post1 and Lower_post2). They are approximately 8 feet tall and each has a ceramic knob with rusted wire near the top. Thus, it is likely these are old electricity posts.

The vegetation is mostly high marsh *Agrostis* spp., *Deschampsia caespitosa*, *Grindelia integrifolia*, and *Argentina egedii* (Pacific silverweed) with some low marsh species *Carex lygnbyei*, *Cotula coronopifolia* and *Triglochin maritimum* inhabiting depressions and tidal channels. A large patch of bulrush occupies the far eastern edge of the wetland. The upland vegetation consists of Scotch broom (*Cytisus scoparius*), shrubs, and a mixed, second growth deciduous and conifer forest (File: Lower_upland).

Upper Site

A dirt road along the upland edge leads to the upper site. Cutting across the marsh are large, wooden, electricity transmission lines (File: Upper_Transmission2). A series of old posts indicates a fence line near one of the tidal channels (File: Upper_post). An abandoned vehicle track is evident by disturbance-related vegetation (reed canarygrass and *Agrostis spp.*), stunted vegetation, and the depressed soil surface (File: Upper_Transmission1). A few pilings are located along the riverside of the marsh. A house sits in the upland adjacent to the wetland area (File: Upper_house). Further southeast are more, old, rotten, fence posts, and a crumbling boardwalk that runs from the house to the river, crossing at least one tidal channel (Files: Upper_boardwalk1, Upper_boardwalk2, and Upper_fence).

The vegetation includes a mix of low marsh species *Carex lyngbyei* and *Lilaeopsis occidentalis* and high marsh species *Deschampsia caespitosa*, *Juncus balticus*, *Argentina egedii* (Pacific silverweed), and *Scirpus acutus* (bulrush), as well as fresher wetland species *Typha latifolia* (cattail) and *Carex obnupta*. The wetland also features a few large spruces, especially a large stand to the southeast, and some tall shrubs such as twinberry. Large patches of reed canarygrass can be found on the site with 10 percent total estimated cover. Other non-native and disturbance-related vegetation found on this site include: *Cotula coronopifolia* (brass buttons), *Agrostis spp.*, *Hordeum brachyantherum*, and *Cirsium spp.* (thistle) (USACE 1984).

Other Evidence of Impacts

USACE Wetlands Review

In 1976, after the passage of the Clean Water Act and the associated laws requiring permits for dredging and filling of wetlands, the USACE in Oregon wrote a report on wetlands in the lower Alsea watershed to determine cumulative impacts, identify “wetlands of importance”

and direct the future management of these resources (USACE 1976). This unique report was unfortunately not duplicated in the other watersheds of this project. The USACE review (1976) found that the lower site was “important” for fish food production and a “limited ecotype”.³⁶

The degree of ecological disturbance was also outlined by the review (see map Fig 13, also located in Appendix B – Alesia, Folder: USACE Wetlands Review).³⁷ In particular, the study found that the lower site had low disturbance, but its upland area had been clearcut. Across the river from the lower site, the area was considered very severely disturbed with fills and development. Meanwhile, the upper site was considered moderately disturbed from agricultural use onsite and in the surrounding area. However, the area just upstream (the current site of a housing development) was considered severely disturbed from development along the river. This review confirms evidence presented earlier that the upper site was impacted by agricultural uses perhaps more heavily than the lower site, especially in the last 40 years.

As a result of their review, the USACE (1976) determined that the lower site was a “wetland of importance,” while the upper site was an “area of environmental concern.”³⁸ This meant that development on the lower site would be restricted and maintained as a natural resource area, because of its uniqueness and high productivity. The main concern near the upper site was restricting lateral residential development to the west (where the upper site is located) and minimizing the proliferation of private docks.³⁹ Thus, the idea in managing the area near the

³⁶ The USACE defined a “limited ecotype” as constituting 0.3-1.0 percent of the Oregon Coastal Zone.

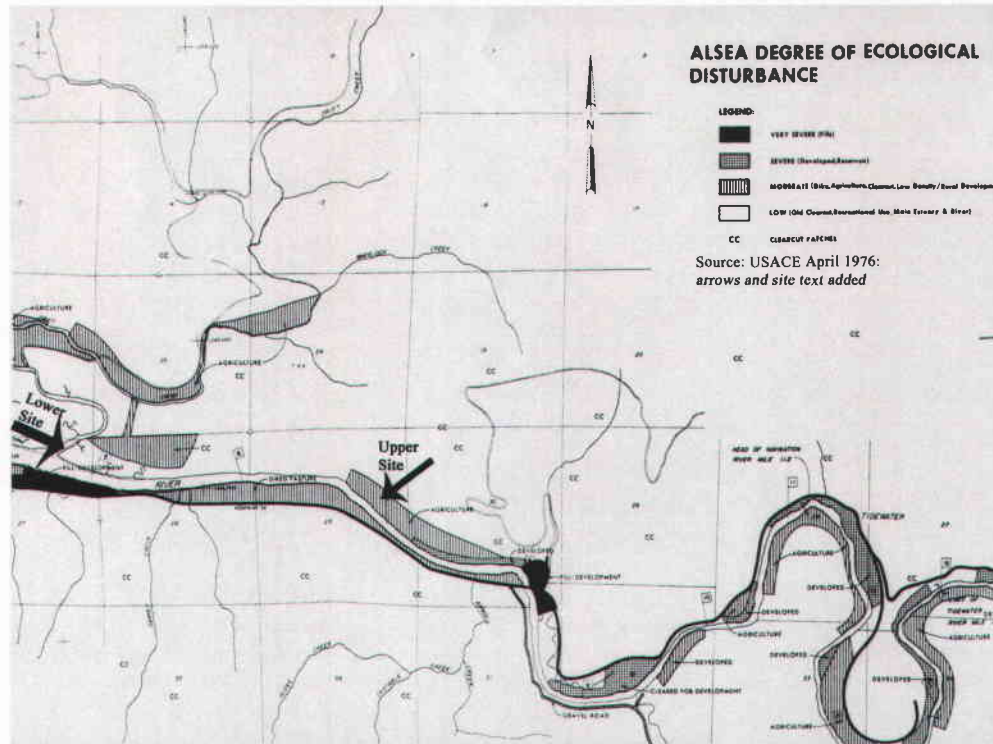
³⁷ The study reviewed data regarding each wetland’s specific uniqueness, productivity, disturbance, habitat value, esthetics, socioeconomic impact, and development limitations in order to come up with management goals and objectives.

³⁸ The USACE used the term “wetland of importance” to designate high productivity and low disturbance sites, which should be protected. The term “wetland of concern” was used for sites that had mediocre productivity, but potential for limiting cumulative impacts to wetlands.

³⁹ The report for Barclay Meadows stated a goal to, “continue development infilling for lots already sold and subdivided; limit lateral extension of subdivision in undeveloped land to the west” (USACE 1976).

upper site was to limit the cumulative effects of development, despite the wetland's moderate habitat value and mediocre productivity.

Figure 13. Degree of Disturbance, USACE 1976.



Brophy (1999)

This study was conducted to prioritize sites for tidal wetland protection and restoration. Historical aerial photography and consultation with experts were the main sources of historical information.⁴⁰ Brophy's (1999) analysis classified the lower site as high tidal marsh and found the site was not altered and a top priority for protection, especially for anadromous fish. Meanwhile, the upper site, Barclay Meadows west, was classified as a high tidal marsh and possible spruce tidal swamp. It was identified as a high priority for protection due to the absence of alteration. However, dikes and tidegates altered the site just upstream, Barclay Meadows east.

⁴⁰ In this study, the lower site is referred to as A29 and the upper site as A24.

Scranton (2004)

In the geographic information system for his master's thesis, Scranton (2004) had a "restoration potential" symbol near the upper site of the Alsea. It is unclear what the restoration potential constitutes most likely opening a tide gate or removing a dike. None of the research in this project uncovered a dike in this location. The "restoration potential" symbol may be referring to the wetland farther east, which has both a dike and tidegates.

SUMMARY OF ALSEA

The Alsea watershed underwent a similar transformation during the switch from domination by Native Americans to Euro-Americans. Fish and shellfish comprised the main food resource for the Alsea tribe. They supplemented this diet with many other resources, including visits to the Alsea Valley to collect camas and other roots and berries. Given these resource uses, it comes as no surprise that the Alsea people lived on or near the estuary much of the time. Many previously forested areas of the Alsea were burned, including areas affected by the fire of 1846.

Euro-Americans began arriving in the Alsea around the 1870s, and especially after the abolishment of the Alsea Indian Reservation in 1879. By the 1880s, up to 5 canneries were operating, a few sawmills, and much of the tidal lowlands were under cultivation, especially for dairying. Large salmon catches influenced the rise of hatcheries by the early 1900s, which caused damage by blocking returning spawning grounds and taking as many eggs as possible.

Geology and geographic position meant the Alsea did not receive nearly the level of development as either of the other watersheds in this study. The Alsea did not have jetties, or some of the other major industrial features, such as major timber mills or fish processing, as the other watersheds. Yet, the resource uses of the area were certainly influenced by its proximity to

more developed areas such as the Yaquina. For example, the Toledo mill received much of its timber from the Alsea watershed. This local Yaquina-area mill helped spur large-scale logging operations in the Alsea throughout the 1900s, which resulted in increased erosion, more frequent landslides, and altered vegetation patterns.

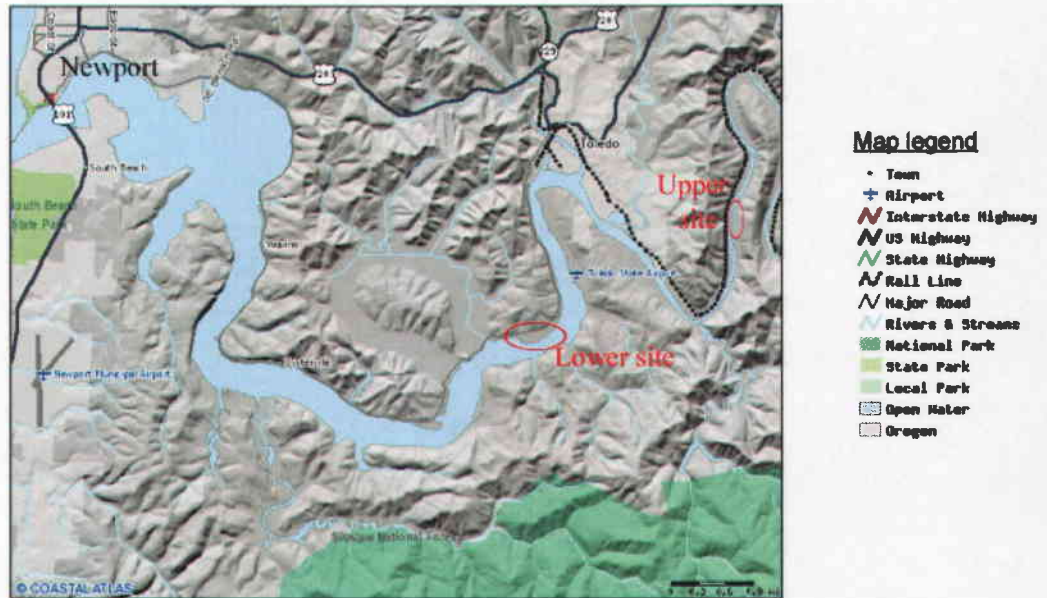
By the 1960s and 70s, the Alsea's economy was rapidly converting to recreation and tourism. Riverside alterations such as docks and small jetties rose during this time. Agricultural production waned, with only a quarter of suitable land in production by 1970. Many of the former agricultural lands were converted to vacation and retirement housing. During this time, the Alsea was determined a "natural" estuary for state planning purposes, which reduced further development on wetland areas.

Resource uses by the Euro-Americans changed the functioning of the Alsea landscape. Agriculture on tidal lands reduced habitat, altered soil chemistry, and allowed non-native vegetation to flourish. Early canneries fostered over-harvesting of salmon runs. Subsequent attempts to boost runs through hatcheries damaged local salmon runs by blocking off spawning grounds and interfering with wild stocks. Dredging, timber transportation, and navigational improvements scoured streambeds and changed circulation patterns. Timber harvesting changed vegetation, and increased sedimentation and occurrence of landslides.

Changes in land-use impacted the sites for this study. However, the lower site appears least impacted of any of the sites. The lower site was influenced by an upland clearcut and potentially early agriculture. But, for much of the 20th century, it appeared relatively undisturbed. As a result, the lower site has fewer non-native species than other sites and a well-developed channel network. Yet, some studies suggest that erosion may be a cause of wetland decline in this area. Erosion on this site was not confirmed in the aerial photos or site visit, but, if

confirmed, could be a result of increased riverbank hardening (e.g. riprap) and changes to circulation and water flow. The upper site received greater direct disturbance. This site provided rural housing, docks and boardwalks and likely was used for agriculture or grazing. It also has a major transmission line cutting across it. These uses resulted in large patches of non-native vegetation and soil composition changes. Despite the alterations that influenced these sites, the Alsea watershed is the least developed and lower site is least disturbed of all the sites in this study.

Yaquina



The Coastal Atlas uses both public and private data sources, including the Cytmap/Cyplay product. © CDT.

