DRAFT SKAGIT RIVER FLOOD DAMAGE REDUCTION STUDY
ENVIRONMENTAL BASELINE REPORT
LOWER BASIN

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I. INTRODUCTION

The Skagit River basin has a drainage area of 3,140 square miles (Figure 1). The northern end of the basin extends 28 miles into Canada, and covers 400 square miles. The headwaters of the Skagit arise in the steep Cascade Mountains of Canada and flow west and south into the United States. The river continues to flow through steep mountains for the next 40 miles where it passes through Ross, Diablo, and Gorge Dams owned by Seattle City Light above the town of Newhalem. The river continues for approximately 70 miles through less precipitous mountain valleys before emerging in the vicinity of Sedro-Woolley (2007 population 10,660). The river then meanders for about 25 miles through the coastal lowlands between the cities of Burlington (2007 population 8,629) and Mount Vernon (2007 population 30,700) before discharging into Skagit Bay. Population in the watershed is concentrated in the lowland delta area. Before it reaches the bay, the river crosses a broad outwash plain and divides into two principle branches, the north and south forks, which are 7.3 miles and 8.1 miles long, respectively, and which normally carry 60 percent and 40 percent of the flow, respectively. This report will focus on the portion of the watershed located below the town of Sedro Woolley.

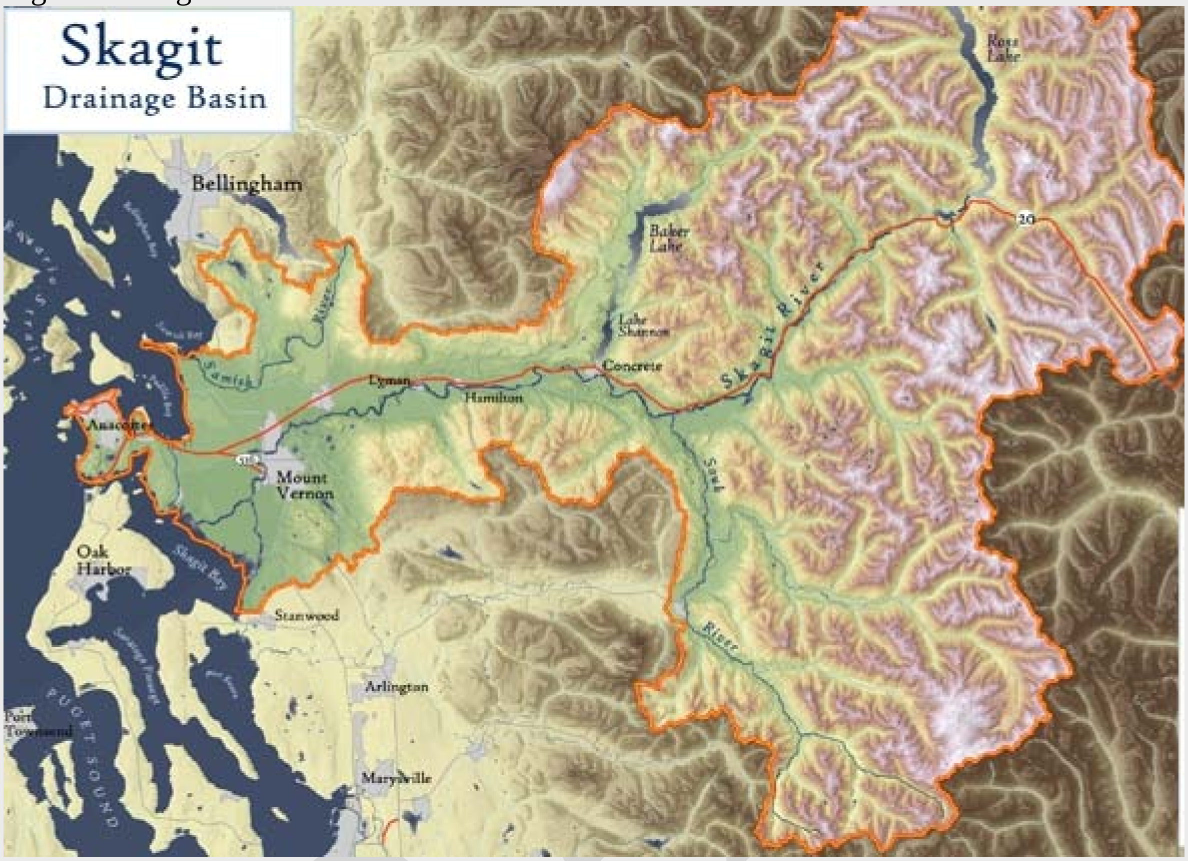
Several flood control projects provide flood protection in the Skagit basin. These include a system of levees in the lower basin and flood control reservoirs in the upper basin. Both Ross Dam on the Skagit, and Upper Baker Dam on the Baker River, are operated on a formal basis for flood control and provide a significant reduction to large and small floods. These dams control 38 percent of the Skagit basin’s drainage area; the remaining 62 percent is uncontrolled. Other hydroelectric and re-regulatory dams situated on the Skagit and Baker rivers provide incidental reduction of flood flows during smaller events.

The Skagit delta area is one of the most productive agricultural areas in the world. However, in recent years, growing population pressure in the Puget Sound region has resulted in conversion of some of this farmland to urban uses. Extensive diking of the lower river dating back to the last part of the 19th century, along with historic land clearing for agriculture, significantly altered the natural environment and physical processes in the delta.

Flooding on the river has been a constant problem. Significant flood events in Skagit County have been estimated as early as 1815, and have occurred as recently as 2003. Flooding is somewhat less severe since the 1920s, when dams were constructed on the Baker and Skagit Rivers providing some retention and upstream storage of flood waters. There has also been an extensive program of levee construction along the Skagit River downstream from Sedro-Woolley

Because much of the urban and agricultural land lies in the lowlands, flooding can cause significant damage. The Skagit River has occasionally overflowed the low divide between Sedro-Woolley and Burlington, and added to the flooding in the Samish River Basin; although, that has not happened since 1921.

