Source descriptions for features in a geodatabase of Puget Sound's pre-settlement river valley, estuary and nearshore habitats (September 14, 2008 version)

Introduction

This is a supplement to a Geographic Information System (GIS) geodatabase of the Puget Sound area's riverine and nearshore environments as reconstructed for the pre-settlement (mid-19th century) era. It consists of descriptions of mapped features. The descriptions include source materials that were used, and discussion on how they were used. Features are primarily wetlands, channels, and landforms.

Features are indexed by an identifying code that is linked to the geodatabase. The code consists of three letters that identify the river or oceanographic basin, followed by the township and range (all townships are North, and ranges are identified as East or West, by "E" or "W") and a number given to features sequentially within each township. Some nearshore features are identified by a separate coding system consisting of a WRIA (Washington Water Resource Inventory Area) number and a unique number within the WRIA. Numerous excerpts from Public Land Survey (PLS) field notes are included; generally the notes' idiosyncratic usage, grammar, and punctuation are preserved.

At present this document contains source descriptions for aquatic habitats. With time descriptions will be added of additional features, or more information will be added for features already in the narrative (e.g., on the seasonal inundation characteristics of wetlands). Source descriptions will also be added for different types of features not included at this time (e.g., forest composition).

How to cite this document: Collins, B. D. 2008. Source descriptions for features in a geodatabase of Puget Sound's pre-settlement river valley, estuary and nearshore habitats (September 14, 2008 version). Puget Sound River History Project, Quaternary Research Center and Department of Earth and Space Sciences, University of Washington. Accessed from http://riverhistory.ess.washington.edu/.

Skip ahead to:

- Nooksack-Lummi Rivers
- Skagit-Samish River Deltas
- Stillaguamish River
- Snohomish River
- Duwamish River
- Puyallup River
- Nisqually River
- Skokomish River
- Dungeness River
- Bibliography
- Acknowledgements (links to another page)

Nooksack-Lummi River

Skip ahead to:

- Nooksack and Lummi River distributaries
- Nooksack-Lummi delta estuarine wetlands
- Sandy Point
- Nooksack-Lummi delta riverine-tidal wetlands
- Nooksack-Lummi delta palustrine wetlands
- Lower Nooksack River mainstem
- Upper Nooksack mainstem and Nooksack River Forks

Nooksack and Lummi River distributaries

The Boundary Survey by the United States and Great Britain produced the first detailed map of the Nooksack River delta in the mid 1850s. It shows the Lummi as the far larger distributary than the Nooksack (Figure 1). General Land Office plat maps from 1859 (T38N, R2E), 1871 (T39N, R2E) and 1873 (Lummi Indian Reservation) also show the Lummi River as the dominant channel. Deardorff (1992) discusses testimony in U.S. District court indicating the entire river had emptied into Lummi Bay in 1852.

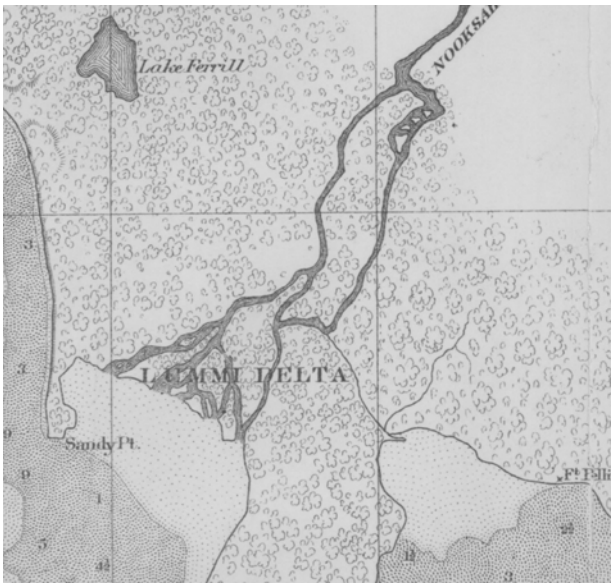

Figure 1. Nooksack River delta in approximately 1856-1858. Excerpted from “Map showing the line of boundary between the United States & British possessions” published in 1868 and likely compiled from US-Canada Boundary Surveys conducted in 1856-1858.

A large logjam at the divergence of the Nooksack and Lummi rivers likely divided and shifted flow between the two distributaries. The “Portage Jam” was present for as long as several centuries judging from reports of forest growing on it; see Wahl (2001) for detail

on the Portage Jam. A settler's description of a jam encountered while travelling upriver in 1871 is presumably this jam:

> "It was three-quarters of a mile long; great logs and huge trees, in every conceivable position, piled high across a bend of the river, reaching from shore to shore. It was evident, by the large trees growing in the midst of it, that this "jam" had been accumulating for many years, and was still enlarging, as every freshet carried on its current a new supply of logs and uprooted trees" (Judson 1984, p. 201-202).

Prior to the Nooksack River becoming the dominant channel, the PLS surveyors characterized the Nooksack River as they surveyed westward, on July 19, 1859, along the northern boundary of S. 5, T38NR2E, which intersects the river. They encountered what appears to have been the Nooksack River, "a rapid stream…Supposed to be a branch of the Lummie" and they measured its width as 1.7 chains, or 34 m wide. On the east side of the stream, they found

> "…the whole country cut up by these sloughs, which are rapid and deep. The Lummie River below the drift being divided into many branches."

We mapped these from features visible on 1933 aerial photographs as a band of anastomosing relict channels.

The majority of river flow switched to the Nooksack River in the late 19th century. In 1892 the Army Engineers' Captain Symons assigned an approximate date to the flow change from the Lummi to the Nooksack channel, and indicated a cause:

> "Until about fifty years ago the Nooksack flowed out into Lummi Bay [through the Lummi River]...the present outlet [to Bellingham Bay] did not exist or was insignificant. A big jam of timber was formed in the river just below the junction, and forced the river to open its present channel, which has remained open ever since. The former outlet is now entirely closed" [Symons 1892, in Appendix VV29, Annual Report of the Chief of Engineers, U. S. Army (abbreviated herein as ARCE) 1892].

The report of Assistant Engineer Robert Habersham, writing for the Army Engineers, also suggests that a natural drift accumulation closed the Lummi River:

> "The…[Lummi River] was closed 20 years ago by a raft of drift-wood, 4 miles above its outlet, which turned the entire volume of water into the [Nooksack River]…" (Habersham 1880, in Appendix 0012, ARCE 1880).

A federal surveyor, present at the time of the diversion, provides an alternate explanation. In the early 1880s the Army began a river improvement program in Puget Sound that focused on clearing wood jams and snags from rivers' navigable portions. The Army's snagboat first reported working in the Nooksack River in September-December, 1886 (Chief of Engineers 1887). The same year, the U. S. Coast & Geodetic Survey was charting the Sound's nearshore waters and coastlines, having made small-scale reconnaissance maps in Puget Sound in the 1850s and 1860s, and larger scale, more detailed maps in the 1870s-1890s. Surveyors filed "Descriptive Reports" with their completed maps, describing the map area's physical and cultural features. Coast Survey Assistant J. J. Gilbert filed his map and report for the lower Nooksack River in 1887, and is likely to have been on the lower Nooksack River when the Engineers' snagboat worked there in 1886. Gilbert confirms the Lummi River was much larger than the Nooksack until

the middle of the 19th century. But Gilbert makes an observation that does not appear in Captain Symons' report or in the Army-commissioned history of the Seattle District (Willingham 1992):

> "One of the oldest Indians is authority for the statement that within his memory, the River had but one outlet, and that there was a much used Indian Trail along the course of the present outlet from Lummi Slough to Lummi Village—that a great fresh [flood] caused the river to cut a new channel across the marshes, following the course marked out by the trail…*When the U. S. snag boat operated on this river in 1886, it filled the outlet of Lummi Slough with snags, and now, at low stages of the river no water enters the slough* [italics added]."

This account suggests that a natural avulsion was made permanent by the Army Engineers when they plugged the Lummi River in 1886. The map record is consistent with Gilbert's statement. Gilbert's map has an 1887 publication date, but was probably made in the months prior to the September 1886 visit by the Army's snagboat. It shows the Lummi River as a viable channel in 1886, approximately equal in size to the Nooksack, with a small amount of drift symbolized in the channel's upper end.

Nooksack-Lummi delta estuarine wetlands

LUM3801E01 Lummi Delta estuarine emergent wetland
LUM3801E02 Lummi Delta estuarine scrub-shrub wetland

While sea dikes had already been placed within 50-100m of the shoreline by survey of T-1871 in 1888, "salt marsh" symbology was used for the area we map as estuarine wetland. The PLS had surveyed the area in summer 1859, and again in October 1873. The second survey included lines along 1/16-section boundaries because it was carried out in the Lummi Indian Reservation. We used the survey line notes and bearing tree records to delineate emergent from scrub-shrub wetland.

The following excerpts are from notes of two PLS surveys (the first in August 1859 and the second in October 1873) within the area we mapped as estuarine emergent wetland:

> South between **S. 14** and **S. 15** T38NR1E: "Through an open grass flat." The line summary adds: "Land level grass flat, good soil, but subject to overflow at extreme high tides;" then on October 2, 1873 "Land low tide prairie, subject to overflow of 3 ft" (October 22, 1859).
>
> West between **S. 11** and **S. 14**, T38NR1E: "Land level, low and wet, and with the exception of the last 20 chains, covered with willow and crabapple. Soil good but subject to overflow at extreme high tides" (August 22, 1859).
>
> Between **S. 10** and **S. 15**, T38NR1E: "Overflowed at extreme high tides. It produces good grass. Timber a few dead willows" and on October 3, 1873 "Land low tide prairie, subject to heavy overflow" (August 22, 1859).
>
> Through the south ½ of **S. 10**, T38NR1E: "Wet tide prairie subject to overflow of 2 to 3½ feet" (October 8, 1873). Through the center of **S. 10** on the same day, "…low tide prairie subject to overflow of 18 in. to 3 ft."

Lines entirely within the area we mapped as estuarine scrub-shrub include:

> Between **S. 2** and **S. 11**, T38NR1E: "…tide prairie. Subject to overflow of 18 in. to 2 ft" (October 4, 1873).
>
> Between **S. 11** and **S. 12**, T38NR1E: "Low and swampy…willow and crabapple" (August 22, 1859).
>
> Between **S. 3** and **S. 10**, T38NR1E: "Land except West 15 chains. Tide prairie with scattering crab apple" (October 8, 1873).
>
> East through the north ½ of **S. 12**, T38NR1E: "Land low bottom subject to overflow. Scattering spruce and cedar timber. Undergrowth Willow and Hemlock" (September 22, 1873).
>
> Through the north ½ of **S. 11**, T38NR1E, "…subject to light overflow…" (October 4, 1873).

Survey lines that cross through our mapped boundary between emergent and scrub-shrub vegetation include:

> Between **S. 10** and **S. 11**, T38NR1E, "Subject to overflow of 18 in to 2 ft" (October 3, 1873).
>
> Through the center of **S. 11**, T38NR1E, "…tide prairie subject to overflow of 12 in. to 18 in." (October 4, 1873).
>
> Through the north ½ of **S. 10**, T38NR1E, "Tide prairie subject to light overflow" (October 9, 1873).

NKS3802E01 Nooksack Delta estuarine emergent wetland

Mapped from T-1798 (1887), which shows a small amount of saltmarsh in the Nooksack River delta. This was corroborated by PLS line description from 1859:

> North between **S. 7** and **S. 8**, T38NR2E [as they leave the area we map as estuarine wetland] "At 6 chains leave tide prairie and enter willow brush" and "at 23 chains enter rushes with little water" and at 28.5 chains the south bank of the Nooksack River. The line description is "Land level and subject to overflow (but to no great depth). No timber. Covered with willow, grass, rushes, and crabapple" (July 7, 1859).

This line description includes the area north of the river, which we map as wetland. Immediately upstream of the mapped emergent wetland we map a 103 ha map unit of "scrub shrub," which we did not map as wetland; the symbol used on T-1798 in that era signified "Woods of any kind (or leaved trees)" and is distinct from the symbols used to describe coniferous forests elsewhere on the sheet.

Additional PLS line descriptions in this unit:

> East between **S. 7** and **S. 18**, T38NR2E: at 20 chains "enter willow bottom" (October 21, 1873). West between S. 7 and S. 18 at 40.5 chains "enter hardhack and willow" (July 7, 1859).

East through the center of **S. 18**, at 27 chains "enter willow bottom" and at 38.5 chains "the beach" (October 20, 1873).

The 1938 aerial photographs don't provide useful clues (e.g. relict tidal channels) because of the extent of deltaic progradation between the 1870s and 1938. While it is possible that the area was an estuarine or scrub-shrub wetland by today's criteria, in keeping with the USC&GS chart and the written descriptions by the PLS, we have mapped the area as simply scrub-shrub. Finally, USC&GS sheet T-1798 (surveyed 1887) shows a "Lummi village" in the NE ¼ of the NW ¼ of S. 18 (T38NR2E), which also supports the interpretation that the area was not a wetland.

The 1859 PLS survey also crosses a portion of the feature along the line between **S. 8** and **S. 17:**

West between **S. 8** and **S. 17** at 21.5 chains "Enter swamp N & S." At 28.5 chains "Leave swamp & enter Prairie N. W. & S. E." (July 7, 1859).

The "swamp" corresponds to a portion of riverine-tidal wetland NKS3802E02 (see below). The border between swamp and prairie corresponds with the boundary on T-1798 between scrub/deciduous forest and fenced grassland. We have used the shape of the grassland as the limit of emergent marsh.

NKS3802E02 Nooksack Delta estuarine scrub-shrub wetland

We map two areas of estuarine scrub-shrub wetland: (1) east of the Nooksack River, and (2) west of the river.

(1) East of Nooksack River: In the western part of this feature, the 1859 PLS survey:

North between **S. 7** and **S. 8**, at 6.00 chains [120 m] "Leave tide prairie & enter willow brush" (July 19, 1859).

Up to 166 m, the 1859 plat map (T38NR02EA) shows marsh symbols, and then a heavy dashed line with no marsh symbols to the north. The dashed line separating the marsh symbol from no symbol extends about 250 m to the east-northeast. This area corresponds with a scrub or deciduous forest symbol on T-1798 (1887). Almost three decades separates the two surveys, and the delta prograded in the intervening time, making it possible that the earlier estuarine emergent marsh ("tide prairie") had become brushier in the intervening time. Alternatively T-1798 mapped as scrub or deciduous forest what was at the time scrub-shrub wetland. We have mapped an approximately 100m wide band of estuarine emergent scrub-shrub wetland, corresponding with the scrub symbol on T-1798, and corresponding with the marsh symbol on the 1859 plat map.

The eastern part of the feature is not ambiguous. T-1798 shows saltmarsh. USGS Blaine (1906) also maps this area as tidal marsh. In addition, the blind tidal channels we have mapped, from 1933 photos; apparently closed by dikes near the network's mouth in T-1798), extends throughout this eastern part of the wetland feature.

(2) West of Nooksack River: This feature is part of the large area mapped as wetland on T-1798, which extends landward as NKS3802E02, riverine-tidal wetland (see below). The area that we have mapped as estuarine scrub-shrub wetland is mapped as tidal wetland on USGS topographic map Blaine (1906). The 1859 PLS survey crosses the

southern part of this feature:

> West between **S. 7** and **S. 18**, at 40.5 chains “hard hack & willow brush” (July 19, 1859).

Sandy Point

SDY3801E04 Sandy Point estuarine emergent wetland

Mapped from T-1871 (1888), and PLS line notes. Primarily estuarine wetland with grassland (presumably largely sand dunes) fringing the southern and western margin.

PLS survey line:

> South between **S. 8** and **S. 9**, T38NR1E, “At 8.39 chains leave swamp and enter grass flat…Thence across mud flat.” Line summary includes, “ Land level, soil 3rd rate. Prairie of good grass but unsuited to agriculture” (August 24, 1859).
>
> Line summary made identically for the lines between **S. 9** and **S. 16**, between **S. 8** and **S. 17**, and between **S. 10** and **S. 17**: “Level prairie, soil gravelly and 3rd rate. Good grass cover.”

SDY3801E05 Wetland north of Sandy Point

PLS notes:

> West between **S. 4** and **S. 9**, T38NR1E at 61 chains “A willow and hardhack swamp course North and South.” At 62.94 chains “The swamp being impassable…” The line summary includes: “marsh subject to overflow in high water of 2 to 3 ft.” (September 9, 1873).
>
> West between **S. 5** and **S. 8**, begin in “a dense swamp.” Line summary: “Through a hard hack and crab apple swamp. Soil 1st rate, dry in summer and wet in winter [underlining added]” (August 24, 1859).

About one-fourth of the area was mapped as wetland on the Blaine 1907 quadrangle.

Nooksack-Lummi delta riverine-tidal wetlands

T-1798 (1887) and T-1871 (1888) use symbols that distinguish freshwater marsh and saltmarsh. The southern part of NKS3802E02 is within T-1798 and is mapped as fresh marsh. The USGS 15’ Blaine 1907 topographic sheet also shows the difference between saltmarsh and freshwater marsh. We used the PLS field notes, hydric soils, and high-resolution DEM to refine boundaries shown on the other two map sources.

The PLS bearing tree record indicates that trees were small and very widely spaced. Six of 39 survey points lacked nearby bearing trees. Of those with trees, the average distance from them to the survey point was 39 m. More than one-half of bearing trees (38 of 68) were willow, which averaged 13 cm in diameter. Crabapple (16 of 68) and alder (10 of 68) were the other common bearing trees. Riverine-tidal wetlands had a species distribution similar to that in estuarine wetlands, with the addition of maple (bigleaf maple, *Acer macrophyllum*) and cedar (western redcedar, *Thuja plicata*), although the sample

size is small. The tree cover was nearly as patchy and sparse as in the estuarine scrub-shrub wetland.

PLS field notes from summer 1859 suggest that at least part of this Nooksack-side wetland was inundated in summer. The Bellingham Bay side may have been wetter in summer than the Lummi side. This speculation is based in part on topography—the Bellingham Bay side wetland would probably have been lower in elevation than that of the terrain downstream, fronting Bellingham Bay which would have hindered drainage—and based on the rendering of wetlands on the delta on the Blaine 1907 USGS topographic map. The Blaine Quadrangle depicts about 60% of the area we map as riverine-tidal wetland in the Bellingham Bay with a wetland symbol. That none of the Lummi Bay side riverine-tidal wetland was depicted as wetland may reflect the effects of early diking (the Blaine 1907 quadrangle does not show diking, but does show roads along the Lummi River), or it may reflect drier conditions. The PLS notes indicate that both marshes are subject to inundation by 2-5 feet of water in the winter, which is comparable to the current relief in the marsh area.

LUM3801E03 Riverine-ridal scrub-shrub wetland
LUM3902E01 Riverine-ridal scrub-shrub wetland

Line notes from PLS survey:

> Through the S ½ of **S. 2**, T38NR1E, "Land level bottom subject to overflow of 2 to 4 ft [underlining added]. Timber spruce and alder. Undergrowth Willow and Rose bush" (October 6, 1873).
>
> Through the center of **S. 2**, "Land level bottom except West 10 chs. Subject to overflow of 1 to 3 ft. [underlining added] and covered with Willow thicket" (October 7, 1873).
>
> On same day, east through the north ½ of **S. 2**, "[at 23.5 chains] Enter bottom," then "[at 37 chains] Open marsh brs. [bears] N. E. and S. W.," and "[at 44.5 chains] Enter Crab Apple thicket." The latter's line description includes "Spruce and Alder…with heavy undergrowth of Willow, Crabapple, and Rose bushes."
>
> North between **S. 1** and **S. 2**, T38NR1E, at 20 chains "Enter swamp bearing NE and W," and the line description is "Land level bottom. All subject to overflow from 2 to 5 ft [underlining added]. Timber spruce, Alder, and Willow. Undergrowth Willow" (September 23, 1873).
>
> Line through the S. ½ of **S. 1**, T38NR1E: "West of river. Swamp covered with Willow & Tule. Subject to overflow of 3 to 5 ft [underlining added]" (September 25, 1873).
>
> Through center of **S. 1**, "West side of river wet swamp covered with Willow & Tule…Timber, Spruce, Cedar and Alder. Undergrowth Willow Hardhack & Raspberry" (September 24, 1873).
>
> Through N ½ of **S. 1** "West of river. Swamp covered with Willow and Tule. Subject to overflow of 3 to 5 ft [underlining added]" (September 25, 1873).
>
> West on north boundary of **S. 1**, T38NR1E, begin "In swamp covered with dense growth of flag Willow and Hardhack. Water in pools [underlining added] …" and

the line is described as “Land, marsh covered with Willow, Hardhack and Tule. …subject to overflow of 2 to 5 ft [underlining added]” (September 10, 1873).

North between **S. 35** and **S. 36**, T39NR1E, at 36.5 chains “Leave marsh & enter dry ground and dead timber” (December 10, 1873).

NKS3802E03 Riverine-ridal scrub-shrub wetland, west of Nooksack River
NKS3802E04 Riverine-ridal scrub-shrub wetland, east of Nooksack River

PLS notes:

South between **S. 5** and **S. 6**, T38NR2E, at 18.5 chains “Open marsh bears West and S. E.” the Line summary: “…subject to overflow from 2 to 4 ft [underlining added]” (October 16, 1873).

North between **S. 5** and **S. 6**, “…high water overflowed the 1st 65 chains“ [underlining added] (July 19, 1859).

North between **S. 4** and **S. 5**, T38NR2E, at 5.5 chains “leave bush and enter open swamp N. E. and S. W.” At 27.2 chains “enter timber E & W.” Ending at 53.4 chains, at the “…edges of an impassable swamp…water from 2 to 4 feet deep [underlining added] and covered with hard hack and willow bush” (July 19, 1859).

Between **S. 5** and **S. 8**, line summary “…subject to overflow to the depth of a foot except along the stream where it is higher [underlining added] …The whole will make good meadow land. Timber, Willow, Crabapple & alder in small clumps” (July 19, 1859).

North between **S. 7** and **S. 8**, T38NR2E at 48.47 chains “…marsh with scattering willow and crabapple” (October 17, 1873).

Through center of **S. 7**, “…covered with Willow and Crabapple” (October 22, 1873).

Through the N ½ of **S. 7** “…marsh covered with scattering clumps of Willow and Crabapple” (October 23, 1873).

Through the south ½ of **S. 6** “…Marsh covered with clumps of Willow and Hardhack. Subject to overflow of 2 to 3 ft [underlining added]” (October 23, 1873).

Through the center of **S. 6**, “Marsh covered with scattering Willow and Hemlock.”

North between **S. 32** and **S. 33** (T39NR02E), “tule marsh” which ends at 20 chains; north of the swamp was a “burn” (October 6, 1871).

Nooksack-Lummi delta palustrine wetlands

NKS3902E03 Tennant Lake area wetland

We map the extent of Tennant Lake from USGS Blaine 1907.

PLS surveyors identify a “swamp” between S. 32 and S. 33, T39NR2E on October 6, 1871. We map the wetland using this information and shape the wetland boundary using hydric soils mapping.

We map two other areas that are not crossed by the PLS survey. The two areas correspond to hydric soils mapping, and to the approximate extent of Tenant Lake/marsh as it appears on 1933 aerial photographs.

The total amount of wetland we have mapped (based on the PLS survey and hydric soils) is considerably less than the amount suggested by modern NWI mapping in this area; the area we have mapped could be a substantial underestimate..

LUM3902E02 Wetland south of Ferndale

The PLS survey:

> North between **S. 29** and **S. 30**, T39NR2E at 68 chains “Enter Hard Hack swamp.” At 80 chains “Corner cannot be established [on account of water] for sections 19, 20, 29, and 30” (October 13, 1871).

The survey in mid-October could either represent late dry season conditions or winter conditions.

USGS Blaine 1907 topographic shows the wetland slightly larger toward the southwest than the PLS map. We used hydric soils mapping and topography to shape the wetland boundary and extended it to the southwest within the wetland within the interior of S. 30.

Lower Nooksack River mainstem

The Nooksack River was relatively straight from approximately RM 5-RM 11 and meandering upstream to approximately RM 24. Upstream to the forks the river historically anastomosed; this section of the mainstem is included with the Nooksack River forks.

Topographic depressions on the lower Nooksack’s floodplain were sites of extensive freshwater wetlands. The bearing tree records that fell within areas mapped as scrub-shrub palustrine wetlands, when grouped together, include about one-half (11 of 23) that lacked any trees near the survey point. At the remaining points, the average tree diameter was only 20 cm, and alder accounted for 42% of trees, the remainder being willow (14%), crabapple, spruce, birch, cedar (11% each), and hemlock (6%). The bearing trees were relatively closely spaced (average distance from survey point of 5.1 m; Figure 13), and their overall distribution suggests that the small trees were patchy and closely spaced within patches.

The field surveys intersected “prairie” areas on the north valley side, near the present-day site of Lynden, which we mapped as “grassland.” Indigenous populations may have created and maintained this forest opening (and likely other, small, unmapped openings) common in other Pacific Northwest environments (e.g., see Boyd 1999), or they may have been natural openings created by wet soils. Floodplain creeks shown are generally the least certain map features. Some channels that existed are probably not shown because they were not shown on early mapping and had been filled by the time of the earliest aerial photos. Other channels that are mapped may not be correctly located, because we reconstructed them from the incomplete traces of relict channels evident on

the early photos. The network of floodplain streams should be viewed as a best estimate from the available sources, but not as a precise or complete representation.

Lower Nooksack River palustrine wetlands (NKS3902E04, NKS3902E05**,** NKS3902E06, NKS3902E07, NKS4002E01, NKS4002E02**,** NKS4003E01, and NKS4003E02).

We mapped all but one of these wetlands (6-ha wetland NKS390207) primarily from PLS field notes (summarized below) and plat maps. We refined wetland boundaries shown on PLS plat maps using hydric soils mapping [USDA-NRCS Soil Survey Geographic Database (SSURGO)], which generally corresponded well with the PLS wetland mapping, and topography. We mapped NKS390207 using SSURGO hydric soils data and topography.

The PLS field surveyors commonly described these marshes as "hardhack swamp," "willow swamp," and "beaver swamp." Surveyors traversed the marshes in T40N R2E in early March 1872, and described several as "impassable," presumably because of standing water, and include notations such as "marsh overflowed in winter to depth of 6 feet." In upstream T40N R3E, surveyed in late November of the same year, notes include "2-4 feet water" and "swamp water."

NKS4002E01 Palustrine wetland

This wetland winds through the west and north side of the river valley between RM 8 and RM 17. The PLS notes are from three different years and times of year:

PLS notes, listed in an upstream-progressing direction:

> East between **S. 9** and **S. 16**, T39NR2E, at 20 chains "Hard Hack and toolie swamp." At 44 chains "Enter willow and alder bottom subject to overflow to the Udepth of 2 to four feet in time of freshets of the riverU [underlining added]" (October 10, 1871).
>
> East between **S. 4** and **S. 9**, T39NR2E, at 27.5 chains "Leave burn and enter Alder & spruce bottom." At 42 chains "Enter Hard Hack marsh." At 62 chains, "Leave marsh and enter willow bottom." Line summary: "Land in bottom Usubject to overflow 2 to 4 feet in winterU [underlining added]" (October 10, 1871).
>
> North between **S. 3** and **S. 4**, T39NR2E, at 24 chains "Enter crabapple and willow bottom which is Usubject to overflow in time of freshets to the depth of 4 to 6 feetU [underlining added]." At 33.5 chains "The land becomes higher and is not subject to overflow." At 41 chains "Enter bottom again Usubject to overflowU [underlining added]." At 60.7 chains "A Ulake with swamp beyond being impassable U[underlining added]" (October 6, 1871).
>
> North between **S. 34** and **S. 35**, T40NR2E, at 45 chains "Willow swamp bears E & W Uwater 2 feet deepU [underlining added]." A "lagoon" between 64.79 chains and 74.59 chains (March 10, 1873).
>
> East between **S. 26** and **S. 35**, T40NR2E, at 10 chains "Ua swamp water 18 in. deepU [underlining added]" (March 10, 1873).
>
> "The corner to sections **25, 26, 35 & 36** [of T40NR2E] which it is Uimpossible to establish on account of water U[underlining added]…Usubject to overflow of 2 to

8 feetU [underlining added] …Timber Willow, Alder & Spruce. Undergrowth Vine Maple & hardhack" (March 5, 1873).

West on the north boundary of **S. 4**, T39NR2E, at 7 chains "Leave belt of timber 150 links wide…and enter swamp of hardhack and willows." At 11.5 chains, "Leave swamp water from 1 to 3 feet deep & enter skunk cabbage swamp." At 19.25 chains, "Leave swamp" (August 7, 1859).

East between **S. 34**, **T40NR2E** and **S. 3**, T39NR2E, line summary: "Land level and unfit for settlement or cultivation Ubeing overflowed by the water of the Nootsahk RiverU [underlining added]. Timber Alder, with Hardhack undergrowth" (August 7, 1859).

South between **S. 33** and **S. 34**, T40NR2E, at 40.5 chains "Swamp covered with hardhack and willow. UWater 2 to 3 feet deep rendering it impassibleU [underlining added]."

North between **S. 34** and **S. 35**, T40NR2E, at 45 chains "Willow Swamp bears E & W water 2 feet deep." At 64.79 chains, "Lagoon bears E & W" and at 74.59, the "North shore Lagoon." At 79 chains, "Dry land. Enter Fir & Cedar Timber." The line summary: "USubject to overflow of 2 to 8 feetU [underlining added]" (March 10, 1873).

East between **S. 35** and **S. 26**, at 10 chains "Swamp water 18 in deep" (March 10, 1873).

North between **S. 35** and **S. 36**, at 55 chains "Water 2 to 3 feet deep." At 80 chains, "The Corner to sections 25, 26, 35 & 36 which it is impossible to establish on account of water. Land…subject to overflow of 2 to 8 feet" (March 5, 1873).

Between **S. 25** and **S. 36**, line summary: "Land level subject to overflow of 2 to 8 feet….Timber Spruce, Cottonwood and Alder. Undergrowth Vine Maple, Willow and Hardhack" (March 5, 1870).

North between **S. 25**, T40NR2E and **S. 30**, at 27 chains "A wet prairie extending 10 chains to the north and as far as can be seen for the brush to the eastward." At 34 chains "Leave wet prairie, [illegible] hard hack swamp, with from 2 to 4 feet of water." At 40 chains "The quarter section post falls in the swamp." At 58 chains "A Slough runs west just between a beaver dam." At 58.66 chains "Leave slough and hard hack swamp" (August 6, 1859).

NKS3902E04 Palustrine wetland

PLS notes:

East between **S. 16** and **S. 21** (T39NR2E), at 36.25 chains "Enter swamp. At 55 chains "Leave swamp and enter burn." Line summary: "Land on west side [of the Nooksack River] subject to overflow in time of freshet to the depth of 2 to 4 feet [underlining added]" (October 9, 1871).

North between **S. 20** and **S. 21**, at 39 chains "Enter crabapple and willow swamp." At 53 chains "Leave swamp and enter alder and vine maple bottom" (October 9, 1871).

NKS3902E05 Palustrine wetland

PLS notes:

North between **S. 9** and **S. 10**, T39NR2E, at 30 chains "Enter swamp covered with Hard hack flags & grass." At 37.7 chains "A lake it being impassable [underlining added];" the lake mentioned is shown on the plat map and appears in our mapping. At 60 chains "Leave swamp and enter [illegible] Alder bottom" (October 5, 1871).

NKS3902E07 Palustrine wetland

PLS notes:

North between **S. 3** and **S. 2**, T39NR2E, at 71 chains "Enter Hard Hack swamp." Then "The corner to sections 2, 3, 34, and 35 cannot be established [due to water; underlining added]" (October 4, 1871).

West between **S.2** (T29NR2E) and **S. 35** (T40NR2E), at 40 chains " …swamp overflowed in winter…Enter marsh overflowed in winter to a depth of 6 feet [underlining added] with a dense growth of hardhack & alders" (August 5, 1859).

North between **S. 34** and **S. 35**, start in "hardhack swamp water 3 feet deep" and at 5 chains "Enter Spruce & Cedar Timber" (March 10, 1873).

NKS3902E02 Palustrine wetland

PLS notes:

North between **S. 30** and **S. 29**, T40NR2E, at 17 chains "Enter open marsh" until 42.5 chains (March 27, 1873).

NKS4003E01 Palustrine wetland

The feature has been drawn from PLS notes and plat map, with minor shaping of the margins using topography. The wetland is elongate in an east-west direction, on the south valley side. PLS surveyors describe "willow and hardhack swamp" and "beaver swamp."

PLS notes:

North between **S. 31**, T40NR3E, and **S. 36**, T40NR2E, at 30 chains "Enter bottom land." Line summary: "Land for the 1st 30 chs. level, 3rd rate…For the balance, overflowed bottom land with hard hack, Crabapple, and alder thickets. At high water the land is I should judge overflowed to a depth of six feet [underlining added]" (August 4, 1859).

North between **S. 31** and **S. 32**, T40NR3E, "[at 50 chains] enter swamp water 2 feet deep [underlining added]" (December 4, 1872).

Between **S. 29** and **S. 32**, T40NR3E, begin "enter swamp." At 40 chains " Enter willow and hard hack swamp." Line summary: "The corner to Sections 29, 30, 31,

& 32. Land swamp covered with willow and hardhack. Water 2 to 3 feet deep [underlining added]. Soil 1st rate" (December 4, 1872).

North between **S. 29** and **S. 30**: "Enter Willow swamp water 2 feet deep." At 10 chains: "Enter Crabapple and Willow bottom" (December 5, 1872).

North between **S. 29** and **S. 28**, T40NR3E, at 30 chains "Leave Willow bottom. Enter Alder bottom bears E & W." (Nov. 30, 1872).

North between **S. 32** and **S. 33**, T40NR3E, at 60 chains "Enter burnt bottom bears E & W." At 70 chains "Enter beaver swamp [underlining added] bears E & NW." The line description (which could include land south of the wetland) indicates "Timber Fir Cedar and Alder. Undergrowth Crabapple and Willow."

East between **S. 33** and **S. 28**, T40NR3E, at 25 chains, "Leave beaver swamp. Enter [illegible] SE & NW." At 36 chains "Enter Willow Swamp brs North & South." At 70 chains "Enter burn brs NW and SE" (Nov. 29, 1872).

North between **S. 33** and **S. 34**, T40NR3E, at 50 chains "enter beaver swamp [underlining added], bears E & W." At 75 chains "Leave swamp enter burn" on November 25, 1872.

Between **S. 34** and **S. 27**, T40NR3E, at 5 chains "enter willow bottom." Line summary: "Land level. Soil 1st rate. Timber Alder Willow and Crabapple" (November 26, 1872).

East between **S. 26** and **S. 35**, T40NR3E, "Enter Wet Bottom." At 25 chains "Enter burned Alder bottom." At 35 chains "Enter open burn" (Nov. 21, 1872).

North between **S. 26** and **S. 27**, T40NR3E, at 30 chains "Leave swamp. Enter Cottonwood Bottom" (Nov 21, 1872).

Between **S. 34** and **S. 35**, T40NR3E, begin "Enter spruce swamp." At 10 chains "Enter burn." At 50 chains "Enter spruce swamp." Line summary: "Land level. Soil 1st rate. Timber Fir Cedar and Spruce. Undergrowth Hard Hack and Willow" (Nov. 22, 1872).

North between **S. 35** and **S. 36**, T40NR3E, at 13 chains "Enter Wet bottom bears E and W." At 30 chains "Enter Swamp water one foot deep" (Nov. 16, 1872).

NKS4003E02 Palustrine wetland

Mapped from 1872 PLS records. Shape of boundary was drawn using lidar DEM and hydric soils. The extent of hydric soils is greater than the area we mappe. Described as a "swamp," in one instance an "alder swamp." It was "subject to overflow" of 1 to 6 feet, with water 1-2 feet deep in November 1872.

PLS survey notes:

North between **S. 21** and **S. 22**, T40NR3E, at 35 chains "enter swamp bears E & W. Water from 1 to 2 feet deep [underlining added]." Line summary: "Land subject to overflow from 2 to 6 feet deep [underlining added]. Soil 1st rate. Timber balm alder and maple. Undergrowth Hard Hack and Maple." This line description

includes land in the 35 chains south of the “swamp” (November 27, 1872).

East between **S. 15** and **S. 22**, T40NR3E, begin “Enter swamp water from 2 to 6 feet deep [underlining added].” At 65 chains, “enter spruce and Hemlock bottom. Water from 1 to 2 feet deep [underlining added].”

North between **S. 15** and **S. 16**, at 3 chains “Leave swamp Enter Prairie brs SE and SW” (Nov. 27, 1872).

North between **S. 22** and **S. 23**, crossing a small lobe of the wetland, at 30 chains “enter Alder Swamp bears E and W.” At 47.5 chains “Leave overflowed land [underlining added] Enter Fir and Cedar timbers bears E and W” (Nov. 22, 1872).

Mapping a “prairie” adjacent to the wetland:

North between **S. 16** and **S. 15**, at 3 chains “Leave swamp Enter Prairie.” At 25 chains “Leave prairie and enter timber…” (Nov. 27, 1872).

East between **S. 16** and **S. 21**, at 30 chains, leave “Fir timber” and “Enter prairie.” At 70 chains “Enter swamp.”

Upper Nooksack mainstem and Nooksack River Forks

The Upper Nooksack River historically had an anastomosing pattern upstream of Everson. Such a pattern has been associated elsewhere with the effects of wood jams. The field descriptions of Assistant Engineer David B. Ogden, writing with an eye to navigability, wrote that the river was shallow and unnavigable upstream of Lynden:

> “…By reference to the maps it will be noticed that there are numerous shoals between Lynden and Everson, making this stretch of river practically unnavigable excepting during times of high water.” (Ogden 1894)

Numerous floodplain sloughs were associated with the river. Smaller sloughs shown on the PLS plat maps were not meandered (field surveyed), making it necessary in some cases to modify their locations using secondary information. In the upper Nooksack and other areas having extensive floodplain sloughs historically (e.g. the North, South and Middle forks), the map representations likely grossly under-represents the number of floodplain sloughs that existed.

The North and South fork valleys both include fans, terraces, and large landslides that in places narrow the valleys. The lower South Fork valley, which has a lower gradient than the forks elsewhere, included an extensive system of wetlands, small channels and ponds in the Black Slough area. The few bearing trees that fall within the wetland complex suggest it was dominantly a spruce-alder swamp. Descriptions in the PLS notes indicate it had “…dense timber and thick undergrowth” and was “swamp covered with skunk cabbage and very dense thickets of spruce and crabapple” (see Appendix 1 for more information).

As indicated above for the upper Nooksack, for each of the forks, it can be assumed that many of the floodplain sloughs and tributary creeks that likely existed are not shown. Forested floodplains such as those of the three forks typically have many small sloughs and tributaries, and the PLS mapping was at too course of a scale to intersect all of them,

and relatively few relict channels were evident on the 1938 photos because of the relatively rapid rate of migration and avulsion in the braided North Fork and Middle Fork.

NKS3904E01 Palustrine wetland

The PLS surveyors mention the area as “swamp” between 46 chains and 60 chains, northward between **S. 19** and **S. 20**, T39NR4E. Wetland is not evident in the 1938 photographs, when part of the area is under cultivation and part has been logged. It is mapped as shown on the plat map.

NKS3805E01 Black Slough area palustrine wetland

The lower South Fork valley, which has a lower gradient than the forks elsewhere, included an extensive system of wetlands, small channels and ponds in the Black Slough area.

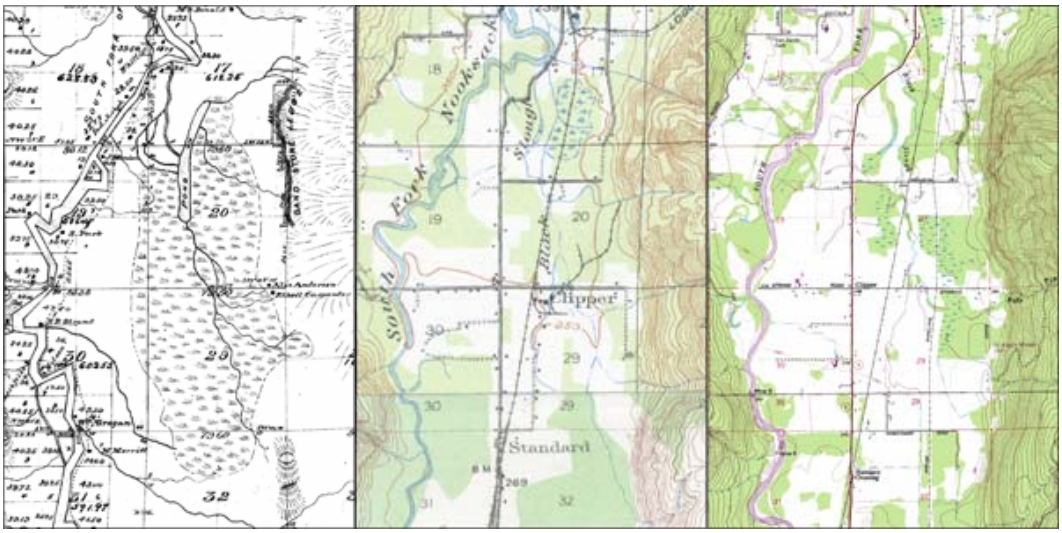

Figure 2. PLS map of wetland in South Fork Nooksack, 1885 (left panel); on 1918 USGS Van Zandt topographic map (center panel); recent USGS topographic map (right panel). Town of Van Zandt is near top center of map.

Mapped primarily from 1885 PLS survey and in northern end of feature, USGS Van Zandt 1918 topographic map (Figure 2). The few bearing trees that fall within the wetland complex suggest it was dominantly a spruce-alder swamp. Descriptions in the PLS notes confirm this, describing “…dense timber and thick undergrowth” and “swamp covered with skunk cabbage and very dense thickets of spruce and crabapple.”

PLS notes:

> North between **S. 29** and **S. 30**, T38NR5E, at 33 chains distance “Enter swamp covered with skunk cabbage and very dense thickets of spruce and crabapple.” Line summary: “Timber alder, cedar, spruce & maple very dense. Undergrowth same with skunk cabbage, vine maple and crabapple very thick” (May 9, 1885).