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<http://www.coastalatlus.net> is a project of the Oregon Ocean-Coastal Management Program in collaboration with Oregon State University and EcoTrust. Funding for the effort has been provided by the National Science Foundation, the NOAA Coastal Services Center and the Federal Geographic Data Commission.

Figure 14. Location of upper and lower tidal wetland sites in the Yaquina River estuary.

Results and Discussion: Yaquina Watershed and Sites

BACKGROUND

Table 8. General Statistics.

Estuary Area (acres)	4329
Watershed Area (square miles)	253
Estuary Rank	4th
Geomorphology	Drowned River Mouth
Head of Tide (river mile from Department of State Lands)	21.8, upriver from Elk City

Sources: Oregon Coastal Atlas 2004; Percy 1974; Oregon DSL 2005; and Scranton 2004.

Site locations

The lower site is located on the north side of Yaquina River, next to the Yaquina Bay Road, southwest of Toledo, just east of Boone and Nute Sloughs and a near a small, local marina in Moody. The upper site is located east of Toledo on the southeast side of Yaquina River, just north of the Cannon Park boat launch and next to Elk City Road. Site locations are marked in red circles in Fig. 14 (see also Appendix C - Yaquina, Folder: Site Locations, File: Yaquina).

Table 9. Site Specifics.

	Lower Site	Upper Site
Location by River Mile from mouth (approximate) ⁴¹	10.4	16.2
Digital Elevation Model (ft. above Mean Low Tide)	3-10	7-13
Habitat Classification (from: Scranton 2004)	Marine Sourced High Tidal Wetland	River Sourced Tidal Wetland
Estuary Plan Book Classification	Tidal High	Not listed
Hydric Soil	Yes	Yes
Soil Type	Coquille Silt Loam	Nekoma-Fluvaquents Complex
Mixing Regime (NOAA Salinity)	Mixing Zone	Not in Mixing Zone
Upland Vegetation Type	Forest is primarily open woodlot, some small conifer and broadleaf forest.	Forest is primarily medium and large conifer intermixed with broadleaf and medium and large mixed forest classes.

Sources: Scranton 2004; Midcoast Watershed Council 1998.

⁴¹ Source: ODFW, Trevan Cornwell, personal communication derived from USGS Topographic Maps.

HISTORICAL RECONSTRUCTION- LANDSCAPE SCALE

Native Resource Use

As mentioned previously, the Yaquina are considered by ethnographers to be in the same cultural group as the Alsea given the similarities in language, social structure, and cultural practices. The Yaquina ('Yacona') generally occupied "from Elk City to the mouth of the river" and from Otter Rock and Cape Foulweather south to Beaver Creek (Beckham et al. 1985, Courtney 1989). Fifty-six village names had been identified, but, again, no specific locations are provided (Beckham et al. 1982). A few were known to be in the vicinity of present-day Elk City and Newport (Minor et al. 1985). Similar to the Alsea, their villages, especially the permanent villages, were primarily near the mouth of the river (Courtney 1989). One archaeological site has been uncovered at Yaquina Head. Researchers discovered, among other things, many remains of marine bird species (Lindsay 1995, Minor et al. 1987).

One of the first white men to explore the area in detail was Lieutenant Theodore Talbot. He arrived in the Yaquina area in 1849 and reported that the Yaquina Indians subsisted "mainly on fish, clams, crabs, and roots" and noted that they "did not travel far from their coastal bay" (Courtney 1989). However, Beckham et al. (1982) provide evidence that Yaquina people followed food resources seasonally, just as the Alsea. It is likely that in the short period that Talbot observed them, they did not need to travel far for natural resources.

From all accounts, the Yaquina procured food resources in a similar manner to the Alsea. Their primary food source was salmon. The Yaquina started in midsummer fishing for Chinook, then shifted to coho and dog (chum) salmon in early autumn, and finally, changed to steelhead in the late fall and winter (Courtney 1989). Other fish, shellfish, seals, and sea lions supplemented this diet. Yaquina people gathered the same roots, berries and fruits that were collected by the

Alesea. Wetland-associated plants, including skunk cabbage and camas, were important food resources to the Yaquina (Courtney 1989).

The Yaquina had similar, if not identical, methods as the Alesea for constructing temporary and permanent housing and developing tools and clothing (Courtney 1989). Thus, it seems likely the two groups may have had similar impacts on the resources of each watershed with minor differences in scale and intensity of resource extraction.

Courtney (1989) notes that it was traditional for coastal tribes to burn off undergrowth including giant ferns to improve hunting for deer and elk. He claims the annual burn in 1846 backfired and burned out of control. Courtney (1989) implies, but does not specifically provide evidence, that the Yaquina were responsible for the fire of 1846, which reached as far south as the Smith River (including areas of the aforementioned burn in the Siuslaw Watershed). However, another report claimed that white settlers were, in fact, responsible for the 1846 fire (USACE 1975).

The Yaquina people signed the same unratified treaty in 1855 as the Alesea, which provided them with reservation land (Beckham et al. 1982, Ruby and Brown 1992). However, they were subsequently removed to the Siletz Reservation in 1866. As noted by a local historian, "previous[ly]...the country was an Indian reservation – opened for settlement by an act of Congress in 1866" (Parry 1985). Talbot reported 80 Yaquina members in 1849. Throughout the 1800s most of the Yaquina succumbed to the diseases such as smallpox and tuberculosis brought by white settlers just as other native peoples on the Oregon Coast (Courtney 1989). Thus, their population before contact with white settlers was likely higher than the 80 recorded in 1849. By 1934, one researcher reported that there were no true Yaquina people left at the Siletz Reservation (Courtney 1989).

General Land Office Surveys

In 1867, the first GLO survey was completed for the area around present-day Toledo, along the Yaquina, Township 11S Range 10W. Both sites of interest are located in this township (see Appendix C – Yaquina, Folder: General Land Office Maps, Files: 11s11w1867, 11s10w1867).

The general description of the township reports:

The parts of this township embraced in this survey, are a series of high mountain ridges and spurs separated by deep cañons and gorges. In many places on each line, five or ten links were all that could be measured at once.

The difficulty of surveying was greatly increased by the fallen and lapping timber, in other places by high and tangled thimble-berry, salmon-berry bushes, crab apple, vine maple and various other impediments.

Irregularities of surface less than 100 ft. have not been noted, in order to avoid making the field notes too voluminous.

Since the commencement of the Corvalis [sic] and Yaquina Bay Railroad there has been a great deal of inquiry about these lands and it is probable they will be taken up as soon as they are open to preemption and homestead.

On the completion of the Railroad the timber, even that which has been killed by fire will become very valuable. (GLO 1867)

Lower Site

The lower site is in section 30, but near the corner to sections 19, 30, 29, and 20. This corner is in the water, thus forcing the surveyor to create a temporary marker on the right side of the bank. The surveyor used firs (diameters 18–40 inches) for bearing trees, noted a nearby home “80 links distant” of Robert Hill and said of the area “sand – tideland, unfit for cultivation – upland rolling – soil good – timber – fir” (GLO 1867).

Recording the meanders of the left (or northern) bank of the Yaquina, the surveyor started at the western corner of section 30 and headed upstream. He recorded crossing past the mouth of “Chetco Slough” (now known as Nute Slough), leaving tide land at 13.00 links distance and entering tide land again at 21.00 links distance (GLO 1867). The meanders head

south, east, and then north, before the surveyor notes the corner of section 19 and 30.⁴² This bend in the river is the same place where the lower site is located. Thus, it is apparent from the surveyor's notes that this lower site was classified as tidally influenced land.

Upper Site

The upper site is bisected East-West by section 16 and 21 and close to a line North-South with their adjacent sections 15 and 22 respectively. The surveyor notes indicated that the North-South line follows a ridge crest, which matches the steep ridge just upland from the upper site. The surveyor walked the section running west between sections 16 and 21 and wrote, "15.00 [links] enter tide land course N & S - 150...20.00 [links] set post on Left bank of Yaquina Bay for corner to fractional sections 16 & 21 from which an alder 8 in[ch] dia[meter]...an alder 6 in[ch] dia[meter]" (GLO 1867). The upper site was considered tidally influenced and contained alder trees. No other evidence is available to discern other vegetation types for this site. Another description for the area just south of this site in sections 21 and 28 yields a slightly better description. The surveyor recorded, "Land next to the Bay is mostly tide land unfit for cultivation and covered with crab apple brush. The East and West ends are on high rough land" (GLO 1867).

U.S. Army Corps of Engineers Surveys

The U.S. Coast and Geodetic Survey conducted its first survey of the Yaquina River and Bay in 1868. However, I was unable to recover detailed field notes or letters from the survey. The next report from the Annual Report of the Chief of Engineers is from 1880, when \$40,000 was appropriated for surveying and planning navigational improvements to the area. This survey

⁴² The notes of the surveyor record the direction in degrees and distance in links. The direct transcription for this bend is as follows (semi-colons denote a new line in the surveyors manual): "N47E 7.50; N15E 5. South 10.00 cross the mouth of Chetco slough; S63E 13.00 leave tide land; N80E 21.00 Enter tide land; S40E 4.00; East 14.00; N53E 5.00; N45E 15.00; N24E 13.00; North 8.70 to come to frac[tional] secs[section] 19&30; thence in fractional section 19."

pointed out that because the entrance was "very changeable" and "made especially dangerous by many small rocks visible at low-water" the best course of action was to "close the south channel, encourage the consolidation of the sand spit on the south side of the entrance, and protect its shore-line on the inside of the harbor against erosions which seemed to be of a serious and threatening character" (USACE 1881). The approved plan involved development of a jetty on the south side to scour a central channel of a depth appropriate for shipping.

Notably the survey also revealed the potential of Newport as a shipping harbor. But, at the time, it was still a small village, making provisions and labor difficult to obtain. The report states:

The village of Newport, in the harbor, is very small, without any trade, and at the time the assistant engineer took charge of the improvement the single saw-mill which the bay possessed was out of order, and had no logs on hand suitable for the construction.

In consequence considerable time was spent collecting logs before any lumber for the scows or timber for the cribs could be obtained, and all the various materials and implements of construction -- iron, anchors, picks, chains, crowbars, oakum, &c. -- had to be purchased either at Portland or San Francisco, and sent to the harbor by a special boat.

These considerations not only made the initial preparations very expensive, but delayed -- much beyond my patience -- the time of beginning the jetty.

At high tide there is now 17 feet on the bar. It is believed that it will be possible to maintain this depth if success attends the efforts for keeping the south channel closed by means of the jetty under construction.

This harbor is only 60 miles from Corvallis, and will in the future be an important shipping point, if railroad connection is made with the fertile valley of Willamette.

It is important, therefore, that a suitable appropriation should be made for an improvement which promises such good results. The existing plan of improvement provides for a jetty on the south, 2,500 feet long, rising 2 feet above mean low-water.

.... The nearest light-house is at Cape Foulweather, 4 1/2 miles north of the entrance, and exhibits a fixed white light of the first order. The light on the north side, which formerly marked the entrance to this harbor, was discontinued in October, 1874.

Imports from foreign ports for the year ending June 30, 1881, none; exports to foreign ports, none; revenue collected, none. The small coasting steamer Kate and Anna and the schooner Alpha have each crossed in twice since January 1.

The commerce of the port is quite limited at present, but it is believed that if a depth of 17 feet on the bar at high-tide can be maintained by the improvement, the harbor will become a shipping port of great importance, not only for the products which are raised in the immediate vicinity, but for a great part of the Upper Willamette Valley, with which it is said there will soon be a railroad connection. (USACE 1881, emphasis added)

General History of Resource Use

Since the arrival of Euro-Americans, the Yaquina Watershed has been dominated by natural resource extraction. In particular, fish and timber resources have been and still remain important to the local economy. A report from 1976 stated, "The Newport and Toledo industrial areas are based primarily on the processing of natural resources for export to other markets" (USACE 1976). In more recent times, tourism and recreation have become more prominent contributors to the local economy.

Transportation

As with the other coastal areas in this study, transportation was a key to opening the Yaquina estuary to increased settlement and economic activity, which spurred increased use of natural resources.

At first, settlers arrived via wagon road, "In 1866, a 45-mile wagon road was opened between the bay at the confluence of Elk Creek and Yaquina River and the town of Corvallis. In 1873, the road was extended westward to the beach at Yaquina Bay" (USACE 1976).

Local residents viewed improved transportation through navigational alterations and development of a railroad as critical to the economic and social growth of the area. While Newport was named July 1, 1864, it was essentially a small village. According to one local historian:

Although Newport had a name in 1866, it was not really a town. Without jetties, entering the bay was difficult at best. Major shipping and fishing industries were decades away.... The dream of prosperity on the bay was still alive, however. In 1868, the government completed a survey of the harbor and found it was deeper than expected.... In 1881, the federal government began construction on the south jetty.... During the 1880's, local residents believed that with the completion of the railroad and jetty, Yaquina Bay would become a major shipping port overnight" (Noah 1999).

The residents' long-awaited dream of a railroad became a reality in the 1880s. As Noah reports, "After many setbacks and a false start, construction of a standard-gauge railroad began in September 1881, nearly 10 years after Hogg started promoting his dream. Not until March 1885 did the first train run from Corvallis to Yaquina Bay" (Noah 1999).