Figure 1. Skagit River Basin



(Pacific Coast Watershed Partnership, 2008)

Despite the major alterations in the physical and biological processes occurring in the river system, the Skagit River still remains the major producer of salmonids in the northern Puget Sound. The delta is also a major wintering area for waterfowl and raptors, as well as a migration stopover for shorebirds.

II. ENVIRONMENTAL BASELINE CONDITIONS

A. Physical Resources

1. Topography

The Skagit River originates in a network of narrow, precipitous mountain canyons in Canada and flows west and south into the United States where it continues 135 miles to Puget Sound. The crest of the Cascades forms the eastern boundary of the basin with altitudes ranging up to 8,000 feet. From the Cascades, the river flows through gorges of glacier peaks to lower mountains, where its banks are heavily wooded with conifers, meanders around island stands of cottonwoods and alders, and then expands into the farm delta of the Skagit Valley. The valley varies in width from less than 1 mile in upper reaches to about 2 miles at Sedro-Woolley to more than 15 miles at the broad delta outwash plain, which encompasses 68,000 acres of floodplain. At Fir Island, the river divides into two principal distributaries of nearly equal length. During the usual range of river discharge, about 60 percent of the flow is carried by the North Fork and 40 percent by the South Fork. The entire floor of the Skagit River Valley and the deltas of the Samish and Skagit Rivers comprise the flood plain. The major portion of the flood plain within the study area is developed farmsteads, large portions of the commercial area of Mt. Vernon, and the urban area of Burlington; the remainder is mostly uncleared bottom land and wetlands.

2. Geology

The study area was glaciated during the Pleistocene by a lobe of continental ice moving south from Canada and alpine glaciers retreating from Mt. Baker and Glacier Peak. These ice formations rounded nearby bedrock knobs and ridges and left behind a varying sequence of glacial deposits. Since the deglaciation, approximately 10,000 years ago, the Skagit River built a broad delta alluvial plain covering older hills of bedrock and glacial drift in a thick deposit of alluvial silt, fine sand, and clay. Though the Skagit River now exists in the southern portion of the delta alluvial plain, prehistoric exits into Samish and Padilla Bays are evident from present topography. The plain is generally 10 to 20 feet above the mean sea level. Ground water levels are close to the surface. Beds of gravel are centered around the Burlington area, close to one of the older hills, which protrude through the plain. Because of man's attempt to control the river, the deposition by the river of silt, sand, and debris onto the delta alluvial flood plain at high-flow stages has been greatly reduced, resulting in increased deposition on the channel bottom and more rapid extension of the active delta into Skagit Bay.

Two volcanoes, Mt. Baker and Glacier Peak, are located in the upper watershed. Previous eruptions of Glacier Peak deposited large amounts of material in the Skagit River floodplain. There is no evidence that Mt. Baker contributed any material into the floodplain. Future eruptions of large volume are likely to form thick fills of lahars and pyroclastic-flow deposits in the upper parts of valleys that head on the volcano. Flows could reach the delta, or there could be induced flooding due to temporary damming of watercourses in the upper watershed. Subsequent incision of volcanic deposits would aggrade valley floors farther downstream with sediment for many years after the eruption, thereby affecting the capacity of stream channels and locally increasing heights of floods. These effects would be especially significant for the extensive low-lying areas of the Skagit river floodplain and delta. Although not a direct volcanic hazard, the increased susceptibility of lowland areas downstream of volcanoes to earthquake generated liquefaction is enhanced by the thick deposits of volcanic lahars, sand, gravel, and generally saturated conditions in many of those areas.

3. Soils

The Skagit River basin from the delta to just above Marblemount (RM 78) can be divided into four broad physiographic areas: (1) the low precipitation uplands, which include several islands; (2) the flood plain-delta; (3) the high precipitation uplands; and (4) the mountains. These areas are further subdivided into nine general soil map units: (1) Skagit-Sumas-Field; (2) Larush-Pilchuck; (3) Barneston-Dystric Xerorthents-Indinaola; (4) Tokul-Skipopa-Dystric Xerorchrepts; (5) Vanzandt-Montborne-Squires; (6)

Chuckanut-Cathcart; (7) Bow-Coveland-Swinomish; (8) Skykomish-Jug-Saxon; and (9) Wollard-Kindy-Diobsud. No survey has been conducted upstream of RM 78 to the Canadian border in the Mount Baker-Snoqualmie National Forest; therefore no soil data is available.

The soils in the surveyed area range widely in texture, drainage, and other characteristics. The physiographic areas and associated soils in the lower basin subject to this report include the floodplain with associated map unit 1 and the high precipitation uplands with associated map unit 7 (Klungland and McArthur, 1989).

General map unit 1 is comprised primarily of Skagit, Sumas and Field soils. This map unit is in the central and western parts of the survey area in the immediate floodplain and delta of the Skagit River. Slope is 0 to 3 percent. Elevation is sea level to 50 feet. The average annual precipitation is 32 to 40 inches, the average annual air temperature is about 51 degrees F, and the average frost-free season is 160 to 220 days.

> Skagit soils are very deep and naturally poorly drained, but they have been artificially drained and protected in most areas. Undrained areas of Skagit soils are high in salt content. These soils formed in recent alluvium and volcanic ash. The surface layer is silt loam about 12 inches thick. The upper 38 inches of the underlying material is silt loam and silty clay loam, and the lower part to a depth of 60 inches or more is very fine sandy loam. Skagit soil is classified as "superactive" and has a high cation exchange capacity (USDA, 2006 and 2008).

> Sumas soils are very deep and naturally poorly drained, but they have been artificially drained and protected in most areas. These soils formed in alluvium. The surface layer, to a depth of about 13 inches, is silt loam over silty clay loam. The upper 17 inches of the underlying material is silt loam and loamy sand, and the lower part to a depth of 60 inches or more is coarse sand.