West between **S. 20** and **S. 29**, T38NR5E, at 13.8 chains “Enter swamp bears SE & NW.” Line summary: “Timber Alder, Cedar and spruce, very dense. Undergrowth [illegible] with vine maple and crabapple very thick” (May 9, 1885).

West between **S. 17** and **S. 20**, at 28.5 chains “Enter swamp bears N. W. and S. E.” Line summary: “Timber Alder and spruce very dense. Undergrowth same, with vine maple and crabapple very thick” (May 11, 1885).

North between **S. 19** and **S. 20**, begin “Along edge of swamp, through dense timber and thick undergrowth.” At 67 chains “Leave swamp bears E & W.” Line summary: “Land low and swampy…Timber alder, cedar, spruce, and maple, very dense. Undergrowth vine maple, skunk cabbage, and crabapple very thick” (May 10, 1885).

East between **S. 19** and **S. 30**, at 70 chains “Enter swamp bears N & S.” (May 10, 1885).

West between **S. 29** and **S. 32**, line summary: “Land low. Soil A.1. Timber Alder, cedar, maple and spruce very dense. Undergrowth same, with vine maple and crabapple very thick” (May 7, 1885).

NKS3805E02 Palustrine wetland

This wetland was not crossed by the PLS survey. It is a forested wetland on recent Deming USGS quadrangle.

Skagit-Samish River Deltas

Skip ahead to:

- Samish River delta
- Olympia Marsh and wetlands bayward of Olympia Marsh
- Wetlands draining toward Samish Bay at distal end of lahar terrace
- Padilla Bay, Swinomish Slough, and Sullivan Slough estuarine wetlands
- Beaver Marsh
- Wetlands north and east of Beaver Marsh (Skagit Flats)
- Fir Island
- East of Fir Island
- Skagit River between Mount Vernon and Burlington
- Sedro Woolley area lahar terrace

Samish River delta

SAM3503E02 Samish Bay estuarine emergent wetlands
SAM3503E03 Samish Bay palustrine forested wetlands

The Samish Bay estuarine wetlands (SAM3503E02) had been diked prior to T-1795 (1887) and T-1746 (1886). The PLS survey was carried out in 1872, prior diking. The extent of "tide prairie" noted by PLS surveyors (see field note excerpts below) generally correspond well with "grassland" symbol on T-sheets. Additionally, near section lines, the boundary between grassland and forest symbols corresponds with lines drawn on the PLS maps that indicate the upper edge of "tide prairie;" the correspondence is poor within section interiors (where PLS surveyors would have estimated the line's location). At section lines we mapped the extent of estuarine marsh by giving precedence to the PLS surveyors' noting of the presence or absence of tide prairie. Between section lines we used the grassland-forest boundary on T-sheets, and elevation, in that order.

We also mapped small areas of palustrine forested wetland (SAM3503E03) to the north and south of higher-elevation fingers of land (late Holocene fluvial deposition). The evidence for these wetlands is lower than for the estuarine wetlands. They were mapped using: (1) the presence of "wooded marsh" symbol on T-1746 (1886) in the southern lobe of this unit; T-1746 only covers the western part of this lobe; (2) The PLS surveys describe these areas along two lines as "Spruce timber with Crabapple undergrowth" (between S. 4 and S. 9), "Crabapple thicket" and "scattering Spruce and Cedar. Undergrowth Crabapple and Willow" (between S. 7 and S. 8); (3) Elevation.

PLS note excerpts:

> North between **S. 27** and **S. 28**, T36NR3E, at 2 chains "Enter tide prairie." At 60 chains "Enter timber" (March 29, 1872).
>
> East between **S. 22** and **S. 27**, beginning in "Cedar and spruce timber." At 35 chains "Enter tide prairie" (March 30, 1872).
>
> North between **S. 32** and **S. 33**: "Marshy tide prairie, subject to overflow by the highest tides to the depth of two to four feet" (April 23, 1872).

West between **S. 28** and **S. 33**, at 5 chains “Leave timber and enter tide prairie.” Line summary: “Tide prairie subject to overflow by the highest tides to the depth of 2 to 3 feet” (April 23, 1872).

North between **S. 33** and **S. 34**, begin in “Spruce and cedar bottom.” At 47 chains “Enter tide prairie” (March 28, 1872).

East between **S. 27** and **S. 34**, begin in “Thick bushes and Timber” (March 29, 1872).

West between **S. 21** and **S. 28**, at 4 chains “Enter tide prairie.” Line summary: “Land tide prairie subject to overflow by the highest tides” (April 2, 1872).

North between **S. 21** and **S. 22**, at 6 chains “Enter tide prairie.” At 65.18 chains “Leave tide prairie and begin to ascend mountain” (March 30, 1872).

East between **S. 6**, T35NR3E, and **S. 31**, T36NR3E, line summary: “Land tide prairie subject to overflow by extreme high tides producing salt grass. Soil 1st rate if reclaimed by diking” (October 3, 1870).

East between **S. 5**, T35NR3E, and **S. 32**, T36NR3E, line summary: “Land tide prairie subject to overflow by high tides but producing good grass” (October 3, 1872).

North between **S. 7** and **S. 8**, at 22.5 chains “Leave bottom, enter Crabapple thicket.” Line summary: “Rich bottom land. Timber scattering Spruce and Cedar. Undergrowth Crabapple and Willow” (November 6, 1870).

North between **S. 8** and **S. 9**, at 60 chains “Leave timber and enter tide prairie bearing E & W.” Line summary: “Land level. Soil in timber rich bottom; in priarie rich soil subject to overflow by high tides but can be reclaimed by dyking. Timber Fir, Cedar, Spruce, and Alder. Undergrowth Vine maple, Crabapple, Rosebrush & Gooseberry” (October 27, 1870).

East between **S. 4** and **S. 9**, T35NR3E, at 24 chains “Leave tide prairie and enter Spruce timber with Crabapple undergrowth” (October 31, 1870).

East between **S. 5** and **S. 8**, line summary: “Soil rich tide prairie subject to overflow by high tides but producing good grass and easily dyked” (November 3, 1870).

West between **S. 18** and **S. 19**, at 2.5 chains “Leave timber & enter tide prairie bearing NW & SE.” At 22 chains “Foot of steep bluff.” At 50 chains “Foot of bluff and enter tide prairie” (November 1, 1870).

North between **S. 5** and **S. 6**, line summary: “Soil rich tide prairie subject to overflow but easily reclaimed by dyking” (November 3, 1870).

West between **S. 6** and **S. 7**, at 3.5 chains “Enter burnt timber.” At 20 chains “Leave timber and enter tide prairie.” Line summary: “Soil 1st rate level subject to overflow by high tides producing rich grass” (November 3, 1870).

North between **S. 7**, T35NR3E, and **S. 12**, T35NR2E, at 9.57 chains “Strike tide prairie…”

North between **S. 1**, T35NR3E, and **S. 6**, T35NR2E, line summary “grass prairie.”

North between **S. 7** and **S. 8**, at 22.5 chains “Leave bottom, enter Crabapple thicket.” Line summary: “Rich bottom level. Timber scattering spruce and cedar. Undergrowth Crabapple and willow” (November 3, 1870).

North between **S. 17** and **S. 18**, at 8 chains “Enter timber.” At 32.5 chains “Alder bottom.” Line summary: “Timber on south half mile, Cedar, Spruce and Alder. On north half mile, Alder, undergrowth Crabapple, Rosebrush, and salmonberry” (November 2, 1870).

West between **S. 7** and **S. 18**, T35NR3E, at 32.5 chains “Leave alder bottom, enter tide prairie.” Line summary: “Soil rich tide prairie and alder bottoms. Timber small alder and Crabapple. Undergrowth Hardhack and Rosebrush” (November 2, 1870).

Samish River

The Samish River consisted of multiple threads and had numerous beaver ponds. As described by the PLS survey:

North between **S. 15** and **S. 16** at 37.75 chains: “A stream 10 lks wide. From this point for a distance of 9.00 chs it is a succession of small streams the general course of them being [illegible] being the waters of Samish River which is thrown out of its channels by beaver dams” (October 21, 1870).

North between **S. 14** and **S. 15**, at 27.75 chains, “ a stream 10 lks wide bearing NW,” at 29.25 chains “A [stream] 15 lks {wide, bearing NW],” at 30.25 chains “A [stream] 25 lks {wide, bearing NW],” at 36.00 chains “A [stream] 10 lks {wide, bearing NW],” at 38.00 chains “A [stream] 30 lks {wide, bearing NW]” and “all of these streams are the waters of the Samish River which is thrown out of the channel by beaver dams” October 15, 1870).

East between **S. 9** and **S. 16**, at 0.75 chains “Samish River still in several channels but all join in one 5.00 chs below here;” at 15.00 chains, “The most eastern stream” (October 27, 1870).

The river was described in its condition prior to being cleared for log drives:

“Since no logs had ever been driven down the Samish River before, E. E. and Milbourne Watkinson began the backbreaking task of cleaning out the river which was then a network of sloughs, islands and jams with no main channel…Islands were cleared of brushy which was towed ashore on a slab raft and burned…the river was cleared from about 2 miles above Alien to saltwater” (Jordon 1962, in Sedell and Duvall 1985).

The PLS map shows these multiple channels schematically. Their topographic trace is not obvious on 1937 photographs or lidar. Consequently for the most part we show the river as a single thread.

SAM3503E04 Wetland south of Bow

PLS survey note excerpt:

> East between **S. 2** and **S. 11**, T35NR3E, at 55 chains "…swamp covered with Hardhack brush bears N and S." At 70 chains "leave swamp" (October 17, 1870).

The Samish Lake 1917 USGS 15' topographic map shows the wetland with boundaries roughly as we have drawn this unit. Most of the map unit also corresponds to Mukilteo Muck, an organic soil.

SAM3603E01 Wetland north of Bow

This unit was mapped by modifying the boundaries of wetland shown on PLS plat map using lidar and hydric soils. PLS survey notes:

> North between **S. 34** and **S. 35**, T36NR3E: at 12 chains "Enter spruce and crabapple Swamp Covered with water to the depth of one to two feet [underlining added]." At 70 chains "Leave swamp and enter cedar bottom." Line summary: "Land level. Timber crabapple, Willow and spruce" (March 25, 1872).

> East between **S. 27** and **S. 34**: beginning in "Thick bushes and Timber." At 54.54 chains "The lake or lagoon. Water 18 in. deep [underlining added]." At 79 chains "Leave lake and enter cedar bottom."

Olympia Marsh and wetlands bayward of Olympia Marsh

SAM3503E06 Olympia Marsh

More than half of PLS survey corners or quarter corners in SAM3503E06 (9 of 15) lacked any trees, and the surface was too wet for surveyors to build a mound at the corner. Spruce (Sitka spruce, *Picea sitchensis*), pine (shore pine, *Pinus contorta*), willow (*Salix spp.*), and birch (paper birch, *Betula papyrifera*) were the most common bearing trees.

The PLS field notes (below) from autumn and winter indicate the marsh was inundated by several feet of water except in summer. The township description for T35NR3E includes the statement "In the S. E. part of the Tp. [township] is a large marsh extending from NW to SE which is overflowed from the beginning of the wet season until July [underlining added]."

PLS notes:

> North between **S. 36** (T35NR3E) and **S. 31** (T35NR4E), witness tree notes at 40 chains: "Leave timber and enter swamp covered with clumps of willows & hardhack brush." Witness tree notes at 80 chains: "No witness trees at hand, attmpted to make a mound but found the soil a kind of peat with water at the surface. Impossible to make a permanent mound." Line summary: "Land Swampy covered with willow and hardhack brush subject to overflow to the depth

of from two to three feet deep the wet season, but nearly dry in summer [underlining added]" (September 27, 1870).

North between **S. 25** (T35NR3E) and **S. 30** (T35NR4E), witness tree notes at 80 chains: "…impossible to establish [bearing tree post] as no witness trees at hand, and impossible to make a permanent mound. Land swampy subject to overflow. Unfit for cultivation, covered with willow and Hardhack brush" (September 27, 1870).

North between **S. 24** (T35NR3E) and **S. 19** (T35NR4E), at 25 chains "Leave swamp and enter heavy timber" (September 28, 1870).

North between **S. 35** and **S. 36** (T35NR3E), at 15 chains, "Emerge from heavy timber into a swamp covered with Hardhack brush & vines." At 50 chains "Swamp covered with grass and low bushes of Hardhack & swamp willow bears SE & NW." At 80 chains "…no witness trees at hand and the soil a kind of peat with water at the surface of which a permanent mound cannot be made [underlining added]." Line summary: "Soil south of 50 chs. rich and fit for cultivation. North subject to overflow and unfit for cultivation. Timber fir Cedar Spruce Hemlock and Alder. Undergrowth Vine Maple & Salmonberry" (October 6, 1870).

Between **S. 25** and **S. 26**, line summary: "In swamp land subject to overflow and unfit for cultivation. Timber Spruce, Cedar, Fir, Alder and Willow. Undergrowth Hardhack, Salmonberry & Vine Maple" (October 6, 1870).

East between **S. 24** and **S. 25**, T35NR3E, at 5 chains "Leave timber & enter swamp." Line summary: "…soil rich bottom. Timber Cedar Spruce Hemlock Fir Alder & Willow. Undergrowth Willow Hardhack & Vines" (October 12, 1870).

East between **S. 26** and **S. 35**, begin "In swamp." Line summary: "…level swamp subject to overflow from two or three feet deep [underlining added] unfit for cultivation but the soil is rich in edge of swamp covered with willow & crabapple" (October 12, 1870).

North between **S. 26** and **S. 27**, at 49 chains "Set a post for ¼ sec. Is impossible to establish it as no witness trees at hand, and cannot make a permanent mound." At 65 chains "Swamp." At 76 chains, "Timber bearing NW by SE." Line summary: "Soil in timber good, but in swamp subject to overflow" (October 12, 1870).

East between **S. 23** and **S. 26**, at 4 chains "Leave timber and enter swamp bearing N & S." At 15. 5 chains "Timber." At 17.5 chains "Swamp." At 25 chains "Timber." At 29 chains "Swamp." At 56 chains "Timber." Line summary: "Timber Spruce, Cedar, Willow, Alder and Birch. The Swamp covered with thick growth of Hardhack brush" (October 13, 1870).

East between **S. 25** and **S. 36,** bearing tree notes at 40 chains: "impossible to establish this corner as no witness trees at hand and impossible to make a permanent mound." Line summary: "Soil in edge of swamp rich but in center is of a peat formation subject to overflow to an extent which renders it unfit for cultivation" (October 6, 1870).

Lines in T35NR4E were surveyed in February, 1873:

> North between **S. 31** and **S. 32** at 20 chains: “Leave timber. Enter Marsh. Water 1 ft. deep [underlining added].” At 55 chains “Enter timber bears N.W. & S.E.” At 62 chains “Enter swamp again.” At 80 chains: “Water 3 ft. deep [underlining added]. No trees at hand.” Lne summary: “Timber Spruce & Cedar. Undergrowth Willow & Hardhack” (February 12, 1873).
>
> West between **S. 30** and **S. 31**, line summary: “Water 3 feet deep [underlining added]. Timber Spruce & Cedar” (February 13, 1873).
>
> At the midpoint (40 chains) northward between **S. 29** and **S. 30**: “The water being 2 feet deep [underlining added] corner cannot be established. No trees at hand” (February 13, 1873).
>
> West between **S. 19** and **S. 30**, “Water 2 to 3 feet deep [underlining added]. Scattering spruce & Hemlock” (February 14, 1873).
>
> East between **S. 29** and **S. 32**, at 18 chains “Leave swamp, ascend steep hill” (February 13, 1873).

SAM3503E05 Sinuous wetlands west of main Olympia Marsh

These wetlands are in the area bayward of Olympia Marsh and generally drained by the present-day Joe Leary Slough, described in the PLS notes (at 18 chains east, between **S. 22** and **S. 27**, T35NR3E) as a “sluggish stream [illegible word] by beaver dam.”

The wetlands formed in sinuous topography created by former river channels. Because the wetlands were narrow and sinuous and the PLS survey crossed it only along section lines, to map boundaries considerable interpolation was necessary between section lines using hydric soils mapping and lidar.

The PLS field notes:

> North between **S. 26** and **S. 27**, between 65 chains and 76 chains “Swamp.” Line summary: “Land in timber good, but in Swamp subject to overflow [underlining added]” (October 12, 1870).
>
> East between **S. 23** and **S. 26**, at 4 chains “Leave timber and enter swamp bearing N & S.” At 15. 5 chains “Timber.” At 17.5 chains “Swamp.” At 25 chains “Timber.” At 29 chains “Swamp.” At 56 chains “Timber.” Line summary: “Timber Spruce, Cedar, Willow, Alder and Birch. The Swamp covered with thick growth of Hardhack brush” (October 13, 1870).
>
> North between **S. 22** and **S. 23**, at 35.5 chains “Leave timber enter swamp bearing E & W” then at 45.5 chains “Leave swamp enter timber.” Line summary: “Swamp covered with willow Hardhack and crabapple” (October 13, 1870).
>
> East between **S. 22** and **S. 27**, at 61 chains “Swamp covered with hardhack” and at 67.58 chains “Timber bears N & S.” Line summary: “Swamp subject to overflow to the depth of about 12 inches [underlining added]” (October 20, 1870).

East between **S. 15** and **S. 22**, beginning in “Edge of swamp bearing NW & SE.” At 11 chains “Scattering spruce timber” and at 15 chains “Heavy timber” (October 21, 1870).

East between **S. 16** and **S. 21**, at 15 chains, Leave swamp enter low timber.” At 35 chains “Leave timber & enter creek bottom” (October 26, 1870).

North between **S. 16** and **S. 17**, at 1 chain “Enter spruce & cedar land low.” At 10 chains “Enter creek bottom [on plat map this is shown with wetland symbol]” At 15 chains “Stream 50 lks wide runs SW. No current.” At 20 chains “Enter timber” (October 27, 1870).

Wetlands draining toward Samish Bay at distal end of lahar terrace

SAM3504E01 Wetland north and west of Sterling Hill, drains to Olympia Marsh
SAM3504E05 Wetland at distal end of lahar terrace, drains to Graveyard Creek
SAM3504E02 Butler Flat area wetland

These three wetlands form in the ridge and swale topography associated with Holocene channels and natural levees. They are mapped by the PLS and crossed a number of times by the PLS survey. Mapping the boundary of these units within the interior of sections was done by extrapolating from lidar and only locally using hydric soils to extrapolate boundaries between section lines.

PLS field notes for SAM3504E01:

North between **S. 20** and **S. 21**, T35NR4E: at 1 chain “Enter swamp” then at 70 chains “Enter timber.” Line summary includes “Land level Water 2 feet deep [underlining added]…Timber Spruce Willow and Alder” (February 10, 1873).

North between **S. 19** and **S. 20**, T35NR4E, at 40 chains “enter Cedar burn bears E & W” and at 50 chains “Enter Hardhack swamp bears E & W,” at 70 chains “Spruce & cedar bottom” (February 14, 1873).

East between **S. 17** and **S. 20**, at 20 chains “Leave timber enter swamp bears N. E. & S. W.” At 35 chains, “Enter cedar timber” and at 45 chains “Enter swamp bears N & S.” At 70 chains “Enter timber bears N & S” (February 15, 1873).

North between **S. 16** and **S. 17**: at 10 chains “Leave timber Enter swamp bears E & W.” At 45 chains “Enter Swamp again bears E & W.” At 60 chains “Leave swamp brs. E & W Enter Timber bears N. E. & S. W.” (February 11, 1873).

East between **S. 20** and **S. 29**, T35NR4E, begin “Enter swamp water 2 feet deep scattering spruce & cedar [underlining added]” then at 35 chains “Enter open marsh extends 5.00 to the N.” At 50 chains, “Enter spruce & cedar bottom bears N & S” (February 14, 1873).

PLS field notes for SAM3504E05:

North between **S. 21** and **S. 22**, T35NR4E, at 41 chains “Enter Willow & Hardhack Swamp 3 feet deep [underlining added].” Line summary: “Timber Cedar Spruce Hard Hack Alder & Willow” (February 6, 1873).

East between **S. 15** and **S. 22**, T35NR4E, beginning: “Enter swamp” and at 39 chains “Enter Fir & Cedar Timber” (February 6, 1873).

North between **S. 15** and **S. 16**, T35NR4E, at 50 chains “Leave swamp. Enter timber bears E & W.” At 60 chains “Enter swamp bears E & W” (February 7, 1873).

East between **S. 10** and **S. 15**: At 38 chains “Leave swamp enter timber bears N & S.” (February 7, 1873).

North between **S. 9** and **S. 10**, T35NR4E, at 10 chains “Leave swamp. Enter spruce bottom bears E & W” (February 7, 1873).

East between **S. 9** and **S. 16**, T35NR4E, at 27.5 chains “Descend abrubtly into swamp bears NE & SW” (February 11, 1873).

East between **S. 16** and **S. 21**, T35NR4E at 5 chains “Leave Timber Enter Swamp bears N and S. Water 2 feet deep [underlining added].” At 60 chains “Leave swamp enter burn.” Line summary indicates “Timber Cedar & Spruce” (February 10, 1873).

North between **S. 16** and **S. 17** at 10 chains “Leave timber Enter swamp bears E & W.” At 45 chains “Enter Swamp again bears E & W.” At 60 chains “Leave swamp brs. E & W Enter Timber bears N. E. & S. W.” (February 11, 1873).

PLS field notes for SAM3504E02:

Between **S. 18** and **S. 19**, T35NR4E, line summary: “Land level. Water 2 to 3 feet deep [underlining added}. Soil 1st rate. Timber Willow” (February 15, 1873).

North between **S. 17** and **S. 18**, T35NR4E, at 1 chain “Enter Open Marsh.” At 57 chains “Leave Swamp. Ascend abruptly 40 feet.”

The above field notes are from the first half of February, 1873. In about one-half of the area, the notes mention standing water two or three feet deep. The survey lines with standing water correspond to the lower elevation parts of the map unit.

Padilla Bay, Swinomish Slough, and Sullivan Slough estuarine wetlands

PDL3403E04 Padilla Bay and North Swinomish Slough estuarine emergent wetland
PDL3403E05 Padilla Bay and North Swinomish Slough estuarine scrub-shrub wetland
SKG3403E07 Sullivan Slough and South Swinomish Slough estuarine emergent wetland
SKG3303E01 North Side of North Fork estuarine emergent wetland
SKG3303E09 North Side of North Fork estuarine scrub-shrub wetland

The estuarine wetland in Padilla Bay, continuous with the area drained to the south by Sullivan Slough and the Swinomish Slough, was historically by far the largest tract of estuarine wetland in the Puget Sound area. There is strong evidence for mapping it as estuarine emergent marsh: All of the PLS survey lines within the area we mapped as EEM are described as “tide prairie” (see excerpts from PLS survey lines, following this description). In addition, line notes also indicate typical depths of tidal inundation, for example: “1 to 2 feet” [between S. 5 and S. 6, S. 18 and S. 19, S. 30 and S. 31 (all

T34NR3E), S. 31 T34NR3E and S. 6 T33NR3E, and S. 32 T34NR3E and S. 5 T33NR3E], “1 to 3 feet” [betweeen S. 19 and S. 20, S. 30 and S. 29, and S. 20 and S. 29 (all T34NR3E)], “2 or 3 feet” (between S. 5 and S. 6, S. 7 and S. 8, S. 6 and S. 7, S. 31 and S. 32, S. 8 and S. 17, S. 7 and S. 8, S. 29 and S. 32, S. 32 and S. 33, S. 28 and S. 29), “3 or 4 feet” (between S. 18 and S. 19), “1 to 4 feet” (between S. 16 and S. 17).

Evidence is reasonably good for distinguishing estuarine emergent wetland (EEM) from estuarine scrub shrub wetland (ESS). There are several indicators of emergent marsh in the field notes: In addition to “tide prairie,” the line summaries or line notes also indicate “grass and tules” (between S. 31 and S. 32, and S. 32 and S. 33 T34NR3E, and between S. 8 and S. 9 T33NR3E), “grassy prairie” (between S. 18 and S. 19 T34NR3E), “fine grass” (between S. 12 T34NR2E and S. 7 T34NR3E, and S. 25 T34NR2E and S. 30 T34NR3E), “wild rye and tide grass” (between S. 8 and S. 17 T34NR3E). In addition, there were no trees available to serve as bearing trees at corners or quarter corners within the areas we mapped as EEM.

We mapped two relatively small areas of ESS vegetation. One is in the western part of S. 17 and northwestern quarter of S. 20, T34NR3E. The line notes between S. 17 and S. 18 indicate “tule swamp with some scattering spruce and crabapple.” In addition, trees were available to serve as bearing trees at the quarter corner between S. 17 and S. 18 (a spruce and a crabapple), and at the corner between S. 18, S. 17, S. 19, and S. 20 (an alder and a willow). This block of ESS may be larger than we mapped it; along the line between S. 18 and S. 19 at the corner quarter two 6”-diameter junipers were available to serve as bearing trees, but on the other hand the line notes indicate that all but the easternmost 10 chains (which we mapped as ESS) are “grassy prairie,” and the line summary indicates the line is “subject to inundation by tides from 1 to 3 feet deep,” suggesting the junipers might reflect small pockets of ESS vegetation but that emergent (“grassy prairie”) vegetation dominates.

The second, smaller (39 ha), block of ESS that we mapped is along the North Fork Skagit within S. 9 and the eastern half of S. 8, T33NR3E. The line notes between S. 8 and S. 9 T33NR3E do not describe this area. The line summary indicates that “Land south of 66 chs. [which is inclusive of the EEM we mapped in Dodge Valley, as well as the ESS we mapped on both sides of the North Fork] tide bottom subject to inundation at very high tides from 1 to 2 feet. A little spruce timber & a thick growth of rosebriers & spice brush [?].”

The area in the upper reaches of Sullivan Slough (S. 29 and the south half of S. 20) appears to have lacked any tree or brush cover. At the margins of the EEM in this area, the line summaries indicate tides of 1 to 4 feet (between S. 17 and S. 18, between S. 19 and S. 20, between S. 28 and S. 9), and describe the land as “tules and grass with strips of timber” (between S. 19 and S. 20, between S. 28 and S. 29). The strips of timber indicated by the PLS along their section lines correspond to stringers of elevated higher ground that are evident on lidar, and are associated with the distal-most portions of the paleo-Skagit River deposition patterns in the Skagit Flats area to the east.

PLS survey note excerpts for Padilla Bay, Swinomish Slough, and Sullivan Slough estuarine wetlands (PDL3403E04, PDL3403E05, SKG3403E07, SKG3303E01, SKG3303E09):

> West between **S. 13** T34NR2E and **S. 24** T34NR2E, “Tide prairie” (August 5, 1871).

West between **S. 24** T34NR2E and **S. 25** T34NR2E, “Soil rich, subject to overflow in high tide” (August 5, 1871).

West between **S. 25** T34NR2E and **S. 36** T34NR2E, begin in “tide prairie” (August 5, 1871).

West between **S. 1** (T33NR2E) and **S. 36** (T34NR2E). At 56 chains “Enter grass marsh near N. end course N & SW.” At 65 chains “Leave same course NE & SW.” Line summary: Land in marsh level. Soil 2nd rte.” (September 5, 1858). Later survey west: At 39 chains “Ascend a timbered rocky knoll.” At 50.50 chains “Tide prairie again” (August 4, 1871).

North between **S. 12** T34NR2E and **S. 7** T34NR3E, line summary: “The land in this section is low and wet and subject to overflow at high tides but might be reclaimed. The land produces fine grass. The timber to the right is about 3 miles distant, to the left 2 ½ miles” (June 17, 1859).

North between **S. 13** T34NR2E and **S. 18** T34NR3E, line summary: “The land in this section is wet tide prairie, but not overflowed except at higher tides than are usual” (June 16, 1859).

North between **S. 24** T34NR2E and **S. 19** T34NR3E, line summary: “Land mostly level and subject to inundation by freshets winter & summer from 2 to 3 feet deep. Soil 1st rate. Timber spruce, cedar, balm & maple. Undergrowth hazel, willows, crabapple &c” (October 19, 1866).

North between **S. 25** T34NR2E and **S. 30**T34NR3E, ine summary: “Land level and overflowed only at very high tides easily diked and made fit for cultivation. The grass is very fine” (June 15, 1859).

North between **S. 36** (T34NR2E) and **S. 31** (T34NR3E), ine summary: “Land level tide prairie. Soil 1st rate, but seldom overflowed and with but few sloughs easily diked and made fit for cultivation” (June 15, 1859).

West between **S. 6** and **S. 7**, line summary: “Land tide prairie, good soil. Subject to inundation by tides two or three feet deep” (November 6, 1866).

West between **S. 7** and **S. 18**, line summary: Land tide prairie, good soil, covered with fine growth of grass. Subject to inundation by tides 1 or 2 feet deep” (November 5, 1866).

West between **S. 18** and **S. 19**,T34NR3E, at 10 chains “Enter grassy prairie.” Line summary: “Land mostly tide prairie, good soil, subject to inundation by tides from 1 to 3 feet deep” (November 5, 1866).

West between **S. 19** and **S. 30**, ine summary: “Land mostly tide prairie with some scattering trees. Red cedar & juniper subject to inundation by high tides from 1 to 3 feet deep, good soil” (November 5, 1866).

West between **S. 30** and **S. 31**, ine summary: “Land tide prairie, subject to inundation by high tides from 1 to 3 feet. Good soil, covered with grass & tules” (November 3, 1866).

East between **S. 31** (T34NR3E) and **S. 6** (T33NR3E), ine summary: “Land tide prairie, good rich soil, subject to inundation, by high tides from one to two feet deep” (October 6, 1866).

North between **S. 5** and **S. 6**, ine summary: “Land tide prairie. Good soil subject to inundation by high tides 2 or 3 feet deep” (November 6, 1866).

North between **S. 7** and **S. 8**, line summary: “Land tide prairie good soil subject to inundation by tides from 2 or 3 feet deep” (November 6, 1866).

North between **S. 17** and **S. 18**, line summary: “Land mostly tule swamp with some scattering spruce & crabapples. Subject to inundation by high tides 3 or 4 feet deep” (November 5, 1866).

North between **S. 19** and **S. 20**, at 21 chains “Enter a narrow strip of timber and briers.” At 29 chains “A deep slough 70 lks wide runs SW.” At 33.5 chains “Enter a swamp covered with grass and scattering clumps of rosebriers.” At 38 chins “Enter timber.” At 41 chains “Enter marsh again, covered with tules.” At 46 chains “Higher ground and scattering trees.” At 50chains “Leave the timber, and enter marsh.” At 68 chains “A stream 20 lks wide runs W. in a strip of timber.” At 70 chains “Leave the timber and enter tule swamp.” Line summary: “Land tide prairie covered with tules, grass & strips of timber. Spruce, red cedar, juniper & thickets of rosebriers &c. Good soil subject to inundatin by tides from 1 to 3 feet deep” (November 5, 1866).

North between **S. 30** and **S. 29**, line summary: “Land level tide prairie, subject to inundation by high tides from 1 to 3 feet deep. Covered with grass and tules. Good soil” (November 3, 1866).

North between **S. 31** and **S. 32**, line summary: “Land tide prairie subject to inundation by high tides 2 or 3 feet deep covered with grass and tules” (November 3, 1866).

North between **S. 6** (T33NR3E) and **S. 5** (T33NR3E), at 20.4 chains “Leave the prairie & ascend a steep hill.” At 44 chains “Foot of the hill to tid prairie.” Line summary: “….prairie, good soil, subject to inundation by high tides one or two feet deep” (October 29, 1866).

North between **S. 7** (T33NR3E) and **S. 8** (T33NR3E), at 28.8 chains “Leave the tide bottom & ascend a hill.” At 67 chains “Foot of the hill & leave the timber.” At 68 chains “Tide bottom & enter prairie.” Line summary: “…tide bottom subject to inundation from 1 to 3 feet by high tides” (October 27, 1866).

West between **S. 5** and **S. 8**, at 8 chains “Leave timber and enter clearing.” At 15.25 chains “Leave clearing and enter tide flats.” Line summary: “Tide flats, soil 1st rate. Timber in the east side of section, fir, cedar, alder and maple. Undergrowth, vine maple and salmonberry” (September 30, 1872).

West between **S. 8** and **S. 17**, at 13.75 chains “Leave timber enter Hard Hack & Willow.” At 32.50 chains, Leave Willow and Hard Hack. Enter Wildrye.” Line summary: “Soil 1st rate but overflowed by tides to the depth of from two to three feet. Timber fir, cedar, spruce, alder, willow and crabapple. Undergrowth, Hard Hack Willows, Wild Rye and tide grass” (September 28, 1872).

West between **S. 17** and **S. 20** begin “Through marsh Covered with Hard Hack Willow and scattering firs. Standing water from 6 in to two feet deep [underlining added].” At 65.75 chains “open tide flats. Covered with grass.” Line summary: “…subject to an annual overflow of from 3 to 5 feet [underlining added]. Timber Willow Spruce and alder. Undergrowth, Hard Hack, Willow, and Rank Grass” (August 30, 1872).

East between **S. 20** and **S. 29**, at 60 chains “Enter timber.” Line summary: “Land mostly tide prairie, a little timber east of 60 chs. Spruce & cedar. Undergrowth sallal, salmonberry, crabapple, briers. Good soil, subject to inundation by high tides from 1 to 3 feet deep” (November 3, 1866).

East between **S. 29** and **S. 32**, line summary: “Land tide prairie subject to inundation by high tides 2 or 3 feet deep covered with tules and grass” (November 3, 1866).

East between **S. 32** (T34NR3E) and **S. 5** (T33NR3E), at 49 chains “Leave the prairie enter timber N & S.” At 51 chains “Begin to ascend a steep hill.” Line summary: “Land west of 49 chs. tide prairie, rich soil subject to inundation by high tides 1 or 2 feet” (October 6, 1866).

East between **S. 5** (T33NR3E) and **S. 8** (T33NR3E), at 66.5 chains “Leave the prairie & enter timber.” At 68 chains “Leave the bottom and ascend about 10 feet.” Line summary: “Land mostly tide prairie covered with tules rich soil & seldom inundated by tides….” (October 29, 1866)

North between **S. 28** and **S. 29**, t 30 chains “Enter prairie bears NW & SE.” At 35 chains “Enter a strip of timber bearing SE & NW. At 38 chains “Leave the timber & enter prairie bearing NW.” At 79 chains “Leave the prairie & enter timber bearing E & W.” Line summary: “Land mostly tide prairie, subject to inundation by high tides 2 or 3 feet deep. Covered with tules and grass. Some strips of timber. Spruce. Undergrowth crabapple, briers, sallal &c. (November 2, 1866).

North between **S. 32** and **S. 33**, at 44.5 chains “Foot of the hill. 20 feet to tide bottom.” At 46.5 chains “Leave the timber & enter tide prairie bearing SE.” Line summary: “Land…north of 46.5 chs. tide prairie covered with “tules” & grass, subject to inundation by high tides 2 or 3 feet deep.”

Beaver Marsh

SKG3403E01 Beaver Marsh palustrine scrub-shrub wetland drains north
SKG3303E08 Beaver Marsh riverine-tidal scrub-shrub wetland drains south

The PLS field descriptions suggest that Beaver Marsh was mostly willow and hardhack brush with some emergent marsh (“flags and tules”) and scattered crabapple, alder, spruce and cedar trees (see PLS excerpts below). All but one corner or quarter corner had bearing trees; most were willow (21 of 39) or alder (16 of 39), with a single crabapple and a single spruce, which was at the southern margin of the wetland.

Channels mapped by the PLS and relict channels visible on 1937 photos and lidar indicate that Beaver Marsh was hydrologically connected to the Skagit River to the south and to Sullivan Slough to the north. An approximate drainage divide can be drawn from lidar dividing the north and south parts of the marsh.

The northern part of Beaver Marsh is described as "subject to an annual [underlining added] overflow" of "from two to four feet." There was at least locally standing water in the wetland in late August 1872 ("water from 6 in. to 3 feet deep" between S. 21 and S. 28; "standing water from 6 ins. To 2 feet deep" between S. 22 and S. 22 and between S. 21 and S. 22).

The southern part of Beaver Marsh, in contrast, is described as "subject to inundation during the winter and most of the year [underlining added] from 1 to 3 feet deep" (between S. 33 and S. 4, between S. 4 and S. 9, between S. 3 and S. 4, and between S. 2 and S. 3). In the southwest corner of the marsh, between S. 3 and S. 4, the surveyors did not run the line because it was judged "practically impassable" on October 18, 1866.

We mapped the southern part of Beaver Marsh as "riverine tidal" and the northern past as "palustrine," because: (1) the described inundation being "annual" in the north and "during the winter and most of the year" in the south, (2) that the southern part of the wetland was hydrologically connected to the North Fork Skagit River and the southern part to Sullivan Slough (and also fed by the streams coming from the wetlands to the north and east of Beaver Marsh).

PLS survey note excerpts for Beaver Marsh (SKG3403E01 and SKG3303E08):

> West between **S. 21** and **S. 28**, at 25 chains "Leave marsh and enter scattering spruce and alder timber." At 33 chains "Leave timber, enter arm of marsh, brs. NE & SW." At 39.3 chains "Leave marsh enter low wet bottom, timbered with alder and spruce." At 41.5 chains, "Leave timber, enter small marsh covered with willow, hardhack and flags. Water from 6 in. to 3 feet deep. Marsh brs. NE and SW." At 47.75 chains "Leave marsh and enter timber." At 70.25 chains "Leave timber, enter flats covered with tules." At 73 chains "Leave flats, enter timber." Line summary: "Soil 1st rate, but subject to an annual overflow of from two to four feet. Timber spruce cedar, and alder. Undergrowth willow hard hack and crabapple (August 23, 1872).
>
> West between **S. 28** and **S. 33**, T34NR3E. Begin "Through marsh covered with dense thickets of willow and hard hack." Line summary: "Soil 1st rate, subject to overflow of from two to four feet. Timber scattering alder, willow and crabapple. Undergrowth hard hack and willow" (August 20, 1872).
>
> East between **S. 33**, T34NR3E and **S. 4**, T33NR3E, at 29 chains "Enter swamp, brs. NW & SE unfit for cultivation. Subject to inundation during the winter and most of the year from 1 to 3 feet deep [underlining added]" then at 43.1 chains "A beaver house 4 feet high brs. N. 60 lks dist." (October 6, 1866).
>
> West between **S. 4** and **S. 9**. Line summary: "East of 54 chs. swamp covered with willows hardhack &c. subject to inundation during the winter & much of the summer from one to three feet deep" (October 26, 1866).
>
> North between **S. 21** and **S. 22**, at 30 chains "Leave marsh [leaving the main part of Beaver Marsh, SKG3403E01], enter spurce, alder and cedar timber." At 53.5 chains "Marsh covered with crabapple. Standing water from 6 ins. To 2 feet deep brs. NW and SW." At 58 chains "Leave marsh, enter timber." At 70.5 chains, "Marsh covered with flags. Standing water from 6 ins. to 2 feet deep [underlining added]. Marsh brs. E. & W." At 79.2 chains "Leave marsh and enter timber." Line summary: "Soil 1st rate but subject to an annual overflow of from two to four feet.

Timber fir spruce cedar alder, willow and crabapple. Undergrowth same with hard hack (August 24, 1872).

North between **S. 27** and **S. 28.** Begin “Through marsh covered with willows, hardhack, tules & flags.” Line summary: “Soil 1st rate subject to overflow of from two to four feet. Timber willow and alder. Undergrowth, willow and hard hack” (August 21, 1872).

North between **S. 33** and **S. 34**, T34NR3E. Begin “Through beaver marsh covered with hardhack & willow.” Line summary: “Subject to an annual overflow of from two to four feet. Timber, willow and alder. Undergrowth, same with hard hack” (August 19, 1872).

Between **S. 3** (T33NR3E) and **S. 4** (T33NR3E) “I omitted running north between secs. 3 & 4 it all being in the swamp & unfit for cultivation & practically impassable” (October 18, 1866).

North between **S. 3** and **S. 4**, T33NR3E: at 2 chains “leave willows and enter alder and scattering spruce timber. Water standing at the surface of the ground” and at 6 chains “Leave timber enter thick willow, 10 to 12 feet high” then at 25 chains “Hard hack brush with scattering clumps of willows and crabapple” (August 29, 1871).

East between **S. 22** and **S. 27**, T34NR3E. Begin “Through hard hack, willows, flags & tules.”At 30 chains “Enter scattering spruce timber.” At 53.6 chains “Enter low bottom timbered with alder spruce and cedar.” Line summary: “Soil 1st rate, but subject to an annual overflow of from two to four feet. Timber spruce, cedar alder and willow. Undergrowth willow and hard hack” (August 22, 1872).

East between **S. 27** and **S. 34**. Begin “Through marsh covered with willows and hardhack thickets.”At 39.5 chains “Leave marsh and enter alder and willow timber.” At 45 chains “Enter alder and scattering spruce timber.” Line summary: “Soil 1st rate, but subject to an overflow of from two to four feet. Timber scattering alder, willow and crabapple. Undergrowth hard hack and willow” (August 20, 1872).

East between **S. 4** and **S. 33**. At 29 chains “Enter swamp bears NW & SE unfit for cultivation subject to inundation during the winter and most of the year from 1 to 3 feet deep.” At 43.10 chains “A beaver house 4 feet high bears North 60 lks dist.” (October 6, 1866).

East between **S. 10** and **S. 3**. At 65 chains “Enter spruce and alder timber.” At 80.22 chains “The cor to secs. 3, 4, 9 & 10. Land west of 65chs in the swamp (near the south edge) unfit for cultivation. Subject to inundation from 1 to 3 feet deep” (October 18, 1866).

North between **S. 34** & **S. 35**. Begin “through marsh covered with flags, hardhack & willow.” At 45 chains “Leave marsh. Enter spruce cedar and alder bottom. Timber.” Line summary: “Land level. Soil 1st rate for the 1st 45 chains. Marks of overflow in trees 4 and 5 feet high. Timber fir cedar alder and spruce. Undergrowth salmonberry vine maple, and hard hack. Water in the marsh from 6 to 18 in deep” for 45 chains (October 4, 1872).