In addition, the railroad provided the opportunity for increasing exports to outside markets. But, the residents wanted improvements to the bar and harbor as well. The river was a critical means of shipping people and goods locally and the natural harbor provided a way to move goods to far-away markets. Construction on the south jetty had already begun and is detailed in a later section. The following letter written in 1885 by two Newport residents to the U.S. Army Corps provides a glimpse of the impact of the railroad on exports, the common resource uses, and residents' desire for completing the improvements on time:

Sir:

.... Exports from this port as yet are somewhat limited, but we notice a large increase over previous year. Wool, hides, furs, hoop poles, and cherry-poles have been the principal exports, of the value which it is hard to get a correct estimate. Dairy products have commenced to swell our exports, and will increase largely as the country improves in this direction. The Government plots of the townships lying along and north and south of Yaquina Bay and River show but little land untaken by actual settlers. The completion of the Oregon Pacific Railroad has given impetus to emigration, and the country tributary to Yaquina has rapidly settled within the last year. Closely connected with the beneficial results certain to follow the operation of the railroad is the development of large natural resources, which, for want of cheap and accessible markets, has heretofore remained idle. ...The importance of this subject has been so often and well represented by petitions, memorials, and reports commanding the highest respect, that we will not attempt to add anything to the weight they deserve.

All the benefits foreshowed are largely contingent on the improvement of the bar. The economical expenditure of moneys already appropriated and the excellent results therefrom only intensify the public demand and increases the intent of all classes to have work pushed to an early successful completion. Very respectfully,

R.A. Bensell and James W. Brassfield (USACE 1885)

The railroad likely caused the increase in exports observed by the local residents, as shipping over the bar was still somewhat treacherous. Major exports included agricultural products such

as dairy and wool, timber, and wildlife including hides, furs, and oysters. This is also reflected in the export log provided by the USACE from the early 1880s, which listed wool, grain, and wheat (USACE 1883-1885). Finally, the letter conveys the desire of local residents to ensure the timely completion of the jetties and bar improvements in order to have safe navigation for commerce.

While the railroad was intended primarily for freight, by 1889 the railroad line was in financial distress, went into receivership, and was subsequently auctioned off. However, the railroad continued to be an important part of the region, “the railroad remained in operation under a series of owners. Instead of freight, the railroad carried primarily passengers drawn to the coast by sandy beaches and fresh salt air” (Noah 1999). Even today, portions of the remaining line are used for freight by the Georgia-Pacific paper mill in Toledo (Noah 1999).

Despite its sporadic use, the railroad, especially its construction, had impacts on the local landscape. In a July 1884 letter J.S. Polhemus, the assistant engineer in charge of local navigational improvements, reported:

It has been reported to me lately that quite a shoaling has taken place upon the bars of the Yaquina River between Oysterville and the stone quarry, owing to the work of the Oregon Pacific Railroad. If it amounts to more than 2 feet over the shoalest bars it will render the use of the steamer General Wright very difficult, or of any boat drawing over 5 feet of water (USACE 1885).

As a result of railroad construction, local sedimentation patterns were changed.⁴³

Eventually transportation evolved as paved roads and bridges replaced the old wagon road. Noah (1999) provides a brief chronology of the movement from wagon road to Highway 20:

⁴³ As will be discussed in the site-specific section, the railroad, later replaced by a road, crosses the lower site on the Yaquina. This changed tidal circulation patterns including cutting off a section of the tidal marsh and impeding tidal flooding.

For hundreds of years before anyone dreamed of driving a car to the coast, Highway 20 was a trail along the banks of the Yaquina River traveled by local Indians. After the discovery of rich Yaquina Bay oyster beds in 1864, a group of settlers proposed a toll road from Corvallis to Elk City, the head of navigation on the Yaquina River. By the 1880s, this responsibility [keeping the route open] had been assumed by Benton County.... A new route for automobile traffic on Highway 20 was chosen in 1917... Beginning in 1919, funding for this and other road construction was generated from a new tax.... By 1921, road conditions on Highway 20 were good enough that rumors began circulating about the possibility of bus service between Corvallis and Newport.... In 1952, the state provided \$1.5 million to build four bridges and a new route just south of the old route” (Noah 1999).

The road made travel and transport of goods easier. Again, construction had direct and indirect impacts on the area. Construction of Highway 20 required development of local stone quarries (Appendix C – Yaquina, Folder: Other Photos, Files: Mill Creek Quarry and Pioneer Quarry) and later road improvements, including straightening, repaving, and widening projects in the 1960s, cleared land and increased sediment loads to the watershed. Some indirect impacts of road improvements included increased economic and population growth, as well as increased demand for natural resources.

Fishing

Salmon and fishing were a large part of the initial development of many Oregon coastal areas. Yet, in the Yaquina Watershed, the discovery of oysters spurred the early economic growth and settlement by Euro-Americans. According to a local historian, “The nation’s insatiable demand for oysters spurred the settlement of this region [Yaquina Bay] in the early 1860s when rich oyster beds were discovered in Yaquina Bay” (Noah 1999). With fame came increased demand, and the Yaquina oyster companies were happy to respond. The demand for oysters had a domino effect on settlement and use of the Yaquina’s other natural resources:

But when the oyster business boomed in the 1860s, a wagon road was built to Yaquina Bay from Corvallis. With the area no longer isolated, entrepreneurs pressured the U.S. government to open it up to Euro-American settlement. In January 1866, the Yaquina Bay, which included lands north to Cape Foulweather and south to Alsea Bay, was

opened for settlement.... With settlement came depletion of the native oyster beds and development of other industries heavily dependent on the coast's natural resources: wood products, fishing, and tourism (Noah 1999).

An environmental history confirms the report of early oyster depletion, "By 1869, the oyster beds near the mouth of the Bay were suffering from depletion, and conservation measures were begun by a group of oystermen" (USACE 1976).

Figure 15. Salmon catch by a local Yaquina boat in the early 1900s.
Photo courtesy of Lincoln County Historical Society.



Salmon, tuna, and bottom fish also became important to the development of Newport's economy. As one early settler wrote in 1878, "The long-looked for salmon run has commenced, and everyone seems happy" (*Weekly Corvallis Gazette* 1878). Another resident claimed many of the salmon caught during the 1888 run arrived two weeks earlier and weighed 50 pounds (*Corvallis Gazette* 1888). As early as 1878, some residents noted changes in the salmon runs. One local resident complained, "The run of salmon has decreased measurably since Eddy's mill dam was built, some five years ago, on the Yaquina" (*Weekly Corvallis Gazette* 1878). He

proposed the legislature require constructing fish ladders on dammed streams to allow salmon to access their spawning grounds.

Tuna became a bigger local industry especially from the 1940s to present. During the summer of 1940, 98 percent of the commercial fleet was fishing for tuna with the average haul at 6,000 pounds (*Newport Journal* 1940). However, some boats were still fishing for salmon and bringing in “good sized loads” at this time (*Newport Journal* 1940). One article noted the “large expansion” of the Newport fishing industry and reported that in 1940 over 2 million mounds of albacore tuna and three-quarters of a million pounds of salmon were landed at local fish plants (*Newport Beacon* 1941). This article also noted the rise of a bottom fishing industry including ground fish, sole, flounder, cod, and red snapper (*Newport Beacon* 1941).

Despite a strong reliance on fishing, canneries were built in Newport and the Yaquina watershed much later than in other Oregon coastal watersheds. One article refers to local canneries being active including one run by Allen Parker in 1888 (*Corvallis Gazette* 1888).⁴⁴ However, no other articles from this time period substantiated this cannery operation. The Burk Fish Company⁴⁵ built what was referred to as the first cannery in 1926; the company packed fruit and berries as well as fish (*Yaquina Bay News* 1926, *Newport Journal* 1925). It was heralded as a “much-needed industry” to handle the fish caught and landed locally (*Newport Journal* 1926). Indeed, Newport salmon packed by this company were shipped as far as New York City and Hamburg, Germany (*Newport Journal* 1928). One boat brought in 500 pounds of coho salmon in one hour during the 1928 fall run (*Newport Journal* 1928). The Columbia River Packing Company closely followed the Burk Company with plans to build a salmon receiving and cold

⁴⁴ The article quotes a letter written by a Yaquina resident. Thus, the canneries referred to were likely located on the Yaquina, but not necessarily. No specific locations for the canneries were given. It is likely that these early “canneries” were local operations intended mostly for subsistence rather than companies set up for canning large amounts of fish.

⁴⁵ Other sources list it as the Burke Packing Company.

storage plant in 1929 (*Yaquina Bay News* 1929). The article claimed that during the mid 1920s three-quarters of the salmon caught along the coast of Oregon and Washington were caught between the Alsea and Siletz rivers (*Yaquina Bay News* 1929). During the depression, a cannery in Toledo ran as a non-profit institution to allow local citizens to can their own fish (*Newport Journal* 1935). Poverty-stricken patrons only had to pay for a quarter of the canning cost. Increased processing capacity resulted in large amounts of canned fish. In 1944, the Yaquina Bay Fish Company had canned over 30,000 cases of tuna, salmon, and crabmeat (*Newport Journal* 1944).

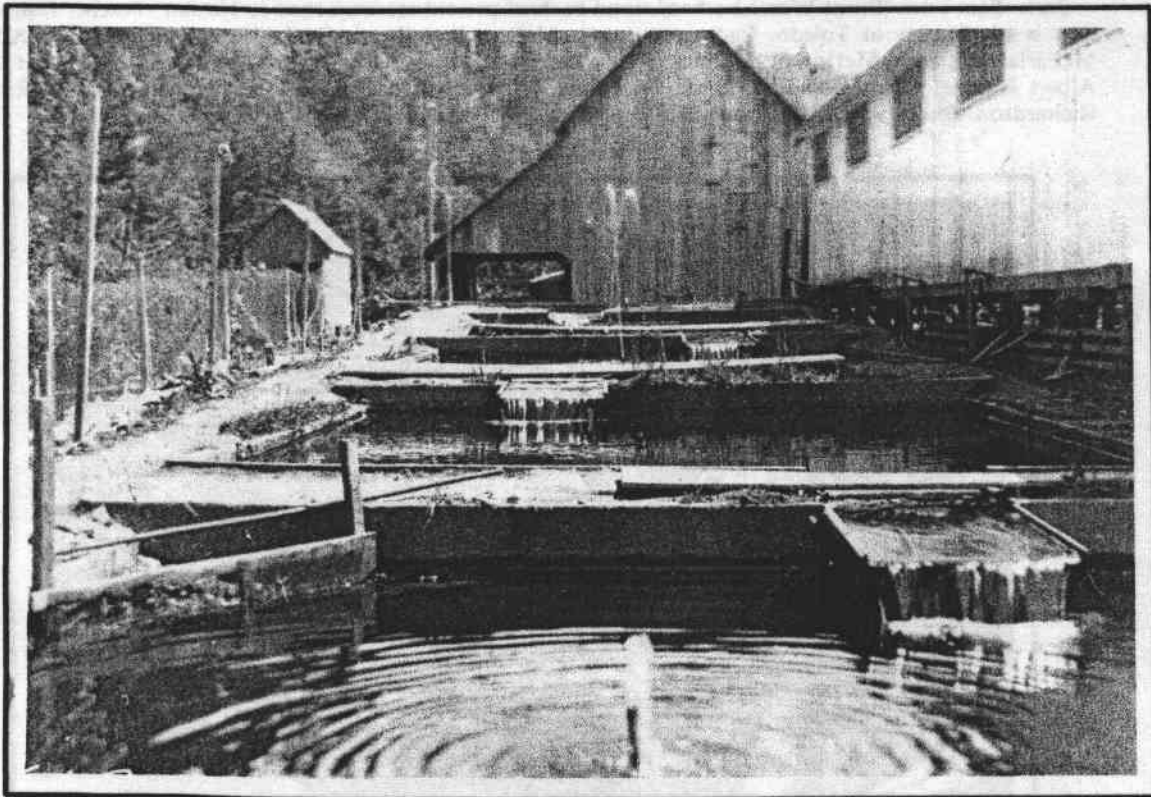
Once the entrance to Yaquina Bay was secured with jetties, it allowed the growth of Newport's fishing industry. Newport rapidly became a homeport for many near-shore and open-ocean fishing vessels where they could further process, pack, or transport their catch to other processors (USACE 1976).

Hatcheries

The first reference to a hatchery was found in a 1903 article from the *Yaquina Bay News*, which alerted local readers to the arrival of several million Chinook eggs from British Columbia (*Yaquina Bay News* 1903). These eggs were used to stock a hatchery near Toledo.⁴⁶ By 1906, the topographic map indicates a State Fish Hatchery on the Big Elk River (a branch off Yaquina River) just east of Elk City. The hatchery was upstream from both sites on the Yaquina (see Appendix C – Yaquina, Folder: Other Photos, File: Yaquina Hatchery). The State Fish Commission inspected potential facilities for a hatchery on Simpson creek in 1926 and promised that a hatchery to handle up to 5 million eggs would be built (*Newport Journal* 1926). However, they determined it would be too expensive to build dams and ladders for extracting eggs locally; instead they opted to import egg stock from other coastal rivers.