> Field soils are very deep and moderately well drained. They formed in recent alluvium and volcanic ash. The surface layer and upper part of the underlying material are silt loam about 21 inches thick. The lower part of the underlying material to a depth of 60 inches or more is stratified fine sand to very fine sandy loam. These soils are frequently flooded.

General map unit 7 is comprised primarily of Bow, Coveland and Swinomish soils. This map unit is in the western upland parts of the survey area and includes some islands. Slope is 0 to 30 percent. Elevation is sea level to 1,500 feet. The average annual precipitation is 20 to 40 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season is 160 to 220 days.

> Bow soils are on glacial remnant terraces. The soils are very deep and somewhat poorly drained. They formed in glacial drift over glaciolacustrine sediment with a mantle of volcanic ash. The surface is covered with a mat of leaves and twigs. The surface layer and upper part of the subsoil are gravelly loam about 8 inches

> thick. The lower part of the subsoil to a depth of 60 inches or more is clay loam over silty clay.
>
> Coveland soils are in swales on glaciated hills. The soils are very deep and somewhat poorly drained. They formed in glaciolacustrine sediment. The surface is covered with a mat of needles, leaves, and twigs. The surface layer is gravelly loam over very gravelly sandy loam about 14 inches thick. The subsoil and substratum to a depth of 60 inches or more are silty clay.
>
> Swinomish soils are on glaciated hills. The soils are moderately deep and moderately well drained. They formed in glacial till with an admixture of loess and volcanic ash. The surface is covered with a mat of needles, leaves, and twigs. The surface layer and upper part of the subsoil are gravelly loam about 20 inches thick. The lower part of the subsoil and the substratum are very gravelly fine sandy loam over very gravelly sandy loam about 11 inches thick over dense glacial till. Depth to dense glacial till ranges from 25 to 40 inches.

The existing levee materials along the delta reaches are very similar to the foundation soil in most cases and are predominantly fine sands and silty sands of loose-to-medium relative density. There is documented evidence of volcanic lahar material underlying the towns of Lyman, Hamilton, Sedro-Woolley, Burlington and La Conner. Primary uses for these soils are agricultural cropping and pasture land.

4. Geomorphology

The geomorphology of the Lower Skagit River is described in the report entitled "Geomorphology and Sediment Transport Study of Skagit River Flood Hazard Mitigation Project Skagit County, Washington Phase 1 Interim Report" (Cherry and Jackson, 2002). Based on review of existing literature and field studies, the authors divided the Skagit from River Mile (RM) 0.0 to RM 30.0 into 6 reaches:

1) North Fork (RM 0 to 8.0)
2) South Fork (RM 0 to 8.0)
3) River confluence to Burlington (RM 8.0 to 19.0)
4) Burlington to Sedro-Woolley (RM 19.0 to 21.9)
5) Sedro-Woolley (RM 21.9 to 23.5)
6) Sedro-Woolley to Cockreham Island (RM 23.5 to 30.0)

Reaches 1 and 2 represent the estuarine portion of the river, tidally influenced but highly altered by diking. Reach 1, the North Fork, is tightly confined with many distributary channels, including Dry Slough and Browns Slough, which were cut off by the U.S. Army Corps of Engineers (Corps) near the turn of the 20th century. Reach 2, the South Fork, while constrained by dikes, is wider and has several large intact distributary channels with expansive riparian vegetation on the lower part of the reach. Large woody debris (LWD) is abundant in the vicinity of Freshwater Slough due to recent restoration efforts (PRNCI, 2002), but is lacking overall (Collins, 2000). Both channels are low gradient. Historically, it has been estimated that tidal wetlands of the Skagit estuary covered an area of approximately 25,766 acres, and the current extent is 1,941 acres. This calculates to a loss of approximately 23,825 acres of estuary habitat - more than 37 square miles, or 93% of historic coverage (Dean, 2000).

Reach 3 begins at the confluence of the North and South Forks and continues upstream to the town of Burlington. In this reach, the river is tightly constrained by dikes on both banks, locking the channel into the same planform present approximately 100 years ago. There is very little LWD in this reach and riparian vegetation is limited. Though the main channel is passable at all times of the year, certain side channels become isolated and/or cut off during low-flow periods. The only significant tributary in reach 3 is Nookachamps Creek which enters the mainstem on the left bank at RM 18.4. At the upstream end of this reach, the riverbed material changes from sand to sand and gravel. Studies show that the channel bottom has been aggrading in recent years (West, 2000).

Upstream of Reach 3, Reaches 4 and 5 represent the transition from the deltaic portion of the river to a higher gradient system coming from the mountains. Reach 4 is relatively unconstrained with several cutoff meanders. LWD quantities are greater. Reach 5 is dominated by bedrock and is higher gradient than downstream. Above Sedro-Woolley, the river transitions into a highly sinuous system, with many side channels and meanders. LWD is common and sediment is coarser in this reach.

Channel conditions in the lower mainstem have changed significantly from historical records. Both aggradation and degradation have been observed in various locations, channel widths and the occurrence of in-stream islands have been modified, and certain channel segments and tributaries have been substantially realigned or structurally modified. Additionally, levees and bank revetments permanently altered the natural stream dynamics.

In 1975, the Washington Department of Fisheries stream catalog identified the lower Skagit River as having long glides and deep pools. However, since that study, a loss of pool area was identified and associated with the historic removal and reduction of input of LWD and increases in sediment supply (Collins, 2000). The current channel morphology (i.e. smooth banks) makes it difficult for any remaining LWD to form jams and associated pools. The system’s constrained configuration and recent aggradations may also contribute to the loss of pools. The majority of existing pools are found in areas of high shear stress (Cherry and Jackson, 2002). The increases in sediment supply are due to mass wasting (landslides) and surface erosion due to forest management activities in the Cascades, and soil creep (Skagit Watershed Council, 1998). However, there are also natural inputs such as glacial and volcanic conditions that are attributed to higher sediment loads

5. Climate

The study area has a mild, wet, maritime climate caused by air masses originating over the Pacific Ocean which influence both the temperature and precipitation regimes. During the winter, the Skagit Basin, lying directly in the storm path of cyclonic disturbances from the Pacific, is subject to a definite rainy season, with numerous storms often in quick succession. During the short summers, the weather is warm and relatively dry as the winter low pressure system is displaced by a semi permanent high pressure system. The mean length of the growing season is 193 days.