> North between **S. 2** T33NR3E and **S. 3** T33NR3E, at 5 chains “Leave the timber and enter a swamp.” At 41.5 chains, “Leave large growth of willows and enter a small growth of same.” Line summary: “North of 5 chs, swamp covered with tules willow, hardhack &c. and subject to inundation most of the year by overflow of the river [underlining added] and unfit for cultivation” (August 28, 1866).

Wetlands north and east of Beaver Marsh (Skagit Flats)

SKG3403E03 Palustrine wetlands north of Beaver Marsh

This complex of sinuous marshes formed in the ridge and swale topography created by relict Skagit River channels that formerly drained to Padilla Bay. According to an Army engineer, based on his 1872 field examination:

> “While making an examination of the low lands lying between the Skagit and Samish, in 1872, I saw indications that the former at one time flowed into Padilla Bay, 12 miles north of the present mouth of Steamboat Slough; the old channel being easily traced, traversed by numerous beaver dams, doubtless the principle cause of the diversion of the river into its present course” (Habersham, 1881, in Appendix OO10, ARCE 1881).

The engineer’s interpretation appears to have been correct for only part of the Skagit Flats: proximal to the Skagit River, wetlands and beaver ponds formed in the lower elevation areas between the ridges created by channel deposition. Distal to the Skagit, as topography becomes more subdued, wetlands appear to have formed within former channels, as indicated by the Army engineer.

The boundaries drawn by PLS surveyors between section lines appear in many cases to be guesses. At section lines, there was generally an excellent correspondence between local relief and the PLS mapping. Between section lines we modified (or created) wetland boundaries using LIDAR and hydric soils mapping. Hydric soils are more extensive than the areas identified by PLS surveyors as wetland. We used hydric soils secondary to lidar for locally modifying marsh boundaries.

The wetlands were most often described as simply “marsh” or as willow and hard hack marsh (see below), and secondarily as “tules” or “flags,” “coarse grass” or “rank grass,” and in one instance crabapple. While no doubt there was great local variation in vegetation cover, we have mapped the entire unit as scrub shrub, which appears to have been the dominant cover type. In addition to marshes, the PLS survey described several instances of “lake” or “lagoon” and one instance of “the former channel of a river, now overgrown with Tules, and brushes, running west,” the latter in the western part of the area, between S. 20 and S. 21.

The “general description” for T34NR3E in 1872 describes this series of marshes as being flooded annually:

> “The central and eastern portion [of the township] is low bottom land generally heavily timbered, but interspersed with extensive marshes. All of which are liable to an annual overflow of from three to seven feet [underlining added].”

Line notes consistently report evidence of water marks on trees as high as 8 feet above the ground (see excerpts from PLS notes, below). PLS surveyors indicated this

frequent inundation was in part because of the wood jams in the Skagit River at the present-day location of Mount Vernon:

> "…a large portion of it is subject to inundation by the Skagit River overflowing its banks. The banks of the river are generally higher than the surrounding country and yet above the large drift it appears to be subject to frequent inundations from one to 3 feet."

Major N. Michler of the Army Engineers, in an 1874 examination of the Skagit River, also observed that the jams "….causes, during high water, an overflow of a considerable part of the adjoining valley" (Micheler, Appendix GG5, ARCE 1875). Additionally, in a more detailed examinination made in 1880, they reported that:

> "Before the jams of drift wood were cut through, the snow floods generally escaped through the sloughs and low places on the river banks, overflowing the flats to a depth of 1 or two feet. This has not occurred since their removal, although the snow flood of 1880 rose higher than any within the memory of the settlers" (Habersham, 1881, Appendix OO10, ARCE 1881).

PLS survey notes for wetlands north of Beaver Marsh:

> North between **S. 19** and **S. 20**. At 21 chains "Enter a narrow strip of timber and briers." At 29 chains "A deep slough 70 lks wide runs SW." At 33.5 chains "Enter a swamp covered with grass and scattering clumps of rosebriers." At 38 chins "Enter timber." At 41 chains "Enter marsh again, covered with tules." At 46 chains "Higher ground and scattering trees." At 50chains "Leave the timber, and enter marsh." At 68 chains "A stream 20 lks wide runs W. in a strip of timber." At 70 chains "Leave the timber and enter tule swamp." Line summary: "Land tide prairie covered with tules, grass & strips of timber. Spruce, red cedar, juniper & thickets of rosebriers &c. Good soil subject to inundation by tides from 1 to 3 feet deep" (November 5, 1866).
>
> West between **S. 17** and **S. 20** begin "Through marsh Covered With Hard Hack Willow and scattering firs. Standing water from 6 in to two feet deep [underlining added]." At 65.75 chains "open tide flats. Covered with grass." Line summary: "…subject to an annual overflow of from 3 to 5 feet [underlining added]. Timber Willow Spruce and alder. Undergrowth, Hard Hack, Willow, and Rank Grass" (August 30, 1872).
>
> North between **S. 16** and **S. 17**. At 35.5 chains "Leave marsh enter timber. " At 39 chains "Leave timber enter marsh." At 52.5 chains "At this point marsh bears S. 50 W N 50 E. At 64.5 chains "Leave marsh enter spruce and cedar timber." Line summary: "…subject to overflow of from one to four feet [underlining added]. Timber Fir Cedar Spruce, Alder Maple Willow and Crabapple. Undergrowth Willow Hard Hack, Flags and Grass."
>
> North between **S. 20** and **S. 21**. Begin "Through low wet bottom." At 53 chains "Spruce timber." At 66 chains "Enter marsh brs N.E and S.W." Line summary: "Land level. Soil 1st rate subject to an annual overflow of from three to six feet. Timber spruce cedar alder and willow. Undergrowth willow and hard hack" (August 29, 1872). Previous survey: At 7.9 chains "The former channel of a river, now overgrown with Tules, and brushes, running west." At 16.5 chains "Leave the large timber and enter swamp and water." At 40 chains "The water was 2 ½ feet deep and appeared to be deeper farther northward, we therefore considered

it unfit for cultivation and impracticable now to survey it [underlining added]" (November 2, 1866).

East between **S. 9** and **S. 16**. At 17.5 chains "Offset north two chains to avoid lake." At 19.75 chains "Enter Marsh brs. North and South." At 28 chains "Leave Marsh Enter Timber." At 33.5 chains "Leave Timber Enter Marsh brs. N. E. & S. W." At 44.5 chains "offset South 2.00 chains to avoid water [underlining added]." At 69 chains "Leave Marsh brs. N. E. and S. W." At 72.5 chains "Offset North 2.00 chains onto line." Line summary: "…low and wet. Subject to an overflow of from 2 to 5 feet [underlining added]. Timber Fir Cedar Spruce. Alder and Willow. Undergrowth Willow Hard Hack and Coarse Grass" (August 31, 1872).

East between **S. 16** and **S. 21**, T34NR3E. At 45 chains "Leave timber and Enter Marsh." At 54 chains "From this point marsh brs. N. and S." At 69 chains "Leave Marsh Enter Timber." Line summary: "…subject to an annual overflow of from two to six feet [underlining added]. Timber Spruce Cedar Alder Maple Crabapple and Willow. Undergrowth Hard Hack and Willow" (August 29, 1872).

North between **S. 9** and **S. 10**, T34NR3E. At 3 chains "Enter marsh covered with Willow and Hard Hack bears E and W." At 18.75 chains "Leave Marsh Enter Alder and Birch Timber." At 23.5 chains "Enter Marsh brs. N. E. and S. W." At 34 chains "Marsh brs. N. 45 E & S. 45 W." At 54.5 chains "Leave Marsh Enter fir and Cedar Timber." Line summary: "For the 1st 56 chains subject to an overflow of from two to four feet" (August 27, 1872).

North between **S. 15** and **S. 6**, T34NR3E at 12.7 chains "Marsh bears E. and W." then at 15.2 chains "Leave Marsh and Enter Timber" then at 17.0 chains "Leave Timber Enter Marsh covered with rank grass, Flags, rushes and scattering willows. Standing water from 6 inches to two feet deep [underlining added]." At 36 chains "Leave marsh Enter Timber." Line summary: "Marks of overflow from one to four feet deep. Timber, Fir, Cedar, Spruce, Alder, Willow and Crabapple. Undergrowth Same with Vine Maple" (August 26, 1873).

North between **S. 21** and **S. 22**, at 30 chains "Leave marsh [leaving the main part of Beaver Marsh, SKG3403E01], enter spurce, alder and cedar timber." At 53.5 chains "Marsh covered with crabapple. Standing water from 6 ins. To 2 feet deep brs. NW and SW." At 58 chains "Leave marsh, enter timber." At 70.5 chains, "Marsh covered with flags. Standing water from 6 ins. to 2 feet deep [underlining added]. Marsh brs. E. & W." At 79.2 chains "Leave marsh and enter timber." Line summary: "Soil 1st rate but subject to an annual overflow of from two to four feet. Timber fir spruce cedar alder, willow and crabapple. Undergrowth same with hard hack (August 24, 1872).

East between **S. 3** and **S. 10**, T34NR3E. At 36.25 chains "Foot of descent, enter Marsh Covered with dry willows and grass." At 50 chains "Marsh [illegible] N. E. and S. W." At 68.5 chains "Leave marsh Enter Spruce birch and Alder Timber." Line summary: "East half overflows some three or four feet deep [underlining added]. Timber Fir Cedar Spruce Birch and Alder. Undergrowth Salmonberry and Willow" (August 28, 1872).

East between **S. 10** and **S. 15**, T34NR3E. At 10.5 chains "Leave Timber Enter Marsh brs. E & W." At 28.75 chains "Offset North four chains to avoid marsh." At 45 chains "Enter Fir and Cedar Timber." At 54 chains "Offset 4 chains to South of Line." At 63 chains, "Enter Marsh Covered with dead timbered Coarse Grass." At

78 chains “Enter green timber, Leave Marsh.” Lne summary: “Marks of overflow from one to four feet. Timber Fir Cedar Spruce Birch and Alder. Undergrowth Same With Crabapple and Vine Maple” (August 27, 1872).

East between **S. 15** and **S. 22**, “In order to avoid Marsh I offset from Corner North 5.00 chains. Through timber” then at 37.3 chains “Offset south, 5.00 chs to line.” Line summary indicates “Marks of overflow on trees 1 to 4 feet deep [underlining added]. Timber, Fir, Cedar, Spruce, Alder and Crabapple. Undergrowth Same with Willow and Hard Hack.”

North between **S. 10** and **S. 11**, T34NR3E, begin “Enter low bottom timber generally alder and dead cedar,” then at 5 chains “Marks of overflow on trees seven and eight feet deep [underlining added].” At 6.5 chains “Water 6 in. deep [underlining added]” and at 24 chains “Leave low wet bottom enter green Timber” and at 39.5 chains “Enter Marsh. Covered with Willows. Hard Hack and rank grass. Marsh brs. N 65 E and S 65 W.” At 62.5 chains “Leave Marsh. Enter Spruce, Cedar, Alder and birch Timber” then at 62.5 chains “Marsh brs. N 76 E & 76 W” then at 78.75 chains “Leave Marsh enter Timber, Spruce Alder and Birch.” The line summary includes “Marks of overflow on trees from two to Eight feet high [underlining added]. Timber, Spruce Cedar and Alder. Willow Maple & Birch, Undergrowth Willow and Hard Hack” (August 16, 1872)

North between **S. 14** and **S. 15.** Begin “Over windfalls and through thickets of rose and gooseberry bushes.” At 28.5 chains “Enter spruce and cedar timber.” Line summary: “Marks of overflow in places in trees three and four feet high. Timber spruce cedar, alder and maple. Undergrowth vine maple, gooseberry and rose bushes” (August 15, 1872).

North between **S. 22** and **S. 23**, T34NR3E. At 3.45 chains “Marsh covered with standing water two feet deep [underlining added] brs. NW and SE.” At 11 chains “Leave marsh and enter timber.” At 15.73 chains “Marsh covered with willow, hardhack and flags, standing water from 6” to 2 feet deep [underlining added].” At 30 chains “Leave marsh, enter spruce cedar and maple timber.” At 40.5 chains “Marsh brs. E & W.” At 45 chains “Leave marsh and enter spruce, cedar and maple timber.” Line summary: “Land level. Soil 1st rate. Marks of overflow in trees from two to seven feet deep. Timber, spruce, cedar, maple, alder, crabapple, and willow. Undergrowth willow, vine maple, rose bush and crabapple (August 13, 1872).

East between **S. 2** and **S. 11**. Begin “Through timber.” At 77.25 chains “Marsh brs. N. 20 E & S 20 W.” Line summary: “Marks of overflow in trees from two to six feet high. Timber, spruce, alder and birch. Undergrowth willow, salmonberry hard hack and crabapple” (August 16, 1872).

East between **S. 11** and **S. 14**. Line summary: “Marks of overflow in trees from two to five feet high. Timber spruce, cedar, alder and maple. Undergrowth vine maple and salmonberry” (August 15, 1872).

East between **S. 14** and **S. 23**, T34NR3E, at 22 chains “Lake bears North and South” then at 23 chains “Offset north 5.00 chains to avoid deep water.” At 25.745 chains “East shore of lake. Water found one to four feet deep [underlining added]” then at 29 chains “Lake bears North and South.” At 32.75 chains “East shore of Lake. Water from two to three feet deep [underlining added]” and at 34 chains] “Offset 5 chains into line.” At 60.5 chains “Marsh covered with Willow

Hard Hack and flags. Water from 6 in. to two feet deep [underlining added]. Marsh bears North and South." At 63.5 chains "Leave marsh. Enter Timber." Line summary includes "Marks of overflow on trees from two to six feet high [underlining added]. Timber Spruce, Cedar and Alder & Maple. Undergrowth, Vine Maple, Willow Gooseberry & rosebush" (August 14, 1873).

East between **S. 23** and **S. 26**, T34NR3E. At 3.5 chains "Lagoon, offset 5.00 chs., to avoid same." At 11.25 chains "Lagoon, offset 125 lks to avoid same. Lagoon brs. Nearly E & W." At 30 chains "Offset north 6.25 chs. into line." At 38 chains "enter marsh covered with willow and hardhack, brs. NE & SW." Line summary: "Land level. Soil 1st rate. Marks of overflow in trees, from 2 to four feet high. Timber spruce, cedar alder willow and crabapple. Undergrowth willow and crabapple" (August 12, 1872).

SKG3403E10 Palustrine wetland east of Beaver Marsh

This wetland formed in a trough to the south of the series of paleo channels and levees that flowed from the Skagit River to Padilla Bay, and to the north of the modern Skagit River and its meander belt. Topography and the PLS mapping indicate that it flowed into Beaver Marsh.

On the two lines that substantially cross this unit, it is described as "marsh covered with willow and hardhack" (between S. 23 and S. 26) and "marsh covered with rank grass & scattering hardhack" (between S. 23 and S. 24).

PLS notes:

North between **S. 26** and **S. 27**. At 39 chains "Leave timber. Enter marsh covered with willow alder and crabapple." At 49.5 chains "Leave marsh enter low bottom." At 58.5 chains "Gradual ascent. Spruce, cedar and alder timber." Line summary: "Land nearly level. Soil 1st rate. Marks of overflow on trees from 2 to 3 feet high. Timber spruce cedar alder crabapple and willow. Undergrowth vine maple and salmonberry" (August 12, 1872).

East between **S. 23** and **S. 26**, T34NR3E. At 3.5 chains "Lagoon, offset 5.00 chs., to avoid same." At 11.25 chains "Lagoon, offset 125 lks to avoid same. Lagoon brs. Nearly E & W." At 30 chains "Offset north 6.25 chs. into line." At 38 chains "enter marsh covered with willow and hardhack, brs. NE & SW." Line summary: "Land level. Soil 1st rate. Marks of overflow in trees, from 2 to four feet high. Timber spruce, cedar alder willow and crabapple. Undergrowth willow and crabapple" (August 12, 1872).

North between **S. 23** and **S. 24**, T34NR3E. At 7 chains "Enter hardhack thicket." At 9.5 chains "Leave same & enter marsh covered with rank grass, & scattering hardhack, bears E. and W." At 58.5 chains "Leave marsh, & enter thicket of willow and hardhack & alder." At 60.5 chains "Enter timber, spruce, cedar & alder." Line summary includes "Land nearly level…subject to overflow of from 2 to 6 feet [underlining added]. Timber, cedar, spruce, alder, willow & crabapple. Undergrowth hard hack rosebush, willow & vine maple" (November 11, 1871).

North between **S. 26** and **S. 25.** At 29.5 chains "Enter thick growth of alder." At 55 chains "Leave alder bottom and enter marsh bears N.E. and S.W." At 60.5 chains "Leave marsh and enter willow alder and crabapple bottom." Line summary: "Land level soil 1st rate for the last 30 chains subject to an overflow of

from 2 to 6 feet. Timber fir cedar, alder spruce, willow and crabapple. Undergrowth vine maple, had hack & rosebush" (November 10, 1871).

SKG3403E08 Wetland south of Olympia Marsh, draining to Padilla Bay

Wetland is between Bayview and Olympia Marsh Road, Avon Allen Road, Pulver Road, and Bennett Road. Shown on PLS plat map, and described in notes. We refined boundaries using elevation from lidar, which is generally confirmed by hydric soils mapping.

Field notes from four PLS survey lines:

North between **S. 1** and **S. 2** (T34NR3E), at 2.6 chains "Leave Marsh, Enter Spruce and Cedar Swamp." At 12 chains "Leave timber Enter Marsh brs E and W." At 20 chains "Leave timber enter Marsh. The marsh extends to the West about 15 chains and to the east about 40." At 50.75 chains "Leave Marsh ascend hill" (August 8, 1872).

East between **S. 1** and **S. 12**, T34NR3E, starting "Through Hard Hack Willow and flags. Water 18 in. to 2 feet deep." At 3.75 chains "Leave Marsh and enter Crabapple thicket." At 13 chains "Enter Marsh brs N and S." At 70 chains "Leave Marsh enter Spruce and Cedar Timber." Line summary: "Marks of overflow in trees from 2 to 7 feet high. Timber Spruce, Cedar, Alder,and Willow and Crabapple. Undergrowth Willow and Hard Hack" (November 14, 1871).

North between **S. 11** and **S. 12**, at 67.6 chains "Enter Marsh covered with flags and Scattering Hard Hack. Standing water from 6 in. to 2 feet deep" (November 14, 1871).

West between **S. 36**, T35NR3E and **S. 1**, T34NR3E, at 12 chains "Leave the timber & enter a marsh or swamp bearing NE & SW." At 65 chains "Leave the swamp and enter timber." Line summary: "Land east of 65 chains mostly swamp unfit for cultivation subject to inundation by the river freshets or moderately high water 3 or 4 feet deep, west of 65 chains slighly rolling" (October 22, 1866).

Fir Island

SKG3303E02 Fir Island estuarine emergent wetland
SKG3303E03 Fir Island estuarine scrub-shrub wetland
SKG3303E04 Fir Island riverine-tidal forested wetland

T-2156 identifies some saltmarsh on Fir Island, but much of the tideland on Fir Island had been diked and converted to agriculture prior to the creation of T-2156 (1889). We mapped estuarine emergent and estuarine scrub-shrub wetlands where PLS surveyors—prior to diking in 1866 and 1872—identified "tide prairie." Between section lines, we relied on elevation and patches of remaining vegetation on T-2156 to extrapolate map unit boundaries.

We distinguished estuarine emergent from estuarine scrub-shrub using PLS descriptions as well as PLS bearing tree records. We mapped estuarine emergent wetland along lines where tide prairie was described as "grass" by PLS surveyors, and at corners and quarter corners where PLS notes indicated there were no bearing trees available. We mapped as estuarine scrub-shrub those areas where the line notes or line

summaries descriptions indicate there was any timber and more than isolated brush. For example: “Tide prairie, covered with tule flags, grass and scattering timber” (between S. 25 and S. 36); “Tide prairie covered with tules, flags, grass and scattering brush and timber, spruce and cedar” (between S. 22 and S. 23).

We mapped a large forested riverine-tidal wetland in the lower elevation land between the higher, forested stringers of land associated with Dry Slough and the South Fork Skagit. We used PLS line descriptions and line summaries to identify it as a tidally-influenced freshwater forested wetland. For example, between S. 13 and S. 24, the line summary indicates “subject to inundation one or two feet at high tides and freshets. Too wet for cultivation.” Between S. 13 and S. 14, the land is summarized “subject to inundation one or two feet at hgh tides and freshets. Too wet for cultivation.” Between S. 12 and S. 13 it is described as “swamp” and the line description indicates that it is “too wet for cultivation, subject to inundation by freshets and high tides 1 or 2 ft.” Between S. 19 and S. 24, “tide bottom subject to inundation by high tides one or two feet. Timber alder & spruce and a thick growth of willow, crabapple, salmonberry &c.” Bearing trees at corners within this unit indicate it was an alder and spruce swamp; 11 of 21 bearing trees (52%) were alders, and 6 of the 21 (29%) were spruce. The remaining bearing trees were willow and crabapple.

The unit also is fed by tidal channels from the Skagit River and from Freshwater Slough. The network of tidal channels, as indicated by relict channels visible on 1937 photos (which we have mapped) extended at least into S. 12, past Polson Road.

We also mapped patches of riverine-tidal forested wetland between Freshwater Slough and Steamboat Slough. These smaller patches had not been diked and remained as wetland in T-2156. The symbology suggests scattered treecover, with less dense cover in the downstream of the two patches. The upstream unit is crossed by one line, and the line notes do not describe that line segment. The line summary indicates “bottom subect to overflow from 2 to 3 ft…Timber spruce & alder. Undergrowth hardhack, willow and crabapple.” Because the line segments to the west of the patchwas described as “open marsh” and then “willow brush,” we assume that the line description (of alder and spruce timber) can be applied to the patch.

PLS survey notes:

> East between **S. 1** and **S. 12**, at 20 chains “Enter a swamp, brs. S.” At 32 chains “Leave the swamp, brs. S.” Line summary: Land level, soil 1st rate. Timber alder Balm & spruce. Undergrowth salmonberry willow &c.” (September 29, 1866).
>
> North between **S. 1** and **S. 2**. At 22 chains “Enter a swale, Crabapple and willow brs. SE.” Line summary: “Land level, soil 1st rate. Timber spruce alder, cedar, balm, crabapple. Undergrowth, vine maple, elder, hazel, pigeonberrry &c.” (October 1, 1866).
>
> East between **S. 2** and **S. 11**. Line summary: “Land level. Soil 1st rate. Timber alder spruce cedar and balm. Undergrowth willow, salmonberry hazel &c.” (October 12, 1866).
>
> West between **S. 8** and **S. 17**. At 2.5 chains “Enter the prairie, brs. N & S.” Line summary: “Land tide prairie good soil, subject to inundation by high tides from 2 to 4 feet deep” (October 27, 1866).

West between **S. 7** and **S. 18**. Line summary: “Land tide prairie subject to inundation by high tides from 2 to 4 feet deep” (October 27, 1866).

North between **S. 8** and **S. 9**. At 8 chains “A tide slough 50 lks wide from SW runs north. Here I offset west 500 links into the prarie to avoid the water and thick briers and run north in the prairie on the offset 12.00 chns. To a point where I set back E. 300 lks. to the line.” At 20 chains “Set a post…on left bank of Skagit River.” At 35.34 chains, “right bank of the river.” At 41.5 chains “Enter timber.” At 44.5 chains “Enter prairie.” At 60 chains “Leave the prairie & enter timber.” At 66 chains “Leave the bottom & ascend gradually.” Line summary: “Land south of 66 chs. tide bottom subject to inundation at very high tides from 1 to 2 feet deep. A little spruce timber & a thick growth of Rosebriers & spice brush. Soil 3rd rate. Timber fir, undergrowth same willow, sallal, &c.” (October 26, 1866).

East between **S. 9** and **S. 16**. At 11 chains “Leave the bushes and enter prairie.” At 19 chains “Enter a strip of timber and bushes.” At 21.5 chains “Leave it and enter prairie.” At 24 chains “Enter timber.” At 26.5 chains “Enter prairie.” At 42.5 chains “Leave the prairie and enter timber N. and S. At 48 chains “Enter the prairie.” At 52 chains “Enter a strip of timber 2 chs. wide N. & S.” Line summary: “Land mostly tide prairie subject to inundation at very high tides 2 or 3 feet deep. Timber spruce cedar & alder. Undergrowth willow rosebriers &c.” (October 18, 1866).

North between **S. 9** and **S. 10**. Line summary: “Land south of 40 chs good first rate soil. The rest 3d rate & swamp unfit for cultivation. Subject to inundation during the winter & much of the summer 2 or 3 feet deep. Timber south part spruce & alder and on the highland fir & cedar. Undergrowth same with willow Hardhack &c.” (October 17, 1866).

East between **S. 10** and **S. 15**. At 3 chains “Leave the timber and enter prairie.” At 9 chains “A strip of timber brs. N. & S.” At 13 chains “Leave it and enter prairie.” At 26.5 chains “A strip of timber brs. N. & S.” At 28 chains “Enter prairie brs. N. & S.” At 65 chains “Leave the prairie, brs. NW & SE.” Line summary: “Land level, good soil. Subject to inundation at very high tides one or two feet mostly prairie. Timber spruce, undergrowth same, rosebushes, oregon grape &c.) (October 13, 1866).

North between **S. 10** and **S. 11**. At 7 chains “Leave the timber and enter willow and hardhack & willow swale.” At 25 chains “Enter alder and spruce timber.” Line summary: “Land level soil 1st rate. Timber alder, spruce & cedar. South of 25 chs. no timber, but thick willows and hardhack” (October 12, 1866).

North between **S. 11** and **S. 12.** Line summary: “Land south of 40 chs. low & wet. North of 40 chs 1st rate. Timber alder, spruce & cedar. Undergrowth same & crabapple, willow salmonberry &c.” (September 29, 1866).

East between **S. 11** and **S. 14**. At 1.5 chains “Enter swale land or swamp.” At 7 chains “Leave the swamp and enter spruce timber.” At 68 chains “Leave spruce timber and enter swale or swamp.” Line summary: “ Land level. Soil 1st rate. Timber spruce alder & cedar. Undergrowth willow, elder, crabapple hazel &c.” (October 9, 1866).

East between **S. 12** and **S. 13**. At 49 chains “Leave the swamp and enter alder timber.” Line summary: Land west of 49 chs. too wet for cultivation, subject to

inundation by freshets and high tides 1 or 2 ft. East of 49 chs. 1st rate Timber, alder, balm and spruce. Undergrowth, willow, crab-apple & c. (September 28, 1886).

West between **S. 13** and **S. 24**. Line summary: Land level and subject to inundation one or two feet at high tides and freshets. Too wet for cultivation. Timber spruce, crabapple, and alder. Undergrowth same and willow Hardhack &c." (September 28, 1866).

North between **S. 13** and **S. 14**. Line summary: "Land level and subject to inundation by freshets and high tides one or two feet. Timber spruce alder cedar, crabapple & a thick undergrowth of willow Hardhack &c." (September 28, 1866).

West between **S. 14** and **S. 23**. Line summary: "Land level, good rich soil. Timber on east half spruce, alder & crabapple, salmonberry &c. West half tide prairie, interspersed with occasional bunches of spruce, cedar, & juniper and thickets of rose briers &c. Subject to inundation by high tides on or two feet" (October 9, 1866).

North between **S. 14** and **S. 15**. Line summary: "Land level with little sign of being subject to inundation in the south part. Soil rich same scattering spruce & juniper & a thick growth of Rosebush, oregon grape &c." (October 9, 1866).

West between **S. 15** and **S. 22**. Line summary: "Land level tide prairie subject to inundation at very high tides 1 or 2 feet deep." (October 13, 1866).

North between **S. 15** and **S. 16**. At 66 chains "Leave the prairie & enter timber brs. NE." Line summary: "Land mostly tide prairie, good soil, subject to inundation by very high tides 1 or 2 feet deep" (October 13, 1866).

West between **S. 16** and **S. 21**. Line summary: "Land tide prairie subject to inundation by very high tides one or two feet deep. Good soil." (October 18, 1866).

North between **S. 16** and **S. 17**. At 70.25 chains "Enter a thicket of briers etc." Line summary: "Land tide prairie covered with grass. Good soil subject to inundation by very high tides 2 or 3 feet deep. In the N part is a thicket of bushes, briers, crabapples, willows &c." (October 18, 1866).

South between **S. 17** and **S. 18**. Line summary: "Land tide prairie subject to inundation by high tides from 2 to 4 feet deep" (October 27, 1866).

West between **S. 17** and **S. 20.** Line summary: "Land tide prairie. Good soil, subject to inundation by high tides two or three feet deep" (October 27, 1866).

South between **S. 20** and **S. 21**. Line summary: "Land low tide prairie covered with grass. Soil 2d rate and 3d rate" (April 22, 1872).

South between **S. 21** and **S. 22**. Line summary: "Land tide prairie covered with tules, flags, and grass. Soil for the 1st 35.00 chains 1st rate balance 2d rate" (April 22, 1872).

West between **S. 22** and **S. 27**. Line summary: “Land, low, tide covered with grass prairie. Soil second rate badly cut up with sloughs” (April 20, 1872).

South between **S. 22** and **S. 23**. At 6 chains “Enter timber.” At 18.6 chains “Leave timber.” Line summary: “Land tide prairie & covered with tules, flags, grass and scattering brush and timber, spruce and cedar. Under growth hard hack rose bush and goose berry” (April 20, 1872).

East between **S. 23** and **S. 26**. Line summary: “Land tide prairie covered with flags, tule, and grass. Soil 1st rate” (April 20, 1872).

South between **S. 23** and **S. 24**. At 16.36 chains “Leave swamp and enter scattering timber, spruce, alder, crabapple and balm.” At 47.86 chains “Leave timber and enter tide prairie covered with tules flags and hardhack.” At 59 chains “Enter timber.” At 67 chains “Leave timber and enter tide prairie covered with tules, flags and scattering Hard Hack.” Line summary: “Land level. Soil 1st rate but subject to overflow from one to two feet. Timber spruce, alder, crabapple, balm & willow. Undergrowth, the same with Hard Hack Rose bush, salmonberry and gooseberries” (April 17, 1872).

East between **S. 24** and **S. 25**. Line summary: “Land tide flats and subject to overflow of 1 to 3 ft. Timber, spruce, crabapple, alder and willow, undergrowth same, with hardhack and gooseberry bushes.”

North between **S. 19** and **S. 24**. Line summary: “Land tide bottom subject to inundation by high tides one or two feet. Timber alder & spruce and a thick growth of willow, crabapple, salmonberry &c.” (September 4, 1866).

South between **S. 25** and **S. 26**. Line summary: “Land level, tide prairie and covered with tule flags, grass and scattering brush” (April 18, 1872).

North between **S. 25** and **S. 30**. Line summary: “Land tide bottom subject to inundation by high tide from 1 to 3 ft. Soil rich covered with a thick growth of willow, crabapple, gooseberry and some stunted spruce and alder” (August 30, 1866).

East between **S. 25** and **S. 36**. Line summary: “Land tide prairie, covered with tule flags, grass and scattering timber, Timber spruce, cedar, alder crabapple and willow. Undergrowth, same with hardhack and rose brush” (April 19, 1872).

South between **S. 26** and **S. 27**. Line summary: “Land low tide prairie covered with grass. Soil 3rd rate” (April 20, 1872).

West between **S. 26** and **S. 35.** Line summary: “Land low tide prairie, covered with grass. Soil 2d rate and 3d” (April 19, 1872).

South between **S. 35** and **S. 36**. Line summary: “Land level tide prairie and covered with grass. Soil 2d and 3d rate” (April 19, 1872).

North between **S. 36** and **S. 31**. Line summary: “Land tide prairie, rich soil, but subject to inundation by high tides from 1 to 3 feet” (August 28, 1866).

PLS notes in T33NR4E:

West between **S. 19** and **S. 30** begin “In open marsh.” At 19 chains A A dyke brs. N. 17 E & S. 17 W.” At 20 chains “Enter willow brush brs. N. & S.” Line summary: “Land level bottom subject to overflow from 2 to 3 ft. Soil 1st rate. Timber Spruce & Alder. Undergrowth Hardhack, Willow and Crabapple.

West between **S. 30** and **S. 31**, at 10 chains “Descend a bank 15 feet high bearing NE & Sw. Enter rich bottom. At 19.4 chains “Enter open marsh brs. NE. & SwW.” At 29.5 chains “Spruce and alder timber brs. N. & S.” At 39.75 chains “Hardhack swamp brs. N. & S.” Line summary: Land level soil except East 10.00 chs. rich bottom and Usubject to overflow from freshets and tides from two to four ft deepU [underlining added]. Timber Fir Cedar and Hemlock on highland and Spruce and alder in bottom. Undergrowth Vine Maple Hardhack & Willow” (October 17, 1872).

East of Fir Island

SKG3203E02 East of Fir Island estuarine scrub-shrub wetland
SKG3203E01 East of Fir Island estuarine emergent wetland

PLS notes for T32NR3E:

West between **S. 1** and **S. 12** T32NR3E. At 2 chains “Foot of hill, enter spruce bottom.” At 5 chains “Leave spruce bottom enter tide prairie” (August 21, 1871).

North between **S. 1** T32NR3E and **S. 6** T32NR4E: At 2 chains “Top of bluff 50 feet high. Commence to descend along west slope to tide prairie.” At 2.08 chains “A branch 3 lks wide, runs west.” At 5.8 chains “Not being able to chain along the side of the bluff, I offset West 0.71 chains to base of bluff and swamp, thence north on offset 10.08 chains, thence east 0.71 chs to line N. At 15.88 chains “leave swamp and enter tide prairie.” Line summary: “Land through a tide prairie overflowed at high tide and very wet and covered with rushes” (August 18, 1871).

SKG3304E01 Riverine-tidal scrub-shrub wetlands
SKG3304E02 Riverine-tidal forested wetlands
SKG3304E03 Riverine-tidal emergent wetlands
SKG3304E04 Palustrine forested wetlands
SKG3304E05 Palustrine scrub-shrub wetlands

These wetlands are mapped by the PLS survey to the east of the South Fork Skagit River. The 1872 PLS field notes indicate a large willow-hardhack scrub-shrub marsh (SKG3304E01) which we mapped as riverine tidal.We map it as riverine-tidal for these reasons: (1) PLS notes mention tidal inundation; (2) the unit is supplied by tidal channels; (3) the elevation and vegetation is similar to the Beaver Marsh wetland (see SKG3403E01 and SKG3303E8).

Within the riverine tidal scrub-shrub unit is a large emergent marsh (SKG3304E03) described as “open marsh” and covered by “Tule and prairie” in the PLS notes.

Higher-elevation land along two tidal channels (the northern one is at Conway and the southern is two km to the south) are mapped with stringers of forest along the channels, and forested wetland distal to the channel at elevations transitional to the scrub-shrub marsh. The same unit occurs at transitional elevations between forest on the

natural levee of the South Fork and unit SKG3304E01. These were mapped using the occurrence of tree symbols on T-2156 (1889) in combination with the PLS notes.

The PLS wetlands extend to the north and up-delta of these units. They include an alder-crabapple swamp (SKG3304E04) and in lower elevations a mix of "open marsh" and willow swamp (SKG3304E05). We map these as palustrine. These units are split into an eastern and western lobe by the higher-elevation land associated with the paleo-channel of the Skagit River now occupied by Beaver Slough.

PLS notes for T33NR4E, arranged from south to the north:

East between **S. 31** T33NR4E and **S. 6** T32NR4E. Begin "In tide prairie." At 10 chains "Enter low brush bearing N. & S." At 27.5 chains "Enter cedar timber." At 29 chains "Ascend steep hill" (May 30, 1872).

West between **S. 30** and **S. 31**, at 10 chains "Descend a bank 15 feet high bearing NE & Sw. Enter rich bottom. At 19.4 chains "Enter open marsh brs. NE. & SW." At 29.5 chains "Spruce and alder timber brs. N. & S." At 39.75 chains "Hardhack swamp brs. N. & S." Line summary: Land level soil except East 10.00 chs. rich bottom and Usubject to overflow from freshets and tides from two to four ft deepU [underlining added]. Timber Fir Cedar and Hemlock on highland and Spruce and alder in bottom. Undergrowth Vine Maple Hardhack & Willow" (October 17, 1872).

North between **S. 29** and **S. 30**, at 30 chains "Descend a bank 15 ft. high…enter swampy bottom." At 57.5 chains "Enter open marsh bearing N.E. & S.W." Line summary: "Land level. Soil 1st rate in bottom, 2nd rate on highland. Timber Fir Cedar Hemlock Spruce & Alder. Undergrowth Vine Maple Crabapple and Willow" (October 17, 1872).

East between **S. 20** and **S. 29**, begin "in open marsh" At 24 chains "Enter brush brs. N. & S." At 25 chains "enter timber" (October 17, 1872).

West between **S. 19** and **S. 30** begin "In open marsh." At 19 chains A A dyke brs. N. 17 E & S. 17 W." At 20 chains "Enter willow brush brs. N. & S." Line summary: "Land level bottom subject to overflow from 2 to 3 ft. Soil 1st rate. Timber Spruce & Alder. Undergrowth Hardhack, Willow and Crabapple.

West between **S. 18** and **S. 19**. Line summary: Land level and subject to overflow from freshets from 1 to 3 ft. Soil 1st rate. Timber Spruce Cedar & Alder. Undergrowth Willow Hardhack & Crabapple."

North between **S. 19** & **S. 20** begin "In open marsh" until 63.75 chains "Enter brush bearing E. & W." Line summary: "Land level marsh covered with Tule & Prairie and Hardhack and Willow brush, subject to overflow from freshets. Soil 1st rate."

East between **S. 17** and **S. 20**, begin "In marsh covered with hardhack & willow" for 35 chains, then at 35 chains "Alder bottom brs. N. & S." and at 38.5 chains "Begin to ascend hill" (October 18, 1872).

North between **S. 17** and **S. 18** begin"In marsh covered with hardhack & willow." Line summary: "Land level covered with Alder Willow & Hardhack. Soil 1st rate. Subject to overflow of 2 ft."

East between **S. 8** and **S. 17**, T33NR4E, begin "In swampy land covered with hardhack & willow." Line summary includes "Timber scattering spruce & Alder" (October 19, 1872).

West between **S. 7** and **S. 18**, begin "In hardhack swamp." At 40 chains "Enter open marsh covered with scattering clumps of hardhack." At 71 chains "A clearing brs. N. & S." Line summary: "Land level swampy. Soil 1st rate. Subject to overflow of 2 to 3 ft."

North between **S. 7** and **S. 8**, begin "In hardhack swamp." Line summary: "Land level swampy. Soil 1st rate. Timber, scattering spruce and alder" (October 21, 1872).

North between **S. 8** and **S. 9,** at 1.5 chains "Crabapple swamp bears E & W." Line summary: "Land level. Soil rich bottom swampy. Timber spruce, cedar & alder. Undergrowth, hard hack, willow and vine maple" (October 19, 1872).

East between **S. 5** and **S. 8**, T33NR4E at 40 chains "Enter alder and crabapple swamp." Line summary "Land level, swamp. Soil 1st rate. Timber, alder spruce & crabapple. Undergrowth, hardhack & willow."

West between **S. 6** and **S. 7**, at 60 chains "Enter spruce & cedar timber bears N. & S." Line summary: "Land level swamp. Soil 1st rate. Subject to overflow of 2 ft. Timber cedar, spruce, & alder. Undergrowth, willow & hard hack" (October 22, 1872).

North between **S. 5** and **S. 6**, at 17 chains "Cedar timber bears N.E. & S.W." At 23 chains "Open swamp bears again N.E. & S.W." Line summary: Land level swamp. Soil 1st rate, subject to overflow of 2 ft. Timber, cedar & spruce" (October 22, 1872).

East between **S. 4** and **S. 9**. Begin "In swamp." At 16 chains "Leave swamp begin to ascend hill bears N & S."

North between **S. 4** and **S. 5**, at 1 chains "Enter open marsh extending 5.00 chs. N. & 7.00 chs. E." At 15 chains "Leave open marsh and enter spruce and cedar timber bearing E & W." At 69.5 chains "Ascend gradually enter old burn…" (October 15, 1872).

East between **S. 6**, T33NR4E and **S. 31**, T34NR4E, at 22 chains "Enter crabapple swamp." At 25.3 chains "Lagoon 80 lks wide, N & S." At 69.6 chains "Enter willow swamp N and S." Line summary: "Land level. Soil 1st rate, bottom. Timber alder, willow, and spruce. Undergrowth, willow, elder, and salmonberry."

East between **S. 5,** T33NR4E and **S. 32,** T34NR2E, at 12.5 chains "Leave willow swamp, enter alder bottom." At 25 chains "Enter heavy timber." At 38.5 chains "a lagoon runs N. & S." At 41 chains "Opposite side of lagoon. Ascend gradually."

PLS notes for T34NR4E:

> North between **S. 31** and **S. 32**, begin “In willow swamp.” At 30 chains “Leave Swamp. Alder bottom brs. E. & W.” Line summary: Timber alder, cedar and spruce. Undergrowth willow, salmonberry and spruce” (September 27, 1872).
>
> East between **S. 29** and **S. 32**, at 298 chains “Lagoon brs. N. & S.” At 30 chains “East shore of lagoon.” At 38 chains “Ascend hill brs. N and S.”
>
> West between **S. 30** and **S. 31**, at 46.54 chains “Lagoon brs. N. and S. Water 3 feet deep.” At 47.75 chains “Leave lagoon N. and S” (September 27, 1872).

Skagit River between Mount Vernon and Burlington

SKG3403E09 Palustrine wetland northwest of NF-SF split

Wetland is in swale and ridge topography created by abandoned meanders of the Skagit River. The boundary of wetland shown on PLS map was shaped using topography and hydric soils.

> East between **S. 26** and **S. 35**. Begin “Through timber.” At 39 chains “Enter marsh brs. N.W. and S.E.” At 42 chains “Leave marsh.” At 71.5 chains “Enter spruce alder and cottonwood timber. No marks of overflow.” Line summary: Land level. Soil 1st rate. Marks of overflow in the lowest places 2 to 3 ft. Timber fir cedar spruce alder and cottonwood. Undergrowth salmonberry maple and hazel” (August 10, 1872).
>
> North between **S. 35** and **S. 36**. At 25 chains “Enter a beaver marsh or swamp, water 2 or 3 feet deep.” At 68 chains “Leave the marsh and enter alder timber.” Line summary: “Land rich bottom 1st rate. Timber spruce, alder, cedar, balm, undergrowth salmonberry, vine maple, hazel, &c.” (October 23, 1866).