⁴⁶ This was the first reference found to a hatchery in the Yaquina watershed.

Figure 16. Yaquina Hatchery



Source: Parry 1985

Yaquina Hatchery, circa 1905.

ODFW hatchery data for the past 30 years indicates significantly lower releases of coho and Chinook salmon from state facilities in the Yaquina River basin than facilities in the Alsea or Siuslaw watersheds.⁴⁷ Between 1970 and 2003, state hatcheries released over 3.5 million salmonids (mainly coho, steelhead and Chinook) into the Yaquina watershed (ODFW 2004). Of these, 2.1 million were coho and half a million were Chinook. The brood stock used was primarily from the Yaquina, Alsea, and Siletz Rivers. Private hatcheries, especially one run by Weyerhaeuser, were responsible for releasing large numbers of juvenile Chinook and coho

⁴⁷ Release points included Thornton Creek, Big Elk Creek, Elk Creek, Yaquina River, Butte Falls, and Wolf Creek.

salmon into Yaquina Bay primarily during the 1980s.⁴⁸ For example, during eleven years of operation from 1980 to 1990, Weyerhaeuser's Ore-Aqua facility released more than 92 million coho salmon smolts from their release-recapture site at South Beach in Yaquina Bay, for an average annual release of 8.4 million smolts per year.

Agriculture

Tidal lands constituted a fair portion of the "bottom lands" in the Yaquina and were often sought by early farmers for their fertile soil and grasses. They were often the only flat land in the hilly Yaquina watershed and were easy to convert for farming or grazing (Appendix C – Yaquina, Folder: Other Photos, File: Haying). Early accounts provide a glimpse of the agricultural beginnings in the Yaquina. In an 1877 account of his travels near Fort Hoskins along the coast near Yaquina, Wallis Nash notes:

We passed Mr. Trapp's farm, a model of what an energetic, sensible farmer can get together in Oregon. About nine hundred acres of land, of which one-third was flat, bottom land by the river, and the rest running up the slopes of the hills round – good crops of oats, potatoes, fruit and vegetables – a flock of two or three hundred sheep – a large herd of horned stock. (Nash 1976)

While the population was sparse, the agricultural production was great enough to strain the available labor supply during harvest. Nash (1976) also claims that Indians, mostly residing on the Siletz Reservation, were not hostile in the area during the 1870s and provided much needed assistance during harvest. USACE letters in 1885 confirm the importance of agricultural products such as wool, wheat, and dairy, for export and subsistence.

The USACE (1976) mapped agricultural areas and tidal wetlands along the lower Yaquina River in the 1970s (Appendix C – Yaquina, Folder: USACE Ag Lands, File: USACE

⁴⁸ Release totals available from Pacific States Marine Fish Commission's Regional Mark Information System (coded wire tag database) at <http://www.rmis.org/>.

Ag Lands). Much of the lower Yaquina, and former wetlands were still used for agriculture. However, the lower site was deemed a tidal wetland at that time.⁴⁹

Timber

Timber has long been an important natural resource to the Yaquina economy. Shipbuilding, jetties, and general economic growth required a supply of lumber, which was abundant in the area. One environmental history (USACE 1976) reported the first sawmill on Yaquina Bay was built in 1866, followed a year later by the establishment of two coal companies (Yaquina Coal Company and the Elk River Coal Company). The report also notes the importance of several shipbuilding companies on Yaquina Bay during this time (USACE 1976). The main method for transporting logs to the early mills was by floating them on the river (Appendix C – Yaquina, Folder: Other Photos, Files: Driving Logs). This remained a favored method of transport throughout the mid-1900s as seen by the numerous log barges in historical aerial photographs.

Production and demand for timber increased in the early 1900s, like many other areas in the region. In Yaquina, this increased demand was met by the city of Toledo, where “a sawmill [was] built in 1918 by the United States Government to produce spruce lumber for airplane manufacture during World War I” (USACE 1976). This and associated splash dams caused damage to riparian areas. As state and federal forests were created throughout the mid-late 1900s, some areas of the Yaquina watershed were affected.⁵⁰ Despite these ownerships, much of the watershed remained privately owned, mostly by timber companies, and logging continued to be a major part of the area economy.

⁴⁹ The Yaquina upper site is not covered in this report, or in this particular map.

⁵⁰ The northern edge of the Siuslaw National Forest overlaps the southern portion of the Yaquina watershed and a State Forest is created in the upper reaches of the watershed.

Even in recent times, timber has remained a major part of the economy, but less important than it once was (USACE 1976). In the 1970s, it was reported that, "The dominating features of Toledo are the Georgia-Pacific Paper Mill and Sawmill.... Georgia-Pacific and two other large firms operate large sawmills, which employ more than 100 men" (USACE 1976). However, another environmental report notes that while the number of employees in the local timber industry has decreased due to mechanization, the lumber production has remained fairly constant (USACE & USDA 1976).

Vegetation composition change is a common result of heavy logging. A study on forest cover change found that due to logging practices in the Yaquina-Siletz between 1936 and 1996 the area of large Douglas fir and large spruce/hemlock forest types significantly declined, while open areas and small Douglas fir forests increased (Wimberly and Ohrmann 2004).

The USACE noted that timber practices in the Yaquina watershed, as in most other watersheds, "affect the turbidity and sediments of the estuary through erosion and run-off, as well as through inputs[sic] of chemical pollutants from wood processing plants upstream" (USACE 1976). A 1973 study of stream bank erosion indicated that the area near Chitwood, considerably upstream from both sites, had suffered "moderate" erosion from human impacts (State Soil and Water Conservation Commission 1973).

Other: Splash Damming, Jetties, Dredging etc.

Other developments undertaken by the Euro-Americans also influenced the landscape and functioning of watersheds and wetlands. In particular, jetties, dredging, and flood control projects altered the river, sedimentation, and reduced overall habitat.

Jetties

Work on the Yaquina jetties began in the 1880s. Yet, the Army Corps of Engineers encountered great difficulty in securing the bar and entrance to Yaquina River. Weather was often too stormy and materials and labor were difficult to procure.

As the engineer in charge reported in 1882:

The difficulties of the situation at Yaquina are so great that they can hardly be overestimated. The heavy storms commence in October and continue through March. During this time some good weather may occur, but frequently men and beasts cannot be prevailed upon to work on the jetty on account of the great exposure.... Besides storm difficulties, the delivery of supplies at the place is very troublesome.... From the scarcity of white men, Indians were employed last season, and unexpectedly found to do first-rate. (USACE 1882)

By 1885, a second jetty was planned because of damage sustained to the south jetty: "Heavy surf during the storms of the third winter, however, lapping more and more around the jetty end, carried away over 300 feet of the land track and leveled the sand-bank of that part of the point to a beach slope. Moreover, heavy drift set afloat in railroad grading up the bay and river had considerably disrupted the jetty tramway. Previously there had been no special damage from drift" (USACE 1885). Construction continued on both jetties and was completed in 1905.

Just as with the Siuslaw jetties, the Yaquina jetties caused changes in the beach morphology and sediment accretion (Lizarraga-Arciniega and Komar 1975; see Appendix C – Yaquina, Folder: Map of Jetty Accretion and Shoreline Changes). Researchers found that, "accretion of the shoreline took place adjacent to the jetties following their construction, both to the north and south. This accretion resulted mainly from the embayment becoming filled until the shoreline is straight and again in equilibrium with the waves such that there is a zero net sand drift.... at the entrance to Yaquina Bay, the jetties are oblique to the trend of the shoreline and so produced a protected zone from the waves where accretion could occur" (Lizarraga-Arciniega

and Komar 1975). The resulting accretion at the Yaquina jetties was "estimated to be on the order of 1.5×10^6 cubic meters south of the jetties with only negligible accumulation to the north" (Lizarraga-Arciniega and Komar 1975).

Navigational improvements continued on the Yaquina River and Harbor throughout the 1900s. The USACE dredged portions of the river from Newport as far west as Toledo, added spur groins and extended the jetties in 1940 and 1966, and created flood control measures along the river.

Dredging

The first proposal for dredging in 1911 was for the shoals along the Yaquina River from Yaquina to Toledo "to a depth of 10 feet at mean lower low water, with a bottom width of 150 feet in straight reaches and 200 feet on the curves" (USACE 1912). With this request are several letters of support and documentation of the area's condition:

August 17, 1911, The tidal influence extends about 5 miles above Elk City, which is as far as the stream may be considered navigable, and then only for skiffs and light-draft scows.

.... To summarize, between Toledo and Yaquina, a distance of about 9 miles, the Yaquina River is a portion of a tidal estuary, with an average range of tide of about 6 feet and with a minimum depth of water of 4 feet at low tide, excepting one long shoal immediately below Toledo, where there is but 3 feet depth.

Yaquina is a small settlement and the terminus of the Corvallis & Eastern Railroad, which connects with the Southern Pacific system at Corvallis and Albany in the Willamette Valley. *Toledo, the county seat, is on the railroad and has a population of about 800. Newport, near the bay entrance, has a population of about 600, but during the summer months is a resort of considerable size.*

A narrow strip of bottom land borders the river and its tributary streams. Considerable clearing and settlement has occurred during recent years, but the valley has not yet passed the sparsely settled stage.

There is a sawmill at Elk City and two at Toledo with a combined capacity of 200,000 feet b.m. per day. There is a creamery at Toledo and a small salmon cannery at Oysterville.

The river and its tributary sloughs are used for logging purposes and by the farmers and others who own gasoline launches and small barges on which they transport wood, hay, and other products to market and bring back supplies. No record of this

traffic is kept, but on account of the small population its amount and value can not be very great. (USACE 1912, emphasis added)

The Board of Engineers for Rivers and Harbors noted that despite the jetty improvements made to Yaquina River and Harbor, “no commerce resulted from this improvement, work was completely discontinued about 1905.... The country tributary is sparsely settled, and there is very little commerce at the present time. There is a large potential commerce in lumber, and the purpose of the improvement is to permit this commodity to be marketed by water” (USACE 1912). Despite initial reservations about the dredging proposal, the Board approved the Congressional request because local entities covered much of the cost and the local timber resource had significant economic potential (USACE 1912).

In 1968, the USACE deepened the channel entrance to 40 feet and the channel to Newport to 30 feet deep. Additionally, the channel from Newport to Yaquina was deepened to 18 feet and near Olalla Creek a 10-foot channel and turning basin was constructed (USACE 1976). The channels were dredged annually to river mile 2.4 and every five years in areas further upriver (USACE 1976). The Environmental Impact Statement (EIS) for maintaining the jetties and dredging schedule summarized the potential impacts of these projects:

Jetty maintenance: alteration of sandy bottom habitat to rocky benthic and intertidal habitat; accretion of sand to the north and south of the jetty mouth; Dredging: alteration of ocean bottom, estuary bottom, some wetlands, and some terrestrial areas by disposal of dredged materials; disturbance of polluted sediments with possible resuspension of toxic compounds; destruction of benthic organisms on 475-acres of bottom in the channels; temporary increases in turbidity during dredging which decreases primary production...increased flood currents near the bottom of the channel entrance, enhancing movement of littoral drift into the estuary. (USACE 1976)

These navigational projects likely influenced tidal wetlands by disturbing toxic chemicals in sediments and changing sediment supply and circulation patterns. Yet no empirical data were available to verify site-specific wetland effects. The report cited a particular concern about

contaminated sediments stating, "The sediments of Yaquina Bay are considered to be polluted. Mercury, oil and grease and nitrogenous compounds are present in relatively high concentrations in some areas of the Bay" (USACE 1976). However, the report also noted that Yaquina Bay was accreting sediment "naturally with marshy growth" (USACE 1976). Man-made disturbances likely increased the siltation rate, but at the same time caused adverse impacts to fish eggs, as well as planktonic and benthic flora and fauna (USACE 1976).

Other important effects of dredging in the Yaquina may result from the disposal of dredged material, which can bury estuarine organisms and habitats with sediment. While most dredge spoils, particularly polluted sediments, were dumped in the ocean, one of the in-river disposal sites was located immediately adjacent to the Yaquina lower site (USACE 1976; see Appendix C – Yaquina, Folder: Dredge Disposal Sites (USACE)). No indication was given as to the amount deposited or how long this disposal site was used, only that it was no longer an option for continued dredge disposal.

Finally, in order to maintain dredged channels in the Yaquina, wing dikes were added, including a dike near the lower wetland site as indicated in a 1911 map by the USACE (arrow added to map; see Appendix C – Yaquina, Folder: Wing dikes). Wing dikes altered the direction of flow and, hence, changed local sedimentation patterns.