Precipitation over the basin varies greatly from a mean annual amount of 32 inches in the vicinity of the mouth of the Skagit River which lies in a topographical rain shadow, to an average of 180 inches or more on the higher elevations of the Cascade Range. Mean annual snowfall varies from 4.4 inches at Anacortes to 647 inches at Mount Baker Lodge. Average winter temperatures vary from 26.9°F at Mt. Baker Lodge (4,150 feet) to 34.5°F at La Conner, and average summer temperatures vary from 56.7°F at Mt. Baker Lodge to 61.7°F at La Conner.

Models from the UW Climate Impacts Group indicate that over the next century the Pacific Northwest area will likely see a trend toward wetter warmer winters and hotter dryer summers in response to climate change. However, these large scale models have difficulty resolving mountain climates such as the cascades so exact sceneries are difficult to predict. Currently the UW climate group is working on meso-scale models that may be able to resolve smaller scale climates (UW Climate Impacts Group, 2008).

It is speculated that the Skagit River system may see higher flows in the winter as the majority of the precipitation would fall as rain and not snow, and lower flows in the summer due to lack of rain and snow melt. Initially, glacial melt would increase, but over time would decrease as the glacier retreats. Not only would this scenario lead to a different flow regime then what is seen in the Skagit today, but will likely lead to increases in water temperatures within the river (Alan Hamlet and John Lumberd, UW Climate Impacts Group, pers. comm.).

In addition to changes in precipitation and air temperatures, sea level rise in Puget Sound is predicted to be 6-50 inches in the next century. This range incorporates higher sea level rises expected in the south around Olympia and Tacoma and lower expected rises in the north around Friday Harbor and Bellingham Bay (UW Climate Impacts Group, 2008).

B. Biological Resources

6. Vegetation

a. Riparian Vegetation

The lower Skagit river basin lies in the Eastern Puget Riverine Lowlands ecoregion (EPA 1996). This ecoregion is composed of floodplains and terraces, historically dominated by Western red cedar and Western hemlock forest. Riparian and riverine wetland habitats were common prior to settlement. Pastures, cropland, and urban centers now dominate the landscape.

Today, the majority of the riparian zones below Sedro-Woolley are either entirely devoid of trees or consist of sparse, narrow, and patchy strips of small to medium sized cottonwood, willow, and alder. If growing on a levee, which most are, this vegetation is subject to the Corps levee vegetation maintenance requirements. This required vegetation removal results in the majority of the banks being covered with grasses and invasive species (i.e. blackberry, knotweed, and reed canary grass). Upstream of the delta, 32 miles (62%) of the mainstem channel edge was hardened with riprap within about 200 feet of the channel's edge.

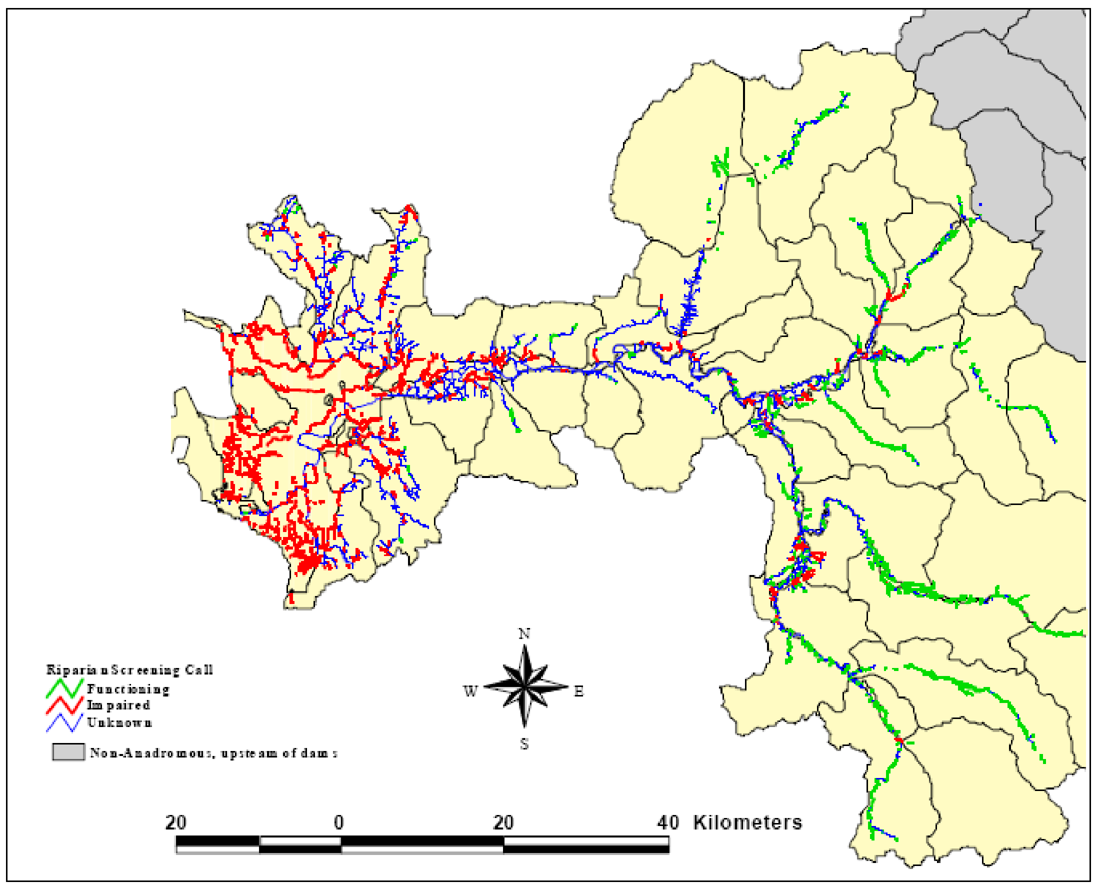
A screening of riparian vegetation conditions in floodplain habitats throughout the Skagit basin found significant impairment in most of the reaches surveyed (Beamer et al., 2000a). Historic, and current, landscape alteration resulted in a riparian zone on the lower mainstem that is fragmented, poorly connected, and provides inadequate protection of habitats and refugia for sensitive aquatic species such as salmon. Lack of riparian vegetation results in reduced potential for LWD input into the lower reaches of the river, further compromising salmonid habitat. Even without further disturbance, this condition is unlikely to improve significantly in the near future due to the existing levee and revetment system and associated policies.