SKG3404E05 Mud Lake palustrine scrub-shrub wetland

Shown on PLS map; boundaries shaped using topopgraphy and hydric soils mapping.

> North between **S.1** and **S. 2**, T34NR4E, at 22.5 chains “Swamp bears E and W Water 2 ½ feet deep [underlining added]. Subject to overflow of 10 feet [underlining added].” At 29 chains “A slough 50 lks Wide runs W.” At 35 chains “Spruce timber brs. N. E. & S. W. At 52 chains “Swamp brs. N. E. and S. W. Water 2 ft. deep [underlining added].” At 75 chains “dry ground.” Line summary: “…level swamp subject to overflow of from 6 to 10 feet [underlining added]” (September 18, 1872).

SKG3404E04 Wetland between Mt. Vernon and Burlington

Wetland shown on PLS map; boundary shaped using topography. The PLS mapped this wetland in September 1872, at which time they noted four feet of water at one point and two feet at another point.

> East between **S. 4** and **S. 9**, T34NR4E, begin “In overflowed swamp [underlining added].” At 40 chains “The point for temporary ¼ Sec. Cor. Which it is impossible

to set as the water is nearly 4 feet deep at this point [underlining added].” At 46.5 chains “Leave swamp brs. N.E. and S. W. Ascend gradually.” Line summary: “Swamp subject to heavey overflow” (September 25, 1872).

North between **S. 8** and **S. 9**, T34NR4E, at 17 chains “Enter Swamp Water 2 feet deep [underlining added].” At 25 chains “Slough 200 links wide runs S. W. Cross on drift.” At 40 chains “the ¼ Section Corner. Cannot be Established owing to the water [underlining added].” Line summary: “Subject to overflow 3 to 8 feet [underlining added].”

Sedro Woolley area lahar terrace

SAM3504E05 Palustrine scrub-shrub wetland north of Sedro Wooley and south of Brickyard Creek

The PLS survey crosses this small wetland twice:

North between **S. 13** and **S. 18**, T35NR4E, at 5 chains “Enter swampy bottom bears N. W. & S. E.” until “timber” is encountered at 10 chains” (January 28, 1873).

East between **S. 13** and **S. 24**, at 43 chains “Enter Willow & Hardhack Swamp brs. N & S.”

SAM3504E04 Palustrine scrub-shrub wetland south of Cook Road, west of Sedro Woolley

PLS notes:

North between **S. 23** and **S. 24** at 22 chains “Enter willow swamp bears N & S” continuing to 35 chains “Enter ffir timber” (January 28, 1873).

SKG3505E01 Hansen-Coal Creeks Wetland

This wetland is at the base of fans built by Hansen and Coal Creeks onto the lahar terrace, and downslope from the fans. The unit is mapped essentially as shown on the PLS map, with minor modifications to the boundary using topography and soils mapping. Parts of the wetland are also mapped on the Wickersham 1918 USGS 15’ quadrangle.

PLS survey notes:

North between **S. 15** and **S. 16**, at 24 chains “Enter Crab-apple swamp N 70 E & S 70 W” then “[at 70 chains] Enter wide grass swamp E & W” then “[at 74.5 chains] Leave grass swamp.” Line description: “Timber Fir Hemlock, Spruce Maple Alder & Crab-Apple. Undergrowth Same” (December 19, 1877).

North between **S. 16** and **S. 17**, at 49.5 chains “Enter swamp E & W. Water from 2 to 3 ft. deep [underlining added]” then “[at 75.5 chains] Leave swamp & ascend on table land 50 ft high;” line notes indicate “Timber-Fir-Hemlock, Spruce, Cedar, Maple & Alder. Undergrowth Same With V. Maple” “December 23, 1877.”

West between **S. 18** and **S. 19**, at 12.5 chains, the western edge of our mapped wetland unit “Leave Beaver Swamp [underlining added].” At 29 chains “Enter Open Prairie.” At 54 chains “Leave prairie and enter fir timber.”

North between **S. 17** and **S. 18**, at 35 chains, the northern limit of our map unit, “Leave beaver swamp [underlining added]” (December 26, 1877).

East between **S. 8** and **S. 17** t 62 chains, “Enter beaver swamp [underlining added] S. E. & N. W. water 2 to 3 feet deep [underlining added].” At 64 chains “Leave same & ascend on table land 30 ft. high” (December 27, 1877).

North between **S. 20** and **S. 21**, at 52 chains “Enter Crab-Apple Swamp E. & W.” At 60 chains “Leave same enter Fir Timber” (December 22, 1877).

East between **S. 16** and **S. 21** at 48 chains “Enter Crab-Apple & Willow Swamp N. E. & S. W.” At 54.5 chains “Leave same & enter Fir timber” (December 22, 1877).

SKG3505E02 Wiseman Creek Wetland

Wetland at base of fan built by Wiseman Creek where it spills off of lahar terrace and onto Skagit River floodplain. Shown on USGS Wickersham (1918). The wetland is within the interior of S. 14 and not crossed by a PLS survey line.

SKG3505E03 Wetland south of Minkler Lake

The southeastern topographic extension of Minkler Lake. It is shown on USGS Wickersham (1918). Within interior of S. 13, it is not crossed by PLS survey.

Stillaguamish River

Skip ahead to:

- Port Susan-Fidalgo Island
- Stillagumish River estuarine wetlands
- Stillaguamish delta freshwater wetlands
- Stillaguamish River valley
- North Fork Stillaguamish River

Port Susan-Fidalgo Island

06-057 Livingston Bay marsh

The PLS line notes between S. 20 and S. 29 refer to "cranberry marsh" and the line summary indicates "Undergrowth scotch pine, hardhack and cranberries." Between S. 29 and S. 28 the notes indicate "cattail flag" for 15 chains and then "leave flags and enter brush." Soils formed under marsh vegetation (Ness and Ritchins, 1958). The soils mapping also indicates beach-soil areas seaward of the marsh. T-1755 (1886) shows patches of what could be grassland or scrub in the sandy soil area. Within the marsh area, T-1755 shows scattered conifers. Based on this information the area is mapped as palustrine scrub-shrub wetland, fringed with a sand barrier. PLS notes:

> East between **S. 20** and **S. 29**. At 24 chains "Enter cranberry marsh bearing N 7 S." At 40 chains, corner notes: "…in cranberry marsh…a scotch pine 7 in…a scotch pine 9 in…." At 62 chains "Leave cranberry marsh bearing NW & SE." At 80 chains, corner notes: "…in cranberry marsh." Line summary: "Land generally level lying principally inmarsh. Soil 1st rate, clay loam, wet. Undergrowth scotch pine Hardhack and cranberries" (July 22, 1859).
>
> South between **S. 28** and **S. 29**: "Run through cattail flag." At 15 chains: "Leave flags and enter brush." At 20.4 chains "Intersect beach" (July 22, 1859).

STL3203E04 Fidalgo Island estuarine emergent wetlands on Skagit Bay, between West Pass and North Pass
STL3203E08 Fidalgo Island estuarine scrub-shrub wetlands on Skagit Bay between West Pass and North Pass

These areas are mapped as saltmarsh on T-1755 and T-2156. Saltmarsh is confirmed by the PLS notes: Between S. 26 and S. 27, "land all level prairie, grass and brush one foot high, good grazing" (July 25, 1859). Between S. 25 and S. 26 the notes indicate "tide prairie covered with grass and flags" (August 18, 1891), and between S. 23 and S. 26 (August 19, 1871) "land tide prairie subject to overflow at high tides 2 to 4 feet."

The small stringer of forested north of Juniper Beach and west of Davis Slough is encountered along the line between S. 26 and S. 27 as a "narrow grove of red cedar bearing NE & SW and corresponds to a stringer of sandy soils in the mapping of Ness and Ritchins (1958). This could describe a beach deposit elevated slightly above the surrounding tidal marsh.

Stillagamish River Estuarine Wetlands

STL3203E03 Estuarine emergent wetland, including unmapped estuarine scrub-shrub wetland

The large area of estuarine marsh north of Hatt's Slough (modern name "Hat Slough") and south of South Pass had mostly been diked prior to T-1755 (1886). The PLS notes provide some bounds for the marsh at section lines (see line excerpts below), but few section lines cross the unit. To map the outer limit of estuarine wetland between section lines we used the landward extent of relict tidal channel networks evident on the 1933 photographs. A large central tidal slough is mapped on T-1755 and outlines of the diked upper part of the channel, and its smaller extensions can be traced from 1933 aerials. Along the line between S. 36 (T32NR3E) and S. 31 (T32NR4E) these channels provided a good constraint (within less than 100 m) between the upper limit of estuarine blind tidal channels (channels fed from Port Susan to the south) and the upper limit of riverine-tidal blind channels (fed by freshwater from the Stillaguamish River to the north). This also coincided with the transition from "tide prairie" to "timber" in the PLS notes, which suggests that where numerous tidal channels are visible on the photos, the limit of visible channels is, at least in this case, a reasonable surrogate for the upper limit of estuarine marsh.

The system of tidal sloughs in this marsh (north of Hatt's Slough) appears to have connected with the sloughs that flowed out of the Stillaguamish River. Relict channels from the Stillaguamish River visible on the 1933 aerial and lidar show appear to connect with the upper extent of the tidal channel network (also visible as relict channels, as described above).

A boundary for estuarine marsh south of Hatt's Slough was shown on the plat map for T31NR4E. While the line on the map is likely progressively less reliable the farther north of the line from which it was likely sketched (between S. 6 and S. 7), it indicates the general extent of the marsh. We included less area than shown on T31NR4E, using the relation between elevation and vegetation on the north side of Hatt's Slough (which was crossed by two section lines, between S. 31 and S. 6, and between S. 6 and S. 1) to guide the boundary on the south side of Hatt's Slough.

There had also been substantial diking north of West Pass prior to T-1755. Landward of the dikes, we relied on the extent of "tide prairie" described in PLS field notes. A visual indicator of historical conditions is provided by an April, 1886 photograph of Stanwood's shoreline; its caption reads "the low-lying flat lands in the foreground [appearing to be estuarine emergent vegetation] were much like those to the north of town" (p. 30, Essex, 1971).

Within STL3203E03 there were no indications in the PLS line notes of the spruce marsh (or estuarine emergent scrub-shrub) vegetation that was described in the Skagit delta. While there was likely some amount of scrub-shrub vegetation, having no mappable basis for it, we included it within unit STL3203E03 as unmapped inclusions.

PLS notes include:

> North between **S. 23** and **S. 24**, T32NR3E, "Tide prairie" (August 19, 1871).
>
> East between **S. 13** and **S. 24**, T32NR3E, at 76 chains "Willow and alder bushes" (August 19, 1871).

North between **S. 13** and **S. 14**, T32NR3E, “Tide prairie.” Line summary: “Tide prairie covered with cattail flags” (August 21, 1871).

West between **S. 23** and **S. 26**, T32NR3E, line summary: “Land tide prairie subject to overflow at high tides 2 to 4 feet…” (August 19, 1871).

East between **S. 24** and **S. 25**, T32NR3E, at 3.5 chains “Clumps of red cedars, Gooseberry and rose bushes.” At 9.5 chains “Leave timber, tide prairie.” At 41.5 chains, “Thick spruce timber. Undergrowth of rose salmonberry and goose berry bushes” (August 19, 1871).

North between **S. 25** and **S. 26**, T32NR3E, “Tide prairie” (August 18, 1871).

West between **S. 25** and **S. 36**, T32NR3E, at 36.5 chains “Leave spruce timber, enter tide prairie” (August 18, 1871).

North between **S. 36**, T32NR3E, and **S. 31**, T32NR4E, at 63.0 chains “Enter low band [?] timber.” At 76.0 chains, “Enter green timber and swamp.” Line summary: “Land except last 17 chains 1st rte tide prairie overflowed by extreme high tides.”

East between **S. 31**, T32NR4E and **S. 6**, T31NR4E, beginning “In tide prairie.” At 21.0 chains “Leave tide prairie. Enter Timber bearing N and S.” At 47.0 chains “Clearing.” At 57.0 chains “Enter timber.”

North between **S. 1**, T31NR3E and **S. 6**, T31NR4E, line description “Land rich tide prairie overflowed at extreme high tides only will make excellent grass and meadow land. Timber about 20 chains to the east.”

West between **S. 6** and **S. 7**, T31NR4E, at 27.0 chains “Enter tide flats N and S” (August 12, 1872).

Stillaguamish Delta Freshwater Wetlands

STL3204E03 Riverine-tidal scrub-shrub wetland north and west of Stanwood

We map the wetland north and west of Stanwood (1-2 km up-valley from Florence in Sections 28, 29, 32, and 33) using PLS field notes along the section lines and drawing the wetland’s boundary by making use of relict tidal channel networks or network fragments. These relict tidal channels are particularly visible on the 1933 photographs in S. 19 T32NR4E and S. 24 T32NR3E, including on the present site of Stanwood. A large tidal channel (Church Creek) bisects the portion of STL3204E03 to the west of Stanwood.

PLS notes:

North between **S. 24**, T32NR3E, and **S. 19**, T32NR4E, at 5.5 chains “Enter hard hack swamp with hemlock growing at intervals and about 20 chains wide from E. to W.” At 80 chains “…in swamp…” Line summary: Land level and through a dense hardhack swamp extending west to the beach. Timber crabapple and hardhack.”

West between **S. 19** and **S. 30**, T32NR4E, at 34.0 chains “Foot of hill and enter Swamp covered with Hard Hack, Crabapple &.”

STL3203E02 Riverine-tidal forested wetland south of Stanwood

This unit south of Stanwood, and on both sides of the Stillaguamish River, is not shown on PLS plat maps, but is identified as swamp in PLS field notes, and is bisected by relict tidal channels on the 1933 aerial photographs. In the PLS notes:

> North between **S. 36** T32NR3E and **S. 31** T32NR4E, at 63 chains "enter low dead timber." At 76 chains "enter green timber and swamp."

The transition to timber at 63 chains from the "tide prairie" to the south corresponds well with the point of transition where relict tidal channels visible on the 1933 photographs to the north connect to the Stillaguamish River (in the riverine-tidal forested wetland) and to the south to Port Susan (in the estuarine wetland).

> East between **S. 24** and **S. 25**, T32NR3E, at 3.5 chains "Clumps of red cedars, Gooseberry and rose bushes." At 9.5 chains "Leave timber, tide prairie." At 41.5 chains, "Thick spruce timber. Undergrowth of rose salmonberry and goose berry bushes" (August 19, 1871).
>
> West between **S. 25** and **S. 36**, T32NR3E, at 36.5 chains "Leave spruce timber, enter tide prairie" (August 18, 1871).
>
> North between **S. 25**, T32NR3E, and **S. 30**, T32NR4E, line description: "Land first rate, but wet and swampy. Timber Fir, Spruce, Hemlock, and Alder. Undergrowth crab apple, briars, Salmonberries etc."
>
> North between **S. 36**, T32NR3E, and **S. 31**, T32NR4E, at 63.0 chains "Enter low band [?] timber." At 76.0 chains, "Enter green timber and swamp." Line summary: "Land except last 17 chains 1st rte tide prairie overflowed by extreme high tides."
>
> West between S**. 30** and **S. 31**, T32NR4E "In cultivated field:' at 15.38 chains "Cross field and enter Woods NW and SE." At 80.2 chains "…trees are blown down in all direction. The line N & S is through the same for several chains." Line summary: "Land level bottoms, alluvial deposit. Soil 1st rate. Timber spruce cedar and alder. Undergrowth Vine Maple Salmonberry Briar and Young Willow. Entire line subject to overflow during winter months from 1 to 3 feet" (September 25, 1872).

Stillaguamish River valley

STL3204E02 Riverine-tidal/palustrine scrub-shrub wetland on north valley side

This map unit in in the lower-elevation part of the floodplain toward the north of the valley bottom. The topography suggests that this linear east-west depression includes in its axis an abandoned river channel, which was large enough to impress PLS surveyors as being "probably a branch of Stillaquamish River." It may have diverged from the modern channel of the Stillaguamish River near the Hwy 530 crossing of the "Old River" near the boundary between S. 36 and S. 35 T32NR4E, at the foot of Prestliens Bluff and the lower end of Jackson's Gulch. Relict channels visible on 1933 aerials and lidar suggest that the depression was also fed by floodwaters from the Stillaguamish River along the length of the wetland.

We mapped this wetland on the basis of descriptions along several PLS survey lines that cross it. The cartographers working from the field notes did not draw wetland boundaries, showing only wetland symbol along the lines. We used topography, soils information, and the drainage network to draw the wetland's boundaries. The low (modern-day) elevation makes it likely that the lower part of this wetland was influenced by tidal backwater, but we lacked an objective means for subdividing the wetland into tidally and non-tidally influence parts.

In STL3204E02, PLS field descriptions include:

> East between **S. 29** and **S. 32**, beginning "In cultivated field." At 58.51 chains "Intersect navigable slough." Line summary: "Land in this line level river bottom of a rich alluvial deposit. Subject to overflow from 1 to 3 feet in the Winter season. Timber Scattering Spruce and Cedar Alder Vine Maple Cottonwood and Willow. Undergrowth Salmonberry briars and willow" (September 25, 1872).
>
> East between **S. 28** and **S. 33**, T32NR4E, at 6.5 chains "Leave Crabapple and Vine Maple thicket and enter Swamp covered with Hard Hack Vine Maple and Willow." At 64.5 chains "Leave swamp and Enter Vine Maple and Alder thicket." Line summary: "This mile with the exception of 6 ½ chains on the East side lies through a Swamp so dense with Hard Hack etc. that it almost impossible to cut a line through it. This can be made good farming land by clearing and draining" (September 23, 1872).
>
> North between **S. 28** and **S. 29,** beginning in "Hard Hack and Crabapple and Willow Swamp." At 22.5 chains, "Leave swamp ascend gradually and enter high land." Line description: "The first 25 chains of this mile is a Hard Hack Swamp" (September 23, 1872).
>
> North between **S. 32** and **S. 33**, beginning "In bottom covered with Vine Maple and Alder." At 48.75 chains "Leave river bottom and enter Hard Hack and Crabapple Swamp." At 79.5 chains "Leave Swamp and enter crabapple thicket." Line description: "The first 49 chains of this line is river bottom. Soil 1st rate. The bottom is Swampy but can be Easily drained and coverted into good agricultural land. Timber Scattering Spruce, Alder and Cedar" (September 20, 1872).
>
> North between **S. 33** and **S. 34** at 52.21 chains "Intersect a slough running E & W, probably a branch of Stillaquamish River. I chain across same 145 lks. [links];" that the channel was substantial enough for the surveyor to interpret this channel as a branch of the main river suggests that it had significant flow in summer. Farther along the line, they note "[at 72 chains] Enter Swale Covered with Coarse grass and Willow bushes." Line summary: "Land rich bottom land covered with a heavy growth of vine maple and Hard Hack" (September 16, 1872).
>
> Between **S. 34** and **S. 35**, in STL320R4E, at 5 chains "Cross marsh 2 chs. wide enter Crab apple swamp." At 8.5 chains, "Leave swamp and enter Maple thicket." At 79.0 chains "Leave marsh and commence abrubt ascent." Line summary: "This mile runs through a marsh until 79 chains when it is high land. The swamp is covered with crabapple and vine maple and alder and very hard to get through. No timber worth mentioning along the line. There being but scattering cedar and spruce trees."

North between **S. 35** and **S. 36**, from 31.5 chains to 54 chains “Swamp covered with a dense undergrowth of crabapple, hardhack, and willow. It gives evidence of having been inundated [underlining added] and bears S69E and N10W.” At 40 chains “There are no bearing trees convenient as I am stuck in swamp which is (and has been the last 7 chains) covered with a growth of coarse grass about 5 feet in height.” Line summary: “subject to overflow of several feet [underlining added].” At 54.0 chains “Leave swamp and enter timber.” Line summary: “Land first 54 chains through bottom subject to overflow of several feet” (September 9, 1872).

The PLS field notes do not suggest that the wetland was significantly inundated in late summer when the survey was made (September 1872). There is only one field description of winter conditions (“subject to overflow of several feet”), which may reflect the lack of visual evidence for that in late September, or it may reflect an absence of widespread winter inundation.

STL3105E01 Palustrine wetlands on the south margin of Stillaguamish River
STL3105E02 Palustrine wetlands on the south margin of Stillaguamish River valley
STL3105E03 Palustrine wetlands on the south margin of Stillaguamish River valley

Described as “marsh” and “swampy ground”in PLS survey. Mapped areas correspond to occurrence of “Mukilteo Muck” soils in pockets of lower elevation at south margin of the valley.

PLS line notes :

East between **S. 15** and **S. 10**, at 35.0 chains “Enter Marsh N & S.” At 41.0 chains “Leave Marsh N & S” (September 3, 1875).

North between **S. 10** and **S. 11**, at 16.5 chains “Enter swampy ground N.W. & S.E. ” (August 26, 1875).

STL3105E04 Palustrine wetland

Mapped generally as shown on PLS plat map. PLS notes:

North between S. 9 and S. 10, at 71.82 chains “Intersect Beaver marsh N.W & S.E., ” and at 71.82 chains “Leave Do N.W & S.E. ” (September 5, 1875).

North Fork Stillaguamish River

STL3206E02 Palustrine wetland

Crossed by PLS survey between S. 21 and S. 16 : Westward, at 16.2 chains “Enter swampy land” and at 40.9 chains “Leave swampy land” (November 16, 1890). This segment of the line corresponds to hydric soil unit, which was used to shape the map unit’s boundary.

STL3206E01 Palustrine wetland

Crossed by PLS survey between S. 11 and S. 12 : Northward, at 45.0 chains “Enter swampy land course E & W” (November 20, 1890) ; swamp symbol is shown on PLS

map until end of line. This segment of the line corresponds to a hydric soil unit, which was used to shape the boundary.

Snohomish River

Skip ahead to:

- Snohomish River estuarine wetlands
- Snohomish River riverine-tidal wetlands
- Snohomish River palustrine wetlands
- Skykomish River
- Snoqualmie River

Snohomish River Estuarine Wetlands

SNH2905E03 Estuarine emergent marsh
SNH2905E02 Estuarine scrub-shrub marsh

We delineated emergent marsh from adjacent scrub-shrub marsh primarily from the presence of absence of bearing trees, and the line description in PLS field notes. Line descriptions falling within the map unit include:

> South between **S. 31** and **S. 32**, T30NR5E, at 4.9 chains "Enter spruce bottom." At 7.5 chains "Enter tide prairie." Line summary: "Land tide prairie subject to heavy overflow from high tides & freshets. Scattering clumps of small cedar" (April 29, 1874).
>
> Between **S. 5** and **S. 6**, T29NR5E, "the land is low and covered with drift logs that have been here many years. At this point the land is forming very fast and a few years time will expose much on the point west of the line that is now under water."
>
> West between **S. 5**, T29NR5E and **S. 32**, T30NR5E, "Land level tide prairie, good grass Soil 2d class" (April 19, 1869).
>
> North between **S. 4** and **S. 5**, line summary: "Land level, fine grass, no timber" (April 17, 1869).
>
> West between **S. 4** and **S. 33**, Line summary: "Land level, fine grass. Land subject to overflow at high tides, but can be reclaimed by dyking. Soil 1st class" (April 19, 1869).
>
> North between **S. 8** and **S. 9**, line summary: "Land level tide prairie…Fine grass" (April 15, 1869).
>
> West between **S. 5** and **S. 8**, T29NR5E, "Land tide prairie and subject to overflow at extreme high tides. Fine grass" (April 17, 1869).

The presence of a spruce at the corner of S. 4, 5, 8, and 9, and the mention of "extreme high tides" in the latter description was taken to indicate a transition between emergent and scrub-shrub marsh in the eastern part of the line between S. 5 and S. 8 (T29NR5E). The boundary between S. 8 and S. 9 was interpreted based on the line description indicating "…tide prairie…fine grass…" and the presence of bearing trees at the corner of S. 8, 9, 16 & 17 and at the corner of S. 4, 5, 8 and 9. To draw the boundaries between S. 4 and 5 (T29NR5E), S. 32 and 33 (T30NR5E), and S. 29 and 32

(T30NR5E) we made use of the line descriptions in combination with the 1933 aerial photos in areas where the tidal marsh remained undiked. The PLS notes describe the line between S. 4 and S. 5 (T29NR5E) as “Land level, fine grass, no timber…” but the absence of timber (generally used by the surveyors to mean dense trees) is consistent with the presence of scattered trees, and bearing trees were noted at the corner of S. 4, 5, 8, and 9. The line between S. 32 and S. 33 (T30NR5E) was described as “open marsh [unreadable] no timber or underbrush.” We draw the line as crossing a small amount of scrub-shrub marsh, based on elevation and the 1933 photos, as consistent with this line description. Along S. 29 and S. 32 (T30NR5E) the notes indicate transitions (“…enter spruce swamp…enter tide prairie…enter spruce bottom”) along the line, which are roughly consistent with those indicated on the 1933 photographs.

Section lines falling within the area mapped as scrub-shrub estuarine wetland, and their PLS field descriptions include:

> West between **S. 3** (T29NR5E) and **S. 34** (T30NR5E) “…. The west 39.8 chains nearly all covered with flags and rose bushes and cut up with innumerable Sloughs in all directions, and covered with high tide water …” (May 19, 1859).
>
> East between **S. 9** and **S. 6** (T29NR5E), line summary: “Land level and mostly tide prairie” (April 15, 1869).
>
> North between **S. 16** and **S. 17**, line summary: “The first 50 chs heavily timbered, the remainder tide prairie with high grass and flags …tide prairie with high grass and flags” (April 14, 1869).
>
> East between **S. 4** and **S. 9**, T29NR5E, Line summary: “Land tide prairie. Fine grass a few scattering juniper trees” (April 16, 1869).
>
> North between **S. 9** and **S. 10**, T29NR5E, “…1st ½ mile covered with rose brush, the remainder tide prairie covered with good grass” (April 15, 1869).

The area also includes a line description that could also be consistent with emergent vegetation:

> North between **S. 3** and **S. 4**, T29NR5E, “The land is subject to overflow from extreme high tides. No brush or timber. Fine tide grass” (April 17, 1869).

This area has been included in the scrub-shrub zone, however; the intent is to map a broad zone that is generally scrub-shrub, but may include areas of emergent vegetation. Three of 15 PLS survey points in the map unit have no bearing trees.

Trees were widely spaced; the average distance to bearing trees from PLS survey points was 32.4 m. Most (10 of 24) bearing trees were spruce (Sitka spruce, *Picea sitchensis*) and their diameter averaged 48 cm. Juniper (Rocky Mountain juniper, *Juniperus scopulorum*) was the next most common tree (8 or 24 trees), averaging 14 cm. This historical abundance of spruce and juniper is similar to our recent field observations in the Snohomish estuary. Incidental trees included 2 cedar, *Thuja plicata* (average diameter 11 cm), 2 fir, *Pseudotsuga menziesii* or *Abies grandis* (average diameter 23 cm), 1 yew *Taxus brevifolia* (7.5 cm diameter), and one crabapple, *Malus fusca* (10 cm diameter).

To delineate emergent from scrub-shrub vegetation we also made use of T-1681 (1884-1885). The density of tree symbols added to the saltmarsh symbol on T-1681 vary in a way that is consistent with the PLS descriptions.

We mapped channels in both units primarily from T-1681 (1884-1885). We used 1938 photos to modify some of the channels, especially the shape of smaller blind tidal channels, and also the position of larger channels farther upvalley, where the T-1681 appears to have been shifted by a survey error. We also mapped some smaller blind tidal channels that did not appear on T-1681 directly from 1938 photos. These channels had not been diked prior to 1938, meaning that the channel shape and location could have changed since the pre-settlement period.

Snohomish River Riverine-Tidal Wetlands

SNH2905E01 Ebey-Island area riverine-tidal forested wetlands

We mapped an extensive area upstream of the estuarine wetland map units as riverine tidal forested wetland. Trees are almost seven times more densely spaced in this area than in the estuarine scrub-shrub wetland. The PLS surveyors described the area as swamp, with occasional references to inundation during high tides in the March-April period of 1869 when the area was surveyed. The area was not uniformly covered with dense forest, with the field notes indicating areas having only scattered trees. The area is rendered on the USC&GS chart as marsh with coniferous tree symbols of varying spacing, with the spacing generally being greater near to the large sloughs; the symbol spacing is also dense on Otter Island. Undergrowth, most commonly rose and hardhack, was typically dense and described as “impassible.”

Descriptions from PLS line summaries include:

> Between **S. 15** and **S. 22** in T29NR5E, and nearly identical description between **S. 21** and **S. 22**, “Land level & swampy a few scattering trees. Rose briars & swamp dogwood [presumably red-osier dogwood, *Cornus stolonifera*] almost impassible.”
>
> Between **S. 22** and **S. 27**, T29NR5E, “Land level and swampy all the way a few scattering Pine. Rose bushes very thick in many places.”
>
> Between **S. 27** and **S. 28**, T29NR5E, “Land level & swampy rose brush very thick many places. The high tides cover the most of the land and we are compelled to wait for low tide” (April 1st, 1869).
>
> Between **S. 27** and **S. 34**, T29NR5E, “Land level & swampy but little underbrush.”
>
> Between **S. 33** and **S. 34**, T29NR5E, nearly identical description between **S. 28** and **S. 33**, “Land level & swampy a few scattering trees. Tall grass & rose bushes.”
>
> Between **S. 26** and **S. 27** T29NR5E, “Land level & swampy but little timber. Underbrush swamp dog-wood, Scotch pine and Buck brush [hardhack, *Spiraea spp.*].”

> Between **S. 34** and **S. 35**, T29NR5E, “Land swampy. Along the bank of slough is a strip of land about 4 chs wide covered with spruce and alder, the remainder is covered with crabapple and a small scrubpine.”
>
> Between **S. 22** and **S. 23**, T29NR5E, “Land level & swampy. Timber spruce alder & willow. Underbrush rosebushes & swamp dog-wood.”
>
> Between **S. 10** and **S. 15**, T29NR5E, “Timber spruce and alder. The land is covered with water at spring tide but can be reclaimed by diking.”

The primary criterion we used to distinguish the scrub-shrub estuarine wetland from the riverine-tidal forested wetland is the distance to bearing trees. In the scrub-shrub estuarine wetlands, surveyors traveled almost seven times farther on average to find a suitable witness tree (32.4 m on average in the scrub-shrub area compared to 4.7 m in the forested area). Otherwise, tree cover in the two areas is broadly similar in size and composition with spruce being significantly larger (58 cm) than other species, excepting three cedar bearing trees in the map area. Primary differences between the two areas are (1) that juniper (*Juniperus scopulorum*) is common in the estuarine scrub-shrub area, while pine (presumed to be shore pine, *Pinus contorta*) is common in the riverine-tidal forested area, (2) spruce, while still the most common tree in the riverine-tidal forest, is less dominant than in the estuarine scrub-shrub zone, and (3) alder (*Alnus rubra*) and crabapple (*Malus fusca*) are common in the riverine-tidal forest, but not in the estuarine scrub-shrub zone.

SNH3005E03 Allen Creek area riverine-tidal forested wetlands

This area is outside the area covered by T-1681. We map it as riverine tidal forested wetland based on the PLS description and the abundance of tidal sloughs and patches of remnant forest vegetation on 1938 aerial photos. PLS description:

> South between **S. 33** and **S. 34**, T30NR5E, at 4 chains “Enter tide marsh, rich loam.” Line summary: “Land level soil 1st rate. Timber Spruce and Cedar underbrush Harc Hack [illegible] and Salmonberry” (December 9, 1871).
>
> West between **S. 33** and **S. 28**, at 4.5 chains “Enter Tide marsh” and at 10 chains “Leave tide marsh and enter high land” [this line crosses the finger of wetland that extends up the Allen Creek valley].

SNH3005E04 Quilceda Creek palustrine wetlands
SNH3005E05 Sturgeon Creek palustrine wetlands

We mapped these wetlands primarily from 1933 aerial photographs.

SNH2805E01 “Marshland” riverine-tidal scrub-shrub wetland continuous downstream with portion of **SNH2905E01**, mapped as riverine-tidal forested wetland

The “Marshland” area is shown on PLS maps and T-1681on the south side of the Snohomish River extending nearly to the valley wall, roughly 3 km wide and 9 km long. T-1681 suggests somewhat larger boundaries to the west than the PLS map, and analysis of the vegetation and topography to the east suggests a smaller boundary than mapped on the PLS map; the easternmost area depicted on the PLS map has a different vegetation pattern suggestive of river bottom, is higher in elevation, and the field notes refer to the area as river bottom subject to overflow from the adjacent Snohomish River.

Marshland at present is approximately at sea level in its central and northern parts, and slopes upward gradually in the upstream direction. The PLS notes indicate the marsh was subject to overflow "from rains and freshets in the river," suggesting the Snohomish River as well as adjacent upland drainage seasonally flooded the area. Morse (in Nesbit et al., 1885) describes it as "fresh-water marsh…." Tidal influence currently extends upstream in the Snohomish River beyond the upper end of the marsh, and would have increased the frequency of flooding in the area. What appear to be tidal creeks are visible on the 1933 and 1938 aerial photos in the lower three-quarters of Marshland. We mapped Marshland as "riverine tidal" for these reasons. The upstream fourth of the marsh was probably transitional in its hydrology to a non-tidally influenced wetland, and inundated more from upstream river flooding, while the bulk of Marshland could have been inundated by tidal backwater flow in tidal creeks, upland creeks, and overbank flooding.

The PLS notes suggest that Marshland was a patchwork of scattered-tree-covered areas, willow-hardhack shrub thickets, and open marsh. Eight of twenty (40%) of survey points lacked trees. Pine was the most common bearing tree, accounting for two-thirds (14 of 21) of bearing trees. Pine trees were relatively small, averaging 19 cm. Forested areas were relatively sparse, with the average distance from survey points to trees being 15.7 m. Cedar, hemlock, and alder formed somewhat more dense stands, with average distances of 8.2 m. Spruce, and pine were more scattered, averaging 18.1 m from survey points. The open spacing of the pine and spruce is consistent with the frequent descriptive references to hardhack-willow thickets with scattered pines. This latter scrub/forest vegetation of hardhack-willow shrub with scattered pines or spruces accounted for about two-fifths (38%) of points. The remaining two-fifths (43%) of points had no trees near enough to serve as witness trees; most of these locations are described as willow-hardhack or as "open."

Line descriptions for the Marshland area include:

> Between **S. 4** and **S. 9**, T28NR5E, "Land level. Soil near & east of river rich. West half of mile not so good, a sort of Peat. All subject to overflow from two to four feet [underlining added]". Timber spruce, cedar, fir & maple. Undergrowth vine maple, willow, crabapple & salmonberries."
>
> Between **S. 8** and **S. 9**, T28NR5E, "Lands in swamps & level. Soil rich but subject to overflow from 2 to 5 ft [underlining added]."
>
> Between **S. 9** & **S. 16**, T28NR5E, "Swamp level Subject to overflow to depths of 3 to 4 feet [underlining added]". Timber Fir, Cedar, Hemlock, Spruce & Pine, Undergrowth Salal Willow & Hardhack."
>
> Between **S. 10** and **S. 15**, T28NR5E, "Land swamp is overflowed 18 inches deep. Covered with willow and Hardhack brush" (March 1st, 1871).
>
> Between **S. 15** and **S. 22**, T28NR5E, "Land swamp covered with hardhack willow and cranberries" (between S. 15 and S. 16, T28NR5E); "Land swamp overflowed from 1 to 2 feet deep and subject to much greater overflow [underlining added]". Covered with willow and hardhack brushes" (February 28, 1871).
>
> Between **S. 21** and **S. 22**, T28NR5E, "Swamp level soil rich. But subject to inundation from 2 to 6 feet deep [underlining added]". Timber Fir Hemlock Cedar & Pine. Undergrowth Willow Hardhack Salall and Salmonberry."

Between **S. 14** & **S. 15**, T28NR5E, "Land swamp overflowed 1 ½ feet and subject to overflow in times of freshets [underlining added]". Soil N ½ mile rich, on S ½ a kind of peat with Scrub Pine and Hardhack."

Between **S. 23** and **S. 26**, T28NR5E, "Land level. Soil a kind of peat. Subject to overflow to the depth of 2 to 4 ft [underlining added]" covered with Scrub Pine Tea bushes and Hardhack" (February 23, 1871).

Between **S. 26** and **S. 27**, T28NR5E, "Marsh rich but overflowed to the depth of 6 inches, and very miry unfit for cultivation" (February 23, 1871).

Between **S. 24** and **S. 25**, T28NR5E, "The ground is here [at a 40 chain distance along the line] overflowed to the depth of 2 ½ ft [underlining added]" and as we proceed further is getting deeper so I am unable to proceed further in this direction…bottom subject to overflow from freshets and rains from 2 to 4 ft deep [underlining added]."

Between **S. 13** and **S. 14**, T28NR5E, "…subject to overflow from 2 to 6 ft deep [underlining added]" … (February 20, 1871).

Between **S. 23** and **S. 24**, T28NR5E, "Level swamp covered with willow and Hardhack brush and Subject to overflow from 2 to 6 feet [underlining added]" (February 18, 1871).

Between **S. 25** and **S. 26**, T28NR5E, "Soil rich but subject to overflow from rains and freshets in the river to a depth of 2 to 6 feet [underlining added]."

Much of Marshland was flooded with a few feet of water at the time of a February 1871 survey. Of 23 survey points, field notes indicate the depth of water at 11, where depth averaged 0.67 m, and at an additional two points the water was too deep for access. Five additional points had too much water to allow the surveyors to build a mound, and three more points were described as "swamp." In total, between 13 and 21 of 23 points had standing water. The water at three points was more than a meter deep and the two points too deep to access were presumably deeper, meaning that at least five points were deeper than 1 m. Most points were described as "subject to overflow" to depths greater than the water that was present at the time of the survey. At eleven points the surveyors provide quantitative estimates of seasonal flood depth which was on average 0.67 m. The published plat map shows "subject to overflow 2 to 6 ft" (0.6 to 1.8 m). Using the percentage of inundated survey points to estimate inundation indicates approximately 80% of the area was inundated in February 1871.

Marshland is designated "cranberry swamp" on the PLS map. Cranberries are mentioned at one location in the field notes. It is interesting to note that in the Fraser River delta, a reconstruction of historical vegetation by North and Tevarsham (1984) includes "cranberry swamp" as a map unit. Similar to the Snohomish's Marshland, the Fraser delta area has "'some hardhack and pine;' described in one instance as 'low pine brush mostly deadened by fire with great abundance of cranberries'" [North and Teversham (1984) identify the pine as *Pinus contorta*]. North and Tevarsham also indicate that ethnobotanic literature suggests it is likely that Indians cultivated the Fraser cranberry swamp.

The native name for the Marshland area, as accessed by the river, according to the transcription of T. T. Wateman' early ethnography by Hilbert et al. (2001), was

> “Ctcgwa’lltc, or “the outer edge of something,” for rather high land along the margin of the river. The area lying [in] back of this high level is an extensive cranberry marsh” (Hilbert et al. 2001).

SNH2806E02 Lower Pilchuck River wetlands

This wetland appears in the same form we have mapped it on the 1895 USGS Snohomish 30’ topographic quadrangle. It is not mentioned in the PLS field notes for the line between S. 18 and S. 19, T29NR5E, surveyed on August 10, 1866.

Snohomish River palustrine wetlands

SNH2806E01 French Creek Marsh

The French Creek marsh is shown as 1,400 ha on PLS maps and is on the north valley side upstream of the town of Snohomish. The marsh appears to have been more densely vegetated than Marshland. All survey points (14 points) had trees close enough to serve as witness trees, and the average distance to trees was 6.3 m. Pine, spruce, and crabapple were the dominant trees; alder, cedar, and willow were less common. All trees were similar in diameter except for crabapples, which were smaller in diameter. Similar to conditions in Marshland, pines tended to serve as witness trees alone, without other trees, and were somewhat more widely spaced, averaging 9.4 m from survey points compared to 5.5 m for other trees. As in Marshland, pine-covered areas appear sparser than tree cover in other parts of the marsh.

According to newspaperman and Snohomish resident Eldridge Morse, writing in the Northern Star Newspaper, April 4, 1877, the marsh had two identifiable portions. A forested band of trees divided the marsh into an upper and lower half:

> “It is nearly cut in half by a swath of spruce and cedar timber...The part below this belt, called the lower marsh ...is splendid pasture land in the summer and fall. [It] is overflowed by freshets in winter and spring...The upper marsh is beaver meadow, covered with grass, hardhack and tea brush [(Ledum groenlandicum) with] no timber of any size.”

Witness tree data do not contradict Morse’s description; the distance to trees is greater in the upper part of the marsh, but there are too few points to make a comparison on that basis. However, the descriptions of water depth and beaver dams do contradict Morse’s description as only the upper part being “beaver marsh.” Surveyors in July and August 1866 describe most of the French Creek marsh as having been inundated by water on account of beaver dams. Further evidence of inundation include that soils in about one-third of the marsh (31%) are mapped as Mukilteo Muck, a deep soil formed “in organic material derived dominantly from sedges.”

PLS field descriptions include:

> North between **S. 2** and **S. 3**, T27NR6E at 8.5 chains “Enter an impenetrable marsh and ascertain that I can proceed no further on this line, the remainder lying mostly in an impenetrable marsh which embraces the greater portion of S. 2 and S. 3, I abandon running as an impracticable undertaking” (August 17, 1871).

All of the following observations are from T28NR6E, in July and August 1866.

North between **S. 35** and **S. 36** T28NR6E at 12 chains “Enter [illegible word] swampy land in places overflowed 6 inches [underlining added], bearing N. E. & S.W.” At 63 chains “ …leave the swampy valley bearing N. W. and S. E. and ascend” (July 19, 1866).

North between **S. 34** and **S. 35**, T28NR6E, beginning “Begin the swampy prairie.” Line summary includes “Land level wet and swampy….Timber scattering pines. Undergrowth Alder Willow and Crabapple” (July 19, 1866).