Flood Control Measures

The USACE, through the Mill Four Drainage District, built structures to prevent flooding in low-lying areas along the Yaquina River. These included two levees with tide gates and pile bulkheads built across Boone and Nutes Sloughs (USACE 1950). In 1952, the Corps was actively researching "additional local protective works such as levees and revetments for flood control protection of additional agricultural lands along the lower reaches of the stream" and

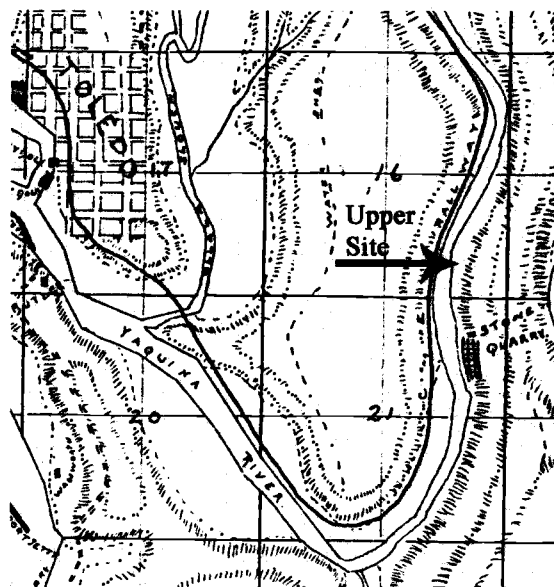
especially for projects of “major drainage” that would be “economically feasible” (USACE 1950). Such projects reduced the total wetland area and fragmented habitat connections across the estuarine landscape. While drainage projects were located in the vicinity of the lower site, I found no evidence of “flood control” activities within either of the Yaquina sites.

HISTORICAL RECONSTRUCTION - SITE LEVEL

1906 Topographic Map

A 1906 Topographic Map (see Fig. 17 or Appendix C - Yaquina, Folder: Deed Data, SubFolder: 1906 Topographic Map) for Yaquina River did not include land ownership data but revealed scattered houses, a few mills, and stone quarries (Map Files, Lincoln County Historical Society 1906). The main routes of transportation appear to be the railway, wagon roads, and the river. The lower site is indicated by the name Montgomery Point, and the nearest house owned by “Hansen” is just across from the railway track. Also nearby is a “Port Jetty”, likely what today is called a “wing dike,” to enhance navigation and deepen channels. Just south of the upper site is a Stone Quarry. Many quarries in the area provided rock for the main jetties, as well as for constructing local roads. This particular quarry is along the river, and no roads or trails are apparent. Thus, the quarry rock was likely shipped by river for further distribution rather than used for adjacent projects. The U.S. government owned this quarry in a deed dating back to 1889.

Figure 17. 1906 Topographic Map



Metsker Atlases

As with the Alsea, the only two surviving Metsker Atlases for Lincoln County are from 1937 and 1956 (see Appendix C – Yaquina, Folder: Deed data, SubFolder: Metsker Maps). In 1937, more roads were visible in the area than in earlier maps and Pacific Spruce Corp. was operating in Toledo. John O. Kadock owned the lower site. In 1937, Joseph Swearingen still owned the northern portion of the upper site. Bert Geer and William Sharp owned two separate parcels along the southern portion. An inferior road cut through these properties and connected with a larger road to Elk City. The former stone quarry is listed as a state quarry in 1937 directly on this inferior road and may have been operating to improve this inferior road.

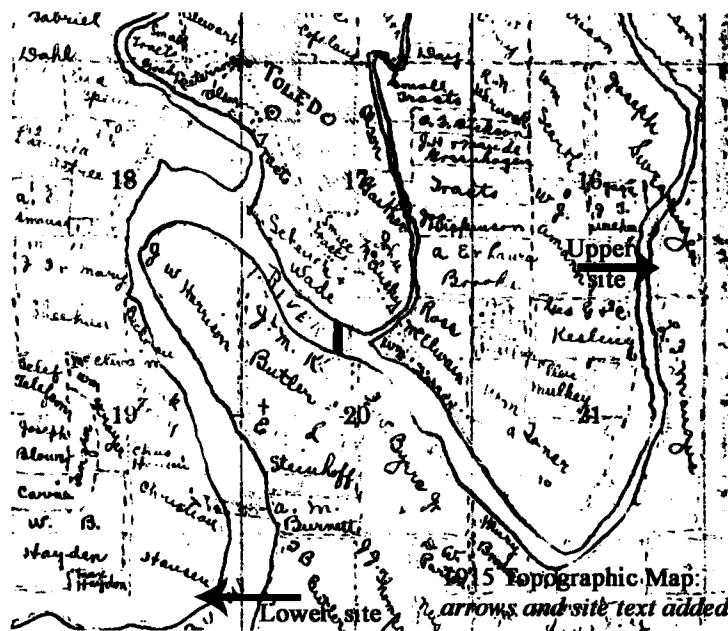
Changes in the 1956 Metsker map include more landowners with smaller parcels, more paved and dirt roads, and replacement of the Pacific Spruce Corp. by C.D. Johnson Lumber Co. A new road from Toledo to Newport replaced the railway segment from Toledo to Yaquina. In 1956, the ownership of the lower wetland site is unclear, as a portion of the area is labeled on the atlas as “Small Tracts.” Roy Swearingen owned the main portion of the upper site while Bert

Geer and Carl Moore owned the two separate lots in the southern portion of the area. The state quarry still existed in 1956 while the former inferior road was paved from Toledo to Elk City.

Deed & Land Ownership Information

Neither of the Yaquina sites is located near federally owned land. Due to time and space constraints, the following will examine the property ownership for only the Yaquina wetland sites.⁵¹

Figure 18. 1915 Plat Map



Lower Site

The earliest land ownership map available is the Lincoln County Surveyors Map from 1912. At this time, the Corvallis Eastern Railroad passed the lower wetland site in the same location as the current Yaquina Bay Road that runs from Toledo to Newport. The upland area and marsh was owned by Anna Bamber (or Bamloer) in a deed dating back to April 1875. She

⁵¹ The general area and sites, in particular, have a history of ownership by private individuals. The resource uses of nearby property owners and previous owners impact the landscape of these sites.

had an orchard and house near the northeastern portion of the marsh but on the opposite side of the railroad tracks. The map lists a “crossing with gate” at two locations over the railroad tracks, which presumably allowed grazing livestock to access the marsh area. One crossing was near the northeastern portion of the wetland and the other was near the present location of a house just upland from the marsh. Again, no dikes or “reclaimed land” were indicated for the lower site.

In the 1915-plat map (Fig. 18) for Yaquina River, the lower site was owned by Christian Hansen (or Hanson). His occupation was listed as farmer in the 1910 census. The 1906 topographic map also confirms this with a mark for the “Hansen house” in the same area (see Appendix C – Yaquina, Folder: Deed data, SubFolder: 1906 Topographic Map). Thus, sometime during the early 1900s, the marsh site changed ownership and both owners likely used it as pasture and possibly for crops.

According to the Lincoln County Assessor’s Office, the lower site went through several ownership changes in the mid 1900s. In 1922 after the death of Christian Hansen, his brother Sibert sold the property on behalf of his young nephew to Bernice Hood. The ownership changed frequently over the next fifty years (Table 10). The high rate of ownership turnover and partial ownerships may indicate more frequent land use changes and/or absentee ownership.

Table 10. Deed ownership history, Yaquina lower site.

* Indicates sales of a portion of the original property area.

Date	Seller	Buyer
1925	Bernice Hood	H.V. & Katie Adams
1932	Adams	Ruby & Roy Rimmer
1934	Rimmer	Eilert & Emma Erikson
1943	Ericksons	Chas. Hart
1947	Hart	Badley & Hays*
1960	Hays	Badley*
1965	Badley	Becker & Uhlenhake*
1970	Hart	Badley*
1971	Badley	Sallie Mitchell*
1971	Becker & Uhlenhake	Sallie Mitchell*
1975	Mitchell, Becker & Uhlenhake	Schmidt

By early 1975, Schmidt had reconsolidated the lots that encompassed the site and in April 1975 Schmidt sold to the current owner, the Port of Toledo.

Upper site

The 1915 plat map (Fig. 18) is the first available for the upper site (see Appendix C – Yaquina, Folder: Deed data, SubFolder: 1906 Topographic Map). It indicates that Joseph Swearingen owned the northern portion, including a portion of land across the river. L.E. Mangus owned the southern portion, most of which is not directly on the upper site, but some of which appears to have been tidal marsh. One indication of Swearingen's use of the land is found in the marriage announcement of his son, Roy, from December 1912 which states, "Mr. and Mrs. Swearingen will make their home on the Swearingen farm two miles above town [Toledo], where Roy will enter into partnership with his father in the peppermint and spearmint industry" (Lincoln County Historical Society 1912).

Joseph and Mary Swearingen transferred ownership to their son Roy in 1931. In 1967, Roy Swearingen sold to Francis and June Boone. The Boones sold to Publisher's Paper Company in 1974. Since that time it has been held by a series of timber companies including Simpson Timber Company and the current owner Green Diamond Resource Company.

Historical Accounts

I was unable to locate any additional historical accounts by or about the early owners of the Yaquina wetland sites from the local historical societies.

Aerial photo narrative & quantitative scaling

Few aerial photos are available for the two Yaquina wetland sites (see Appendix C – Yaquina, Folder: Historical Aerial Photos, SubFolders: Lower site and Upper site). Neither site is

located near a National Forest or other publicly owned land, which generally received more aerial photo coverage throughout the mid to late 1900s.

Lower Site

The first photo, from 1939, shows an abundance of driftwood on the marsh surface. The NE corner of the site has a house, a dock, and a crossing over the road to access the marsh surface. The upland portion shows signs of agricultural use suggesting the lowland area may have been used for pasture. Today, this area is occupied by a marina and young forest.

In a poor-quality photo from 1945, the edge of the marsh is still littered with large piles of logs, and large log rafts appear in the middle of the river. The crossover road to the marsh and the dock no longer exist. A house has become visible on the upland portion near the back-marsh.

By 1952, large log rafts are still apparent in the area, especially near the Toledo mill. Roads and logging have become more pervasive in the area. A dock is present again in the NE corner of the marsh, but appears more extensive, perhaps a small marina. Pilings are evident just to the west at the openings of Boone and Nute Sloughs. The adjacent upland forest appears to have been selectively logged with roads and thinner tree coverage.

The 1959 photo reveals increasing activity in the area, including roads, houses, and industrial development. Much larger log rafts were present in the area. An island to the west of the site was larger than in previous years, suggesting that significant sedimentation accretion had occurred near the site. The photo also shows large piles of wood lodged on the marsh surface. The marina complex has become larger and has an adjacent enclosure, possibly a pasture, mowed vegetation, or filled area. It is likely this area was used in conjunction with the marina, perhaps for parking or dry storage for boats. The previously forested upland has been converted

to low vegetation with an adjacent building site. The area around the upland house has been cleared.

The 1968 photo again contains many log rafts on the river. In general, more houses and docks appear in the area. On the marsh, trees and shrubs have grown in the NE area, the site of the large pile of logs in the 1959 photo. By 1968, the adjacent enclosure near the marina still appeared disturbed, but appeared as fill or construction. An oval shaped bright spot near this disturbed area may be a pile of logs, fill, or other material. The vegetation in the previously cleared upland portion has grown taller and increased in areal density.

The scene in the final photo from 1972, appears similar to that of 1968. However, the trees cover a more extensive area of the former marsh. The marina has expanded and the disturbed area next to it has experienced further development, including construction of several docks. A bright white spot located on the west side of the forested patch may have been a large pile of drift logs or cleared vegetation.

Upper Site

In 1939, a road runs along the upland edge of the tidal wetland site. A few large trees, probably the same large spruces that still occupy the site today, are visible in the middle of the marsh area (the southern portion of the wetland research area).⁵² Logs appear on the downriver, or southern, portion of the marsh.⁵³ The similar alignment and proximity of the logs to buildings on the marsh imply they were harvested or otherwise collected by the occupants as drift logs from the river. A square road or fence line surrounds the buildings. The area was covered by vegetation, which is lighter in texture and has a different pattern from that of the rest of the

⁵² These spruce trees are visible in all of the aerial photos for 1930-1970. They also appear in recent infrared photos.

⁵³ The area south of the trees is not considered part of the research area, but appears to be part of the larger wetland area. The activities on the land adjacent, especially contiguous wetland areas, impact the overall functioning of the wetland and thus, are included in this narrative.

marsh. Thus, this area has likely been mowed or used for pasture. Near the north end of the marsh, a narrow strip of clearcut forest runs above the road. North of the site and on the opposite side of the river, similar low lands along the river were used for agriculture.⁵⁴

The photo from 1945 still shows logs neatly piled on the lower portion of the marsh. Near the piles, a straight channel was apparently dug, possibly to access and transport the logs. Near this channel are two small, square embayments, which may have provided boat moorage. This photo still shows buildings nearby but a new fence line is visible from the upland to the river edge. Additional buildings and a dock now occupy the far southern tip of the area. The far southern cluster may be associated with the "state quarry" listed in the same area on the 1937 Mestker Atlas. The dock also contains a number of logs, so it may have been used for booming logs along the river. Near the far northern tip of the marsh, the ridge top to river has another narrow clearcut strip. This is the same area where electricity transmission lines were later placed and still exist today.

By 1952, many log barges occurred near the marsh and the log-booming operation apparently continued near the southern tip. Pilings were placed in the river adjacent to the marsh to support the log booms, and another dock was built in the southern area. As in the previous photos, logs were still piled on the marsh surface in the same area. A faint road can be detected along the ridge top, and new clear cuts and reforested areas are apparent. The light fence line in the middle of the marsh from upland to the river is still visible in the 1952 photo.