In many areas below Sedro–Woolley, the historic establishment of dikes and levees disconnected the river from the floodplains, reducing the river to a single, non-migratory channel. Furthermore, these floodplain habitats were significantly altered over the past 100 plus years due to road building, bank hardening, hydropower operations, timber harvest in riparian zones and contributing upland areas, and rural development. By 1990, 16 diking districts had been created to maintain approximately 56 miles of levees and 39 miles of sea dikes in the Skagit River delta (Halverson, 1999). Examination of GIS maps (from the Corps and Skagit Cooperative) show downstream of Sedro-Woolley, from approximately RM25, the mainstem channel is hardened with riprap within about 200 feet of the channel's edge in an almost contiguous system of levees and revetments.

Limited examples of beneficial riparian habitat are found in the lower reaches. One example is Cottonwood Island, a 170 acre parcel at the confluence of the North and South Fork, which is representative of a historic habitat type (prior to logging and development) and provides valuable habitat for a variety of forest birds and raptors, primarily buteos and eagles (Garrett et al., 2006).

Climate change may greatly alter the vegetation communities in the Lower Skagit basin. Increased winter precipitation and summer drought, longer growing seasons, and warmer temperatures may result in changes in plant species and increased pest populations throughout the basin. Invasive species may proliferate and fill previously unaffected niches as native species are stressed and displaced by more generalist species.

Figure 1: Riparian buffer widths are likely impaired or functioning; based on Landsat data (Lunetta et al., 1997 *in* Beamer et al., 2000)



b. Estuary and Salt Marsh Vegetation

The Skagit River delta was originally a very large salt marsh/tidal wetland complex covering over 50 square miles (Dean, 2000). By the late 1800s dikes were being constructed throughout the delta to drain the lowlands for agriculture. Today, little remains of this vast tidal habitat. The remaining salt marsh vegetation is typical of that found in the Puget Sound region. Areas regularly inundated with salt water are dominated by salt grass, pickleweed, gumweed, jaumea, and arrow grass. Regions higher up on the beach more brackish in nature are dominated by tufted hair grass, dune grass and sedges.

Eelgrass and kelp dominate the shallow sub-tidal zone and provide countless cultural and ecosystem values; including providing habitat for hundreds of species of invertebrates, shelter and refugia for dozens of fish and commercial invertebrate species, including juvenile salmon, and providing an enormous amount of primary production in nearshore waters (Mumford, 2007).

Sea level rise will likely shift the eelgrass beds, mudflats, and salt, brackish, and freshwater marshes landward. This shift will be difficult on the landward side due to the development that abuts the marshes leading to an overall decline in brackish and freshwater habitat. Most of the brackish marsh in Skagit Bay today would be converted to salt marsh (Glick et.al., 2007). It is speculated that eelgrass beds may benefit due to an increase in shallow saltwater habitat (Greg Hood, per. comm., Skagit River System Cooperative, 2008)

c. Large Woody Debris

Assessment of LWD in the lower Skagit River indicates that there is a lack of large wood in the system (Collins, 2000). While LWD is generated in large quantities in the upper basin, there are few areas in the lower river where the LWD can become anchored to the bank due to the predominance of smooth banks (riprap). There are some localized areas, such as Freshwater Slough, where LWD collects.

d. Off-Channel Habitat

Many beaver ponds, side channels, and sloughs once used by salmon have been disconnected from the main river channel as a result of diking and other agricultural practices and bank revetments. In the last century, the lower Skagit basin has lost approximately 45% of the historic side slough habitat (424,200 m^2) that provided critical rearing and refuge functions in the floodplain (Beechie et al., 1994). The Skagit basin has lost approximately 72% of historic estuarine delta habitat, including a loss of 68% of estuarine emergent habitat, 66% of transitional estuarine forested habitat, and 84% of riverine tidal habitat (Beamer et al., 2002a, Collins and Montgomery 2001). The Skagit delta has lost approximately 75% of its distributary channel habitat (Beechie et al., 2001). A reduction in the number of side channels and sloughs, changes and reductions in the quality of riparian vegetation, and a reduction in the number of high quality stream channel pools significantly reduced the amount of available refugia for juvenile salmonids.

7. Wildlife

The Skagit River Delta area is considered critical wildlife habitat, particularly outstanding as a waterfowl wintering area due to mild climate and good habitats, such as expansive freshwater marshes, saltwater marshes, and intertidal flats. Dikes along its numerous sloughs have created upland areas for agriculture. In these areas, such as the Skagit Wildlife Recreation Area between Tom Moore Slough, Freshwater Slough, and the Hayton Reserve, crops are produced which are beneficial to waterfowl and other wildlife. Few winter residents breed in the project area (in spring most leave for breeding areas further north). Wintering waterfowl common along the area sloughs in Skagit Bay and upland on farms during the peak months of October and November include ducks, geese, and swans. Dabbling ducks, such as mallard, pintail, American widgeon, and green-winged teal, are numerous, and utilize estuarine and agricultural areas**.**

Snow geese are present in the fall and winter months in the Skagit Delta. In past years, up to 50,000 have wintered in Skagit Flats. Swans (mainly trumpeters, but also more than a thousand tundras) visit the Skagit Estuary, feeding mainly on vegetation in shallows and agricultural fields. The trumpeter swan, once an endangered species, has increased in numbers in Skagit County from a 1963 population of 20 to several thousand today. The major wintering roosting area for this species is the Nookachamps Creek drainage (DeBays Slough and Judy Reservoir).