North between **S. 33** and **S. 34**, at 10 chains “wet swampy valley land bordering on Brushy prairie bears N 20 W S 20 E.” At 69.5 chains “Deep Creek 40 lks wide runs slowly N 20 W.” Line summary includes “Land swampy and in places overflowed to the depth of 12 inches in consequence of Beaver dams in Deep Creek [underlining added]...Timber scattering Spruce Pine & Cedar. Undergrowth Willow and Crabapple” (July 25, 1866).

East between **S. 27** and **S. 34**, at 15 chains “Enter Hardhack prairie bears N. W. & S. W.;” the line description includes “Land level and swampy….Timber scattering Spruce and Pine, Undergrowth same with Willow and Crabapple.”

North between **S. 27** and **S. 28**, the line summary: “Land swampy and generally overflowed to the depth of 12 inches in consequence of Beaver dams [underlining added]…Timber Spruce & Cedar. Undergrowth same with crabapple” (July 25, 1868).

East between **S. 22** and **S. 27**, at 7 chains “Enter hardhack prairie bears N 70 W S 10 E” on July 31, 1866. Northward between S. 21 and S. 22. At 13 chains “Enter open prairie bears West and S. E.” At 32 chains “Leave the prairie bearing N 50 W S 20 E” (July 31, 1866).

North between **S. 28** and **S. 29**, at 47 chains “Intersect overflow land to the depth of 6 inches bears [underlining added] N. W. and S. E.” Line description: “The Soil in the valley now overflowed in consequence of beaver dams [underlining added], is first rate. Timber Cedar Fir and Spruce. Undergrowth same, with Alder, Crabapple and Willow” (August 1, 1866).

The line description between **S. 21** and **S. 28**: “Land level mostly overflowed to the depth of 6 inches [underlining added]….Timber Spruce Pine and Hemlock. Undergrowth same with Crabapple” (August 1, 1866).

North between **S. 20** and **S. 21**, at 24 chains “Enter thick Willows on the bottom of French Creek, liable to annual inundations to the depth of 36 inches, now covered with water to the depth of 8 inches [underlining added], bears E and W.” At 36.6 chains “French Creek 48 lks wide, 7 feet deep, runs N 60 W. There is a large Beaver dam on the creek about 6.00 chs from the line down stream and N 60 W.” At 60 chains “Leave the willow thicket and overflowed bottom [underlining added] and enter scattering Pine timber undergrowth a dense Crabapple thicket E & W.” The line summary includes “Land level and mostly overflowed now to the depth of 4 to 8 inches. Liable to annual inundation 36 inches [underlining added]….Timber scattering Pine, undergrowth same with Willow and Crabapple” (August 2, 1866).

East between **S. 16** and **S. 21**, at 44 chains “Leave the open overflowed valley and gradually ascend;” the line description includes “Land in the valley mostly

overflowed to the depth of 4 inches [underlining added]…Timber scattering Pine undergrowth Crabapple" (August 2, 1866).

Northward between **S. 16** and **S. 17**, "Leave the wet valley bears S 80 E and extends N 70 W about 40 chs" (August 2, 1866).

East between **S. 17** and **S. 20**, "[at 37 chains] Enter swampy bottom bears N & S" then "[at 47.2 chains] Leave the swampy timbered crabapple thicket, the land still wet and liable to inundation from 20 to 25 inches. [underlining added]"

The recorded water depth were in the driest part of the year (July and August) and indicate a inundation of one foot or less. The linear distance for which the notes explicitly mention inundation is about one-third of the total surveyed length; using this as a measure of inundated area is almost certainly a conservative estimate, because the surveyors do not appear to have consistently noted inundation. The notes excerpted above describe two to three feet of winter inundation.

Skykomish River

The Skykomish valley historical map includes several small (2 to 60 ha) wetlands on the northern part of the valley. Most appear related to old river bends or oxbows.

SKY2707E01

The PLS survey crossed the wetland between S. 2 and S. 3, T27NR7E; they noted "impenetrable marsh bears E & W." We mapped the unit as shown on the plat map.

SKY2707E03
SKY270704

These wetlands were not crossed by a section line. They appear on 1938 aerials and are coincident with mapped muck soil.

SKY280801

Two separate wetlands in close proximity. The western wetland was not crossed by a PLS survey line; the mapped area has muck soils and has ponded water in recent photos. The middle wetland was not crossed by the PLS survey. The eastern wetland was crossed by the PLS between S. 34 and S. 35 (T38NR8E) and described as a "swamp."

SKY2808E02

Wetland was not crossed by a section line. The area appears on the 1938 aerials as forested with widespread ponded water. The area coincides with muck soil.

SKY2808E04

This arcuate wetland on a terrace in the lower Sultan River valley is continuous with a pond that is visible on recent aerial photos and shown on recent topographic maps. It was not crossed by PLS survey line. The map area coincides with muck soil.

Snoqualmie River

SNQ2606E01 Palustrine wetlands northeast of Duvall

This extensive marsh appears on PLS plat maps. The PLS field notes describe this marsh as having a thick growth ("…almost unpassable…") of shrubs and small trees. The shrubs were described as hardhack, crabapple, willow, alder, and tule. A few areas are described as "cranberry marsh." The tree cover was described as "…a few scattering scrubby spruce and cedar" or "…a few scattering scrubby spruce, entirely worthless." From this information the area appears to have been primarily a scrub-shrub wetland. This interpretation is supported by images of a 3-km^2 remnant of the marsh shown on 1938 aerial photographs (Figure 3), which suggest a brushy marsh with scattered conifers. Bearing tree data also support the description of marsh tree cover as spruce having a small diameter, and small-diameter alder, maple, and vine maple.

The PLS notes indicate the marsh is seasonally "subject to overflow" by as much as 8 feet of water, which is consistent with its modern elevation several meters below the Snoqualmie River's bank. At the time of a survey on April 4, 1873, the water was described as "… U6 to 18 inches deepU [underlining added]." Descriptions in the PLS field notes include:

> Between **S. 1** and **S. 2** (T26NR6E) "…low scrubby open timber….Usubject to overflow at high water to the depth of from 6 to 8 feetU [underlining added]. Timber in the last ¼ mile [moving north] low scrubby pine undergrowth crabapple willow & hard hack."
>
> East between **S. 1** and **S. 12**, T26NR6E, at 28 chains, "Intersect point of spruce timber N & S," and at 41 chains, "leave scrubby spruce timber & enter cranberry marsh N & S." At 69 chains, "Leave cranberry marsh & enter vine maple & crabapple bottom NE & SW." Line summary: "Mostly cranberry marsh, Usubject to overflow to the depth of 8 feetU [underlining added]. Timber a few scattering scrubby spruce & cedar. Undergrowth hard hack & tule."
>
> East between **S. 11** and **S. 14**, T26NR6E, at 34.5 chains "Enter swamp Ualmost impassableU [underlining added]." At 60 chains, "Leave spruce swamp enter open marsh." Line summary: "…land level, low swampy. USubject to overflow to the depth of from 2 to four feetU [underlining added]. Timber, a few scattering scrubby spruce entirely worthless. Undergrowth alder & crabapple with hard hack & tule" (April 10, 1873).
>
> East between **S. 2** and **S. 11**, T26NR6E, at 46.5 chains "Foot of hill, enter [illegible] swampy bottom." At 50 chains, "Leave spruce & cedar timber & enter open swamp." Line summary: "…low level swamp and Usubject to overflow in winter to the depth of from 2 to 4 ftU [underlining added]. Timber a few scattering scrubby spruce & pine. Undergrowth same with spruce alder crabapple willow & hard hack & nettle."
>
> Between **S. 11** and **S. 12**, (T26NR6E), "Land level & swampy Uwater on it to the depth of from 6 to 18 inches at time of high water it is subject to overflow to the depth of from 4 to 8 feetU [underlining added] ….timber none. Saw a few scattering scrubby spruce. Undergrowth hard hack & willow with tule" (April 5, 1873).

Between **S. 26** and **S. 35**, T27NR6E, “Land unfit for cultivation. This land is Usubject to inundation 2 to 6 feet U[underlining added].”

North between **S. 35** and **S. 36**, T27NR6E, at 2 chains “open swamp [illegible word] unfit for cultivation.” At 40 chains, “This Ucorner cannot be witnessed owing to the depth of water U[underlining added] and absence of timber.” Line summary: “Land level soil dark rich brown. Timber sparse Spruce Maple & Cottonwood. Undergrowth Hard Hack and Maple. Plants Wild [illegible] and Cranberry” (August 10, 1871).

Figure 3. A patch of wetland SNQ2606E01 remained in 1938 (left) and in 1990 (right). Also visible in 1938 photo is patch of wetland SNQ2706E02, to north of river.

Lidar DEM shows some subdued, sinuous topography within this marsh, presumably created by ancient river meanders, and the water depth would have varied locally. The notes, plat maps, and more recent mapping and photos also show several perennial ponds, which are accounted for separately as ponds.

SNQ2706E01

We map this unit as it was drawn on the PLS plat map. The PLS survey approached this marsh from four directions but turned back in each case because the marsh was “impenetrable.”

The corner to **S. 23**, **S. 24**, **S. 25**, and **S. 26**, T27NR6E, was described as being in an “impenetrable marsh.” The marsh between **S. 23** and **S. 24** was not surveyed because it was noted as impenetrable.

Between **S. 25** and **S. 26**, at 27.5 chains, surveyors noted “Impenetrable open marsh…” ceased surveying, and described the line as “…Uland subject to overflow 1 to 10 feet U[underlining added].”

Between **S. 23** and **S. 26**, at 41 chains, “Low bottom Usubject to inundation by water 2 to 6 feet in depthU [underlining added],” and at 60 chains, “the edge of an inaccessible marsh” (August 15, 1871).

SNQ2706E02

PLS field notes describe the marsh:

Between **S. 25** and **S. 36**, T27NR6E, at 18.5 chains “Open marsh…this marsh is impenetrable…” (August 11, 1871).

SNQ2706E03

Mapped as shown on PLS map.

SNQ2607E01 Cherry Valley area marsh

We map the eastern two-thirds of this unit as shown on PLS notes (slightly smaller at the north and south ends). In the western one-third of the unit, the wetland symbology on the plat map is ambiguous, and the field notes do not include description. The PLS field notes:

North between **S. 7** and **S. 8**, T26NR7E, beginning in “swamp,” and at 39 chains “leave swamp.”

Between **S. 6**, T26NR7E and **S. 31**, T27NR7E as “hard hack thicket & marsh ground” (September 23, 1873).

South between **S. 7**, T26NR7E and **S. 12**, T26NR6E, no line notes; quarter corner bearing trees falling within the mapped unit are a 4” diameter crabapple and a 5” diameter crabapple.

SNQ2607E02

PLS notes:

East between **S. 6** and **S. 7**, T26NR7E, “impracticable to extend the line further on account of swamp…” (May 27, 1874).

SNQ2606E05

Wetland is within S. 36; it was mapped from 1936 photographs.

SNQ2507E01

This wetland was mapped from PLS survey notes, which record the surveyors approaching the wetland from each direction, and then avoiding it as an “impassable swamp :’’

North between **S. 12**, T25NR6E and **S. 7**, T25NR7E, at 64 chains, ”Enter swamp…almost impassable.” At 74.5 chains “at this point the swamp becomes impassable.”

East between **S. 1** and **S. 2** or T25NR6E, at 74.3 chains ”Margin of impassable swamp.”

Between **S. 6** and **S. 7**, T25NR7E, at 48.5 chains “enter swampy ground.” At 63 chains “impracticable to extend line” (October 20, 1873).

The wetland is partially coincident with the area mapped as the “Ames Lake Creek peat area” by Rigg (1958), which is significantly larger than the area shown on the PLS map and that we mapped. The field references to the wetland’s impassability likely indicates significant winter inundation.

SNQ2507E02

Three small palustrine wetlands mapped from 1936 and 2006 aerial photos.

SNQ2507E03

The PLS survey eastward between S. 3 and S. 10 notes at 10 chains “leave springy ground” on October 11, 1873. We map unit from 1936 aerial photos and NWI.

SNQ2507E04

The PLS survey crossed the feature :

North between **S. 9** and **S. 10**, T25NR7E, at 4 chains ”enter swampy ground.” At 49.2 chains ”enter hard hack swamp.” At 62.5 chains ”south side of marshy lake.” Line summary : “Land level subject to overflow fr. 1 to 7 ft [underlining added]. Covered with c-apple V Maple Alder &c” (October 10, 1873).

SNQ2507E05

The wetland is elongate north-south, and crossed in an east-west direction by the line between S. 20 and S. 29 and by S. 29 and S. 32, neither of which mention the wetland, but the plat map shows a wetland between S. 29 and S. 32. We drew the unit roughly coincident with NWI mapping. Most of the area we included in this unit is also shown as wetland on current Fall City USGS topographic.

SNQ2507E07

Described as “springy land” in field notes (between 19 and 27 chains, northward between S. 27 and S. 28 on September 14, 1873) and shown as wetland on plat map. Mapped as shown on plat map.

SNQ2507E08

The PLS survey crossed a small part of this wetland :

North between **S. 33** and **S. 34**, T25NR7E, ”E. end of cranberry marsh” (June 1, 1865).

This area is also mapped as wetland on Fall City USGS topographic quadrangle. We expanded area to include wetland mapped on Fall City USGS quad.

SNQ2407E02

PLS survey crosses wetland between S. 4 and S. 9, describing “marshy ground” and wetland symbol is used on plat map. We expanded boundary into the interior of S. 9 using topography and NWI.

Duwamish River

Skip ahead to:

- Duwamish River valley overview
- Duwamish River tidal wetlands
- Palustrine wetlands in the Duwamish River valley
- Elliot Bay
- Sammamish River valley
- Lake Washington
- Lower White (modern Lower Green) River valley

Duwamish River valley overview

High-volume lahars and lahar-runout floods inundated the valleys of the lower White River and Duwamish in the late Holocene at least three times in the last 2,000 ybp (Zehfuss et al. 2003). Puget Sound's shoreline in the Duwamish embayment was approximately at the present-day neighborhood of South Park by ~2000 ybp. A lahar about 1200 ybp prograded the shoreline to near its present location.

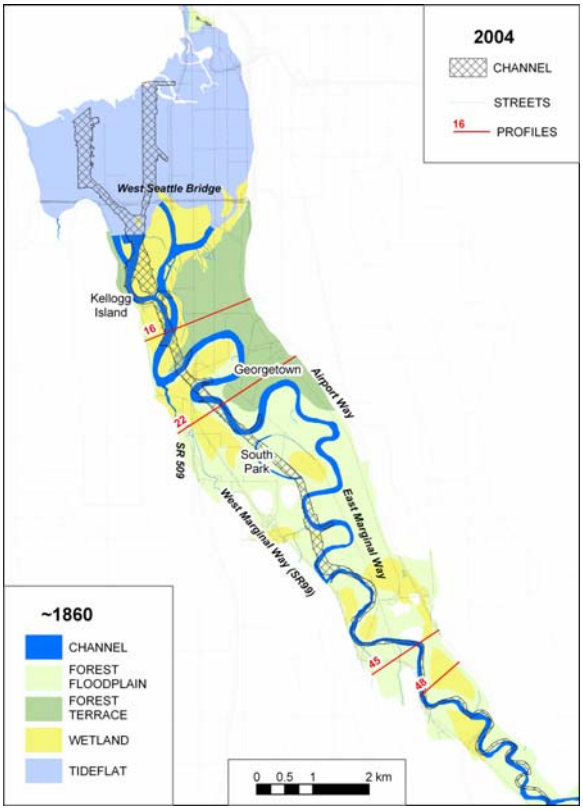

Figure 4. Duwamish River valley; modern cultural features referred to in text, relative to historical land cover and channels.

About 1000 ybp uplift along the Seattle Fault upwarped the lower Duwamish valley. The Duwamish River subsequently partially excavated the valley to create its modern floodplain, creating terraces of the unexcavated portion of 1,200 ybp lahar surface. The north-side terrace (site of the present-day neighborhood of Georgetown) and south-side terrace (on which archaeological excavations indicate continuous inhabitation for ~1,200 y) constrict the floodplain; at the narrowest the floodplain is about 700 m at the present-day Kellogg Island area.

Valley bottom morphology and landforms and historical land cover and habitats differed in the lower Duwamish River valley from the upper valley. The lidar DEM indicates that in the upper part of the Duwamish the riverbanks are 3 to 4 m higher than the lowest point on the floodplain. An early Army Engineers surveyor noted this about the upper valley's topography, on an inspection of the White and Duwamish rivers in 1897:

> "…[the land near the Duwamish River] is usually higher than that near the foot of the flanking hills, but the difference in elevation is but slight compared with that along White River [modern lower Green River]. The area of cultivated land is less in proportion to the area of the valley [compared to the lower White River], and the area of the waste and swampy land is greater." (Ober, 1898, in Appendix VV17, ARCE 1898).

The elevation of riverbanks above the floodplain indicates the river has been aggrading in the last several hundred years since the valley was last inundated by a Mt. Rainier lahar. Wetlands formed in these topographic lows.

In contrast, the river banks of the lower Duwamish River valley is lower in elevation than the rest of the valley bottom, which includes at least one terrace level. We mapped the terrace on the basis of five lines of evidence. The first is that the large surface that broadly includes the neighborhood of Georgetown on the river's right bank is 2 to 3 meters higher in elevation than the riverbanks. The second line of evidence is that mapping of floodwaters by the Army Engineers during the record flood of 1906 (likely to remain the largest flood of record, because the drainage basin of the Duwamish is now less than one-third the area it was in 1906, and much of the remaining watershed is regulated by dams) showed the area we have mapped as a terrace was not inundated, while elsewhere in the Duwamish flood depths were as great as 15 feet over the floodplain (Figure 5). The Army Flood mapping also indicates a symbol that appears to mark an escarpment, along the west side of higher-elevation area; the apparent escarpment is coincident with the boundary between forest vegetation and marshland shown on USC&GS T-1406. The boundary shown between the forest and estuarine vegetation by the Coast Survey cartographers is a third line of evidence for mapping a river terrace.

Soils and vegetation data contained in the General Land Office field notes provide a fourth line of evidence. The line description between S. 19 and S. 20, T24N R4E (the section line coincides with 1st Ave S. northward from its intersection with E. Marginal Way roughly to the northern end of the Federal Building South) reads, "Land high dry level bottom. Soil sandy, [emphasis added] good 2 rate. Timber-fir & cedar. Undg'th sallal and fern." Walking along the line between S. 28 and S. 29, T24N R4E, which traverses both sides of the river valley, the surveyors contrasted the land on the two sides of the river: "Land on W. side of Dawamish River [currently the Boeing Co. buildings to the SW of Boeing Field; historically the Duwamish River snaked along what is now Boeing Field], in places low and liable to inundation 30 or 40 ins, but the E. side [currently the north end of Boeing Field] high, dry sandy bottom [emphasis added]." Fir was the dominant bearing tree (see later in report, Figure 24) in the area, consistent with the dry soil conditions described. Finally, the fifth line of evidence is the indigenous place name for the land on

the north side of the river in the within S. 20, T24N R4E, in the present day vicinity of S. Lucile St. and 6th Ave. S. “tcE’btcEbid” was translated by T. T. Waterman as “fir trees on the ground,” and that “natives went there to get dry bark for fuel” (Hilbert et al. 2001).

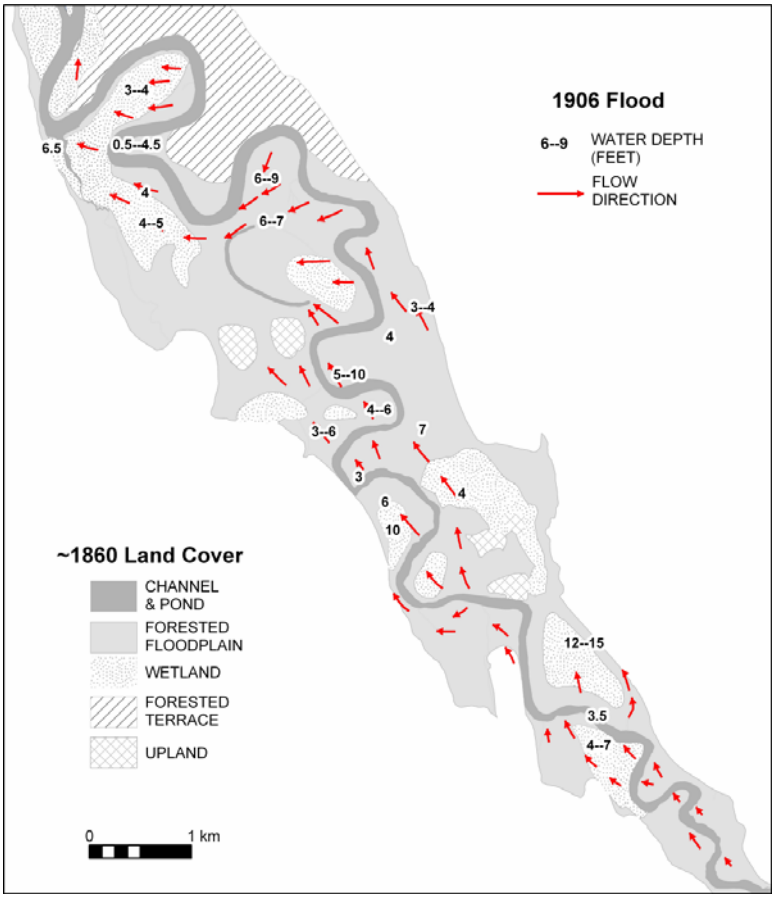

Figure 5. Field observations of the 1906 flood in the Duwamish River valley, from ACOE (1907). Arrows showing direction of flood flow over the floodplain have been generalized. Point depths of floodplain water are in feet. Depth of 3.5 ft in upstream part of valley was the depth over the levee top.

Terraces in the lower Duwamish River valley likely resulted from uplift associated with the Seattle Fault ~1100 ybp (Brian Atwater, unpublished data). The surface of the terraces is black sand from a Mt. Rainier lahar from ~1200 ybp, which prograded the shoreline of the Duwamish River from roughly the location of South Park to the near the historical shoreline (i.e. ~1850, prior to modifications by Euro-American settlers). The black sand is consistent with the PLS surveyor’s observing sandy soils. The lower Duwamish valley has thus been in a degradational setting in the late Holocene—downcutting and creating a terrace or set of terraces—in contrast to the aggradational setting of the upper valley, where the river is building up above the floodplain.

The diverse Duwamish valley bottom forest was dominated in frequency by red alder and Oregon ash (*Fraxinus latifolia*). However, few hardwood trees were large, as indicated by the overwhelming dominance by western redcedar (*Thuja plicata*) and to a lesser extent Douglas fir (*Pseudotsuga menziesii*) in basal area. [The fir identified in the

lower Duwamish may have included some Sitka spruce (*Picea sitchensis*). Edwin Richardson, who surveyed four townships in the Duwamish-White-Green system, identified only one spruce, while E. M. Meeker identified 10 spruce in two townships. Other river deltas on the east side of Puget Sound also suggest that spruce would be the dominant tidewater tree.] Forests on the surface we have mapped as an alluvial terrace in the lower Duwamish contrasted markedly with those in the valley bottom, being dominated by conifers (primarily Douglas fir (*Pseudotsuga menziesii*) and secondarily western redcedar (*Thuja plicata*) both by number and in basal area.

Streamside forests were broadly similar to valley bottom forests in composition. Streamside tree species being both relatively common and large in diameter include Douglas fir (*Pseudotsuga menziesii*, as indicated above, may actually have included some Sitka spruce, *Picea sitchensis*), western redcedar (*Thuja plicata*), bigleaf maple (*Acer macrophyllum*), and black cottonwood (*Populus trichocarpa*).

Duwamish River tidal wetlands

DUW2404E01 Estuarine wetland
DUW2404E02 Estuarine scrub-shrub wetland
DUW2404E03 Riverine tidal emergent wetland
DUW2404E04 Riverine tidal scrub-shrub wetland

The extent of estuarine marshes associated with the Duwamish River was relatively small (177 ha) considering the size of the Duwamish watershed. This is in part because the recent river terraces narrowed the floodplain, to about 700 m at its narrowest point at Kellogg Island, which is also roughly the upper extent of estuarine marsh. Most estuarine marsh existed on two large islands (Kellogg Island is the upstream-corner remnant of the larger, 65 ha island), a few smaller islands, and a smaller amount of estuarine marsh on the north shore of the river. The T-sheets do not show tidal channels in the Duwamish estuarine marsh, and any relict evidence of them would long have disappeared by the time of the earliest aerial photographs in 1940.

A similar amount (163 ha) of tidal marsh was likely freshwater dominated, and extended upstream in two lobes, one to South Park, roughly even with Slip Number 4 waterway (a remnant of the historical, meandering Duwamish River), and the other within a bend of the Duwamish River, to eastward of the intersection of West Marginal Way and Highway 99. We have mapped these wetlands along the river as riverine-tidal marsh. We mapped as emergent marsh those areas noted by the land survey as “prairie” or “tidal prairie,” and scrub-shrub those areas noted as “crabapple thicket” or “willow and crabapple thicket.”

DUW2404E01 Estuarine emergent marsh

Mapped as salt marsh on T-1406; 1907 Army Corps flood map includes notation “salt marsh.”

In PLS survey:

> West between **S. 18** and **S. 19** “[illegible] of the river bottom and island mostly liable to inundation during very high tides from 10 to 20 in.” (September 28, 1861).

North between **S. 17** and **S. 18** at 7.5 chains “Intersect prairie brs. E. & W.” (September 27, 1861).

DUW2404E02 Estuarine scrub-shrub marsh

Tidal wetland on island in Duwamish River. Shown with brush or deciduous forest cover on T-1406 and as saltmarsh on T-2421.

DUW2404E03 Tidal freshwater wetland

Includes 49 ha on both sides of the river, upriver of estuarine wetland, and another 38 ha downvalley of present day South Park and west of Hwy 509).

The area had been diked by 1875 T-1406, which shows the area as grassland. We characterized this as riverine-tidal emergent wetland based on the PLS line notes:

West between **S. 19** and **S. 30** at 16.39 chains “Intc’t tide prairie brs. N. 30 E. seldom overflows” but in the line description “Land in bottom level and on the left bank of the river liable during highest tides to inundation 20 or 30 in.” (September 27, 1861).

North between **S. 29** and **S. 30** at 19.00 chains “Enter wet prairie brs. E. & W.” and at 31.5 chains “Leave the prairie & enter crabapple thicket” (September 24, 1861).

DUW2404E04

Includes 32 ha in present-day Georgetown area and 44 ha in South Park area). On left bank of river, willow and crabapple thickets that are continuous with and upstream of DUW2404E02.

The lobe of DUW2404E04 in the Georgetown area is shown as grassland on T-1406 (1875); the South Park area lobe is beyond the T-sheet coverage. We characterized it as riverine-tidal scrub shrub based on PLS line notes:

North between **S. 29** and **S. 30** at 31.50 chains “Leave the prairie & enter crabapple thicket” then at 35.50 chains “leave the thicket & enter [illegible] cotton-wood timber.” At 65.00 chains “In’ct. willow & crabapple thicket E. & W.” (September 24, 1861).

East between **S. 29** & **S. 32** at 8.50 chains “Enter willow & crabapple thicket wet land brs. N. & S.” and at 24.00 chains “Leave the thicket and wet land, enter fir and alder timber N. & S.” At 32.00 chains “Enter low wet land and crabapple thicket N. & S.” and at 44.00 chains “Leave the wet land and thicket & enter a small prairie b’ring N & S….” The line description includes “Land nearly level. Soil 1st rate. In places liable to inundation 30 in.” (August 15, 1861).

North between **S. 29** and **S. 30** at 65.00 chains “In’ct. willow & crabapple thicket E. & W.” (September 24, 1861).

Between **S. 29** and **S. 20**, “Land on w. side of Dawamish river [almost entirely within map unit DUW240406], in places low and liable to inundation, 30 or 40 ins.” (September 26, 1861).

Palustrine wetlands in the Duwamish River valley

We mapped about 200 ha of freshwater marsh on the Duwamish floodplain upstream of the tidally-influenced wetlands. A great deal of water would have been funneled from the watershed during floods through the relatively narrow Duwamish valley. The Army Engineers during the 1906 flood mapped the floodplain as having up to 15' of standing water, including a depth of 3.5 ft above the levee top. Because most of the floodplain was lower in elevation than the riverbanks, it is likely that these wetlands would have had some standing water from floods for much of the year.

Most of these features were symbolized on PLS plat maps as wetland, and simply described in their notes as "swamp" and in one case "cranberry marsh." We mapped as wetland a few areas not intersected by PLS survey but shown as wetland on the 1:125,000-scale 1895 USGS topographic map or on the basis of descriptions on Army Corps 1907 flood map (e.g., "low marshy ground;" "low and marshy"). In addition to these wetlands, we mapped an oxbow pond (DUW2404E05).

DUW2404E05 Oxbow pond in present-day South Park

Shown on 1861 PLS plat map, and described between S. 32 and S. 33 as a "slough 92 links [18.5 m] wide" and between S. 32 and S. 29 as "a slough 87 links [17.5 m] wide." Also shown on USGS Seattle 1897. We shaped the feature using 1940 photos.

DUW2404E07 Palustrine wetland

Within interior of S. 33 of T23 N R4E, and not shown on PLS map. Wetland is drawn with generalized boundary to include locations of notations on Army Corps of Engineers 1907 flood map "marsh" and "swamp." Wetland is likely larger than we show; PLS survey was conducted in dry months of August and September 1861, and mentions wet areas along lines near to the area we have mapped:

> Between **S. 32** and **S. 33**, "In places wet, liable to inundation 20 or 30 in…." (August 5, 1861).
>
> Between **S. 29** and **S. 32**, "…in places wet liable to inundation 30 in." (August 15, 1861).
>
> North between **S. 28** and **S. 29** at 15.5 chains "Enter the margins of low bottom land liable to inundation 20 or 30 in" (September 22, 1861).

DUW2404E08 Palustrine wetland southeast of South Park and near to river

Mapped from PLS plat map and notes:

> West between **S. 4** and **S. 33** (T23NR4E) at 45.00 chains "Enter Swamp of about 15 acres brs. N. 70 W." and at 53.83 chains "Leave [Swamp of about 15 acres brs. N. 70 W.]" (September 9, 1861).

DUW2404E09 "Cranberry marsh" south (upstream) of South Park

Mapped from PLS notes:

North between **S. 32** & **S. 33** at 9.5 chains (plat map shows the marsh beginning at 0 chains) “Enter a swamp brs. N. 70 W.” and at 10.5 chains “Leave the [swamp brs. N. 70 W];” the line description includes “Land nearly level. Soil 1st rate, in places wet, liable to inundation 20 or 30 in.” (August 15, 1861).

West between **S. 32** and **S. 5** (T23NR4E) at 21.00 chains “Enter cranberry marsh, descends E. & brs. N. E.” and at 31.50 chains “Leave cranberry marsh N. E. and Enter fine growth of fir & cedar timber brs. N. E.” (August 15, 1861).

DUW2304E01 Right bank wetland

Mapped as wetland between S. 3 and S. 4 and between S. 3 and S. 10 by PLS. Within the interior of S. 3, USGS Tacoma 1897 topographic map indicates wetland. Topography was also used to shape portion of the wetland. In addition, Army Corps of Engineers 1907 flood map indicates: “Ground 4’ under water.”

PLS notes:

North between **S. 3** and **S. 4** at 37.15 chains “Intersect Swamp brs. N.20E.” and at 55.00 chains “Leave Swamp brs. E. & W.” (June 4, 1862).

East between **S. 3** and **S. 10** at 41.00 chains “Intersect a swamp brs. N & S.” and at 48.00 chains “Leave the swamp and ascend” (June 2, 1862).

Northward extension of wetland appears on 1897 USGS Tacoma quadrangle.

DUW2304E02

Appears on USGS 1897 Tacoma topographic map. Also, notations appears on Army Corps of Engineers 1907 flood map: “Low and marshy” and “Average 6’ under water.”

DUW2304E05

Mapped from PLS notes:

East between **S. 4** and **S. 9** at 67.83 chains “Intersect a swamp brs. N. & S.” and at 77.5 chains “Leave the swamp” (June 10, 1862).

DUW2304E03

Mapped from notations on ACOE 1907 map: Very low here. 12’ to 15’ water at high flood. Water remained here all winter” and ”Low marshy ground” and “Water up to shingles on house near here.”

DUW2304E04

Mapped from PLS notes and ACOE 1907 map annotations. PLS line notes:

North between **S. 14** and **S. 15** at 49.50 chains “Intersect Swampy bottom brs. N. 20 W.” and at 76.00 chains “Ascend dry rich bottom.” The line description for the latter transect includes “Land: bottom level. Soil 1st rate liable to inundation 15 to 30 in.” (May 20, 1862).

East between **S. 10** and **S. 15** at 65.00 chains “Intersect the Swamp brs. S. 20 E.” and at 75.00 chains “Leave the Swamp” (May 29, 1862).

Army Corps of Engineers 1907 flood map notations: “4 to 7 ft. water here in high flood.”

Elliot Bay

ELB2503E01 Smith Cove tidal marsh

According to T-1390b-1 (1874), the cove was protected at the mouth by a sand spit (2.4 ha) attached to Magnolia Bluff, with a linear strand of saltmarsh (3.4 ha) shoreward of the spit. The northern, innermost part of the cove (in present-day Interbay Neighborhood) was a salt marsh (18.9 ha including channel area) fed by a single large tidal channel network. The tidal network entered on the western side of the cove, and the marsh was bounded otherwise by a grassy sand accumulation (5.5 ha) on its south side. The Smith Cove saltmarsh and sand spit remain the same on T-2422 (1899) as on T-1390b-1 (surveyed 25 years earlier in 1874), except for the railroad trestles shown on T-2422. Mangum et al. (1909) shows more development in the outer cove, but none in the marsh area.

Morse (p. 88 in Nesbit 1885) reported that:

> “all the tide marsh [in Smith Cove] was diked in 1877. In front of the marsh is a sand spit across the head of the cove. The sand blown up on the on the edge of the marsh was used to build the dike, which was supported on the inside by cedar lagging driven into the marsh.”

However, the Smith Cove saltmarsh and sand spit remain the same on T-2422 (1899) as on T-1390b-1 (surveyed 25 years earlier in 1874), except for the railroad trestles shown on T-2422. Mangum et al. (1909) shows more development in the outer cove, but none in the marsh area. Morse estimated that the “tract contained about 50 acres [20 ha],” which compares well with the estimate from the T-sheets.

ELB2404E010 Occidental Square area tidal marsh and lagoon

The area of the Occidental Square area lagoon-marsh complex had already been filled and streets platted by the 1875 T-1406 map, and the only map record we are aware of is from the sketch map made for military purposes in 1855-1856 during the Battle of Seattle. The map was revised in 1930 to show streets then present, which made it possible to crudely georeference the map. A sand barrier (0.2 ha) with a central opening for tidal flow bounds the complex (2.6 ha, 2.1 ha of which was mapped as marsh and the rest lagoon) at its opening to Elliott Bay. Most of the complex is labeled “tide marsh” and shows several isolated lagoons.

ELB2503E02 Tidal marsh on West Point

Mapped from USC&GS T-1064 (1867). T-1064 shows single tidal channel network opening on the north side of the point, with grass-covered sand mapped surrounding the marsh. The West Point marsh (6.8 ha including channel area) was completely bounded by a sand barrier (2.4 ha) except for a single channel network that opened on the north side of the point. The western one-third of the West Point marsh had been diked and

drained by the 1899 T-2422, and Mangum et al.'s (1909) map shows no marsh on West Point.

Sammamish River valley

SMM2605E02 Sammamish River

The Sammamish River, as shown on USGS Snohomish 1895 topographic map, was intensely meandered (Figure 6). The PLS survey did not survey the Sammamish River, and on the PLS plat maps the channel is sketched in between section lines.

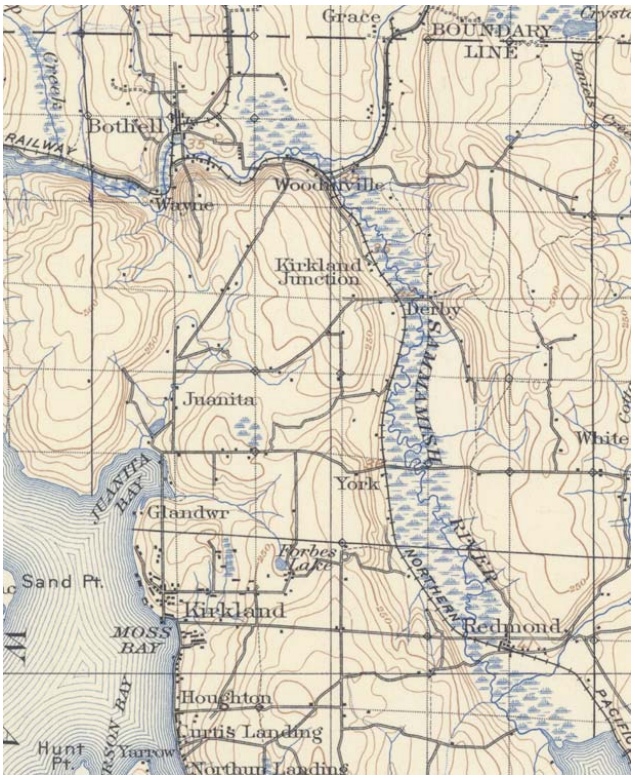

Figure 6. Sammamish River valley wetlands on USGS Snohomish 1895 topographic map

Because the USGS topographic map was at a small scale, it was not positionally accurate enough to serve as a mapping source. The river had been channelized early in the 20th century, prior to aerial photos in 1936 and 1938. However, the pre-channelized river remains visible in the 1936 and 1938 photos (Figure 7). We used these photos, supplemented with lidar DEM, to map the historical channel location and shape. We used the PLS mapping only for the channel in the first approximately 800 m as it exits Lake Sammamish.

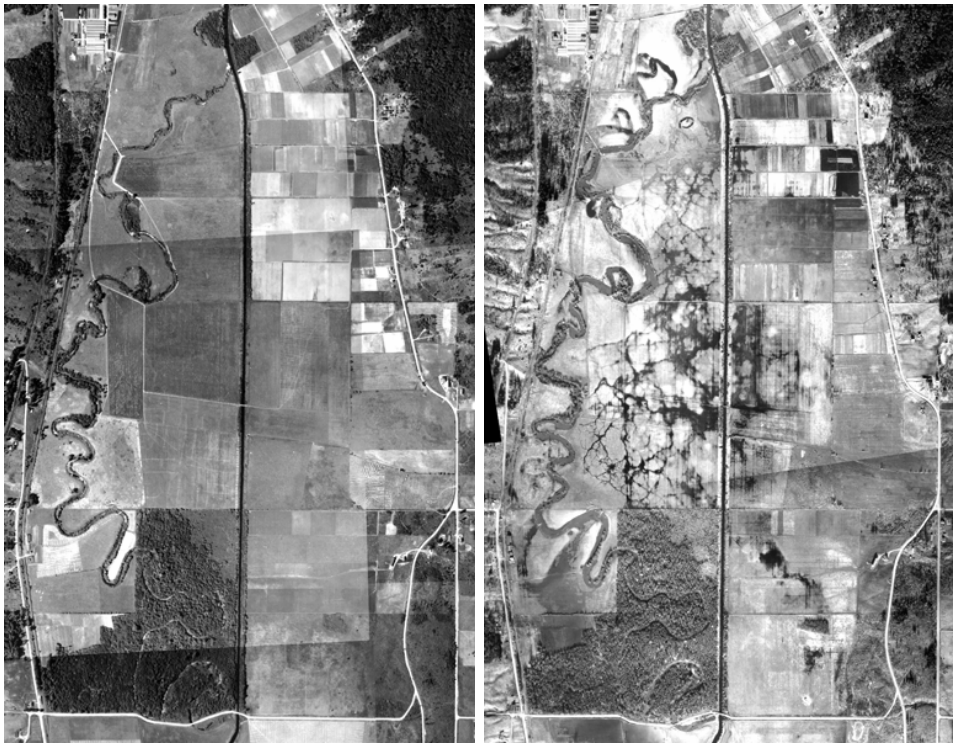

Figure 7. Sammamish River valley on aerial photos from 1936 (left panel) and 1938 (right panel).

SMM2605E01 Sammamish-North Creek palustrine wetland

USGS Snohomish 1895 topographic map shows that wetland occupied most of the Sammamish River valley and extendednorthward into North Creek. The PLS survey also maps wetland in the valley, describing it as “swamp” that “overflows in winter 3 or 4 inches.” The survey was conducted in September 1870; the notes don’t indicate the information source for the estimated depth of winter flooding. The lateral extent of the wetland is limited, in general, by the presence of alluvial fans on the valley margins. The largest of these fans was the location of the town of Redmond. PLS bearing trees within the wetland are dominated in frequency by alder, crabapple, and Oregon ash, and by basal area by spruce, cedar, and alder.

PLS notes for wetland in Sammamish River valley and Swamp Creek valley:

> In T26NR5E, North between **S. 5** and **S. 4** “Over Swamp land and rich.” Line summary: SW qr Sec 4 low rich swampy land. Overflows in winter 3 or 4 inches. NW qr Same. SE qr Sec 5 Same. NE qr Sec 5 Same” (September 30, 1870).
>
> East between **S. 5** and **S. 8** at 20 chains “Enter low Swamp land,” at 42 chains “Leave low Swamp land,” at 62 chains “Low Swamp land” (October 1, 1870).
>
> East between **S. 4** and **S. 9** “Overflow Swamp land. Rich Soil.” At 45 chains “Leave low Swamp land.” Line summary: NW ¼ Sec. 9 Swampy overflows in

winter 3 to 4 inches. E ½ of S.W ¼ and W ½ of SE ¼ Section 9 Swamp land. Timber Crab Apple Willow & Ash on the low lands" (September 30, 1870).

North between **S. 9** and **S. 10**, at 18.5 chains "Overflow land unfit for cultivation." Line summary: "Soil bordering Stream good remainder gravelly. Timber Fir Cedar and Hemlock. Undergrowth very little Maple hemlock fern and blackberry" (September 17, 1870).