In 1959, fewer logs were present on the same area of marsh compared with the earlier periods, and the dug channel and nearby embayments had become partially filled with sediment. The density of shrubs and trees in the area had increased relative to the previous photos. The

⁵⁴ The texture and pattern of agricultural land in aerial photography is quite distinguishable from other types of vegetation and land cover.

dock and buildings at southern-most tip of the marsh had been removed while the other dock remained and may have been used to assist log booming operations. Across the landscape, more clearcuts and roads appeared by 1959. Many low-lying areas nearby were used for agricultural production. Development in nearby Toledo increased, including construction of a large factory, likely the result of the mill and other businesses expanding.

The 1968 photo indicates that the southern dock was still used, but possibly not for log booming. A few additional buildings appear in the southern area of the marsh, just north of the dock and building. The area with the new buildings has more trees than previously. Fewer logs are captured on the marsh surface in this photo, but are still scattered in the middle area. In the general area, some secondary forest growth is apparent following previous timber cuts but new clearcuts are also evident.

In 1972, the final photo, the southern dock and buildings are still present as are log piles on the wetland surface. Land has been cleared at the south end as indicated by a large bright spot in the photo. The ridge-top strip has been cleared of trees and a road has been built, likely a precursor to timber clearing. Overall, development, growth, and resource use in the area remains similar to levels indicated in the previous photos.

A quantitative scoring of the historical photos generated the highest disturbance score for the lower Yaquina site and a moderate score for the upper Yaquina site (Table 11). In particular, the lower site has a high disturbance score and has not significantly decreased in recent decades. This reflects the permanent nature of the alterations, including reduction in wetland area from development and vegetation change and rural residential growth. The lower site has also sustained impacts from clearcuts and roads. The upper site has a moderate disturbance score. Again, a portion of this wetland was permanently altered by fill and development. However, the

area of disturbance and amount of rural residential development was relatively⁵⁵ smaller than for the lower site. The scoring shows a peak impact for the upper site in the 1950s, when part of the wetland was used for agriculture and log storage and booming.

Table 11. Historical aerial photo scores for the upper and lower Yaquina sites by decade.

Site	Total Average Decadal Score							
	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Lower Yaquina	28	22	56.5	75	73	N/A	N/A	74
Upper Yaquina	15	20	34	25	26	N/A	N/A	28

The detailed data and spreadsheets for the aerial photo scoring can be found in Appendix D, excel file: Historical_Aerial_Photos.

Field Observation

Results of field observations at each site are summarized below and documented in photos in Appendix E (Folder: Field Photos Yaquina, SubFolders: Lower site and Upper site). The filenames for photo images illustrating current conditions are referenced in the text below.

Lower Site

The northeastern area was former tidal wetland, but now houses a marina, parking area and docks. The area adjacent to it has grown over with a young mixed forest of alder and Douglas fir (file: Lower_upstream). Yaquina Bay Road runs along the upland length of the research site along a former railroad bed (file: Lower_road). The road also limits flooding to a back-marsh area, where a large culvert impedes tidal flow into the area (file: Lower_backmarsh). A house sits in the upland area, across the road from the marsh and adjacent to the back-marsh area. The culvert appears to have increased erosion and caused the tidal channel to widen (file: Lower_culvert). The river has many pilings along its shores from former wing dikes and log booming operations. However, only a few are located near the site. The river edge of the marsh shows no indication of a former dike or levee. However, the upland edge, alongside the road

⁵⁵ Relative impact was determined by the size of the impact compared to the associated wetland size.

bank contains a short straight ditch that runs parallel to the road. The bank is secured with gravel and also is spotted with occasional garbage (file: Lower_garbage). Only one post was found (file: Lower_post). Located near the road, the post has not weathered significantly and thus, may be a recent addition.

The lower site contains high marsh vegetation, mainly: *Juncus balticus*, *Grindelia integrifolia*, *Deschampsia caespitosa*, and *Atriplex patula* (files: Lower_veg1, Lower_veg2, Lower_veg3, and Lower_veg4). Disturbance-related vegetation such as Himalayan blackberry (*Rubus discolor*) and reed canarygrass are found only in small patches alongside the roadway and upland edge. The lack of reed canarygrass may be due, in part, to the higher salinities at this site. While reed canarygrass is fairly tolerant of wet and semi-salty conditions, this area may be too salty for it to flourish.

Upper Site

Currently, the southern end of the former tidal wetland area is a public boat launch⁵⁶ and a private residence. The research site itself has several markers indicating former uses. A fence line runs from the upland to the river in the southern portion of the research area near the spruce trees (files: Upper_fence3a and Upper_fence3b) and another fence line runs along the upland edge (file: Upper_fence2). Other scattered fence posts and fence lines are found throughout the site (file: Upper_fence1). Along the river edge, pilings are still embedded in the muddy shoreline from past log booming (file: Upper_river_edge). Railroad tracks still occur on the opposite side of the river and the riverbank is stabilized with riprap. A road runs along the upland edge, at the base of a steep hill with a mixed deciduous and conifer forest (file: Upper_upland). Power lines extend along the top of the ridge (file: Upper_landscape1) and cross the river just to the north of

⁵⁶ The former Cannon Rock Quarry was transferred in a quitclaim to Lincoln County for use as a public park and boat launch in 1973.

the research area. The upper site is just upriver from Toledo and a major lumber mill. The area also has many pilings from log booming operations (file: Upper_landscape2)

The upper site includes a mixture of emergent, shrub-scrub, and forested vegetation. The emergent vegetation includes a mix of high marsh (such as *Deschampsia caespitosa*, *Juncus balticus*, and Pacific silverweed) and low marsh (such as *Carex Lyngbyei*) with fresh tolerant species such as cattail (*Typha latifolia*) and *Carex obnupta*. Other major plants include spruce trees (file: Upper_spruces), twinberry shrubs (file: Upper_veg1), and yarrow. Most pertinent to the historical reconstruction of this site are a few large patches of reed canarygrass (*Phragmites arundinacea*), which as mentioned previously, generally indicate use for pasture or agricultural production (files: Upper_veg2 and Upper_veg3). Reed canarygrass covers approximately 5 to 10 percent of the site.

Other evidence of impacts

Brophy (1999)

Again, the purpose of this study was to prioritize sites for tidal wetland protection and restoration.⁵⁷ Brophy (1999) identified the lower site as a high tidal marsh, not altered in the western half, but restricted by buildings in the eastern end. She also treated the area restricted by the culvert (northern edge of the wetland) as a separate site where the culvert and tidal restriction represent the primary disturbance. Citing an early study of Oregon wetlands (Jefferson 1975), Brophy noted that the lower wetland is considered “one of the best remaining examples of undisturbed mature high marsh in Oregon,” and therefore, worthy of protection and restoration.

Brophy (1999) classified the upper site as a tidal spruce swamp and the only example of this type given by Jefferson 1974 (Brophy 1999). She found few alterations except for a ditch on

⁵⁷ Historical aerial photography and consultation with experts were the main sources of historical alteration. In this study the lower site was referred to as Y13 and Y13a and the upper site was Y28.

the southern property line and adjacent land use for rural residential homes. Brophy (1999) also suggested that this wetland should be protected.

Scranton (2004)

In his master's thesis, Scranton (2004) utilized a Geographic Information System (GIS) to classify wetland types, describe impacts such as filled areas, and identify wetlands with "restoration potential." He concluded that the lower site has been constricted by a culvert through the road and should be considered for restoration. He also listed the southern area as having "restoration potential," but indicated that part of the area has been filled.

SUMMARY OF YAQUINA

The Yaquina watershed has a similar history of resource uses as the other areas included in this study. Prior to arrival by Euro-Americans, the Yaquina tribe occupied the area. Like the Alsea, fish, shellfish, camas, and skunk cabbage were important food resources to the Yaquina. It is unresolved whether the Yaquina tribe was responsible for the 1846 fire, which started in the Yaquina watershed. Regardless, it is clear that they frequently burned undergrowth to improve hunting.

The Euro-Americans interacted differently with their environment than the Native Americans. Profit quickly became a main driver of natural resource production. The Yaquina differs from the other land use histories in this study primarily by the duration, intensity, and scale of Euro-American development. The earlier explorations of the Yaquina and subsequent discovery and development of the oyster industry spurred much earlier settlement by whites. Talk of building a railroad and jetties to secure better transportation of goods such as oysters, wool, hides, timber, and dairy products to market began in the 1860s. By 1880, a time when settlement was just beginning in the Alsea and Siuslaw, the Corvallis-Yaquina railroad was

almost complete and the jetties at Newport were under construction. Other important resources during this time included fish and agricultural production. Despite its earlier settlement, Newport remained a small village in the late 1880s and 90s. The early 1900s brought increasing industrialism with the Toledo mill and Newport's canneries, marinas, and fish processing plants. In order to maintain shipping channels, the Yaquina River was frequently dredged up to the Toledo mill. These industries resulted in increased resource extraction as well as a larger local population and more development. While tourism and recreation play a larger role in the economy today, these early industries remain an integral part of the local economy.

These landscape changes influenced the functioning of the watershed and wetlands. Dredging, jetties, riprap, and railroad construction changed circulation patterns, caused shoaling and influenced erosion. Timber, logging, and transportation scoured riverbeds and increased sedimentation and erosion. Residential and industrial wastes caused poor water quality and polluted sediments. Agricultural production increased non-native species and reduced habitat availability through diking and draining. Hatcheries damaged wild salmon stocks while canneries fostered huge, unsustainable catches.

Other researchers have declared both the upper and lower sites are unique examples of a tidal spruce swamp and undisturbed high marsh respectively and warrant protection. Despite these claims, land use history impacted the functioning of these sites. Both sites permanently lost a portion of former tidal wetland. The lower site lost a greater percent of its area from a marina. The upper site had a quarry operating, which was later turned into a public boat launch. Both sites were influenced by onsite and offsite residential development; the upper site has a few residences still located on it. Both sites were influenced by agricultural production at various times resulting in non-native species, especially on the upper site, and likely soil chemistry

changes as well. The lower site remains affected by the road (former railroad) and culvert, which have influenced local circulation, erosion, and sedimentation. While these two sites represent some of the few remaining and least disturbed tidal wetland sites in the Yaquina, they have sustained more permanent changes than the other sites in this study.

Conclusion

“Our project must be to locate a nature which is within rather than without history, for only by doing so can we find human communities which are inside rather than outside nature.” (Cronon 1983, quoting Thoreau; italics added)

Nature is often described as something outside of human influence. Yet human influences are pervasive throughout history. Thus, for the purposes of natural-resource management we must examine various ways humans have interacted with natural resources to choose an appropriate course of action. As demonstrated in this paper, Native Americans caused impacts, sometimes quite large, on the landscapes of the Alsea, Yaquina, and Siuslaw watersheds. They exerted heavy extractive pressure on natural resources such as salmon. Native Americans likely harvested marsh plants for food, mats, baskets, and other tools. Some tribes utilized wetland tidal channels for fishing weirs, which when left in place may have increased marsh accretion (Byram and Witter 2000). Additionally, they may have used wetlands as temporary settlements. Finally, they may have burned forested areas to improve hunting and potentially to gather seeds on wetland areas.

Natural variability also influenced the functioning of wetlands and watersheds. High spring rainfalls combined with melting snow brought high flows through the watershed; downed trees created both pools and debris dams; and landslides supplied sediment to downstream wetlands and maintained gravel beds for salmon (Botkin 1995). Coastal watersheds were dynamic landscapes with a disturbance history of their own. Within this context, historic wetlands such as the sites in this study⁵⁸ regulated and transformed nutrients and retained floodwaters and sediment. Trees and shrubs contributed organic material and wood and provided complex habitat structure for a variety of species, including juvenile salmonids (Benner 1991).

⁵⁸ The evidence in the General Land Office Surveys supports that the sites in this study were wetlands prior to Euro-American settlement.

Some changes over the past century are likely attributable to such natural variability. For example, some researchers claim that tidal influence does not penetrate as far up streams as it once did due to geologic rise (Hall and Hall 1995).

The switch from using the land for subsistence to using it for profit had large implications for the landscape. The Euro-Americans' use of natural resources vastly exceeded the scale and intensity of the Native Americans occupying these areas. As Robbins writes:

For the Oregon country the literal and figurative meaning of industrialism was expressed in terms of nature's industries: that is, enterprises seeking to profit from the region's magnificent forests, its fertile valley bottom soils, the mineral riches that underlay the interior mountains, and the seemingly limitless multitudes of salmon that plied its numerous waterways. (Robbins 1997)

Nothing in the landscape of these watersheds escaped the impact of the Euro-American's enterprises, including the tidal wetland sites utilized for this historical reconstruction.

The way in which Native people and Europeans controlled the land were vastly different, Cronon argues, "Where Indians had contented themselves with burning the woods and concentrating their hunting in the fall and winter months, the English sought a much more total and year-round control over their animals' lives" (Cronon 1983). A similar case can be made for the Pacific Northwest, where local Native people routinely burned forests to improve hunting, but relied mostly on traveling to locally abundant food resources. The Euro-Americans practiced more intense use of natural resources throughout the year. This, coupled with segmenting the land by property ownership, resulted in disconnected ecosystems and a larger overall landscape impact.