Freshwater riparian habitat is important for waterfowl. The numerous sloughs adjacent to Skagit Bay are highly productive for mallards and wood ducks. Moore Slough, near Milltown, provides productive habitat for waterfowl.

Wading birds, such as great blue heron, utilize the estuary areas year round. Shorebirds use flooded agricultural fields and estuaries mainly during migration and in winter. Mainly dunlin and black bellied plover winter in the Skagit delta. Several species of birds of prey are found in the project area including bald eagle, red-tailed hawk, rough-legged hawk (winter only), Northern harrier, gyrfalcon (winter only), peregrine falcon, merlin, Coopers hawk, sharp-shinned hawk, and osprey. The Skagit Delta provides habitat for one of the largest wintering populations of raptors in the contiguous United States.

Large upland mammals, such as black tailed deer, can be found on Hart Island and are occasional visitors to the estuary, although this type of habitat is not favored by this species. The abundance of small mammals in the Skagit Delta accounts for the presence of raptors in the area. Semi aquatic mammals such as muskrat, mink, and beaver inhabit the sloughs. In addition, nutria, large, destructive, semi-aquatic, non-native rodents are confirmed present in the Skagit Valley. Nutria cause severe damage to native wildlife habitat and dikes due to their indiscriminate consumption of vegetation and burrowing techniques.

A large population of bald eagles over winters along the upper Skagit River, making up one of the two largest seasonal concentrations of bald eagles in the lower 48 states. In general, the bald eagle wintering season peaks along the Skagit from mid December to late January. The eagles are drawn to the area by the large numbers of spawned out salmon in the upper Skagit watershed. Up to 579 eagles were counted in the upper Skagit River area (Skagit River Bald Eagle Awareness Team, 2006). Most of the area eagles are migrants; however, resident bald eagles do occur in the areas. Bald eagle nesting typically occurs between early January and mid-August.

Reptile and amphibian species in the Lower Skagit basin include northwestern garter snake, western terrestrial garter snake, common garter snake, northern alligator lizard, northern red legged frog, bullfrog, Pacific tree frog western toad, long-toed salamander, northwestern salamander, and northern rough-skinned newt.

Climate change may lead to a much different river and delta system then what is seen today (as discussed in section A5 “Climate”). Sea level rise will likely shift the subtidal, intertidal, and freshwater marshes landward. This shift will be difficult on the landward side due to the constraints of development that abuts the marshes leading to an overall decline in brackish and freshwater habitat as more land is converted to the subtidal zone. This loss of freshwater marsh could potentially affect amphibians, small mammals, and reptiles that inhabit these areas as well as migrating and residential birds and waterfowl. Additionally, this could potentially further decrease populations of already declining anadromous fish, which will in turn impact a variety of marine and freshwater fish, birds, reptiles, amphibians, and mammals which are reliant upon them. It will also affect the distribution and abundance of benthic invertebrate within the river, the estuary, and the bay due to changes in salinity and temperature. Details about specific impacts of climate change on fish populations in the Skagit are discussed below.

8. Fish

The Skagit River and the Skagit Estuary are critically important to all five species of Pacific salmon as well as steelhead and sea-run cutthroat. The Skagit River and its tributaries also host the largest population of Puget Sound bull trout in Puget Sound Basin (Conner, Seattle City Light, pers. comm.). The lower reach of the Skagit River serves as a transportation route for spawning adult and provides rearing environment for juvenile anadromous species during their outmigration to the sea. The historic loss of tidal wetland and channel habitat has been identified as one of the most significant limiting factors in the recovery of Skagit Chinook (SWC, 2005; WCC, 2003). Research by the Skagit River System Cooperative and others has shown that the reduced amount of estuarine habitat is likely limiting the production of Chinook (Beamer et al., 2003; Beamer et al., 2002; Beamer et al., 2000; Congleton et al., 1981). Less than 27% of estuarine habitat remains (SWC, 2004; WCC, 2003), with the greatest loss being in riverine tidal habitat (less than 16% remaining). Most of the historic estuarine habitat was lost after diking isolated the habitat from riverine and tidal processes.

Very little spawning occurs in the lower reaches of the Skagit River, although documented pink and mainstem steelhead and Chinook spawning areas fall within the lower portions of the watershed (WDFW 2003). Spawning does occur in the Carpenter and Fisher Creek drainages and in Nookachamps Creek. In the more natural upper sections of the river, suitable habitat features are available for spawning and rearing. Sieler et al. (1999) found that egg-to-migrant survival rates were dependent on flow.

In 1992, six populations of steelhead were described in the Skagit Basin: three populations of winter steelhead and three populations of summer steelhead. All of the winter steelhead populations are listed as being native origin with wild production. The winter steelhead population declined from a healthy status in the 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI), to a depressed status in the 2003 Washington State Salmonid Stock Inventory (SaSI) (WDFW et al., 1993; WDFW and WWTIT, 2003 draft).

With impending climate change in the Skagit Basin (discussed in section, A5, “Climate”) it is likely that future pressures on salmonids in the Skagit system may be severe. Skagit River salmonids have already experienced a variety of pressures caused by the diking of the river, insufficient riparian vegetation and large woody debris, and the development of the floodplain. The combination of these existing pressures with the scenario of warmer wetter winters and hotter dryer summers could lead to elevated summer and early fall water temperatures, due to a lack of buffering from snow and glacial melt. These increased temperatures may be intolerable to salmonids, Bull trout populations in the Skagit River system would be particularly affected by these elevated temperatures since they require water no warmer than 9˚C for spawning and no warmer than 12˚C for rearing.