East between **S. 10** and **S. 15** at 60 chains "Leave swampy land and ascend hill." Line summary: 200 acres of the East Side of W ½ overflows in winter 3 to 4 inches. Timber Scattering. Undergrowth Willow Crap Apple & Vine Maple. Soil dark loam. Very rich" (September 16, 1870).

Line summary, between **S. 22** and **S. 15**, "N.E. qr. And S.E. qr. Sec. 22 Swamp land. Timber Fir and Cedar. Undergrowth Willow Crab Apple Alder Wild Cabbage and course grass" (September 16, 1870).

North between **S. 22** and **S. 23**, at 65 chains "Leave low Swamp land and enter high Cedar land." Line summary: Low land overlows in winter 43 to 4 inches. Timber Crab Apple Maple Willow and Cedar" (September 12, 1870).

East between **S. 22** and **S. 27**, at 50 chains "Low swampy land overflows in winter to 3 or 4 inches" (September 15, 1870).

Line summary between **S. 23** and **S. 26,** "130 acres on west side overflows in winter 3 or 4 inches" (September 12, 1870).

Summary for line between **S. 26** and **S. 27** "Land overflows in winter 3 to 4 inches. Undergrowth Willow Maple Crab Apple. Soil rich. No large Timber" (September 12, 1870).

East between **S. 26** and **S. 35** at 23.5 chains "Leave low Swamp lands enter high fir land." Line summary indicate "100 acres on west side Section 35 overflows in winter 3 to 4 inches" (September 12, 1870).

Summary for line between **S. 34** and **S. 27** S. E. qr. Sec. 34 and NE qr. Sec. 34 Swampy. Timber Fir Cedar Alder and Hemlock. Undergrowth Crab-Apple & Spruce" (September 15, 1870).

Line summary for line between **S. 34** and **S. 35**: "Land in SW quarter unfit for cultivation overflows in Winter 3 or 4 inches. Timber scattering Cedar and Hemlock. Undergrowth Willow, Alder, Maple, Wild Cabbage and parsnips" (September 10, 1870).

West on north boundary of **S. 2** T25NR5E and south boundary of S. 35, T26NR5E, the line notes describe the land west of 37 chains as " Swampy bottom…Timber…in bottom Willow Vine Maple and Spruce" (August 13, 1855).

In T25NR5E:

Line summary between **S. 11** and **S. 12**, described as "Land unfit for cultivation. Soil dark [word illegible]. Timber Cedar, Hemlock & Spruce. Undergrowth Willow Crabapple and Skunk Cabbage" on September 13, 1870. Line description would

have included northern third of line on the Redmond Fan, which is not mapped as wetland.

East, between **S. 12** and **S. 13**, at 5 chains “lands unfit for cultivation. Subject to overflow from 1 to 3 inches.” Line description is “Land level unfit for cultivation. Soil dark [word illegible]. Timber Cedar Hemlock & Spruce. Undergrowth Willow Crabapple & Wild Cabbage” (October 8, 1870).

Line notes between **S. 2** and **S. 3** indicate “Land unfit for cultivation. Timber Fir Cedar Maple & Hemlock. Undergrowth Same with Alder Crabapple Fern & Wild Cabbage.”

East between **S. 2** and **S. 11**, at 33.5 chains “enter land unfit for cultivation” (October 14, 1870).

SMM2605E03 Lower Sammamish River (Bothell area) palustrine wetland

The Sammamish River valley downstream of North Creek leaves the north-south trending, 1-1.5 km wide glacial trough occupied by North Creek and the Sammamish River upstream of Woodinville. The valley turns east-west, and narrows to 0.1-0.4 km wide.

The USGS Snohomish 1895 topographic map shows the valley as wetland, and two PLS survey lines describe the valley as “swamp”:

South between **S. 7**, T26NR4E, and **S. 12**, T26NR5E, at 47.07 chains “Intersect swamp or brushy portion of Lake Dwamish…The swamp or brushy portion of the lake is covered with too great a depth of water to chain on line…” At 62 chains “arrive at firm ground” (May 22, 1859).

North between **S. 7** and **S. 8**, T26NR5E, at 54 chains “Sammamish River 150 lks [30 m] wide runs SW,” at 55.5 chains “N bank of river and enter land unfit for cultivation,” and at 65 chains “Leave Swamp land” (October 1, 1870).

PLS plat maps show an arm of Lake Washington extending up the Sammamish River valley (Figure 8). The survey between S. 12 and S. 7 (excerpted above) describes the land between the shorelines shown on the plat map as “swamp or brushy portion of the lake” that was covered by deep water at the time of the survey in May 1859.

T-2606 (1902) also shows the junction of the Sammamish River, their known as “Squawk Slough,” and Lake Washington (Figure 8). The lake shoreline on T-2606 was not mapped farther eastward than approximately the line between S. 11 and S. 12 (now marked by Juanita Drive); it shows wetland filling the arm of Lake Washington, with an indefinite opening about 100 m wide; this depiction is consistent with the depiction on the PLS map and the description between S. 11 and S. 12. However, neither provides a map view of the channel in this lower reach. On USGS Snohomish 1895 topographic map the river is straight and tapers conically. The lake level has been dropped and the river channelized by the 1936 photos. We mapped the Squawk Slough area using a combination of T-2606 and the 1936 Sammamish River photos.

Figure 8. Mouth of Squawk Slough (Sammamish River) at Lake Washington. Upper panel: PLS plat maps, overlain onto recent topographic map, to show shoreline of Lake Washington extending up the Sammamish River valley. Lower panel: Plat maps overlain on T-2606 (1902).

Lake Washington

LWA2604E01 Palustrine wetlands at mouth of Thornton Creek

Mapped from T-2606 1902. Also shown on USGS Seattle 1897 topographic.

LWA2604E02 Palustrine wetlands at Sheridan Beach, mouth of McAleer Creek

Mapped from T-2606 1902.

LWA2605E05 Palustrine wetlands at mouth of Juanita Creek

Mapped from T-2607 1902.

LWA2504E01 Pond (Mud Lake) and associated wetlands at Magnuson Park

Mapped from T-2606 1902. Also shown as smaller lake with associated wetlands on PLS plat map (1856). Wetland area is shown as much larger on USGS Seattle 1897 topographic.

LWA2504E02 Palustrine wetlands at mouth of Ravenna Creek

Mapped from T-2606 1902. Also shown on PLS plat map (1856). Wetland area is shown as much larger on USGS Seattle 1897 topographic.

LWA2504E03 Palustrine wetlands at head of Fairweather Bay

Mapped from T-2607 (1902). Also shown on USGS Seattle 1897 topographic.

LWA2504E04 Palustrine wetlands in Foster Island area; in Washington Park Arboretum and in Madison Park neighborhood

LWA2504E05 Palustrine wetlands in Pontiac Bay (2 ha)

Mapped from T-2607 (1902).

LWA2505E01 Palustrine wetlands at mouth of creek draining into Moss Bay

Mapped from T-2607 (1902).

LWA2505E02 Palustrine wetlands in Yarrow Bay

Mapped from T-2607 (1902). Also shown on USGS Seattle 1897 topographic.

LWA2505E03 Palustrine wetlands at head of Cozy Cove

Mapped from T-2607 (1902). Also shown on USGS Seattle 1897 topographic.

LWA2505E04 Palustrine wetlands in Meydenbauer Bay

Mapped from T-2607 (1902). Also shown on USGS Seattle 1897 topographic.

LWA2405E01 Mercer Slough

Lower part is mapped by T-2608 (1902). Newport Shores area had been cleared by then, but USGS Seattle 1897 topographic, a few years earlier (1897), shows the entire area as wetland. Upstream of the T-sheet coverage we used USGS Seattle (1897) topographic, and lidar DEM.

LWA2405E02 Palustrine wetlands associated with tributary north of May Creek

Mapped from T-2608 (1902). Also on USGS Seattle 1897 topographic.

LWA2405E03 Palustrine wetlands associated with May Creek delta

Mapped from T-2608 (1902). Also on USGS Seattle 1897 topographic.

LWA2404E11 Palustrine wetlands in Rainier Beach area

North and east of Rainier Ave. S. Extended northward along shore, filling shallow water between shore and Pritchett Island. Mapped from T-2609 (1902). Also on USGS Seattle 1897 topographic.

LWA2404E12 Andrews Bay/Seward Park

Palustrine wetlands. Uppermost extent to within a few meters of the Audubon Center building. Mapped from T-2609 (1902).

Lower White (modern Lower Green) River valley

The topography of the Lower White River valley is influenced largely by the legacy of Pleistocene glacial erosion and post-glacial (Holocene) fluvial sedimentation. The riverbanks are about 2-4 m higher in elevation than the valley bottom. Early Army engineering surveyors observed the topography and commented on its causes in the lower White River valley in 1898:

> "Successive freshets by depositing the sediment, which is carried by the current in discontinuous suspension, have, in the course of ages, built up the banks of the river and the area adjacent to a considerable height above the general level of the valley. This superelevation ranges from 3 to 8 feet. The low ground is generally found near the foot of the flanking hills…" (Ober, 1898, in Appendix VV17, ARCE 1898).

Wetlands formed historically in low-elevation parts of the valley outside of the meander belt which is elevated several meters above the floodplain; in both respects the lower White River was similar to rivers in other valleys that formed in glacial troughs (e.g., the Snoqualmie, Snohomish, Sammamish).

Because the lower White River valley is north-south trending with three major east-west flowing rivers that deposit their sediment into it, patterns of Holocene sediment deposition by these tributaries also strongly influenced the topography and drainage network. Topographic effects of the White River fan dominate the form of the channel network for about one-third of the White River valley. The elevation difference from the White River Fan from its head to the historical marshes in the Mill Creek area is about 24 m. Floodwaters from the upper White River would have diverged and flowed down the fan, in a number of shifting and ephemeral flood channels to the southwest and south to the Stuck River drainage. Other channels drained to the northwest and west to Mill Creek, which drained the marsh-filled lower elevation western part of the lower White River valley at the western margin of the Auburn fan. The channels we mapped reflect a combination of streams shown on the PLS maps and flood channels evident on the 1940 aerial photographs. Some of the channels mapped from the photographs likely were created more recently than the 1860s. Many of the channels were mapped as discontinuous because it was not possible to trace them on the photographs; in the GIS layers they are coded as "ephemeral" and are not included in channel area estimates. The White River Fan also deflects the Green River northward as the Green River emerges from its valley.

Downvalley of the White River Fan, the cross-valley topography is dominated by the effects of Holocene deposition within the lower White River's meander belt, with the lower White River elevated several meters above the valley bottom. Between Kent and Auburn, the valley was dominated by a system of wetlands fed by drainages shed by the White River fan, which drained northward (Mill Creek) into the Green River near Kent.

Downstream (north) of Kent, numerous channels on the eastern part of the lower valley flow to the north, caused, at least in part by, and draining, White River floodwaters. The regular, large-amplitude meanders of the main floodplain channel suggest it could have been an abandoned main channel at some time in the late Holocene (but prior to the 1861 land survey). Floodwater mapping from the 1906 flood (Figure 9) shows that during flood, the lower White River would spill over its banks and into the floodplain, which funneled floodwaters northward toward the Black River. Because the lower White River was elevated above most of the valley, once the river flooded, its floodwaters then drained into and northward through the largely independent channel network that did not rejoin the lower White River until the north end of the valley, primarily after having first flowed into the Black River. A system of north and northwest flowing channels in the Kent area, evident on the 1940 aerials and on the PLS plat maps, apparently originated from small drainages entering the White River valley from the east, and which may also have been responsible over time for creating the small east-to-west cross-valley gradient in this area.

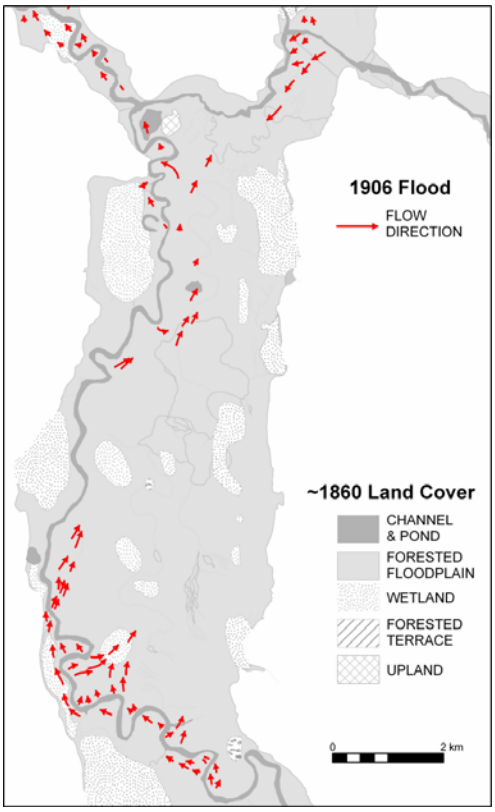

Figure 9. 1906 White River valley floodwaters map. Arrows showing direction of flood flow over the floodplain have been generalized from Army Engineers mapping.

The northward flowing channel network draining the eastern part of the lower valley joins what appear to be historical avulsion channels of the Black River. The 1940 aerials show a relatively recent channel, 30-90 m wide, flowing southward from the Black River just west of the I-405 and SR 167 junction. This channel appears to have been a distributary of the Black River (a distributary is a branch of a river that flows away from the main channel), rather than a tributary, based on the north to south topographic gradient indicated by the lidar DEM. This apparent paleo-channel of the Black River may have then flowed to the Green River or rejoined the Black to the west, along with the outflow of the northward flowing channel network on the lower, eastern floodplain. This interpretation is consistent with the 1906 flood mapping.

This apparent historic avulsion channel of the Black River reflects the topographic influence of the Cedar River Fan. The upper Black River is similar to the lower White River in the vicinity of the White River Fan in being deflected, in this case northwestward, to the base of its fan. Topographic constraint of the valley wall to the north then forces the Black River onto the fan, explaining the apparent historic avulsion channel. The Cedar River Fan, which has about 7 m of relief from the fan head to the center of the lower White River valley, had flood channels, evident on the 1940 photos, similar to those mapped on the White River Fan.

The topographic effect of the Cedar River fan concentrated or funneled the northward flowing floodwaters of the White River system into the Black River. The extensive valley depression accounted for most of the valley width in the lower White River valley, and is evident today in the remnants of wetlands that historically formed in the area. However, to the north, while the valley sloped down and east from the lower White River, it also flowed down and west on the Cedar River fan funneling flow into the Black River in the area of the present-day Springbrook Creek ditch.

Flooding was frequent in the lower White River valley. Evidence for this includes the dense network of flood channels shed from the three fans described above. While the river was not gauged prior to 1937, historical photographs provide an indication of the frequency of flooding. The town of Kent appears under floodwaters in photos from a number of years. For example, an Internet search found photos taken in nine different years in which the town of Kent was under enough floodwater to warrant photographic documentation, in the forty-year period between 1906 and 1946 (Figure 10). This entire period (1906-1946) is after the entire flow of the White River had been diverted to the Puyallup River to the south, so flooding would have been even greater before the photographic record.

The pattern to the field-mapped 1906 floodwaters reiterate elements of the preceding discussion of the topographic influences on channel networks: (1) Flow patterns of Cedar River floodwaters show how the Cedar's position on a fan caused water to diverge to the north (to Lake Washington and its nearshore wetlands) and to the southwest; (2) The floodwaters that diverged to the southwest flowed down the fan, consistent with ephemeral flood channels mapped from the aerial photos, and toward a confluence with floodwaters coming from the south, in the Springbrook Creek complex; (3) Floodwater poured out of the White River channel and into the Springbrook Creek drainage complex, all along the White River's course from Kent to within a few kilometers of the Black-White confluence. Both the White and Cedar funneled much of their flood flow through this Springbrook Creek drainage complex, back into the Black River, and then into the Duwamish valley. The flood-flow map also substantiates floodwater from the White River as a mechanism for recharging the floodplain wetlands of the lower White River. For example, the flood flow map arrows point toward the wetland in the present-day Southcenter area and into a few additional wetlands farther up-valley.

Figure 10. Photographs of flooding in Kent between 1906 and 1946: (a) “Interurban station in a flood, Kent, ca. 1906,” White River Valley Museum Photograph Collection (WRVM) #1161; (b) “Flood in Kent, November 12, 1911,” WRVM #1362; (c) “Kent Interurban Power Station flood, Kent, ca. 1915,” WRVM #55; (d) “Hallock Garage, exterior, during flood, Kent, ca. 1920,” WRVM #922; (e) “Pay’n Takit store in flood, Kent, ca. 1931,” WRVM #3877; (f) “Flood in downtown Kent, ca. 1933,” WRVM #287; (g) “Flooded road at entrance to Kent, 1936,” Museum of History and Industry Photograph Collection (MOHAI) # PI23103; (h) “People leaving flooded house during Green River flood, Kent, 1938,” MOHAI #PI23110; (i) “Flooded street, Kent, August 14, 1946,” MOHAI #PI23132.

Mapped wetlands in the lower White River valley can be grouped into five broad areas having similar topographic and hydrographic settings (Figure 11). Moving generally north to south, these groupings are: A. Wetlands associated with south shore of Lake Washington (BLK230501); B. Wetlands on west side of lower White River in the downstream half of the valley; C. Wetlands on the east side of the lower White River in the downstream half of the valley; E. Upper Mill Creek wetlands.

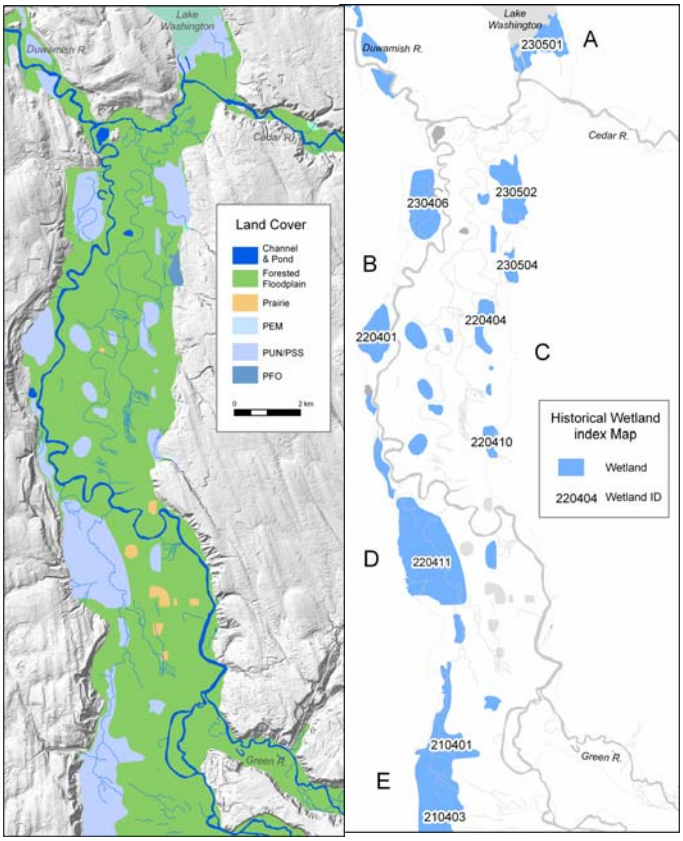

Figure 11. Historical wetlands mapped in the lower White River valley. Index map on right identifies wetlands mentioned in the text in five geographic groupings “A” through “E.”

(A) Wetlands associated with south shore of Lake Washington

BLK230501 Wetlands on south shore of Lake Washington

Wetlands on the south fringe of Lake Washington and surrounding the Black River as it exits Lake Washington are shown on several early map sources, the most detailed being T-2609 (Figure 12). Mapping is based primarily on T-2609. The PLS map shows the wetland, but field notes do not describe it. Shown on plat maps as three patches, one in the middle of S. 8, with a stream that drains it to Lake Washington, a second along Lake Washington in the NW of S. 8 and NE of S. 7, and at the Black River where it exits Lake Washington. The 1897 Tacoma USGS topographic quadrangle shows a single wetland that encompasses the first two wetland patches and links to the third; the wetland complex is mapped as a single unit. A small part of the southern margin was added to the unit from its appearance in the 1940 aerial photos.

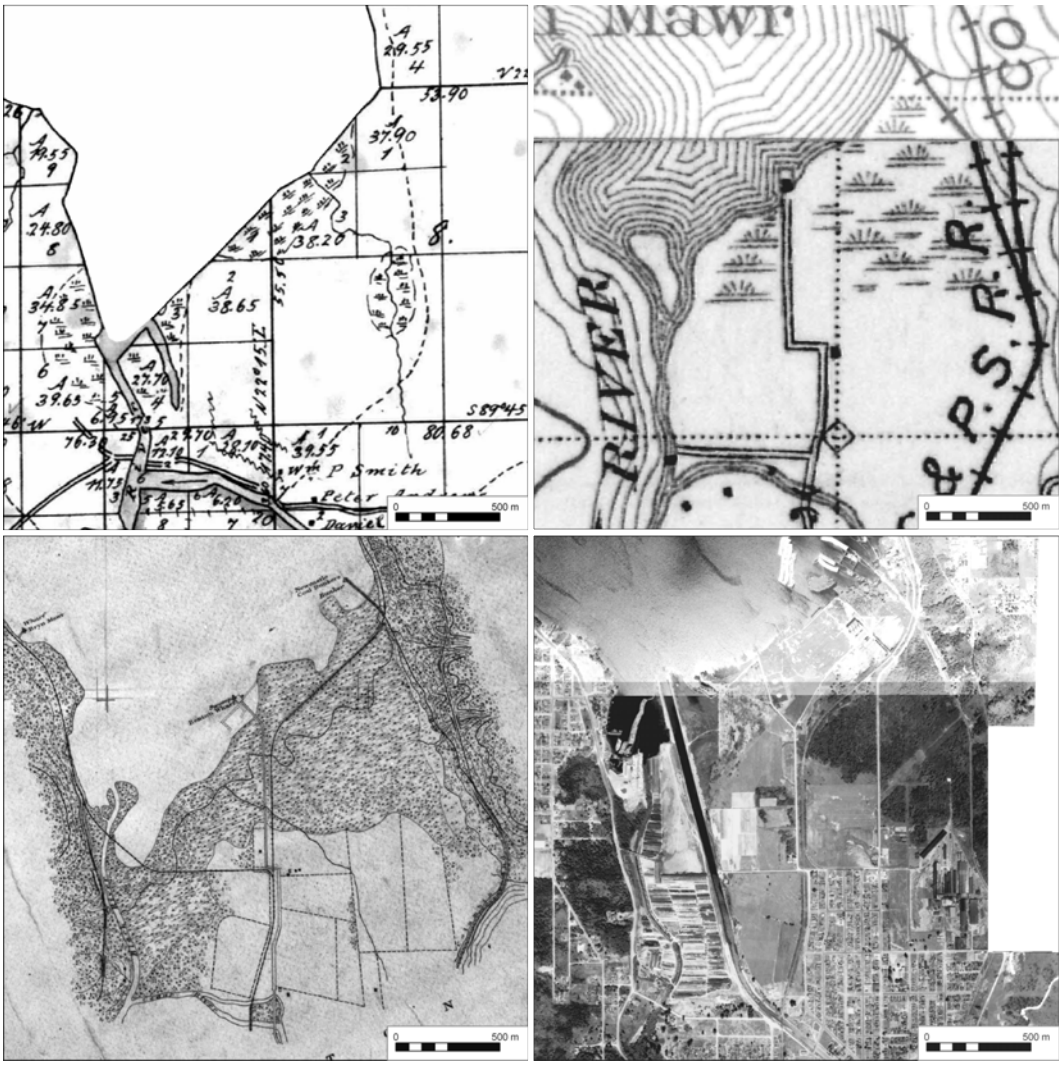

Figure 12. Wetland BLK230501 at the south end of Lake Washington. Clockwise from upper left: 1863 PLS plat map, USGS Seattle 1897 topographic, 1940 aerial photos, 1902 1:10,000 T-2609.

B. Wetlands on west side of lower White River in the downstream half of the valley.

These wetlands formed in low-elevation areas marginal to the elevated meander belt. WHL220401, unique among wetlands in the area, is symbolized on the PLS plat map with numerous springs and is described in the notes as a “cranberry marsh;” in Lushootseed, “Pa’lEqw,” for “marsh, spring” (Hilbert et al. 2001).

WHL230406 Wetland in Southcenter Mall area

Now the site of Southcenter Mall, in Lushootseed, the wetland was called “besx^{w}uqid,” or “where there are cranes” (Hilbert et al. 2001). In the PLS notes:

North between **S. 25** and **S. 26**, line summary: “Land nearly level, in places wet. Liable to inundation 36 in.” (February 14, 1862).

The wetland is shown on 1897 USGS Tacoma 1:125,000 scale topographic map, along with an oxbow pond (Figure 13). By 1940, the wetland has been drained, and a relict central channel (likely an abandoned location of the White River) is visible in the former wetland. The had been heavily developed by 1990.

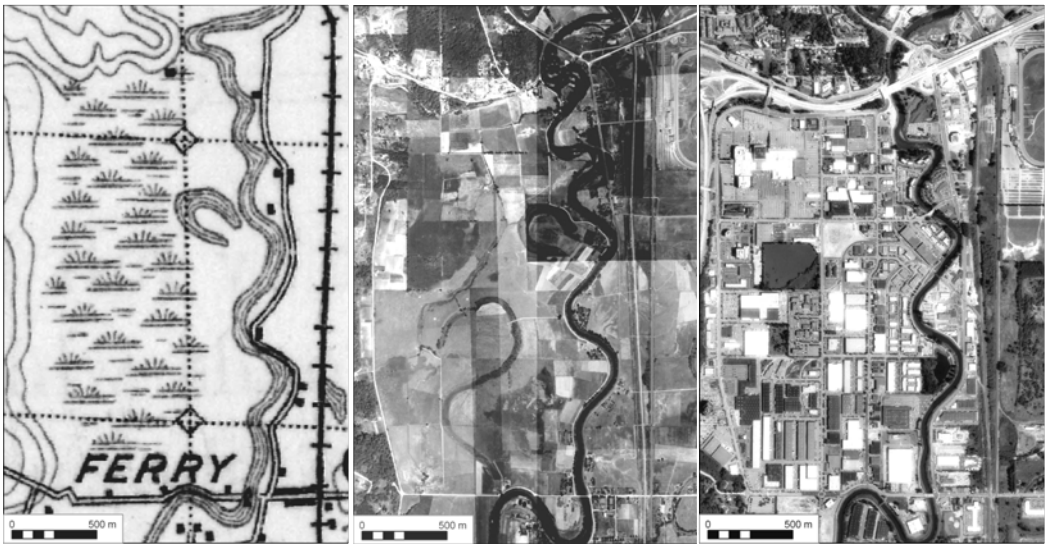

Figure 13. Wetland WHL230406. Left panel: Wetland and oxbow pond on 1897 USGS topographic map Tacoma 1:125,000. Middle panel: in 1940 photo, wetland has been drained but relict channel, probably an earlier location of the lower White River, and relict oxbow pond, are visible. Right panel: By 1990 (USGS DOQQ), area is heavily built up.

WHL220401

Mapped as shown on PLS plat map, with southernmost boundary modified using NWI mapping. PLS notes:

North between **S. 2** and **S. 3** at 52.00 chains “Leave the cranberry marsh brs. S. 70 W & N 30 E” (April 18, 1863).

East between **S. 3** and **S. 10** at 38.00 chains “The foot of hill when intersect a cranberry marsh brs. N & S.” Northward between **S. 10** and **S. 11** on April 15, 1863, at 60.00 chains “Intersect an extensive Cranberry Marsh and about 300 acres brs. N 10 E & S 10 W.”

East between **S. 2** and **S. 11** at 5.00 chains “Leave the cranberry marsh.”

The PLS plat map has numerous symbols that presumably indicate springs, not used on other plat maps in the study area (Figure 14).

Figure 14. Wetlands in area south of Tukwila and west of O'Brien (WHL220401 to west of river and WHL220402 to east of river) in 1863. Symbols in large wetland to west of river indicate springs; the PLS maps do not use the symbol elsewhere in the White River valley. Wetlands were drained and cultivated by 1940 and partially developed by 1990 (USGS DOQQ).

C. Wetlands on the east side of the lower White River in the downstream half of the valley.

These wetlands exist in lower-elevation areas marginal to the meander belt. They appear to have been fed by flood channels from the upland to the east, from the Cedar River Fan, avulsion channels from the Black River, and overbank flooding from the White River. Numerous floodplain creeks in the area existed in a complex drainage pattern, including a main channel having large-amplitude meanders suggestive of having been an abandoned main channel. Larger wetlands in this zone include WHL230502 (121 ha) and WHL230504 (31 ha) at the east margin of the valley in Tukwila, WHL220404 (54 ha) north of O'Brien and WHL220410 (30 ha) immediately north of the older part of Kent at the valley wall. The boundaries of these wetlands are generally poorly constrained, mapped primarily from the PLS. They are commonly described as "swampy" and as "willow thicket." Our mapping shows the system of creeks that feed and drain this complex draining into the Black River to the east (upstream) of the present day location of Springbrook Creek, which had been ditched prior to the 1940 aerials. The location is based on (a) relict channels discontinuously visible on the 1940 aerials, (b) that the PLS survey did not note a channel crossing the section line between **S. 13** and **S. 24** in T23NR5E, and (c) Hilbert et al. (2001) in this vicinity show the place name "ct^{3}u'lEgwEli" for "'resembling a trail' for a creek draining a swamp." Waterman's Indian informants indicated "they caught lots of salmon trout ('silver salmon') in it" and that they "built a little fish weir in the middle course of it" (Hilbert et al. 2001).

WHL230502

Most of the area is shown on USGS Tacoma 1897 topographic. The northern part is crossed by two PLS survey lines. Boundary in the northern part was shaped using wetlands shown on 1940 photos.

PLS notes:

> West between **S. 19** (T23NR5E) and **S. 30** (T23NR5E) at 35.00 chains "Intersected impassable swampy bottom overflowed by Beaver dams bears N29W and South….I run an offset line as follows South 5.00 chs. To overflowed bottom land, less swampy" and at 45.00 chains "Leave overflowed bottom and enter Willow thicket." The line summary includes "…liable to annual inundation to the depth of 30 inches" (January 21, 1865).
>
> North between **S. 19** and **S. 24** (T23NR4E) at 8.20 chains "A wet prairie brs. N. E." and at 20.00 chains "Leave wet prairie and enter willow and alder thicket bears E & W" and at 23.00 chains "Leave willow and alder thicket and enter timber." The line summary indicates "…in places liable to inundation 24 in. seldom overflows" (July 26, 1861).

WHL230503

Drawn as shown on PLS plat map.

> North between **S. 31** and **S. 36** at 45.00 chains "Enter Swampy bottom N. & S." Line notes describe "Land level. Soil 1st rate, last 35 chs. Subject to inundation 15 in." (July 24, 1861).

WHL230504

Not on PLS map (within interior of S. 31) or shown on Tacoma 1897 topographic map. Most of area appears forested on 1940 aerial photograph and is mapped as forested wetland by NWI.

WHL220402

Mapped as shown on PLS map. PLS notes:

> East between **S. 2** and **S. 11** at 32.00 chains "Intersect a swamp brs. N 10 W & S 5 E" and at 60.00 chains "Leave the Swamp here brs. N. W." (April 18, 1863).

WHL220403

> East between **S. 1** and **S. 12** at 12.50 chains "Intersect low overflowed bottom water 30 in. deep runs N 45 W" and at 22.00 chains "Leave overflowed bottom" (April 9, 1863).

WHL220404

Shown on PLS maps and crossed by two survey lines. Mapped as shown on plat maps. The PLS notes:

> Eastward between **S. 1** and **S. 12** at 57.00 chains "Intersect overflowed bottom brs. N 10 E & S 10 W" and at 68.00 chains "Leave overflowed bottom brs. N & S" (April 9, 1863).

Northward between **S. 1** and **S. 6** at 23.00 chains “Enter willow swamp” on July 2, 1861. Northward between S. 7 and S. 12 at 54.50 chains “Enter swamp” and at 63.00 chains “Leave” (July 1, 1861).

WHL220405

Mapped as shown on PLS map. PLS notes:

Eastward between **S. 11** and **S. 14** at 50.64 chains “Intersect a swamp brs. N.W. & S. E.” and at 69.00 chains “Leave the swamp” (April 15, 1863).

WHL220406

Mapped as shown on PLS map. Likely extends beyond mapped extent but no supporting data sufficient to draw extension. PLS notes:

North between **S. 7** and **S. 12** at 30.15 chains “Enter swamp” and at 34.00 chains “Leave.”

WHL220407

Mapped as shown on PLS map. Likely extends beyond mapped extent but no supporting data sufficient to draw extension. PLS notes:

East between **S. 12** and **S. 13** at 70.00 chains “Intersect swamp brs. N & S” (April 9, 1863).

WHL220408

Shown on PLS map; boundary extended to west side using NWI. PLS notes:

North between **S. 13** & **S. 14** at 42.00 chains “Intersect Swamp brs. 70 E & N 75 W” and at 55.00 chains “Leave swamp” (April 3, 1863).

WHL220409

Mapped as shown on PLS map. PLS notes: Eastward between **S. 14** and **S. 23** at 35.00 chains “Intersect a swamp brs. N 10 E & S 10 W” and at 59.00 chains “Leave the swamp” (April 14, 1863).

WHL220410

Mapped as shown on PLS map. PLS notes:

Eastward between **S. 13** and **S. 24** at 68.00 chains “Swampy bottom brs. N. 5 E. & S. 5 W.” on April 2, 1863. Northward between **S. 13** and **S. 18** at 25.00 chains “Leave Swamp” (July 2, 1863).

D. Lower Mill Creek wetlands.

The main wetland, WHL220411, about 443 ha, was fed by runoff from the White River fan, by tributary drainages, and from upper Mill Creek and its wetlands. It was

mapped by the PLS in 1863 and does not appear on the 1895 USGS topographic map. The PLS surveyors described it as “overflowed land” in late March of 1863.

WHL220411 Mill Creek area marsh

Most of this unit was mapped by PLS survey; boundary extended to wets and north using NWI mapping. PLS notes:

> East between **S. 26** and **S. 35** at 38.00 chains “Intersected overflowed land & a deadening on White River bottom brs N. 15 E. and N. 15 W.” (April 11, 1863).
>
> North between **S. 25** and **S. 26** at 45.00 chains “Leave the overflowed bottom brs. S. 15 E. & N. 80 W.” (March 31, 1863).
>
> East between **S. 25** and **S. 36** at 20.00 chains “Leave the overflowed deadening here brs. N. 10 W. & S. 10 E.”
>
> North between **S. 35** and **S. 36** “The line begins in a deadening of overflowed bottom the western border of which brs. N 20 W.” and at 80.00 chains “…in water 12 in. deep running N. 20 W.” (March 30, 1863).
>
> West between **S. 1** and **S. 36** at 10.50 chains “Small prairie ___ two acres brs. N & S” and at 14.00 chains “Leave the prairie & enter thicket [both witness trees at 40 chains are 3’’ diameter willows]” (March 25, 1863).

WHL220412

Mapped as shown on PLS map. PLS notes:

> East between **S. 25** and **S. 36** at 70.00 chains “Intersect W. overflowed bottom N. & S.” (March 31, 1863).
>
> North between **S. 31** and **S. 36** at 49.00 chains “Enter swamp [at 80.00 chains witness trees include two willows and two ash].”

WHL220413

Mapped from NWI, is within interior of S. 15; south of and adjacent to pond mapped by PLS.

WHL220414

Crossed by two PLS survey lines; wetland boundary drawn using NWI.

PLS notes:

> North between **S. 22** and **S. 23**, at 26 chains, “Intersect swampy river bottom brs. E & W,” and at 38 chains, “Leave the swampy bottom here brs. N. W.” (April 13, 1863).
>
> East between **S. 23** and **S. 26**, at 2.5 chains “Intersect swampy bottom brs. N & S.” and at 14.55 chains, “…dry rich bottom” (April 12, 1863).

E. Upper Mill Creek wetlands.

Wetland WHL210401 (357 ha), continuous with STK210403 (285 ha), which drained to the Stuck River, was at the western margin of the valley at the base of the White River Fan. The PLS mapped discrete patches of wetland in this area, but we grouped them into a larger wetland to include the area shown by soils mapping as having organic soils. The area was fed by floodwaters from the White River Fan and tributaries from the west valley side. It was variously described as “swamp” and “cranberry marsh.”

WHL210501

Mapped from PLS, with western boundary drawn using NWI. PLS notes: Westward between S. 7 and S. 18 at 63.92 chains “…at this point leave open land and enter gooseberry thicket” on September 24, 1867.

WHL210402

Mapped from NWI.

WHL210401

This large wetland map unit has been created by linking six areas mapped or described in the PLS maps and notes. Areas not mapped by PLS were either mapped by NWI or shown as organic soils in 1971 soils mapping. The PLS field notes include:

Northward between **S. 23** and **S. 24** at 38.18 chains “…leave swamp and enter open dead timber” on October 8, 1867. Eastward between S. 24 and S. 25 at 35.00 chains “Leave brush & swamp and enter timber bears N & S” (October 7, 1867).

East between **S. 13** and **S. 24**, at 19.84 chains “a Slough, water stagnant caused by Beaver dams bears N & S,” at 35.00 chains “Leave Slough,” at 60.00 chains “Leave swamp and enter vine maple brush.” The line summary includes “Land level, good soil wet, underbrush Vine maple & willow” (October 8, 1867).

This map unit is continuous with PUY210403. PLS notes for PUY210403 include:

Northward between **S. 25** and **S. 26** at 16.00 chains “Leave thick brush & enter cranberry marsh scattering brush and timber” and at 46.00 chains “Leave cranberry marsh and enter thick brush.” The line description includes “underbrush black birch willow & hardhack” (October 7, 1867).

Puyallup River

Skip ahead to:

- Puyallup River nearshore wetlands
- Puyallup River valley palustrine wetlands
- Stuck River

The Puyallup River from about Orting to Puyallup has a floodplain about 200-800 m wide inset into low terraces; these terraces are not shown on geologic maps, but can be mapped from lidar and generally correspond to published soils mapping. Towns in the Puyallup River valley—Orting, Sumner, and Puyallup—were founded on these higher surfaces. Downstream of Puyallup, the river valley topography "inverts;" while upstream the river has incised and created terraces, downstream it has built an alluvial wedge several meters above the floodplain, extending downstream to about the town of Fife. Wapato Creek occupies a similarly elevated wedge, presumably created by an earlier location of the Puyallup River. Palustrine wetlands in the lower Puyallup River formed in the low elevations marginal to these two elevated wedges.

Puyallup River nearshore wetlands

PUY2003E03 Puyallup River estuarine emergent wetland

PUY2003E03 was mapped from T-1453 (1877). The salt marsh on T-1453 included 10 ha mapped as cultivated fields**.** The total area without saltponds or channels is 943 ha.

Tidal channels shown as polygons on T-1453 were mapped as shown on T-1453, except for channels farther from the shoreline, where accuracy appeared to diminish; in these areas, channel locations were modified by using channels shown on 1940 aerial photographs. Tidal channels shown as lines on T-1453 appear to have been decorative only, and we did not use them. In some areas, smaller (line) tidal channels could be drawn from 1940s photographs. For this reason, tidal channels shown on our mapping are incomplete, and where they do appear, are likely representative of, but not precisely the same as the historical condition. There were 7.1 ha of what appears to have been symbolized as saltpond mapped on T-1453. The blind tidal channels that appear on our map as polygons total 102 ha. The total area of saltmarsh with blind channels and saltponds is 1,052 ha.

Eldridge Morse's 1884 inventory of tidal wetlands includes this description of the Puyallup's tidal marsh:

> "South of the Puyallup River the total area of tide marsh is about 500 acres [202 ha], 200 acres [81 ha] being in a reservation and 300 acres [121 ha] controlled by the railroad company. The school farm for the Indians is on the reservation tide marsh, of which 60 or 70 acres [24 or 28 ha] have been diked. The rest is used for pasturage. North of the Puyallup is a tract of about 2,000 acres 809 ha] of unreclaimed tide marsh, all on the Indian Reservation" (p. 87, Nesbit 1885).

Morse's estimate of the total amount of tidal marsh on the Puyallup River was 1,011 ha. His estimates presumably included tidal channels and saltponds. While the correspondence is probably coincidental, given the round number of Morse's estimate (500 acres), it is nonetheless close to our mapped area of 1,052 ha.

A stringer of (presumably) higher elevation land extends northward into the EEM map unit, likely natural levee deposits associated with Wapato Creek (likely, based on the scale of the channel and amplitude of its meanders, a paleo channel of the Puyallup River). We mapped this area (PUY2003E07) totaling 27 ha as scrub-shrub, based on PLS field notes and symbology on T-1453. The PLS line notes along one line describe it as "hard ground, brush," and distinguish it from "tidemarsh" or "swamp" on either side of it. On another east-west line, the notes distinguish it from "marsh" (mapped as saltmarsh on T-sheet) on the one side and "swamp" (mapped by us as ESS) on the other, suggesting it is not a wetland. The symbology in the finger of land on T-1453 includes sparse "grassland" symbols with numerous dots, and sparse grassland symbols mixed with sparse deciduous symbols and dots; there are also a few cultivated fields in the finger of land.

PUY2003E08 Estuarine scrub-shrub wetland
PUY2003E09 Palustrine scrub-shrub wetland

Along the up-valley margin of estuarine emergent wetland north of the Puyallup River, there are three small patches we map as scrub shrub (8 ha), palustrine scrub-shrub (27 ha; PUY2003E09), and estuarine scrub-shrub (18 ha, PUY2003E08). T-1453 shows part of PUY2003E09 with wetland/deciduous symbols, and the PLS notes describe part of the unit as "swamp" and part as "marsh." It is possible PUY2003E09 is estuarine scrub-shrub instead of palustrine scrub shrub as we've mapped it. Three patches of scrub-shrub were identified from PLS notes "briars, no trees," or by grassland/dots symbol on T-1453. The areas mapped as estuarine scrub shrub (PUY2003E08) by a combination of symbology on T-1453, PLS field notes, and the presence of tidal channels on 1940 aerial photographs.

Puyallup River valley palustrine wetlands

PUY2003E02 Palustrine scrub-shrub wetland

Described in PLS line notes as "hard hack swamp," "dense hard hack," and "dense willow thicket."