Euro-Americans also viewed the landscape differently which, in turn, affected their relationship with it. They perceived particular resources within the environment such as salmon or trees as separate entities, commodities that were useful not just for survival, but for profit as

well. As Cronon writes, "Seeing landscapes in terms of commodities meant something else as well: it treated members of an ecosystem as isolated and extractable units" (Cronon 1983). Euro-American settlers were also struck by the apparent abundance of natural resources and fueled a notion of continuous expansion that could not last (Cronon 1983). Ultimately, "when that gift was finally exhausted, ecosystems and economies alike were forced into new relationships" (Cronon 1983). For example, as a result of a wasteful, reckless approach to natural resources in the past, today the extinction of salmon in the Northwest is a real possibility. This for a species once so abundant Lewis and Clark marveled at their "inconceivable" numbers (Botkin 1995).

According to Cronon, commercial production depended on factors such as population growth and ease of transportation to urban markets (Cronon 1983). This was true in Oregon, too. Early settlers were hampered in their ability to develop the resources of coastal areas due to isolation. As seen in all three estuaries examined for this study, as transportation improved and population grew, so too did the ecological consequences of the Euro-Americans removal and use of nature's "commodities" for both national and international markets. Just as in New England, Oregon's landscape, "increasingly met not only the needs of its inhabitants for food and shelter but the demands of faraway markets for cattle, corn, fur, timber, and other goods whose 'values' became expressions of the colonists' socially determined 'needs'" (Cronon 1983). Products such as oysters, fish, and timber were no longer used merely for survival, but became major exports to regional, national, and international markets. Cronon claims that this market transition did not have immediate ecological consequences. Instead, it took time for the "degree to which land was committed to commercial production" to influence the ecology of the area (Cronon 1983).

In his analysis of Oregon's environmental history, Robbins proclaims:

Indeed, what is striking about the region is the *very* recent and *very* rapid pace of human-induced environmental disturbance over *very* extensive areas in a *very* brief span of time. (Robbins 1997)

The tidal marshes in this study were impacted by the rapid, recent, and extensive land uses of the Euro-Americans, especially timber and agriculture. Tidal channels were straightened or blocked; sedimentation and accretion increased; and vegetation types were altered and harvested. This resulted in altered tidal marsh ecology and reduced habitat for fish. As Taylor observes, "The more farmers tilled the soil, the greater the sediment loads became in the streams....Siltation and increased precipitation brought more floodings, so farmers began to dike their fields and dredge streams to move goods to market, but this only further reduced the rearing habitat for juvenile salmon" (Taylor 1999). Timber harvest also greatly increased sediment loads in the river, as landslides and erosion increased, due to clearcutting practices. While sedimentation is natural in estuaries and tidal marshes, the sheer scale of increased sediment was not.

Comparing the three watersheds in this study, the three Native American tribes shared similar interactions and impacts on natural resources. The Euro-Americans adopted a very different attitude toward natural resources. Yet, the Euro-Americans that settled in all three watersheds used natural resources similarly and exhibited a similar progression of resource development: dependence on natural resources for subsistence, transition to profit making and industrialization, and, finally, reduced reliance on resource extraction accompanied by a rise in recreation and tourism. However, the scale of human disturbance and development varied. The Yaquina had more industrial processes and greater development than the Alsea. Certain resources had greater prominence in some watersheds than in others. Timber was very important to the Siuslaw's economy, while industrial-scale fishing and timber production were both

important in the Yaquina. Timing also played a role. The Yaquina was settled by Euro-Americans nearly twenty years prior to the Alsea or Siuslaw.

While each of the watersheds in this study underwent similar transformations due to the natural resource uses by Euro-Americans, determining the degree of disturbance presents a difficult task when utilizing primarily qualitative data. However, the quantitative scoring of historical aerial photos provided a way to support qualitative data on human disturbances over the past 70 years.⁵⁹ It provided a way to compare and confirm alterations between the sites (see Table 12).

Table 12. Historical aerial photo scores for all sites by decade

Total Decadal Score								
Site	1930s	1940s	1950s	1960s	1970s	1980s	1990s	2000s
Lower Alsea	0	0	3	0	N/A	4	3	3
Upper Alsea	23	20	18	N/A	N/A	18	N/A	12
Lower Yaquina	28	22	56.5	75	73	N/A	N/A	74
Upper Yaquina	15	20	34	25	26	N/A	N/A	28
Lower Siuslaw	20	16	19.6	22.3	20	16	N/A	10
Upper Siuslaw	50	52	58.6	56.3	40	38	N/A	26

The detailed data and spreadsheets for the aerial photo scoring can be found in Appendix D, excel file: Historical_Aerial_Photos.

The sites were initially chosen because of their status as relatively “undisturbed.” Thus, these sites would be expected to have lower disturbance scores than other wetlands in the area, which have been more extensively filled, developed or diked.⁶⁰ Most of the sites have lower levels of disturbance, especially the Alsea sites. However, wetland area has been permanently reduced due to development on both of the Yaquina sites. The lower Yaquina site, in particular, has a larger amount of rural residential development and thus has sustained a high disturbance score into

⁵⁹ This method had some flaws, including underestimating grazing or pasture use of wetlands. However, it provided a basis for comparison of impacts and their persistence through time.

⁶⁰ However, this study did not incorporate these other more typically modified sites for quantitative analysis.

current times. The upper Siuslaw site has been heavily impacted by agricultural use, which has waned in recent times.

LANDSCAPE ALTERATIONS

At the landscape level, human disturbances such as transportation development, timber removal, dredging, hatcheries, canneries, and agricultural production in all of the watersheds resulted in increased sedimentation and erosion; changed circulation patterns; changed vegetation composition; altered water flow, quality, and timing; interfered with wild salmon runs; and reduced habitat quality and availability.

As early as 1887 on the Coquille River, reduced navigability described as “decay of the channel” was attributed primarily to logging and land clearing (Benner 1991). Driving logs down the river required alterations to the river channel and bed to improve navigation (Benner 1991). This resulted in increased water flow, greater erosion of stream banks, and more sediment supply to the river. However, timber harvest was not the only cause of increased erosion, “The removal of the forest, the increase in destructive floods, the soil compaction and close-cropping wrought by grazing animals, plowing – all served to increase erosion” (Cronon 1983). Accounts of chronic shoaling were typical symptoms of increased sedimentation due to timber harvest (Benner 1991). Development also caused shoaling from sedimentation. The USACE found that some shoaling on the Yaquina was attributed to the construction of the railroad.

According to a state study on erosion of stream banks, “[M]an can and does exert considerable influences upon stream bank erosion...When building bridges and piers or creating new land within stream channels, man may encroach on effective stream width and locally increase the stream velocity. Heavy accumulations of logging debris can be carried downriver to grind against channel banks” (State Soil and Water Conservation Commission 1973). During the

1970s, the area around the Siuslaw sites was determined to have moderate erosion likely caused by extensive use of the river for log rafts. Splash dams scoured stream channels down to bedrock and eliminated spawning gravel and other upstream rearing habitat. Diking, dredging, and bank hardening structures such as riprap, and wing dikes changed the circulation patterns of rivers and accelerated flow affecting the rate and location of sedimentation.

Timber harvest also significantly changed vegetation composition of coastal areas. During the 1000 years prior to Euro-American settlement, large conifer forests were estimated to constitute 52 to 85% of forested areas along Oregon's coast (Wimberly et al. 2000). Due to human-induced fires and heavy logging, one study showed large conifer forests in Oregon's Coastal Range have decreased from 42% in 1936 to 18% in 1996 (Wimberly and Ohrmann 2004). Since many large trees provide shade to streams, their removal causes increased water temperature. Fewer large trees also may decrease large woody debris input to aquatic systems (Wimberly and Ohrmann 2004).

Reservoirs changed the timing and amount of water flow influencing the water quality and quantity available to juvenile salmon. Industrial practices such as logging, mills, and quarries also altered water quality. Water quality from chemical pollutants appeared to be a serious concern only in the Yaquina. However, water quality was an issue in all three watersheds, particularly temperature and sediment issues (OWEB 2003). In fact, pile and rock dikes built to improve navigability in the Alsea actually caused water quality to decrease by increasing temperature and decreasing dissolved oxygen (Brophy 1999).

Canneries fostered over-fishing of local salmon runs. Hatcheries attempting to restock rivers mined eggs and cut off spawning grounds resulting in little success. They also may have influenced timing of fish migrations through spawning, rearing, and release practices. Many

recent studies have examined the potential negative impact of hatchery fish on wild stocks such as competition for resources, genetic loss through interbreeding, and disease introduction (Independent Multidisciplinary Science Team 1998).

As discussed in the introduction, all three watersheds in this study have estimated tidal wetland losses of about 60 to 70 percent (Good 1999). Road building, residential development, and agricultural practices have reduced the amount and quality of wetland habitat available in all three watersheds. These alterations resulted in fragmented and isolated wetlands. This reduced habitat opportunity for rearing juvenile salmon and increased the importance of remaining tidal wetlands. Less wetland area also meant other wetland functions important to the whole ecosystem were reduced, such as absorption of floodwaters, nutrient processing, sediment retention, and habitat opportunity for other fish and wildlife dependent on wetlands.

This project was unable to discern any types of tidal wetlands disproportionately impacted by historical land uses. Some studies suggest that tidal spruce swamps were once prevalent in other Oregon coastal watersheds, but are now rare habitat types (Benner 1991, Coulton and Williams 1996). The upper sites of the Yaquina and Alsea are considered, in part, spruce swamps and may represent a rare remnant habitat. The remaining sites in this study are a mix of high and low tidal marshes. High tidal marshes were often favored for agriculture due to rich soil, lack of trees to be cleared, and drier conditions than low tidal marshes. Thus, a greater percentage of high marshes may have been converted for agriculture, but this study did not confirm such a pattern. Understanding which types of habitats have been disproportionately impacted is important to effective resource management. It implies that the remaining wetland habitats may not accurately represent the assemblage of wetland types present 150 years ago. Without this understanding, managers may mistakenly focus on restoring habitats that were not

as prevalent instead of those that were. An analysis of wetland types present historically at the watershed level is needed to solve this question.

The amount of landscape level disturbance and development varied across the three watersheds in this study. The Yaquina watershed is more commercially developed than the Alsea (Brophy 1999). The Siuslaw watershed, with its history of high timber harvests, mills, and agricultural operations likely falls in the middle for development disturbance.

SITE ALTERATIONS

Human-induced alterations to the wetland sites in this study impacted their functionality by changing vegetation composition, channel morphology, soil properties, sedimentation, woody debris, and habitat composition and availability.

The agricultural practices of the Euro-Americans required large tracts of pasture. With the disturbance caused by grazing animals, non-native species of grass flourished, "native grasses and field plants were slowly being destroyed and replaced by European species" (Cronon 1983). In fact, the Euro-American way of life not only introduced these grasses, but sustained them as well; "their populations sustained in all places by the habitats human beings and domesticated animals created for them" (Cronon 1983). Large patches of reed canarygrass (*Phalaris arudinacea*), an introduced species and indicator of agricultural use, thrive on all three of the fresher, upper estuary sites. The lower sites all have some reed canarygrass, Himalayan blackberry and/or Scotch broom in the adjacent upland or on levees. Other disturbance-related species such as *Agrostis* spp., *Cotula coronpifolia* (brass buttons) and *Hordeum brachyantherum* (meadow barley) were found on the both Alsea sites (USACE 1984, Pojar and Mackinnon 1994, Guard 1995).

Agricultural practices on tidal wetlands required draining the land through ditches. The creation of ditches altered channel morphology and, "greatly impacts hydrology, and undoubtedly affects benthic invertebrate communities...and therefore has a strong impact on the ecology of the entire marsh community and the estuary" (Brophy 1999). Ditches were particularly evident in aerial photos of the upper Yaquina and upper Siuslaw sites.

Euro-American use of tidal wetlands for agriculture and grazing changed the soil resulting in compaction, subsidence, and altered biogeochemistry. Grazing animals compacted the soil:

Their weight had the effect of compacting the soil particles so as to harden the soil and reduce the amount of oxygen it contained. This in turn curtailed the root growth of higher plants, lowered their ability to absorb nutrients and water, and encouraged the formation of toxic chemical compounds. Soil compaction, in other words, created conditions that were less hospitable to plant life and eventually lowered the soil's carrying capacity for water. (Cronon 1983)

While a highly functioning tidal wetland would absorb floodwaters, one with compacted soil from grazing would have a reduced capacity for retaining water.

The fact that restored tidal marshes drop in elevation, or subside, as a result of oxidation, soil compaction, and peat consolidation after restoration has been well documented (Cornu and Sadro 2002, Good 1999, Frenkel and Morlan 1991, Restore 2002). Over a long period of time, these marshes accrete sediment and gain elevation faster than reference marshes (Frenkel and Morlan 1991). Yet studies in the Salmon River indicate that even after 20 years, restored marsh elevation remains somewhat lower than the reference marsh (Frenkel 2000). Natural recovery of elevation may prolong the recovery of target marsh functions (Cornu and Sadro 2002). Recent work on Coos Bay's South Slough manipulated initial marsh height of restored areas to measure the physical and functional responses of the marsh (Cornu and Sadro 2002). Among other parameters, the marshes were measured for vegetation, tidal channel development, and fish use.