Predicted sea level rise would cause the freshwater and brackish marshes to retreat landward due to saltwater intrusion with little room to encroach on already developed land. This further reduction of brackish habitat, required for smoltification and acclimation to changes in salinity, is estimated to range from 77%-97% (Glick et.al., 2007); further limiting the production of anadramous fish in the Skagit Basin.

Table 1: Summary of Salmon Data for WRIAs 3 and 4
(WDFW et al., 2002; SWC 2005)

Stock	Origin	Production Type	Stock Status
CHINOOK			
Samish/MS Nooksack	Non-native	Composite	Unknown
Upper Skagit Mainstem/Tribs	Native	Wild	Depressed
Lower Sauk	Native	Wild	Depressed
Upper Sauk	Native	Wild	Depressed
Suiattle	Native	Wild	Healthy
Upper Cascade	Native	Wild	Depressed
COHO			
Samish	Mixed	Wild	Healthy
Skagit	Native	Composite	Healthy
Baker	Mixed	Composite	Healthy
CHUM-FALL			
Mainstem Skagit	Native	Wild	Healthy
Sauk	Native	Wild	Healthy
Samish/Indpendent	Mixed	Composite	Healthy
PINK			
Skagit	Native	Wild	Healthy
SOCKEYE			
Baker	Native	Cultured	Healthy
STEELHEAD-SUMMER			
Finney Creek	Native	Wild	Unknown
Sauk	Native	Wild	Unknown
Cascade	Unknown	Wild	Unknown
STEELHEAD-WINTER			
Samish	Native	Wild	Healthy
Mainstem Skagit	Native	Wild	Depressed
Sauk	Native	Wild	Unknown
Cascade	Native	Wild	Unknown

9. Invertebrate Communities

According to Plotnikoff, 1992, benthic invertebrate communities typical of rivers in the Puget Sound lowlands are dominated by stonefly, caddisfly, and common midge, mosquito, and blackfly larvae, Other taxa present include beetle larvae, amphipods, and aquatic isopods. These lowland invertebrate assemblages are characterized as shredder-gatherer communities.

Invertebrates found in the estuary and salt marsh area include oligocheate and polycheate worms, fly larvae, and crustaceans such as aquatic isopods, amphipods, and copepods (Cordell et. al, 1998). Bays and salt marshes of Puget Sound are home to a variety of bivalves (including clams, cockles, and mussels), snails, anemones, and crustaceans such as shrimp, crab, and aquatic isopods. Numerous invertebrate taxa (both micro and macroscopic) including hydroids, jellyfish, snails, nudibrachs, sea stars, sea cucumbers, copopods, isopods and crabs are dependent on the shallow eelgrass beds found in Skagit and Padilla bays (Kozloff, 1983).

Climate change may affect invertebrate assemblages throughout the Skagit system due to changes in temperature, flow regime, and sea level rise.

10. Threatened and Endangered Species

Numerous species of plant, fish and wildlife species occur in the Skagit Basin including several threatened and endangered species that have the potential to occur in the project areas (Table 2).

Table 2: Listed Species

SPECIES	SCIENTIFIC NAME	STATUS
Puget Sound Steelhead	*Oncorhynchus mykiss*	Threatened
Puget Sound Chinook Salmon	*Oncorhynchus tshawytscha*	Threatened
Coastal/Puget Sound Bull Trout	*Salvelinus confluentus*	Threatened
Marbled Murrelet	*Brachyramphus marmoratus*	Threatened
Northern Spotted Owl	*Strix occidentalis*	Threatened
Grizzly Bear	*Ursus arctos*	Threatened
Canada Lynx	*Lynx canadensis*	Threatened
Gray Wolf	*Canis lupus*	Threatened

a. Puget Sound Chinook Salmon

The lower Skagit Chinook population was classified as depressed in both the 1992 SASSI and the 2003 SaSI (WDFW et al., 1993; WDFW and WWTIT, 2003 draft). The lower Skagit Chinook spawns in the mainstem Skagit River and in tributaries downstream of the Sauk River confluence; most of the spawning occurs in the mainstem Skagit River between Sedro-Woolley and the Sauk River (WDFW and WWTIT, 2003 draft). Upper Skagit Chinook spawn in the mainstem Skagit River and in tributaries upstream of the Sauk confluence. The lower Sauk Chinook population spawns in the Sauk River from the mouth upstream to the Darrington Bridge (RM 21.2). Its status was classified as depressed in both the 1992 and 2003 population inventories (WDFW et al., 1993; WDFW and WWTIT, 2003 draft). The lower Sauk population spawns earlier, beginning in late August and continuing to early October, than the mainstem Skagit populations. Upper Sauk Chinook spawn upstream of the Darrington Bridge and into the North and South Forks of the Sauk River. The status changed from healthy in 1992, to depressed in 2003 (WDFW et al., 1993; WDFW and WWTIT, 2003 draft). Spawning occurs from late July through early September. Suiattle Chinook have the same early spawn timing as upper Sauk Chinook. The Suiattle population spawns in the mainstem Suiattle River, and in the Big, Tenas, Straight, Circle, Buck, Lime, Downey, Sulphur, and Milk Creeks. Its population status changed from depressed in 1992, to healthy in 2003. Upper Cascade Chinook spawn in the mainstem Cascade River above RM 7.8, in the lower reaches of the North and South Forks of the Cascade River, and in Marble, Found, Kindy, and Sonny Boy Creeks. Its population status changed from unknown in 1992, to depressed in 2003. Spawning occurs from late July through early September.