PUY2004E03 Palustrine scrub-shrub wetland

Formed in lowland to north of Wapato Creek, and about 1 km upvalley of the estuarine emergent vegetation. Present-day elevation about 14 ft in town of Fife; I-5 interchange is in southern part of wetland. Mapped from PLS plat maps and field notes. PLS notes describe "swamp," "swampy," "willow swamp small timber." Of 15 bearing trees, 11 were willow. The remainder were crabapple, ash, and alder.

PUY2003E05 Palustrine scrub-shrub wetland

Small wetland on PLS map, in low elevation between Wapato Creek and Puyallup River. Described in field notes as "swamp" and "marsh grass swale."

PUY2004E01 Palustrine scrub-shrub wetland within tributary embayment of Hylebos Creek

PLS notes describe area as "brushy swamp," "open swamp," "wet, willow swamp," "wet thicket," "swamp," "swampy," and "wet swamp, no trees." Of 20 bearing trees, at eleven survey points (there were no trees at one point), 9 were willow, five were alder, 3

cedar, 2 cottonwood, and one hazel. Most of the wetland is also mapped on the USGS 1895 30' topographic map.

PUY2003E01 Palustrine scrub-shrub and forested wetland

Scrub-shrub and forested wetland that includes a system of creeks in lowland to south of Puyallup River. The wetland, and its central creek, was fed by four tributaries from the upland to the south. Patches of forested wetland within scrub shrub was mapped based on the PLS notes. The larger area mapped as scrub-shrub (267 ha) was described in field notes as "swamp, thick brush," very wet swamp," "swamp," "swampy," "swamp, no large timber," "willow swamp," "swampy, large dead timber." The areas we mapped as forested wetland (44 ha) include descriptions "large timber," "heavy timber, swampy," "timber, underbrush." Most of the unit is also mapped as wetland on USGS Tacoma 1897 topographic.

PUY2004E02 Palustrine scrub-shrub wetland

In low-elevation depression between Wapato Creek and Puyallup River. Described in PLS notes as "hard hack swamp," and "dense hard hack."

PUY2004E04 Palustrine emergent wetland

Mapped from occurrence of Semiahmoo Muck and Shalcar Muck soils from SSURGO 653.

Stuck River

STK210403 Palustrine scrub-shrub wetland west of Stuck River

PLS notes describe marsh with thick brush; the unit was drawn to include these survey descriptions, and to encompass the extent of "Semiahmoo Muck" and "Shalcar Muck" soils (SSURGO 633). PLS notes in T21NR4E:

> East between **S. 25** and **S. 36**. At 28.58 chains "A swampy creek 15 lks wide courses south" and at 33.65 chains "A swampy creek 20 lks wide course SW. Enter heavy timber bears N & S" (October 6, 1867).
>
> Northward between **S. 25** and **S. 26** at 16.00 chains "Leave thick brush & enter cranberry marsh scattering brush and timber" and at 46.00 chains "Leave cranberry marsh and enter thick brush." The line summary includes "underbrush Black Birch Willow & Hardhack" (October 7, 1867).

In T20NR4E:

> East between **S. 12** and **S. 13**; at quarter corner (40 chains): "land gradually getting very low & wet." Line summary: Land very wet unfit for cultivation. Timber Willow & Alder. Undergrowth same" (August 25, 1864).
>
> North between **S. 13** and **S. 14** line summary: Land level wet overflowed from November till April [underlining added], rich soil. Timber very scattering, Fir cedar & willow. Undergrowth Hardhack" (August 24, 1864).

North between **S. 11** and **S. 12** line summary: "Land very wet and marshy unfit for cultivation [underlining added]. Soil rich. Timber Alder & Willow. Undergrowth very heavy hardhack & Willow. Note—I find it impossible to run either East or North, or in any other direction except South, on account of the land being overflowed by Beavers damming up Stuck in Sec. 12 [underlining added]" (August 26, 1864).

North between **S. 11** and **S. 12**, T20NR4E, at 40 chains, bearing tree notes: " No bearing trees near, brush very thick, ground to soft to build mounds." Line summary: "No timber except at the extreme North end of line, brush Black Birch, Willow & Crabapple" (Nov. 22, 1873).

North between **S. 1** and **S. 2**, at 5 chains "Water 6 in. deep," at 10 chains "Do 2 ft [deep]," at 13 chains "Do 3 [ft deep} Strong current to the southeast." At 30 chains "Deep water & Beaver signs abundant." At 37.8 chains "To bank of slough 8 1 lks wide. The water is here confined in banks of slough." Bearing tree notes at 40 chains: "No timber near, ground still so soft as to render building mounds impracticable." At 62.5 chains "Bank of Creek 20 lks wide 18 in deep runs S 43 E. From this on to the Standard Parallel the ground is firm and dry" (Nov. 22, 1873).

East between **S. 1** and **S. 12**, bearing tree notes: "No bearing trees, brush very thick, ground too soft to build mound." Line summary: "1st 30 Chs on this line covered with water overflow seems to be caused by Beaver dams above [underlining added], balance of land good, covered with thick growth of Black Birch Crab-Apple & Willow" (Nov. 22, 1873).

STK210503 Palustrine scrub-shrub wetland east of Stuck River

The unit was drawn to encompass the extent of "Semiahmoo Muck" and "Shalcar Muck" soils (SSURGO 633).

STK210405 Palustrine scrub-shrub wetland

North between **S. 35** and **S. 36**, at 49.4 chains "A swamp bears NE & SW. This swamp is caused by she beavers damming up the creek, and is easily drained." The line summary is "No timber except a few willows and small alders. Very thick brush. Black birch, a specis of willow & Hardhack. There is a kind of coarse grass that grows 6 feet high" (October 7, 1867).

STK210502 Palustrine wetland

Shown on PLS map as wetland, mentioned in line notes as "swampy bottom" (June 26, 1861).

Nisqually River

The Nisqually River estuary is in a low-gradient glacial lowland valley into which the Nisqually River has built a fan. On the upper fan, roughly above 4-5 m elevation, the forest was a mix of conifer and broad-leaf deciduous species. At seven survey points having 14 bearing trees, 36% were fir and 29% cedar; the remainder consisted of vine maple, maple, and cascara. The average diameter of all trees was 69 cm. The average diameter of firs was 90 cm, and of cedars 70 cm. Morse, writing in 1885, described these fir forests:

> "There are no spruce bottoms on the Nisqually, but about 1,000 acres now or formerly covered with fir. Around the whole upper sound the best of the fir within 2 miles of salt water has been cut. On the Nisqually not over 15,000,000 feet of fir have been cut, and most of this was on upland" (Morse, p. 86 in Nesbit 1885).

The lower fan was a brushy broadleaf deciduous forest variously described in PLS survey notes as "vine maple and thorn bottom" or "vine maple and thorn thicket," "vine maple bottom." The twelve bearing averaged 23 cm in diameter, and all were deciduous: the trees included three maples, two each of elder, willow, ash, and alder, and one crabapple.

The uppermost extension of the glacial trough, in the area drained by McAllister Creek, was a large scrub-shrub wetland described as a "willow and thorn swamp" in PLS notes.

Downvalley of the lower fan was saltmarsh. Some of this had been domesticated for hay production by 1878, when T-1672 was surveyed. Morse wrote that settlers had found some of the marsh suitable for pasturage and hay:

> "Tide marshes vary greatly in the character, amount, and value of their product when in a wild state. On some the wild grass is worth little for pasturage and nothing for hay, while on others it approximates closely in value to tame grass produced on diked or other improved land. The best wild grass is a fine-blade bunch grass, which looks like orchard grass or timothy before they head out. This marsh grass keeps green all summer. Daniel M. Mounts has 200 acres [81 ha] of tide marsh mainly set with this grass, which he considers equal if not superior to timothy for hay and pasturage." P. 86

By Morse's estimate, little of the Nisqually Delta tidal marsh had been diked by the time of his report; he reports two diked plots totalling 65 ha:

> "Washington Hartman has 15 acres [6 ha] of diked marsh, from 4 acres of which an annual yield of 4 tons of timothy hay per acre is reported…George D. Shannon has 50 acres [20 ha] protected by a dike...four small sloughs were dammed..." P. 86

NSQ1901E01 Estuarine emergent wetlands

We mapped 612 ha of estuarine emergent tidal marsh. Of this, 95% (577 ha) was mapped as salt marsh on T-1672 (1878). The additional 5% (35 ha) that we mapped as estuarine emergent wetland using a combination of PLS notes, elevation, and 1937 photos. Within NSQ1901E01 we mapped 135 ha of blind tidal channels as polygons

(excluding the Nisqually mainstem and distributaries); of this 135 ha, 106 ha we mapped as shown on T-1672, and 30 ha we mapped from 1937 photos and lidar.

Morse's quantitative estimate of tidal marsh, made in 1884, appears high:

> "The total area of tide lands on the Nisqually River is 3,357 acres [1,359 ha], of which only about 70 acres [28 ha] have been reclaimed" (Morse, p. 87 in Nesbit, 1885).

NSQ1801E02 Riverine tidal marsh associated with Nisqually River up-delta from estuarine emergent marsh

Several small patches of marsh mapped from T-1672 (1878) totalling 8 ha. Includes part of an oxbow that is now intersected by I-5 to the west of the Nisqually River.

NSQ1801E01 McAllister Creek scrub-shrub wetland

Labeled on PLS plat map as "Willow and thorn swamp." We mapped the feature as riverine-tidal because tidal influence is documented in present day in McAllister Creek nearly to the upper end of the wetland.

> PLS notes:
>
> West between **S. 18** and **S. 19**: "at 8.60 chains intersect Willow & Thorn swamp Flowed with water by McAlisters Mill dam…distance across swamp 37.93 chs. [763 m]."

Skokomish River

Much of the lower river is within the Skokomish Reservation. Surveyed by PLS in 1873, the township summary included this description:

> "Much of the surface…is at present covered by two large swamps in which water is standing from 6 in to 6 or 8 ft. deep. These swamps cover most of Secs. 11 & portions of Secs. 12, 13, and 14. There are also other portions of low swampy land, through which pass many deep and ugly sloughs. All these obstacles however can be greatly overcome or remedied, and the soil made useful and productive, by drainage, dyking and other needed attention, at comparatively trifling cost."

SKO2104W01 Estuarine emergent wetland

This feature was mapped virtually as shown on T-1560b (1884). The area on the T-sheet totals 195 ha, and our map includes 194 ha (without tidal channels). Polygon tidal channels shown on the T-sheet were mostly adopted as shown; in a few cases 1938 photos were used to modify or extend channels.

SKO2104W02 Estuarine scrub-shrub wetland

We identified a scrub-shrub wetland unit, expanding the amount of estuarine marsh shown on T-1560b (1884). Depending on how a symbol is interpreted, T-1560b does not map it, or it shows a two ha patch of this unit; we mapped 47 ha. We mapped this unit where (1) tidal channels and scrub-shrub vegetation are visible on the 1938 aerial photographs; (2) the area is mapped as estuarine wetland in current NWI mapping; (3) from observations in PLS notes (1873); and (4) the elevation was lower than about 11 ft.

SKO2104W03 Riverine-tidal scrub-shrub (to east of river) and riverine-tidal forested wetland (to west of river)

Mapped from PLS, 1938 photos west of river and 1938 photos east of river.

SKO2104W04 Palustrine scrub-shrub wetland and palustrine forested wetland

"Impassable swamp" written on PLS map. PLS notes:

> West between **S. 1** and **S. 12**, at 62 chains "To edge of a big swamp covered with high flag grass and dead brush, water standing from one to 4 ft deep in pools and sloughs. The whole having the appearance of an old lake. Line of swamp bears mainly N & S at this point." At 66 chains "Water so deep in swamp, find it impossible to proceed further" (September 17, 1873).
>
> East between **S. 1** and **S. 12**, at 18 chains "Leave hardhack and enter timber N & S" ["leave hardhack" would correspond with leaving map unit 2104W04]. At 75 chains, "enter tide flat bearing S 10 W" (August 8, 1861).
>
> East between **S. 1** and **S. 12** 1873 "Through swamp, water from 1 to 2 feet deep." At 5 chains "At this point water in swamp becomes so deep that further progress on line is inexpedient and dangerous" (September 20).

West through **S ½ of S. 1** at 48.5 chains “Enter timber and brush N & S” and at 64.75 chains “Intersect big swamp N & S, water standing from 1 to 4 feet deep” and at 77.5 chains “Leave swamp NE & SW and enter crab-apple brush” (September 17, 1873).

South between south halves of **S. 1** and **S. 2**, at 2 chains “Enter big swamp.” Then running north along the same line, at 49 chains “Enter tide prairie N 50 W & S 50 E;” at 53.5 chains “Leave prairie & enter point of timber E & W;” at 57 chains “Re-enter tide prairie N 50 E & S 60 W.” Line summary includes: Land in timber low and mucky, balance tide prairie” (September 18, 1873).

East on north boundary of **S. 2** at 21 chains “Enter alder & crabapple swamp” and at 58.5 chains “Leave swampy bottom and enter tide prairie N 40 W and S 40 E” (September 27, 1873).

West through north ½ of **S. 2**, beginning “In tide marsh” and at 8.5 chains “Leave tide prairie and enter brush and swampy bottom N 8 W & S 8 E” and at 54 chains “Leave swampy bottom & enter large timber” (October 4, 1873).

East through center of **S. 35**, at 15 chains “Enter Swampy bottom N & S” and at 41 chains “Enter tide prairie N & S” (October 6, 1873).

South between **S. 11** and **S. 12**, beginning “In swampy water deep in places” and at 31.5 chains “Leave swampy creek bottom and enter upon dry land” (September 20, 1873).

East through north 1/2 of **S. 12** starting “through swamp water from 1 to 3 feet deep,” and at 19 chains “Running water from 1 to 4 feet deep, falling SE.” At 22 chains “Enter soft mucky bottom land” and at 34.5 chains “Leave swampy bottom and enter corn field” (September 23, 1873).

SKO2104W05 Palustrine scrub-shrub wetland

“Impassable swamp” written on PLS map. Line notes:

South between **S. 10** and **S. 11**, at 12.42 chains “Strike impassable swamp NW & SW” (August 26, 1861).

North between **S. 10** and **S. 11**, at 6 chains “Enter Swampy land E & W,” and at 13.23 chains “At this point the Swamp becomes impassable in consequence of its being overflowed by water to the depth of 18 in. and its Sloughey nature” (August 20, 1861).

East between **S. 11** and **S. 14** at 25 chains “Enter Swamp overflows water 6 to 36 in. deep” (August 20, 1861).

West between **S. 11** and **S. 14** starting “Through mucky bottom very brushy;” at 7 chains “enter swamp” and at 10 chains “At this point swamp assumes more the character of a lake, the water so deep it is impossible to proceed further” (September 23, 1873).

West through S. ½ of **S. 11** at 17.5 chains “Enter Swamp;” at 19 chains “Water 18 in deep in pools, high grass and thick brush and briars.” At 20 chains “I find it

impossible to extend this line further, owing to depth of water in swamp" (September 23, 1873).

West through center of **S. 11**, at 30 chains "To edge of big swampy lake from which flows the water in slough" (September 23, 1873).

SKO2104W06 Palustrine wetland

PLS notes:

North between **S. 14** and **S. 15**, at 13.25 chains "Leave Swamp" (August 19, 1861).

Between **S. 15** and **S. 22,** "The line bet. Secs. 15 & 22 will run through an impassable swamp, it is inundated to the depth of 4 feet. It is also full of holes & Sloughs of a very [illegible word] nature" (August 24, 1861).

Dungeness River

Skip ahead to:

- Overview of Dungeness River and associated nearshore
- Dungeness River and Meadowbrook Creek deltas
- Coastal plain and Cassalery Creek fan
- Gierin Creek paleochannel and Grays Marsh
- Bell Creek paleochannel and Port Washington
- Dungeness River
- Upland prairies and wetlands in the greater Dungeness area

Overview of Dungeness River and associated nearshore

The Dungeness River mapping area includes the fan-shaped lowland that encompasses the Dungeness River downstream from the river's exit from the Olympic Mountains, and the associated lowland drainage system. It extends westward to McDonald Creek, and eastward to Washington Harbor.

The Dungeness River formerly occupied valleys (referred to here as "paleochannels") at different times in the Holocene. In this mapping these are named (named informally for the creek now occupying it) as the "Bell Creek Dungeness River Paleochannel" (abbreviated "DRP"), the "Gierin Creek DRP," and the "Cassalery Creek DRP. The "Dungeness River valley" refers to the modern alluvial valley of the Dungeness River.

Stratigraphic evidence indicates that the Dungeness River abandoned the Bell Creek DRP in the first half of the Holocene. Surficial sediments about 1.5 km east of Sequim consist of fluvial gravels overlain by sandy/silty muck, which is overlain by about 10 cm of peat radiocarbon dated to 6,780 $\pm$ 60 ybp (Hartmann, 1997, referenced in Gough, 1999). A layer of Mazama ash lies on top of the peat layer, and the ash in turn is overlain by 70 cm of peat dated to 6,300 + 60 ybp. The Mazama ash and radiocarbon dates indicate that the paleo-Dungeness River incised and abandoned the Bell Creek Paleochannel by 6,780 ybp, at the latest (Gough, 1999).

Published ages are lacking for the Dungeness River's abandonment of the other two paleochannels. A lidar DEM shows a number of escarpments on the Gierin Creek and Cassalery Creek DRPs, which indicates incision by the Dungeness River to elevations lower than the Bell Creek DRP surface. This evidence of incision is consistent with the paleo-Dungeness River consecutively incising and abandoning the Bell Creek DRP, the Gierin Creek DRP and later the Cassalery Creek DRP, prior to incising again to create the modern Dungeness River valley. The three DRPs have successively gentler land gradients: 0.015, 0.012, 0.009, for the Bell, Gierin and Casselary creeks DRPs, respectively, and 0.008 for the Dungeness River valley (Gough, 1999). This trend in decreasing slope of the four surfaces indirectly supports successive incision, because the declining gradients could represent each surface having been graded to a successively higher sea level, as Holocene sea levels rose. An escarpment on the Bell Creek DRP near Port Washington also suggests the possibility of earlier, higher surfaces than the Bell Creek DRP.

A coastal plain extends from about Cline Spit to near the town of Jamestown. It also extends as much as two nautical miles into the Strait of Juan de Fuca as a shallow wave-cut platform; this presumably reflects an early Holocene shoreline when sea levels were lower than at present.

A large alluvial fan associated with the Cassalery Creek DRP is built onto the coastal plain. A second large fan has built onto the coastal plain to the west of this older fan, and nearly coalesced with it. Associated with the modern Dungeness River, this second fan is actively building. The modern Dungeness River fan is smaller than the fan associated with the Cassalery Creek Paleochannel. It is notably asymmetric toward the southeast, and less developed on its north-northwest area, which corresponds to the modern Dungeness River delta. In contrast to the Dungeness River valley and the Cassalery Creek DRP, the Gierin Creek and Bell Creek DRPs lack alluvial fans; the Gierin Creek DRP grades to Grays Marsh ("Graysmarsh" in local usage) which was historically saltmarsh, and the Bell Creek DRP grades to sea level in the Port Washington lagoon.

Within the area of the modern Dungeness River fan, the Dungeness River has had different locations and deltas. Several lines of evidence argue that the Dungeness River has been building the delta in its current general location for possibly only a few hundred years. The first argument for this interpretation is simply the prominence in the earliest (mid 19th century) mapping of a delta associated with an earlier location of the Dungeness River, in which the Meadowbrook Creek channel now flows. This Dungeness River paleochannel and associated delta are referred to here as the "Meadowbrook Creek Dungeness River Paleochannel (or "Meadowbrook Creek DRP"). In the earliest mapping (T-0539, 1855), the Meadowbrook Creek delta protruded conspicuously into Dungeness Bay, suggesting that fluvial sedimentation dominated longshore drift in the few decades prior to the earliest mapping. This argument is bolstered by the well-preserved morphology of the Meadowbrook Creek DRP, a relict channel comparable in size to the modern Dungeness River that diverges from the Dungeness River at RM 2.5. The well preserved morphology implies that not a great deal of time has passed since the Dungeness River abandoned the channel (i.e., with increasing time since abandonment, the paleochannel and its banks would become more rounded and indistinct).

A second argument for the Dungeness River delta having been active for a relatively short period of time is the likelihood that the Dungeness River was until recently topographically isolated from its current delta. The river currently flows through a narrow notch between the glacial upland to the west and a several-hectare detached piece of that upland. The topographic shape of the Dungeness River fan is the basis for a second, less equivocal argument. The fan morphology shows that most sedimentation from the Dungeness River valley has been directed to the east-southeast. A significant lobe of deposition is also present in the area of the Meadowbrook Creek DRP. This latter deposition originated because the eastern margin of the detached glacial upland likely deflected the river eastward. There is relatively little deposition associated with the current location of the Dungeness River. This argues that the river until recently was deflected eastward by the glacial upland remnant, in the process of carving away at the upland, and only recently broke through to create the notch. This interpretation is also supported by the topographic evidence for a paleochannel at the base of the glacial upland remnant (labeled "Schoolhouse DRP" in Figure 5) that could be an expression of a (relatively recent) Dungeness River that was deflected by the upland remnant. If it is correct that the Dungeness River has passed through the Schoolhouse notch only recently, the area of the modern Dungeness River delta would have been isolated from the river until recently, when the river created the notch.

A third argument for the recent dominance of the Meadowbrook Creek DRP delta is that the historical morphology of the Meadowbrook Creek estuary is suggestive of the Dungeness River having only recently abandoned it (in the decades prior to the first, 1855 mapping). In the 1855 map the Meadowbrook Creek delta had the morphology of an active estuary created by a large flow of water. The estuary's morphology was almost identical to that of the modern Dungeness River estuary during much of its history. In the years following 1855, longshore drift closed the estuary, and smoothed the coastline,

erasing the formerly protruding delta. This same sequence of events happened to the 1855 Dungeness River estuary following the river's abandonment by 1870 for the modern estuary. The details of this last argument, and the history of these three estuaries—the likely pre-1855 estuary (the Meadowbrook Creek DRP), the 1855 estuary, and the 1870-onward (modern) estuary are discussed later in the report.

There was historically a total of 129 ha of saltmarsh in the greater Dungeness area, and over half of this (67 ha, or 52%) was in Grays Marsh. The remaining area was divided among the Dungeness River (17 ha, or 13%), Washington Harbor (17 ha, 13%), Dungeness Spit (13 ha, 10%), and Cline Spit (3 ha, 3%). Wetlands mapped adjacent to Grays Marsh to the east include a "cedar swamp," shoreward from which is a wetland mapped as freshwater, but which also could have been a saltmarsh component of Grays Marsh.

Dungeness River and Meadowbrook Creek deltas

The Dungeness River delta in the earliest (1855) map was west of its modern location. The earliest map shows a large saltmarsh, which is separated on its northeast side from Dungeness Bay by a strip symbolized as "grassland." The same surveyor, 15 years later, in a more detailed T-sheet of the same area, symbolized as "sand" the same feature he previously symbolized as "grassland" on the Meadowbrook Creek delta. The General Land Office survey notes add no information on these features, the survey not having crossed them.

The Meadowbrook Creek delta—presumed to be associated with a late-Holocene location of the Dungeness River—had a morphology similar to that described above. The Meadowbrook Creek complex appears older and more complex than the Dungeness River delta, comprising an estuary, lagoons, and a spatially complex pattern of saltmarsh. Note that the patch of saltmarsh immediately south of the Meadowbrook estuary in 1870 was mapped 15 years previously as a cultivated field (Figure 15). However, the 1859 PLS survey transected the area and in the line notes call it a "low marsh," and the 1870 T-1168 symbolizes it as saltmarsh. Possibly the 1855 survey was in error, because the 1855 and 1870 surveys were by the same person, or possibly an early attempt to cultivate the low-lying coastal marsh was quickly abandoned and became (or reverted to) marsh. That the PLS survey notes it as "low marsh" while the T-sheet symbolizes it as saltmarsh may mean it was difficult for surveyors to determine if it was salt or fresh marsh.

We map as deciduous forest/brush a large area on the lower elevations of the Dungeness River valley fan [referred to as a "low flat" in descriptive information filed with T-2859. This is based on the use of deciduous forest symbology on the T-sheets, and on the descriptor "brush" in the PLS line notes. Additionally, bearing trees from the "brush" area are deciduous—willow, maple, alder, and crabapple—except for one fir, although the sample size is very small (n=9, survey points=3).

Meadowbrook Creek is mapped from the PLS maps and field notes, and from 1942 and 1963 aerial photos. The river's mouth is drawn from T-0539.

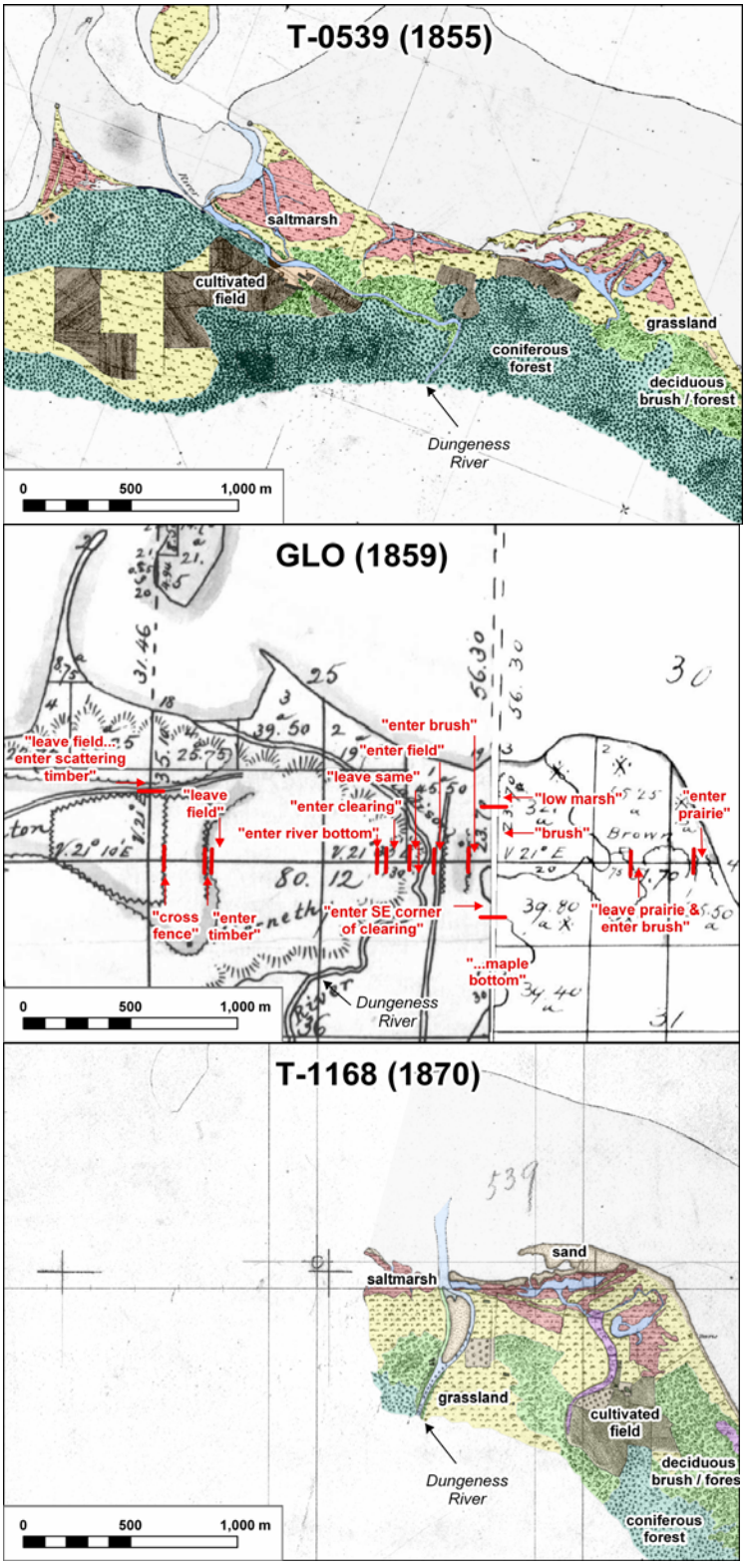

Figure 15. The Dungeness River delta area, shown on three early map sources: T-0539 (1855), PLS plat maps (1859, field survey 1858), and T-1168 (1870). Color added to T-sheets to enhance interpretation.

DNG3103W02 Estuarine emergent wetland associated with Meadowbrook Creek delta

Mapped from T-0539 because T-0539 is the earliest source, and because features mapped near to shore on T-0539 are presumed to be accurate (unlike inland, where features appear sketched, in comparison to the later T-1168, where inland features appear to have been mapped). Wetlands are protected by a sand berm (shown as grassland on T-0537, but distinguished from grassland immediately shoreward on T-1168). Wetland exists in patches, either fringing the barrier sand spit, or intermixed with area mapped "grassland" on both T-1168 and T-0539 and several lagoons, including one large lagoon which is consistent in shape with its being an abandoned channel of the Dungeness River. Grassland area could be grass-covered sand, by analogy to the 20th century condition and history of the modern Dungeness delta (see main report). Inland and extending along the coastal plain to the southeast we map "brush." This is based in part on the description "brush/deciduous forest" along three section lines crossing the map unit (between S. 30 and S. 31, T31N R03W, between S. 25 and S. 30, T31N R03W, and between S. 25, T31N R03W, and S. 36, T30 N R03W). It is also based on symbology showing dense deciduous forest on T-1168 and T-0539.

DNG3104W01 Estuarine emergent wetland on Dungeness Spit
DNG3104W02 Estuarine emergent wetland onCline Spit saltmarsh

Both are both mapped as shown on T-0539.

DNG3104W03 Estuarine emergent wetland associated with 1870-onward Dungeness River mouth
DNG3104W05 Estuarine emergent wetland associated with 1855 Dungeness River mouth

Both are both mapped as shown on T-0539.

DNG3104W04 Palustrine emergent wetland associated with the 1870-onward Dungeness River delta

Mapped as grassland on T-0539, but as "low marsh" in PLS field notes. PLS plat maps for the Dungeness and Meadowbrook deltas area:

> North on west boundary of **S. 30**. At 14.00 chains "Leave brush & enter low marsh, E. & W." At 23.70 chains "Intersect shore of Straits & set meander post between Sections 25 & 30, no trees convenient. Drove charred stake & raised mound with trench & pits, Set flag over in line to Dungeness Spit" (May 6, 1858).
>
> East between **S. 30** & **S. 31**: At 18.50 chains "Creek 75 lks. Runs N. E." At 21.32 chains "Creek 75 lks. Runs S. E." At 25.50 chains "Same Creek runs N. E. & enter field." At 27.10 chains "Barrows House bears N 20 E." At 31.47 chains "Leave field N. E. & S. E. Barrows house bears N 40 W." At 34.00 chains "Leave prairie & enter brush N 70 E & S 70 W." At 39.25 chains "Set ¼ section post from which, A Willow 4 in. dia. bears S. 53 W 8 liks. Dist., A Willow 3 in. dia. bears N. 60 E. 10 lks dist." At 46.00 chains "Enter prairie N 70 W & S. 70 E." At 47.20 chains "Cross fence N. E. & S. W." At 51.25 chains "Leave field N. & S." At 51.70 chains "Set meander post on beach between Section 30 & 31 no trees convenient. Drove charred stake & raised mound Land level soil 1st rate Undergrowth briers gooseberry willows &c." (May 12, 1858).

North on west boundary of **S. 31**. At 40.00 chains “Set ¼ Section post from which, An Elder 8 in. dia. bears S 71 E 58 links dist., A Maple 60 in. dia. bears N 80 W 8 liks. Dist.” At 46.50 chains “Creek 30 links runs N. E.; 52.75 chains—Same Creek runs West.” At 56.30 chains “Same Creek runs N. E.” At 66.00 chains “Enter S. E. Corner of clearing E. & W.” At 67.50 chains “house bears West about 100 links.” At 69.35 chains “Same Creek runs N. 30 W. & leave Clearing.” At 78.75 chains “Same creek runs East. At 80.00 chains “Set post Corner to sections 25, 30, 31 & 36, from which, A maple 18 in. dia. bears N. 17 E liks dist., A Maple16 in. dia. bears N 88 W 93 links dist., A Maple21 in. dia. bears S. 39 W. 92 links dist.” Line summary: “Land level, Timber Maple, alder, fir &c, Undergrowth gooseberry, Crabapple briers nettles &c. &c, Soil 1st rate” (May 6, 1858).

East between **S. 25** & **S. 36**, at 3.60 chains “Cross fence N. & S.” At 13.00 chains “Enter timber N. & S.” At 13.60 chains “Leave field N & S.” At 40.00 chains “Set temporary ¼ sec. Post.” At 51.50 chains “Descend N. E. & S. W.” At 52.75 chains “Enter river bottom N. E. & S. W.” At 54.75 chains “Enter clearing N. E. & S. W.” At 60.75 chains “Leave same.” At 64.20 chains “Dungeness River 130 lks wide course N. 30 E.” At 66.40 chains “Cross road & enter field N. 30 E. & S. 30 W. Madisons House bears N. 42 W.” At 75.00 chains “Enter brush Madison’s house bears N. 25 W.” At 80.12 chains “Intersect E. boundary 77 lks. South of post.”

West between **S. 25** & **S. 36**, at 40.06 chains “Set ¼ sec. Post from which a fir 12 in. dia. bears S. 52 E. 32 liks. dist., a fir 8 in. dia. bears N. 39 W. 38 lks dist.”At 80.12 chains “To section corner. East 27 chs. in river bottom soil 1st rate balance rolling. Soil 2nd rate. Timber chiefly fir” (June 2, 1858).

Coastal Plain and Cassalery Creek fan

A large complex of wetlands extends southeast along the coast from Meadowbrook Creek toward Gierin Creek.

DNG3103W01 Palustrine emergent wetland
DNG3103W01a palustrine scrub-shrub wetland

Palustrine wetland on coastal plain between Cassalery Creek wetland complex and Meadowbrook Creek wetland complex).

The two T-sheets (T-0539 in 1855 and T-1168 in 1870) map the area as a combination of grassland, wetland and deciduous forest. The wetland symbol in both (the same surveyor drew both maps) is not the standard symbol for freshwater marsh (dashed lines) or for saltmarsh (solid lines), instead consisting of patches of solid lines; this could have been intended to indicate marsh intermediate between fresh and salt. The PLS notes describe it as “open marsh,” which is likely intended to describe freshwater marsh, because the PLS surveyors commonly used “saltmarsh” or “tide prairie” to describe saltmarsh. The 1914 County Assessor maps indicate “saltmarsh;” by then, the area would have gone through a history of draining and cultivation—the southern half of the marsh is shown as grassland in 1870, which could be cultivated land—and could possibly have undergone subsidence. While we map it as freshwater marsh, it could also have been saltmarsh or intermediate between the two.

T-1168 (1870) shows DNG_W3103001 as wetland. T-0539 shows a portion of the area as wetland; on the whole, based on a comparison of the two with other sources, the

earlier T-0539 (1855) is less reliable than T-1168 (1870). DNG3103W01 is also within an area shown as wetland on the 1914 Clallam County Assessor maps. The southern part of the map unit is mapped wetland on the 1914 Assessor map; T-1168 maps it as grassland, but it appears diked at that time. The PLS survey crosses a portion of this southern part of the unit, describing it as "open marsh." A NW-SE running, linear band of "thick alder timber" (PLS) nearly splits the map unit; this band of trees is shown on T-1168 and alsodescribed in the PLS notes; we have mapped it using the same alder forest unit used adjacent to DNG3003W12. We have delineated the unit's margins to the southeast using the boundary between grassland and deciduous forest or brush on T-1168.

T-1168 shows DNG3103W01a on the inland fringe of DNG3103W01 as wetland with patches of trees; it is also within the area mapped as wetland by the 1914 Assessor maps. We map DNG3103W01a as PSS.

This coastal wetland (whether fresh or brackish) grades to the southeast into alder forest on the lower elevations of the older alluvial fan associated with the Gierin Creek DRP, and to the south the coastal wetland grades into a wetland complex in the lower elevations between this fan and the fan associated with the Dungeness River valley.

DNG3003W12 Palustrine wetland northwest of Jamestown and near mouth of Cassalery Creek

This wetland complex, from which Cooper Creek originated, includes emergent and scrub-shrub vegetation. It is largely coincident with an area of peat soil mapped on the County Assessor maps and on more recent geologic mapping.

This wetland complex was on the lower part of the large alluvial fan from the Cassalery Creek Paleochannel, and in the Coastal Plain between that fan and the large fan from the modern Dungeness valley. Much of the area is mapped as peat soil on the 1914 Clallam County Assessor map and on geologic maps. DNG_W3003012 is mapped as emergent wetland. It is located in a low-elevation trough between the two Holocene fans mentioned above, and is shown on PLS plat maps. The PLS survey crossed the feature along two section lines on May 5th, 1858:

> North between **S. 31** and **S. 32**, T31NR03W, at 16 chains, "leave thick alder & enter open marsh N. E. & S. W.," then at 35 chains "enter thick alder timber N. W. & S. E."
>
> East between **S. 31**, T31NR03W, and **S. 6**, T30NR03W, at 64 chains "Enter grass marsh N. E. & S. W.," then at 69 chains "Enter alder timber, N. & S."

The mapped area also generally corresponds to areas symbolized as field and grassland on T-1168 (1870). PLS plat maps show DNG_W3003012a as wetland. Surveyors crossed the feature twice along the line:

> North between **S. 6** and **S. 5**, T31NR03W, at 34.0 chains "enter alder bottom," at 41.0 chains "leave alder bottom," and at 58.0 chains "enter alder bottom."

The northern margin of the feature is not recorded in the notes, but the plat map shows the wetland ending at about 64 chains. We map DNG_W3003012a as forested wetland.

North and northeast of DNG_W3003012a we map a large area as alder forest. The extent of the alder forest is based on the PLS descriptions “thick alder” between **S. 31** and **S. 32**, and “alder timber” between **S. 31** and **S. 6**. We also used the extent of deciduous forest symbol on T-1168 to delineate the map unit; this unit is not mapped as wetland, but is mentioned in this description because it is related to the complex. One interpretation is that DNG3003W12a was a particularly wet area of the alder forest owing to its topographic position, but the entire area shares a similar geomorphic position at the lower portion of the alluvial fan associated with the Cassalery Creek Paleochannel. DNG3003W12b is mapped to the west of DNG3003W12, roughly coincident with the limit of “peat and muck” soils in the 1914 Clallam Assessor maps, and roughly coincident with (faintly drawn) wetland symbol on the PLS plat map. The wetland is not mentioned in the PLS notes, between S. 31 and S. 6. Several creeks originate within the map unit. Information is lacking on the vegetation. The line notes (notes for the entire line, including parts that do not pass through DNG3003W12b) indicate “Land low & mostly swampy. Timber fir, Cedar, alder & some Spruce. Undergrowth brier, arrowwood, salllal, gooseberry & c.” Bearing trees on the western edge of the map unit are spruce and cedar. The 1914 Assessor maps show a portion of the area that could be original vegetation (lacking stumps, unlike surrounding areas) as “brush.” We have mapped the unit as scrub-shrub wetland, possibly characterized by scattered cedar and spruce trees.

An unnamed stream between Cassalery Creek and Meadowbrook Creek drains the large wetland complex DNG3003W12. Its location is based on 1942 and 1963 aerial photographs, and, near the mouth, T-1168.

Cassalery Creek

We approximated the location of Cassalery Creek from the PLS plat maps, lidar, and 1963 aerial photos. Cassalery Creek flows on a floodplain, identifiable on lidar, from 20 to 200 m wide, inset roughly 1.5 m below the surface of the Cassalery Creek Paleochannel.

DNG3003W05 Small palustrine wetland SE of Towne Road and Gaskell Road intersection, and NW of Cassalery Creek, on northwest (left bank) side of Cassalery Creek Paleochannel

Shown as wetland on PLS plat map, described in PLS field notes as “alder & grass swale” (northward between S. 7, T30NR03W and S. 12, T30NR04W, between 51.5 chains and 62.5 chains) on May 5, 1858. Boundaries are as shown on plat map, lacking other information to refine boundary.

The Cassalery Creek Paleochannel grades into a large alluvial fan. An alder forest is mapped at the lower north and northwest fringes of the fan; the alder forest is adjacent to a wetland complex on the coastal plain between the nearly coalescing fans from the Cassalery Creek Paleochannel and from the modern Dungeness River valley. The latter wetland extends southeast into an incised portion of the Cassalery Creek fan. This wetland-alder forest complex on the fan and adjacent to it on the coastal plain are described as part of the coastal plain, below.

Gierin Creek Paleochannel and Grays Marsh

The location of Gierin Creek, as shown in the GIS coverage, draws from the 1914 Clallam County Assessor maps, lidar, and 1942 and 1963 aerial photographs. Upstream of the channel as shown, Gierin Creek had already been ditched by 1914, and relict

channels on early aerial photographs are faint and ambiguous; consequently the upstream part of Gierin Creek is not mapped in the GIS coverage.

DNG3003W02 Gieren Creek palustrine wetland

A “cedar swamp” shown on 1859 PLS plat map. Unit is extended downstream into interior of S. 9 in area mapped with peat soils in 1909 soils mapping. Lidar was used to map the lateral extent of wetland map unit between terraces 2-3 m above floodplain. The map unit is continuous downvalley with Grays Marsh. PLS notes:

> North between S. 16 and S. 17, T30NR2W, at 51 chains “foot of descent & enter Cedar swamp NE & SW;” at 62.5 chains “Enter burnt timber & leave swamp E & W;” at 75.5 chains “Enter cedar swamp E & W.” Line summary includes “North 39 chains mostly cedar swamp.”

DNG3003W07 Grays Marsh estuarine emergent wetland

Described in PLS line notes (1859) between **S. 4** and **S. 9**, T30NR03W as “open tide marsh” and symbolized on T-1169 (1870) as saltmarsh with no tree symbols; soil is described as “saltmarsh” on 1914 Clallam County Assessor maps. Tidal channels are as shown on T-1169. Includes a small (3 ha) inclusion (DNG3003W07a) symbolized on T-1169 as grassland, with a very small (0.01 ha) patch of forest in its center.