The manipulations found a trade-off between rapid vegetation establishment and fish usage (Cornu and Sadro 2002). This is particularly important for the sites in this study that have a history of use for agriculture or grazing, which could be subject to subsidence. The upper Siuslaw site may have subsided after the dike broke and thus, may be a lower elevation than it once was.⁶¹ Further studies on elevation history are required to substantiate any potential changes to the sites.

The period and extent of estuarine degradation can have a significant impact on the biogeochemistry of the soils before and after restoration (Portnoy 1999). This, in turn, can cause problems for vegetation establishment in a recovering marsh. Portnoy's research found that diked and waterlogged sites were characterized by organic accretion, reduced sulfide and alkalinity, and *Spartina* decline. When flooded from restoration, the soils subsided, nutrients were mineralized and sulfide toxicity significantly inhibited plant growth (Portnoy 1999). On the other hand, soils from areas that had been diked and drained were characterized by iron enrichment, acidification, decomposition and subsidence, and *Spartina* decline. When the diked and drained areas were restored, iron and nutrients became mobilized in the soil, the pH was buffered and *Spartina* grew vigorously (Portnoy 1999). Although his work was done on the East Coast, Portnoy's research reveals the importance of understanding biogeochemistry in soils for salt marsh restoration on the West Coast, as well. It is especially significant to the biogeochemistry of the upper Siuslaw site and lower Yaquina site. The upper Siuslaw has a remnant dike and at one time tidal flow was blocked completely by the dike. The lower Yaquina site still retains a culvert, which runs under the road to a back-marsh area. This restricted flow has likely altered the flooding frequency and extent and therefore, changed the soil biogeochemistry. As Brophy

⁶¹ The upper Siuslaw is classified as a mix of low and high marine-sourced wetland. The low-marsh areas may be a result of subsidence.

(1999) puts it, "sites with reduced tidal flow or simplified physical structure may function at a reduced level."

Not all impacts resulted in poorly functioning tidal wetlands. Higher sediment loads from human disturbances resulted in accretion on some wetlands. On the lower Siuslaw, likely with the aid of its abundant pilings, marsh accretion was visible over a matter of decades.^{62 63} On the other hand, the amount of increased sediment might have translated to poorer water quality for fish and other aquatic organisms in the estuary.⁶⁴

Woody debris is important for tidal wetland functions (Brophy 1999). The presence of large woody debris, or fallen logs, both in streams and on wetlands has historically been important to forming tidal channels, capturing sediment, transforming nutrients, and maintaining pools and structural complexity (Benner 1991, Maser et al. 1988). Traveling up the north fork of the Siuslaw River in 1826, a Hudson Bay Company Scout noted, "finding the Navigation much impeded by fallen trees they returned at dusk conceiving the Obstacles insurmountable" (cited in Benner 1991). As seen in many of the aerial photos, the supply of wood was maintained during years of log booming on the coastal rivers. Benner argues that the present sources (anthropogenic or natural) of wood are not what they were in historical times (Benner 1991). Other researchers claim that forest composition change due to logging has decreased the amount of large tree forests by 87% on the Oregon coast (Wimberly and Ohrmann 2004). These large trees are the ones which contribute woody debris important to aquatic systems (Wimberly and Ohrmann 2004). The supply of wood was particularly abundant on the lower Siuslaw site throughout

⁶² A more detailed analysis of the historical photos could quantify this apparent accretion.

⁶³ Structures such as pilings are also often used as cover by fish (Benner 1991). Pilings have a downside too, because they are coated in chemicals to prevent premature decay. These chemicals leach into the surrounding environment over time.

⁶⁴ In higher order streams, increased turbidity causes damage to aquatic organisms. However, the estuary is naturally turbid and the impact of increased sediment loads is unknown.

heavy logging periods in the mid-1900s. However, the log storage and booming activities likely resulted in constant removal and disturbance on the site. The scale and number of logs present on the marsh surfaces for the lower Siuslaw site was likely not "natural" and probably would have impeded tidal marsh functions by clogging and altering channels and limiting vegetation growth.

Euro-Americans also changed habitat composition and availability of the tidal wetlands in this study. Bounding the land and segregating it for different uses separated formerly contiguous wetlands. Wetland size was permanently and significantly reduced for both Yaquina sites by filling and development. Furthermore, a corner of the lower Yaquina site was converted from wetland to potential forested wetland.⁶⁵

How persistent are the disturbances to these wetlands? As most ecological historians claim, past land use can affect the functioning of an ecosystem. However, some disturbances have a greater degree of persistence than others. For example, sediment loads and erosion may increase during the construction of a road. Afterward, the road will permanently increase run-off. Benner (1991) asserts that previous work to clear brush and trees from stream banks was maintained by agricultural uses on tidal wetlands, but that some of the vegetation has likely grown back and improved bank stability. Many of the alterations from agricultural use and development appear to have more persistent impacts to soil chemistry, vegetation composition, channel morphology, and wetland size.

As the quantitative scaling and other qualitative data indicate, the functions of the wetland sites for this study were impacted by Euro-American settlement at both the landscape and site level. However, the question remains: can they be used as reference sites? Yes, as the definition used in the introduction indicates, reference marshes can encompass both least and most disturbed wetlands (Brinson and Rheinhardt 1996). Furthermore, the tidal wetland sites in

⁶⁵ The forested area contains a mix of alder, Douglas fir, and other evergreen trees.

this study are relatively undisturbed compared to other tidal wetland areas within their watershed (Brophy 1999).

Additionally, Brinson and Rheinhardt (1996) claim the least disturbed wetland is likely the best functioning wetland. This study allowed the sites to be differentiated based on the amount of historical disturbance and therefore, potentially their functionality as well. Land-use histories play an important role in how well "reference" sites function comparatively, including their ability to provide habitat for juvenile salmon. This study shed some light on relative condition of the functionality of upper versus lower sites in terms of human disturbance. It appears the upper, less saline sites are more subject to non-native vegetation than all of the lower sites. This, in turn, may influence prey resource availability for juvenile salmon. Additionally, two of the lower sites (Alsea and Siuslaw) were among the least disturbed of all six sites. Thus, one would expect these sites to have better functionality than the others.

A few generalizations can be made regarding the sites at all of the locations. Overall, land-use impacts were similar. As a result habitat quantity and quality has declined; non-native species are fairly prevalent; woody debris input is lower; and land-uses such as dredging, culverts, logging, and agriculture have changed accretion and erosion patterns and soil chemistry in wetlands. However, more important factors to site disturbance were: 1) the overall level of landscape development including availability and condition of wetlands; 2) the specific site history; and 3) wetland characteristics such as vegetation composition and marsh typology.⁶⁶

Reference sites must be chosen with careful selection of wetlands similar in type, size, geomorphology, potential tidal range, landscape position, water quality, and adjacent land use (Neckles 2002). Yet, limited examples of highly functioning reference wetlands exist. As a

⁶⁶ While not directly related to site disturbance, the life history composition of the juvenile salmon population is another likely influence on whether these fish are present in wetland habitats and for how long.

result, the sites were chosen with careful consideration to these factors, but some differences do exist. For example, the upper Siuslaw site is considered a mix of low and high marsh, while the other two upper sites are considered high marshes, with many spruce trees. The lower site on the Siuslaw is considered mostly low marsh, while the lower Alsea is considered a mature high marsh. An important lesson of this project is to consider historical as well as current differences in characteristics of reference sites that may cause dissimilarities in the results. That is, change is not necessarily attributable to upper and lower geographic distinctions alone. Inferences into causation must be made with care. Therefore, another lesson is to choose reference sites that have as few differences as possible, including the factors listed above and adding site land use history. By limiting variables findings will be focused on the variable in question, such as geographic distinction (upper versus lower).

The historical approach utilized in this project is a valuable tool for assessing reference sites as well as determining restoration goals. While some studies rely primarily on aerial photos, these alone do not tell the complete story. Photos only provide a snapshot of land uses and, as in this study, are usually available only for more recent decades. The methodology of this study provided a more complete understanding of the historical impacts to the landscape and wetland sites. For example, documents from the Lane County Surveyors office were able to confirm the presence of a dike, which could have been misconstrued as a natural levee. By providing a longer time period and more diverse sources, this study was able to provide a more detailed historical context and baseline for the watersheds and sites in question. This, in turn, allows researchers to examine whether differences in functionality are potentially related to land use histories. It also allows resource managers to more appropriately determine the best course of action for prioritizing wetland protection. Finally, historical context can assist in setting realistic restoration

goals. However, it is important to note that using a single, static point of time in history can be misleading. Researchers and resource managers must also understand the natural variability inherent in the system in order to make wise decisions.

FURTHER RESEARCH

“An ecological history begins by assuming a dynamic and changing relationship between environment and culture, one as apt to produce contradictions as continuities.” (Cronon 1983)

As with any study, examining the data brings about more questions. This is especially true for a study attempting to cover such a large time period. The intention of this study was to provide a better general understanding of the land use history of these sites and put their current condition in historical context. Therefore, not every potential source was utilized and other useful information may be available. In particular, some interesting historical accounts were uncovered, but not for all sites. Other resources, such as the Army Corps of Engineers reports, were informative but too voluminous to cover all details in the time and space available for this study.

Sources indicating the presence and extent of splash dams in each estuary were difficult to locate. Splash dams were used to hold water and logs behind a temporary dam in order flush logs downstream to timber mills and shipping operations. These resulted in bank erosion, channel bed and bank scouring, sedimentation, and loss of stream habitat (Benner 1991). Thus, an investigation into location and extent of past splash dams in each estuary would yield a greater understanding of channel alterations.

The original intention was to reconstruct former vegetation via Benner's approach, but found to be too time-consuming. A more detailed reconstruction using the General Land Office Survey notes would yield a better understanding of the overall landscape structure at the time,

including the variety of wetland types and amount of wetland area. However, enough information regarding these areas was uncovered to identify some key vegetation types and whether the surveyor considered the sites wetlands at the time.

Most historical ecologists rely on both “natural” sources such as soils, pollen and fire records, vegetation patterns, climate and hydrology, as well as “documentary” sources such as maps and historical accounts (Swetnam et al. 1999). While this project utilized both types of sources, the resources and expertise did not allow for detailed examination of “natural” data sources. One of the main criticisms of historical reconstructions is their static description of what constitutes a dynamic process (Simenstad and Bottom 2003). Further research into the historical “natural” sources such as vegetation composition patterns, soil chemistry changes, elevation history, pollen records, and other disturbance patterns would provide a better understanding of historic variability in past functioning of tidal wetlands and how human impacts have changed them. This is particularly important to inform scientists utilizing reference marshes and to improve restoration methods.

Despite the advances in wetland science and restoration, these areas require further research in order to accommodate and ameliorate the impacts of human-caused disturbances. Watersheds damaged by impervious surfaces, damming and logging activities can make restoration downstream a moot point, because the natural water flow and quality is altered by too great an extent (Zedler and Griswold, 1990). Does this mean estuarine restoration should not proceed? While historic conditions provide an important guide for many restorations, much of the time historic conditions are unattainable without the historic processes that formerly maintained them (Simenstad and Bottom 2003). In these cases, learning how historic

disturbances have modified the landscape will yield a better understanding of what is possible in modern watersheds.

Appendices

Digital Appendix Guide

All image data is saved in .jpg or .tiff formats and compressed into .zip files.

Appendix A – Siuslaw (CD 1)

Folders:

- Site Locations
- General Land Office Maps
- Map of Jetty Accretion and Shoreline changes
- Deed Data
 - Metsker Maps
- Dike Maps
- Historical aerial photos
 - Site Boundaries: onsite and offsite outlines for quantitative scoring
 - Lower site
 - Upper site

Appendix B – Alsea (CD 2)

Folders:

- Site Locations
- General Land Office Maps
- Deed Data
 - Metsker Maps
 - Lincoln County Plat Map 1915
- Historical aerial photos
 - Site Boundaries: onsite and offsite outlines for quantitative scoring
 - Lower site
 - Upper site
- USACE Wetlands Review

Appendix C- Yaquina (CD 3)

Folders:

- Site Locations
- General Land Office Maps
- Map of Jetty Accretion and Shoreline changes
- Deed Data
 - 1906 Topographic Map
 - Metsker Maps
 - Lincoln County Plat Map 1915
- Historical aerial photos
 - Site Boundaries: onsite and offsite outlines for quantitative scoring
 - Lower site
 - Upper site
- Dredge Disposal Sites (USACE)

Appendix C- Yaquina (CD 3) (cont.)

USACE Ag Lands
Wing Dikes
Other Photos

Appendix D – Historical Aerial Photo Scores (CD 4)

Historical_Aerial_Photos.xls: first excel spreadsheet provides summary scores for every site and each decade, other sheets provide detailed impact scoring for every photo available for each site.

Appendix E – Field Photos; Siuslaw, Alsea (CD 4)

Appendix E – Field Photos; Yaquina (CD 5)

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