DNG3003W08 Forested palustrine wetland (“Cedar swamp”) west of Grays Marsh

Mapped by PLS adjacent to and west of Grays Marsh. DNG3003W08a is a continuation of the wetland, adjacent to DNG3003W08 extending into the interior of S. 4, T30NR03W, beyond the extent shown on the PLS map. Both areas are mapped in 1909 US Bureau of Soils map as peat soil, but mapping has a scale of 1:125,000, making boundaries approximate. A portion of DNG3003W08a could instead be an extension of Graysmarsh (saltmarsh); soils of that part are mapped as saltmarsh on the 1914 Assessor map; T-1169 maps this portion as a field, which could correspond to easily-cultivated (not requiring forest clearing) saltmarsh. On the other hand, the surface of DNG3003W08a is roughly 1 m higher than the adjacent Graysmarsh, although this could reflect differential settlement since the settlement era, because Graysmarsh has been mostly ditched and drained. DNG3003W08a is mapped as palustrine wetland; alternatively it could have been saltmarsh. Both DNG3003W08 and DNG3003W08a are lower in elevation than the surface to the west, which is that of the alluvial fan associated with the Cassalery Creek Paleochannel. PLS line notes:

Eastward between S. 4 and S. 9, T30NR03W, at 4.00 chains “foot of descent & enter cedar swamp N. W. & S. E.” then at 19.5 chains “enter open tide marsh [Grays Marsh].”

Bell Creek Paleochannel and Port Washington

The PLS plat maps suggest that Bell Creek terminated in a wetland at the base of Bell Hill; the plat map does not show Bell Creek emerging from the wetland and the line notes from surveys that crossed the Sequim Prairie in a north-south direction do not mention a creek. We map a small creek draining the wetlands in the Bell Creek DRP; this channel was mapped from topographic traces visible on lidar; there likely were other very small creeks within the wetland complex.

The PLS plat maps show a channel from the upland emptying into wetland DNG3003W04 (see below) to the south of the structure labeled “Jno Bell.” The plat maps do not show a continuation of this creek beyond the wetland. The line notes between S. 20 and S. 21, and between S. 21 and S. 22, T30NR03W (1859), which the modern Bell Creek cross, include no notations of channels. T-1169 (1870) shows two small creeks that terminate near the shoreline; it seems likely the creeks drain from the cedar swamp (DNG3003W03; see below) to the west of the Bell Creek estuary into the lagoon. Topographic traces of older meandering channels appear on the lidar; these may or may not be part of an historical Bell Creek. Lacking evidence for a continuous Bell Creek extending from the base of Bell Hill (DNG3003W04), only these discontinuous channels apparent on lidar have been drawn.

DNG3003W04 Palustrine wetland

The PLS map shows Bell Creek terminating in this small wetland at the base of upland. Plat map symbolizes area as wetland, but described as “bottom” in field notes:

> North between S. 19 and S. 20, T30NR03W, at 2.50 chains, “Enter bottom E & W;” at 12.00 chains, “Enter scattering fir & oak timber E & W.”
>
> West between S. 19 and S. 30, T30NR03W, at 2.5 chains “Enter maple bottom N.E. & S.W.;” at 13.00 chains, “Leave same & enter timber N & S.”

PLS plat map shows Bell Creek terminating in the wetland.

DNG3003W03 Palustrine wetland in the Bell Creek Paleochannel

Primarily a forested wetland (“cedar swamp”); a portion was emergent marsh (DNG3003W03a). Most of the wetland was shown as wetland on PLS plat map. A portion in the interior of S. 21 was extended using areas shown on 1914 county assessor map either as wetland or as “peat and muck” soils. DNG3003W03a was mapped on basis of PLS description (“open grass swamp”), which coincides with drained and cultivated portion of wetland W3003003 as shown on 1914 Assessor map. The lower part of DNG3003W03 is limited on the south side by a low terrace (~1.5 m high), higher ground on which early settlement and the road to Sequim Prairie were located. PLS notes:

> East between **S. 16** and **S. 21**, T30NR03W, at 11.00 chains “Enter cedar swamp N & S;” at 17.5 chains, “Enter open grass swamp N & S;” at 36.5 chains “Leave swamp & enter timber N.W. & S.E.”
>
> North between **S. 21** and **S. 22**, T30NR03W, at 58.00 chains “Enter swamp E & W;” at 72.0 chains “Leave swamp E & W.”

DNG3003W06 Estuarine emergent wetland in Port Washington

Showing no map evidence of having been altered in the settlement period, the Washington Harbor lagoon, barrier spits, and associated saltmarsh were drawn directly from T-1169 (1870). Large intertidal lagoon was 42 ha (all measurements are from T-1169). Gibson Spit, the main barrier spit attached to the mainland on the north end of the lagoon, included 12.8 ha of saltmarsh (including 0.2 ha of channels shown on T-1169), 8.2 ha symbolized by sparse grass (interpreted as grass on sand), and 1.2 ha symbolized as sand. The mainland shoreline included 2.7 ha of saltmarsh. The smaller spit attached at the lagoon’s southern end included 0.8 ha of saltmarsh (including channel area), and

0.9 ha of sparse-grass symbol (interpreted as sparse grass on sand). This spit continued southward past the prominent point of land (to the modern hamlet of Washington Harbor) as 0.9 ha of sparse-grass symbol and 0.2 ha lagoon.

Dungeness River

The Dungeness River as shown does not represent the location or condition of the river in pre-settlement time. The PLS plat maps show only a sketched version of the river, which was not meandered (see text). The GIS coverage instead shows a depiction of the river from the 1914 County Assessor maps. The rationale for using data from 1914, well after the early settlement period, is that it is the earliest relatively detailed map available. The location of Matriotti Creek has varying degrees of certainty. It was drawn from lidar, 1942 and 1963 photographs, 1914 Assessor maps, and the PLS in different segments of the creek.

The Dungeness River mapping was taken with few modifications from the 1914 Clallam County Assessor Maps, in the absence of an earlier map depiction. The location of tributaries to the river, primarily Matriotti Creek and its tributaries, was drawn from a combination of 1942 and 1963 photographs, lidar, the 1914 Assessor maps, and the PLS plat maps and field notes. The positional certainty (and in some cases presence or absence) of Matriotti Creek and its network of tributaries is variable. Additionally, the earliest aerial photographs (1942) appeared to show scrub-shrub and forested wetlands along parts of Matriotti Creek in the Dungeness River valley, but could not be interpreted on the grainy photographs and lacked corroborating information from the PLS notes, and so are not shown.

Upland prairies and wetlands in the Greater Dungeness area

DNG3104W01 Prairie near Old Town

Described in PLS field notes as “prairie.” Shown on T-0539 with grassland symbol. On T-0539 (1855), it includes 33 ha of fields, assumed to have been prairie pre-settlement. Boundaries of the prairie were expanded on the south (landward) edge, using 1859 PLS plat map and line notes, from field mapping in 1858:

> North between **S. 35** and **S. 36**, T31NR04W, at 68.30 chains “Leave timber N. W. & S. E. & enter prairie. Abernethys house bears S. 63 30 E” and then at 72.40 chains “Enter field E & W.”
>
> North between **S. 34** and **S. 35**, same township, at 68.25 chains “Enter prairie N.W. & S.E.” and at 72.60 chains “cross fence E & W.” Both lines were surveyed on June 3rd 1858.

DNG3004W03 “Gibson Prairie”

Not described in PLS field notes; shown on plat map, identified by label on road leading to prairie “Road to Gibson Prairie,” and label at prairie “Gibson.” Includes 8 ha of field assumed to have been prairie prior to settlement.

DNG3004W04 “Davidson” Prairie

Not described in PLS field notes because not crossed by survey line, but shown on plat map as immediately adjacent to line between **S. 3**, T30NR03W and **S. 34**,

T31NR04W. House in prairie labeled “Davidson.” Assumed to have been prairie prior to settlement.

DNG3104W07 Prairie west of Lotzgesell Road

Boundary of prairie is not fully drawn on PLS plat maps. Field notes indicate that part of prairie map unit was a field: Westward on north boundary of **S. 4**, T30NR04W, at 60.2 chains “enter field” and at 79.5 chains “Enter brush & leave prairie.”

DNG3003W06 “Squim Prairie” and associated woodlands and wetlands

Most of the Sequim Prairie was described in PLS notes as “prairie” or “open prairie,” and it included two woodland areas described as having “scattering fir & oak timber” or “fir timber.” The Sequim Prairie graded into wetland on its eastern margin; it also included two small wetlands toward its northern edge, mapped from the County Assessor maps. Bearing trees (n=31) within the prairie are dominantly very widely spaced fir. The average distance a surveyor traveled from his survey point to the nearest bearing tree—which provides an index of forest density—for all bearing trees in the greater Dungeness River area was 14.9 m. The average distance to firs in particular in forests on the three different age surfaces was 7.1 m on recent alluvium, 9.2 m on older alluvium, and 14.0 m on glacial sediments. In contrast, the average distance to firs within the prairie bearing trees was 50.9 m. Oak, presumably garry oak (*Quercus garryana*), was the second most common bearing tree in prairies, where they averaged 18 cm (7.1 inches) in diameter. Oak trees were spaced more than twice as distant as fir trees; the surveyor walked 139.0 m to the nearest bearing tree that was an oak.

The Sequim Prairie was 681 ha, excluding he two woodland areas within the Prairie area; including the woodlands the prairie was 751 ha. PLS surveyors describe the Sequim Prairie along section lines as “prairie” or “open prairie.” The 681ha includes 109 ha that the PLS mapped as fields in 1858; these fields are assumed to have been prairie prior to settlement. The two woodland areas, DNG3003W01a, totalled an additional 70 ha (49 ha and 21 ha). The larger, more central woodland was described in line summaries (between S. 18 and S. 19, T30NR01W) as “scattering fir & oak timber” and (between S. 17 and S. 18, T30NR01W) “scattering fir timber & oak do [timber].” The smaller woodland to the west is described as “fir timber” (between S.18, T30NR01W and S. 13, T30NR04W). Two small (10 ha total) wetlands within the prairie, DNG3003W011, are shown on 1914 Assessor maps. Both are mapped as “peat and muck” soils, and the larger one is annotated “brush and grass” and was crossed by a network of drainage ditches on the 1914 Clallam County Assessor’s map.

DNG3004W01 Prairie east of Dungeness River, west of Bell Hill and northwest of Happy Valley

Described in PLS notes as “small prairie” along line between S25, T30NR04W and S. 30, T30NR03W.

DNG3004W02 Prairie west of Dungeness River near Carlsborg, between S. 15 and S. 22, T30NR04W

Referred to in PLS notes as “prairie.”

DNG3003W09 Palustrine emergent wetland on glacial upland between Grays Marsh and Washington Harbor

Wetland is on glacial terrace on bluff near Port Williams. In PLS line notes (1859), between S. 10 and S. 15, T30NR03W, eastward at 17.00 chains “enter grass swamp N. 60 W & S 60 E” and at 31.00 chains “leave same N & S.” Wetland boundaries (except along section line) were modified using T-1169 (1870); wetland was narrowed on basis of mapping of field (assumed to have been marsh) and forest boundary on east, and wetland was elongated to north, based on mapping of grassland (also assumed to have been marsh).

DNG3004W05 Palustrine emergent wetland

Mapped from PLS notes and plat maps (westward on north boundary of S. 3, T30NR04W at 30.75 chains “Enter open grass swamp N & S W”).

DNG3004W06

Mapped from the PLS notes and map, and boundary refined from aerial photos. North between S. 3 and S. 4, T30NR04W, at 20.40 chains, “Enter grass swale, E & W.”

DNG3004W07

Mapped from PLS notes and map, and boundary refined from aerial photos: north on line between S. 9 and S. 10, T30NR04W, at 77.80 chains “Swale 150 links courses E. & W.”

Bibliography

This list includes references cited in this document and additional sources used in creating the geodatabase that are not cited in this document.

Skip ahead to:

- Miscellaneous text sources
- Annual reports of the Army Engineers
- Electronic databases
- Miscellaneous maps
- U. S. Geological Survey topographic and land classification maps
- Aerial photographs
- U. S. Coast and Geodetic Survey Topographic Sheets

Miscellaneous text sources

Boyd, R.(ed.). 1999. Indians, Fire and the Land in the Pacific Northwest. Oregon State University Press, Corvallis, OR, 313 p.

Coleman, E. T. 1869. Mountaineering on the Pacific. Harper's Monthly Magazine *40: 793-817.*

Chittenden, H. M. 1907. Report of an investigation by a board of engineers of the means of controlling floods in the Duwamish-Puyallup valleys and their tributaries in the State of Washington. Lowman & Hanford S. and P. Co., Seattle , WA.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1985. Classification of wetlands and deepwater habitats of the United States. U. S. Fish & Wildlife Service Report FWS/OBS-79/31.

Deardorff, L. V. 1992. A brief history of the Nooksack River's delta distributaries. Unpublished manuscript. 33p.

Eide, O. 1996. Log jams on the lower Stillaguamish River. Stanwood Area Echoes, Newsletter of the Stanwood Area Historical Society.

Essex, A. 1971. The Stanwood Story. The Stanwood News, Stanwood, WA. 125 p.

Gough, S., 1999. Environmental setting, Chapter 2 in: Morgan, V. E., ed., The SR-101 Sequim bypass archaeological project: mid- to late-Holocene occupations on the northern Olympic Peninsula, Clallam County, Washington. Archaeological and Historical Services, Eastern Washington University, Cheney, WA.

Hilbert, V., J. Miller, and Z. Zahir (editors). 2001. Puget Sound Geography, Original Manuscript from T. T. Waterman. Lushootseed Press, Federal Way, WA. 375 p.

Interstate Publishing Company. 1906. An illustrated history of Skagit and Snohomish Counties. 1117 p.

Jeffcott, P. R. 1949. Nooksack tales and trails, being a collection of stories and historical events connected with the most northwest county in the United States. Sedro-Woolley Courier-Times, Ferndale, Wash.

Judson, P. G. 1984. A pioneer's search for an ideal home. University of Nebraska Press. 309 p.

Keeting, V. K., ed., 1976, Dungeness: The lure of a river, a bicentennial history of the east end of Clallam County. The Sequim Bicentennial Committee and The Peninsula Daily News, Port Angeles, Washington, 190 p.

Morse, E. 1983. Morse's Monthly: A Puget Sound Magazine for the People of the Northwest 1: 1-14. Snohomish City, Washington Territory.

Nesbit, D. M. 1885. Tide marshes of the United States. U. S. Department of Agriculture Miscellaneous Special Report No. 7.

Ness, A. O. and C. G. Ritchins. 1958. Soil survey of Island County, Washington. U. S. Department of Agriculture Soil Conservation Service and Washington Agricultural Experiment Station. United States Government Printing Office, Washington, D.C. 58 p.

Northern Star Newspaper, Snohomish, Washington Territory. 1877.

Rigg, G. B. 1958. Peat resources of Washington. Washington Division of Mines and Geology Bulletin 44.

Royer, M. H. 1982. The Saxon story: early pioneers on the South Fork. Whatcom County Historical Society, Bellingham, Wash.

Sedell, J. R. and K. J. Luchessa. 1981. Using the historical record as an aid to salmonid habitat enhancement. In N. B. Arementrout (ed.) Acquisition and utilization of aquatic habitat inventory information. American Fisheries Society, pp. 210-223.

Sedell, J.R.; Duval, W.S. 1985. Influence of forest and rangeland management on anadromous fish habitat in Western North America: water transportation and storage of logs. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station General Technical Report PNW-GTR-186. 68 p. Portland, OR.

Wahl, T. 2001. Channel changes of the Lummi River. Report to the Lummi Natural Resources Department, Bellingham, WA.

Willingham, W. F. 1992. Northwest Passage: A history of the Seattle District U.S. Army Corps of Engineers, 1896-1920, U. S. Army Corps of Engineers, Seattle District.

Zehfuss, P. H., B. F. Atwater, J. W. Vallance, and H. Brenniman. 2003. Holocene lahars and their by-products along the historical path of the White River between Mount Rainier and Seattle. In: Swanson, T. W., ed., UWestern Cordillera and adjacent areas: Geological Society of America Field Guide 4U, Boulder, CO.

Annual reports of the Army Engineers

Habersham, R. A. 1875. Report of Mr. Robert A. Habersham, Assistant Engineer, October 5, 1875, in: Appendix FF7, Survey of Puyallup River, Washington Territory, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1875. Government Printing Office, Washington, D. C.

Habersham, R. A. 1881. Report of Mr. Robert A. Habersham, Assistant Engineer, June 30, 1881, in: Appendix OO10, Improvement of Skagit River, Washington Territory, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1881. Government Printing Office, Washington, D. C.

Habersham, R. A. 1881. Report of Mr. Robert A. Habersham, Assistant Engineer, November 18, 1880, in: Appendix OO11, Examination of the Stillaquamish River, Washington Territory, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1881. Government Printing Office, Washington, D. C.

Habersham, R. A. 1881. Report of Mr. Robert A. Habersham, Assistant Engineer, November 10, 1880, in: Appendix OO12, Examination of the Nooksack River, Washington Territory, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1881. Government Printing Office, Washington, D. C.

Habersham, R. A. 1881. Report of Mr. Robert A. Habersham, Assistant Engineer, November 23, 1880, in: Appendix OO12, Examination of the Snohomish River, Washington Territory, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1881. Government Printing Office, Washington, D. C.

McMillan, A. J., 1891, October 28, 1890 Report of Mr. A. J. McMillan, in “Preliminary examination of Duwamish and Black rivers, Washington,” Appendix WW15, Annual Report of the Chief of Engineers, U. S. Army, 1891. Government Printing Office, Washington, D. C.

McMillan, A. J., 1891, October 28, 1890 Report of Mr. A. J. McMillan, in “Preliminary examination of Puyalllup River, Washington,” Appendix WW14, Annual Report of the Chief of Engineers, U. S. Army, 1891. Government Printing Office, Washington, D. C.

Micheler, N., 1875. Examination of Skaget River, Washington Territory. Appendix GG5, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1875. Government Printing Office, Washington, D. C.

Micheler, N., 1875. Examination of Snohomish River, Washington Territory. Appendix GG7, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1875. Government Printing Office, Washington, D. C.

Ober, R. H., 1898, Report of Mr. R. B. Ober, Surveyor, in “Report of Capt. Harry Taylor, Corps of Engineers,” in “Survey of Duwamish River and its tributaries, Washington,” Appendix VV17 in Annual Report of the Chief of Engineers, U. S. Army, 1898. Government Printing Office, Washington, D. C.

Ogden, D. B. 1895. Report of Mr. David B. Ogden, Assistant Engineer, December 7, 1894, in: Appendix TT36, Survey of Nooksack River, Washington, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1895. Government Printing Office, Washington, D. C.

Symons, Captain Thomas W. 1893. October 13, 1892 letter to Brigadier General Thomas L. Casey, Report of Capt. Thomas W. Symons, Corps of Engineers, in Appendix VV29, Preliminary Examination of Nooksack River, Washington, with a View to Removing Obstructions, Straightening Channel to Prevent Jams, and the Filling of Bellingham Bay with Deposits of Earth, in Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1893. Government Printing Office, Washington, D. C.

Taylor, Captain Harry. 1898. Report of Capt. Harry Taylor, Corps of Engineers, December 11, 1897. in Appendix VV18, Survey of Skagit River from its mouth to the town of Sedro, Washington, Annual Report of the Chief of Engineers, U. S. Army, to the Secretary of War, 1898. Government Printing Office, Washington, D. C.

Electronic databases

U. S. Department of Agriculture, Natural Resources Conservation Service. 2007. Soil Survey Geographic (SSURGO) database for Jefferson County Area, Washington (Wa631). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2007. Soil Survey Geographic (SSURGO) database for San Juan County Area, Washington (Wa055). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Clallam County Area, Washington (Wa609). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for King County Area, Washington (Wa633). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Kitsap County Area, Washington (Wa635). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Island County Area, Washington (Wa029). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Mason County Area, Washington (Wa645). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Pierce County Area, Washington (Wa653). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Skagit County Area, Washington (Wa657). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Snohomish County Area, Washington (Wa661). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Department of Agriculture, Natural Resources Conservation Service. 2006. Soil Survey Geographic (SSURGO) database for Whatcom County Area, Washington (Wa673). HU**http://SoilDataMart.nrcs.usda.gov/U**

U. S. Fish & Wildlife Service (USF&WS). 2004. UNational Wetlands InventoryU. Online link HUhttp://wetlands.fws.gov/U

Washington Division of Geology and Earth Resources staff. 2005. Digital 1:100,000-scale Geology of Washington State, version 1.0. Open-File Report 2005-3. Accessed from HUhttp://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/pub_ofr05-3.aspxU

Washington State Department of Ecology, Shorelands and Environmental Assistance Program. 2002. Net Shore-Drift in Washington State HUhttp://www.ecy.wa.gov/services/gis/data/shore/driftcells.htmUH.

Miscellaneous maps

Clallam County Assessor. 1914. Tax assessor records; original scale unknown, digital images of individual land sections.

Lapham, Macy H., and A. W. Mangum. Reconnoissance Soil Survey of the Western Part of the Puget Sound Basin, Washington. U. S. Soils Bureau. Washington: G.P.O. 1912.

Mangum, A. W. Reconnoissance Soil Survey of the Eastern Part of the Puget Sound Basin, Washington. U. S. Soils Bureau. Washington: G.P.O. 1911.

Plummer, G. H., Plummer, F. G., and Rankine, J. H. 1902. Map of Washington showing classification of lands. Plate 1 in: H. Gannet, The forests of Washington, a revision of estimates. In U. S. Geological Survey Professional Paper 5, Series H, Forestry 2. 38 p.

Unknown. Plan of Seattle, 1855-6, Showing the position occupied by the Decatur's Crew, Jany 26, together with the line of barricades erected and roads constructed, Photograph of map. University of Washington Special Collections. http://content.lib.washington.edu/cdm4/item_viewer.php?CISOROOT=/seattle&CISOPTR=328

Unknown (drawn by Alfred Kielland). 1907. Map of the Duwamish-Puyallup valley, Washington, 1907. To accompany a report by a board of engineers upon the problem of flood control in this valley. Publ. Lowman & Hanford S. and P. Co., Seattle. Digital achive by University of Washington at http://content.wsulibs.wsu.edu/cgi-bin/viewer.exe?CISOROOT=/maps&CISOPTR=679&CISORESTMP=&CISOVIEWTMP=

U. S. Army Corps of Engineers. 1897. Index Map of Skagit River, From its Mouth to the Town of Sedro, Washington. Surveyed under direction of Captain Harry Taylor, Corps of Engineers, USA, March & April, 1897, by J. M. Clapp, Asst. Engr.

U. S. Army Corps of Engineers. 1892. Chart of Swinomish Slough, Skagit Co. Washington: showing proposed channel & dikes (1891). from: Swinomish Slough, Washington: letter from the Acting Secretary of War, transmitting, with a letter from the Chief of Engineers, report of the examination and survey of Swinomish Slough, Washington, with view of constructing a ship channel through same, connecting Saratoga Passage and Skagit Bay with Padilla Bay. Washington, G.P.O., 1892. (Ex. Doc. / 52d Congress, 1st Session, House ; no. 31). Washington : G.P.O.

U. S. Geological Survey topographic and land classification maps

U. S. Geological Survey. 1895 (surveyed in 1893-1895). Snohomish Quadrangle, Washington. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1897 (surveyed in 1893-1895). Land classification sheet, Washington, Seattle quadrangle. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1897 (surveyed in 1894-1895). Land classification sheet, Washington, Tacoma Quadrangle. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1899 (surveyed in 1897-1899). Stillaguamish Quadrangle. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1899 (surveyed in 1897-1899). Glacier Peak Quadrangle. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1900 (surveyed in 1894-1895).Tacoma Quadrangle. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1907. Blaine Quadrangle, Washington. 1:62,500 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1908. Sumas Quadrangle, Washington. 1:62,500 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1911 (surveyed in 1909). Mount Vernon Quadrangle. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1913 (surveyed in 1910-1911).Cedar Lake Quadrangle. 1:125,000 scale On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1915. Mount Baker Quadrangle. 1:125,000 scale On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey.1918 (surveyed in 1917-1918). Wickersham Quadrangle, Washington. 1:62,500 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1918 (surveyed in 1917-1918). Van Zandt Quadrangle, Washington. 1:62,500 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1918. Samish Lake Quadrangle, Washington. 1:62,500 scale. On file at University of Washington Libraries, Seattle, WA.

U. S. Geological Survey. 1921 (surveyed in 1919-1921). Sultan Quadrangle, Washington. 1:125,000 scale. On file at University of Washington Libraries, Seattle, WA.

Aerial photographs

Army Air Corps. 1938. Aerial photographs of Sammamish River area. 1:10,600 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Brubaker Aerial Survey Company. 1937. Aerial photographs of Skagit River area. 1:12,000 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Pacific Aerial Surveys. 1933. Aerial photographs of Stillaguamish and Snohomish rivers area. 1:10,000 scale, BW 7” x 9” prints. On file at Snohomish County Public Works, Everett, WA.

Pacific Aerial Surveys. 1936. Aerial photographs of Sammamish River area. 1:10,600 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Unknown. 1931. Aerial photographs of White River area. 1:20,000 scale. On file at Inter County River Improvement District, Auburn, WA.

Unknown. 1937. Aerial photographs of Nisqually River area. 1:6,000 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Unknown. 1938. Aerial photographs of Snohomish River area. 1:10,000 scale, BW 7” x 9” prints. On file at Snohomish County Public Works, Everett, WA.

Unknown. 1938. Aerial photographs of Nooksack River area. 1:12,000 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Unknown. 1938. Aerial photographs of Skokomish River area. 1:12,000 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Unknown. 1940. Aerial photographs of Duwamish, Green, Black, White, and Puyallup rivers area. 1:12,000 scale, BW 7” x 9” prints. On file at Seattle District, US Army Corps of Engineers, Seattle, WA.

Unknown. 1936. Aerial photographs of Cedar and White rivers area. 1:10,600 scale, BW 7” x 9” prints. On file at King County Department of Natural Resources and Parks, Seattle, WA

Unknown. 1942. Aerial photographs of Dungeness River area. 1:20,000 scale, BW prints. On file at U. S. Bureau of Reclamation, CO.

Unknown. 1943. Aerial photographs of Dungeness River area. 1:30,000 scale, BW prints. On file at U. S. Bureau of Reclamation, CO

U. S. Geological Survey. 1939. Aerial photographs of Hood Canal and Strait of Juan de Fuca area. 1:34,000 scale, BW 9" x 9" prints. On field at USDA Forest Service, Olympia, WA.

U. S. Coast and Geodetic Survey Topographic Sheets

0386. 1852. Map of Cape Flattery, Oregon. J.S. Lawson. 1:10,000 scale.

0387. 1852. Map of Cape Flattery, Oregon, Sheet No. 2. J. S. Lawson. 1:10,000 scale.

0537. 1855. Map of Port Ludlow at the Entrance to Hood's Canal, Washington Ter. J. S. Lawson. 1:10,000 scale.

0538. 1855. Map of Smith's Isd., Strait of Juan de Fuca, Washington Ter. J. S. Lawson. 1:10,000 scale.

0539. 1855. Map of New Dungeness, Strait of Juan de Fuca, Washington Ter. J. S. Lawson. 1:10,000 scale.

0540. 1855. Sketch of Mats-Mats (Boat Har.), Port Ludlow W.T. J. S. Lawson. 1:10,000 scale.

0581. 1856. Map of Port Townsend, Admiralty Inlet, Washington Ter. J. S. Lawson. 1:10,000 scale.

0582. 1870. Tracing: Pt. Wilson Correction for sheet No. 582-1, Port Townsend, Admiralty Inlet. J. S. Lawson. 1:10,000 scale.

0582-1. 1856. Map of Port Townsend, Admiralty Inlet, Washington Ter., Sheet No. 2. J. S. Lawson. 1:10,000 scale.

0584. 1856. Preliminary Survey of Murden's Cove, Admiralty Inlet, Washington T. J. S. Lawson. 1:20,000 scale.

0585. 1856. Map of Port Gamble and Part of the Entrance to Hood's Canal, Washington Ter. J. S. Lawson. 1:10,000 scale.

0589. 1856. Sketch and Profile of the Port Townsend Base, Washington T. J. S. Lawson. 1:10,000 scale.

0668. 1857. Part of Admiralty Inlet, Washington Ter. J. S. Lawson. 1:10,000 scale.

0669. 1857. Entrance to Hood's Canal, Washington Ter. J. S. Lawson. 1:10,000 scale.

1064. 1867. Map of Shilshole Bay, Admiralty Inlet, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1087b. 1868. Map of Port Madison, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1124. 1868-9. Map of Entrance and Approaches to Port Discovery, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1125. 1869. Map of Part of Port Discovery, Wash. Ter., Sheet No. 2. J. S. Lawson. 1:10,000 scale.

1126. 1869-1870. Port Discovery, Wash. Terr. J.S. Lawson. 1:10,000 scale.

1164. 1870. Admiralty Bay, Puget Sound, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1165. 1870. Washington Harbor, Strait of Juan de Fuca, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1168. 1870. Part of New Dungeness, Strait of Juan de Fuca, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1169. 1870. Protection Id. To New Dungeness, Strait of Juan de Fuca, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1170. 1870. Smith's Id., Strait of Juan de Fuca, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1252. 1871. Sheet No. 1, Deception Pass to Finger Pt., Whidbey Isd., Wash. Ter. J. S. Lawson. 1:10,000 scale.

1253. 1871. Sheet No. 2, Finger Pt. to Pt. Partridge, Whidbey Isd, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1254b. 1871. Sheet No. 3, Pt. Partridge to Eastward, Whidbey Isd, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1255. 1871. Kilisut Harbor, Wash Ter. J. S. Lawson. 1:10,000 scale.

1303a. 1872. Admiralty Inlet, East Side of Bainbridge Island, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1303b. 1872. Admiralty Inlet, from PoinNo. No-Pt. to President Pt., Wash. Ter. J. S. Lawson. 1:10,000 scale.

1304. 1872. Oak Bay, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1327a. 1873. Sheet No. 1, Budd's Inlet, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1327b. 1873. Sheet No. 2, Budd's Inlet, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1388a. 1872. Admiralty Inlet, from Lagoon Pt. to Double Bluff, Wash. Ter. J. S. Lawson, E. Ellicott. 1:10,000 scale

1388b. 1872. Useless Bay, Wash. Ter. J.S. Lawson. 1:10,000 scale.

1389a. 1872. Possession Sound, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1389b. 1872. Admiralty Inlet, from Possession Sound to Pt. Edmund, Wash. Ter. J. S. Lawson. 1:10,000 scale.

1390a. 1874. Admiralty Inlet, from Pt. Edmund to Meadow Pt., Wash. Ter. F. A. Lawson. 1:10,000 scale.

1390b-1. 1874. Sheet No. 1, D'wamish Bay, Wash Ter. J. S. Lawson. 1:10,000 scale.

1406. 1875. Duwamish Bay, (part of) Washington Territory. J. S. Lawson. 1:10,000 scale.

1452a. 1876-77. Topography of Puget Sound, Wash. Ter., From Restoration - Alki Pts. To Robinson's Pt. E. Ellicott. 1:20,000 scale.

1452b. 1876-77. Topography of Puget Sound, Wash. Ter., from Robinson Pt. To South End of Vashon I., Including Quartermasters Hbr. E. Ellicott. 1:20,000 scale.

1453. 1877. Topography of Commencement Bay, Puget Sound, Wash. Ter. E. Ellicott. 1:10,000 scale.

1528. 1879-1880. Case's Inlet, From its Head to Herron Island and Pickering Passage, Puget Sound. E. Ellicott. 1:20,000 scale.

1552a. 1884. Possession Sound, from Mukilteo to Preston's Pt. And from Hawk Station to Randall's Pt., Washington Ter. J. F. Pratt. 1:20,000 scale.

1556. 1878. Hood's Canal, Port Gamble to Hazel Pt., Washington Territory. J. J. Gilbert. 1:20,000 scale.

1557a. 1883. Sheet No. 5, Hood's Canal, Dabop and Quilcene Bays, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1557b. 1883. Sheet No. 4, Hood's Canal, Dabop and Quilcene Bays, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1558a. 1884. Sheet No. 3, Hood's Canal, Dabop Bay, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1558b. 1883. Sheet No. 2, Hood's Canal, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1559a. 1883. Sheet No. 6, Hood's Canal, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1559b. 1883-4. Sheet No. 7, Hood's Canal, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1560a. 1884. Sheet No. 8, Topography of Hood's Canal, W.T. J. J. Gilbert. 1:10,000 scale.

1560b. 1884. Sheet No. 9, Hood's Canal, Annas Bay, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1561a. 1884. Sheet No. 10, Hood's Canal, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1561b. 1884. Sheet No. 11, Hood's Canal, Washington Territory. J. J. Gilbert. 1:10,000 scale.

1609b. ~1878. Hammersley's Inlet and Oakland Bay. E. Ellicott. 1:10,000 scale.

1637. 1881. Shore Topography of Port Orchard, Puget Sound, Wash. Terr. E. Ellicott. 1:20,000 scale.

1667. 1885. Sheet No. 1, Topography of Rosario Strait, W T, Deception Pass to Ship Harbor. J. J. Gilbert. 1:10,000 scale.

1671. 1877-78. Puget Sound, From Pt. Defiance to Ketron Isd., Washington Territory. E. Ellicott. 1:20,000 scale.

1672. 1878. Topography of Puget Sound, Wash. Ter., From Nisqually River to Totten Inlet. E. Ellicott. 1:20,000 scale.

1673. 1879. Topography of Totten Inlet, Puget Sound, Wash. Ter. E. Ellicott. 1:10,000 scale.

1674. 1878. Carrs Inlet, Washington Territory. E. Ellicott, F. Westdahl. 1:20,000 scale.

1675. 1880. Eld Inlet, Puget Sound, Wash. Terr. E. Ellicott. 1:10,000 scale.

1681. 1884-5. Snohomish River, Washington Ter. (To head of ordinary steamboat navigation). J. F. Pratt. 1:20,000 scale.

1682. 1885. Possession Sound, Washington Ter. J. F. Pratt. 1:20,000 scale.

1746. 1886. Sheet No. 2, Topography of Rosario Strait, W T, Ship Harbor and Padilla Bay. J. J. Gilbert. 1:10,000 scale.

1747. 1886. Sheet No. 3, Topography of Rosario Strait, W T, Fidalgo and Padilla Bays. J. J. Gilbert. 1:10,000 scale.

1748. 1886. Sheet No. 4, Topography of Rosario Strait, W T, Cypress, Guemes, and Sinclair Islands. J. J. Gilbert. 1:10,000 scale.

1755. 1886. Port Susan and Stillaguamish River, Washington Territory. J. F. Pratt. 1:20,000 scale.

1794. 1887. Sheet No. 5, Topography of Rosario Strait, WT, Guemes, Samish, and Vendovi Islands. J. J. Gilbert. 1:10,000 scale.

1795. 1887. Sheet No. 6, Topography of Rosario Strait, W. T., Samish Bay. J. J. Gilbert. 1:10,000 scale.

1796. 1887. Sheet No. 7, Topography of Rosario Strait, W T, Samish Flats to Bellingham. J. J. Gilbert. 1:10,000 scale.

1797b. 1887. Sheet No. 8, Topography of Rosario Strait, W T, Lummi and Eliza Islands and Point Frances. J. J. Gilbert. 1:10,000 scale.

1798. 1887. Sheet No. 9, Topography of Rosario Strait, W T, North Part of Bellingham Bay. J. J. Gilbert. 1:10,000 scale.

1799. 1887. Sheet No. 10, Topography of Rosario Strait, W T, Nooksachk River. J. J. Gilbert. 1:10,000 scale.

1869. 1888. Sheet No. 1, Topography of Gulf of Georgia, W T, North East Part of Orcas Island. J. J. Gilbert. 1:10,000 scale,

1870. 1888. Sheet No. 2, Topography of Gulf of Georgia, W T, Patos, Sucia, and Matia Islands. J. J. Gilbert. 1:10,000 scale.

1871. 1888. Sheet No. 3, Topography of Gulf of Georgia, W T, Village Point to Base of Sandy Point. J. J. Gilbert. 1:10,000 scale.

1872. 1888. Sheet No. 4, Topography of Gulf of Georgia, W T, Base of Sandy Point to Birch Bay. J. J. Gilbert. 1:10,000 scale.

1873. 1888. Sheet No. 5, Topography of Gulf of Georgia, W T, Birch Bay to Boundary. J. J. Gilbert. 1:20,000 scale.

1874. 1888. Sheet No. 6, Topography of Gulf of Georgia, W T, Point Roberts. J. J. Gilbert. 1:10,000 scale.

1952. 1889. Sheet No. 1, Topography of Washington Sound, Wash, Part of Orcas and Blakeley Islands. J. J. Gilbert. 1:10,000 scale.

1953. 1889. Sheet No. 2, Topography of Washington Sound, Wash, Thatcher Pass to Watmough Bight. J. J. Gilbert. 1:10,000 scale.

1954. 1889. Sheet No. 3, Topography of Washington Sound, Wash, Part of Orcas Island. J. J. Gilbert. 1:10,000 scale.

1955. 1889. Sheet No. 4, Topography of Washington Sound, Wash, North End of Lopez Island. J. J. Gilbert. 1:10,000 scale.

1994b. 1887-8. Topography of Saratoga Passage and Holmes Harbor, Wash Ter. J. F. Pratt. 1:20,000 scale.

2011. 1888. Penn's Neck and Saratoga Passage. J. F. Pratt. 1:20,000 scale.

2079. 1891. Port Townsend Bay, Wash. J. F. Pratt. 1:10,000 scale.

2079. 1891. Port Townsend Bay, Wash, Resurvey showing improvements. J. F. Pratt. 1:10,000 scale.

2108. 1892. Map of the Harbor of LaConner Wash, Topography and Hydrography. J. J. Gilbert. 1:4,800 scale.

2109. 1892. Map of the Harbor of Port Angeles, Wash, Sheet No. 1, Topography and Hydrography. J. J. Gilbert. 1:4,800 scale.

2110. 1892. Map of the Harbor of Port Angeles, Wash, Sheet No. 2, Topography and Hydrography. J. J. Gilbert. 1:4,800 scale.

2156. 1889. Skagit Bay, Delta and River, Washington. J. F. Pratt. 1:20,000 scale.

2192. 1894. Sheet No. 5, Topography of Washington Sound, Wash, Orcas and Waldron Islands. J. J. Gilbert. 1:10,000 scale.

2193. 1894. Sheet No. 6, Topography of Washington Sound, Wash, Stuart, Spieden and Other Islands. J. J. Gilbert. 1:10,000 scale.

2194. 1894. Sheet No. 7, Topography of Washington Sound, Wash, San Juan and Henry Islands. J. J. Gilbert. 1:10,000 scale.

2229. 1895. Sheet No. 8, Topography of Washington Sound, Wash, Orcas, Shaw and Other Islands. J. J. Gilbert. 1:10,000 scale.

2230. 1895. Sheet No. 9, Topography of Washington Sound, Wash, Orcas, Shaw and San Juan Islands. J. J. Gilbert. 1:10,000 scale.

2231. 1895. Sheet No. 10, Topography of Washington sound, Wash, Part of San Juan Island. J. J. Gilbert. 1:10,000 scale

2300. 1897. Washington Sound, Part of San Juan Island, Dead Mans Bay to Eagle Point, Washington. J. J. Gilbert. 1:10,000 scale.

2301. 1897. Washington Sound, Part of San Juan Island, Pear Point to Eagle Point, Washington. J. J. Gilbert. 1:10,000 scale.

2302. 1897. Washington Sound, Part of Lopez Island, Big Rock to Point Colville, Washington. J. J. Gilbert. 1:10,000 scale.

2421. 1899. Topographic Resurvey of Seattle Bay and City, Washington, City Front and Head of Bay. J. J. Gilbert. 1:10,000 scale.

2422. 1899. Topographic Resurvey of, Seattle Bay and City, Washington, Shilshole Bay to Alki Point. J. J. Gilbert. 1:10,000 scale.

2606. 1902. Lake Washington, Northern Sheet, Washington. O. B. French. 1:10,000 scale.

2607. 1902. East Shore of Lake Washington, Juanita Bay to Meydenbauer Bay, Washington. O. B. French. 1:10,000 scale.

2608. 1902. East Shore of Lake Washington, Meydenbauer Bay to May Creek, Washington. O. B. French. 1:10,000 scale.

2609. 1902. Lake Washington, Southern Sheet, Washington. O. B. French. 1:10,000 scale.

2856. 1908. Washington, Northern Part of Skagit Bay. P. C. Whitney. 1:20,000 scale.

2857. 1908. Crescent Bay. W. C. Dibrell. 1:20,000 scale.

2858. 1908. Washington, South Shore Strait of Juan De Fuca, Freshwater Bay and Vicinity. W.C. Dibrell, W. B. Dunning. 1:20,000 scale.

2859. 1907-1908. Washington, South Shore Strait of Juan De Fuca, Morse Creek to Dungeness. C. G. Quillian, W. B. Dunning. 1:20,000 scale.

2906. 1909. Port Angeles, Washington. H. W. Rhodes. 1:10,000 scale.

2906a. 1909. Port Angeles, Washington. H. W. Rhodes, additions by H. A. Seran. 1:10,000 scale.

2907. 1908-1909. Twin Rivers to Callam Bay, Strait of Juan de Fuca, Washington. H. W. Rhodes. 1:20,000 scale.

2908. 1908-1909. Strait of Juan De Fuca, Callam Bay to Neah Bay, Washington. H. W. Rhodes. 1:20,000 scale.

3048. 1909. Tongue Point, Boundary Reference Monument, Strait of Juan de Fuca, Washington. F. Morse. 1:1,000 scale.

3675. 1888-1891. Port Orchard, Northern Part, Washington. Surveyor unknown. 1:20,000 scale.

4182. 1926. Crescent Bay to Deep Creek, Strait of Juan de Fuca, Washington. C. I. Aslakson and M. O. Witherbee. 1:20,000 scale.

4193. 1926. South Shore, New Dungeness to East Side of Port Angeles. Carl I. Aslakson. 1:20,000 scale.