Critical habitat has been designated for the entire Lower Skagit and Upper Skagit River. Critical habitat primary constituent elements (PCEs) include freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors. Additional PCEs were developed for estuarine and marine habitats.

b. Coastal/Puget Sound Bull Trout

The Skagit River supports the largest natural population of bull trout/Dolly Varden in Puget Sound. Of this population, lower Skagit bull trout were identified as a distinct stock based on their geographic location; an area which includes all of the Skagit River and its tributaries located below the Gorge Dam, excluding the Baker River (WDFW, 1998). Anadromous, fluvial, adfluvial, and resident life history forms are all found in the Skagit River system, at times spawning at the same time and place. Spawning usually takes place during September and October, and occurs in upriver areas that are less than 8°C (WDFW, 1998). Bull trout are apex predators that locate where prey is abundant. Bull trout will also follow prey around, such as migrating juvenile salmon.

Based on sampling by the Skagit River System Cooperative (Beamer and Henderson, 2004), bull trout were found to use delta blind tidal channels, but did not directly use smaller and shallower channels, or channels more distant from river distributaries. Trends in annual abundance remained constant. The presence of bull trout varies significantly throughout the year, with the primary period from April through August, with a peak in June. Bull trout in the Skagit are known to migrate to both Puget Sound and other river systems, including the Stillaguamish and Snohomish, in search of food; although the majority of these migrants return to the Skagit to spawn (Geotz, per. comm., 2008).

Bull trout are also present in Skagit Bay; however, their presence in shallow intertidal habitat was very low compared to the deeper intertidal-subtidal fringe. Bull trout are present in the deeper intertidal-subtidal habitats year round. Peak abundance in the bay occurs in May or June, with recent data showing a second peak in fall.

Critical habitat was designated for the entire Lower Skagit and Upper Skagit River to the portions of Ross Lake and its tributaries that lie within the boundaries of the United States. Critical habitat PCEs determined essential to the conservation of bull trout include water temperatures between 36°F and 59°F, complex stream channels, appropriate substrate for spawning and rearing success, a natural hydrograph, sufficient water quality and quantity including subsurface connectivity, migratory corridors, abundant food base, and lack of nonnative predatory or competitive species.

c. Puget Sound Steelhead

All six stocks of Skagit River steelhead (3 summer and 3 winter) transit the project area. All but one of these stocks are native, and considered to be distinct based on geographic separation. Steelhead in the Skagit River system spawn in both the mainstem and tributaries from the anadromous zones to the headwaters. Summer steelhead run through the Skagit system from May to October, and winter steelhead run from November to April. Although there is some fishing pressure on wild steelhead in the Skagit River system, the majority lies on hatchery fish that are planted in the river annually. Of the six wild stocks of steelhead in the Skagit system five of them have an unknown stock status. The remaining stock is the winter run of the mainstem Skagit River and has gone from healthy in 1992 to depressed in 2003 (WWTIT draft, 2003). Critical habitat has not yet been designated for Puget Sound Steelhead

d. Marbled Murrelet and Spotted Owl

Marbled murrelets and spotted owls nest in old growth forests in the Coastal Range and Cascade Mountains. Critical habitat for the marbled murrelet and spotted owl has been designated throughout the Upper Skagit basin (USFWS, 2006). Numerous confirmed occurrences of both species have been recorded in Skagit County over the last few years. Marbled murrelets are expected to fly through the project area when traveling from fishing in the shallow tidal habitats of the Skagit and Samish deltas to nesting habitats in the upper basin. Spotted owls may transit the area in search of prey, and nest in the forests adjacent to the Skagit River valley.

e. Grizzly Bear, Gray Wolf, and Canada Lynx

While grizzly bears, gray wolves, and Canada lynx have been recorded within the watershed of the Skagit River, none of these records are near the project area. WDFW priority habitat lists both Whatcom and Skagit County (both of which encompass the upper Skagit basin) along with all their neighboring habitats as potential grizzly bear, gray wolf and Canada lynx habitat (WDFW, 2008). Bears, wolves, or lynx are not expected to be found in the lower Skagit basin.

Climate change will have the same impacts on listed species as described in sections B7 and B8 under “Wildlife” and “Fish”

11. Wetlands and Other Waters of the U.S.

The historic extent of vegetated tidal wetlands for the Skagit was approximately 25,766 acres, and the current extent is 1,941 acres, indicating the Skagit delta has lost approximately 23,825 acres of estuary habitat — more than 37 square miles, or 93% of historic coverage (White, no date).

National Wetland Inventory (NWI) maps identify pockets of wetland areas on both sides of the dikes in the Skagit delta. However, the majority of lowlands in the delta exhibit wetland characteristics. In most cases, the intensive agricultural practices, including the construction of dozens of levees and dikes, have caused these lands to be effectively drained and thus would be designated as prior converted cropland (Kilcoyne, per. comm., 2006). In general, NWI maps were drawn using aerial photo analysis of vegetation patterns, visible hydrology and geographic position. Due to limitations of this type of aerial photo interpretation inaccuracies are common – often wetlands exist in areas not identified by NWI maps. This is particularly common in areas where human disturbance (agricultural practices or development) dominate the landscape, this would encompass the vast majority of the lower Skagit basin.

A wetland survey of the delta conducted by Shapiro and Associates for the Corps of Engineers in 1978 identified 3,450 acres of estuarine wetland, 120 acres of riverine wetland, and 3,150 acres of palustrine wetlands adjacent to the Skagit River in the delta. This study did not attempt to identify wetlands that were converted to agricultural uses. Beyond the sea dikes at Fir Island is a large expanse (~2,500 acres) of vegetated wetlands (Shapiro, 1978).

In light of the possible errors of NWI maps, the radical development changes that have occurred in the lower Skagit since the 1978 wetland inventory, and changes in wetland regulation, it is suggested a new inventory be conducted to establish more accurate wetland data in the lower basin.

Beyond the vegetated wetlands on Fir Island, are approximately 6,600 acres of eelgrass beds (G. Hood, pers. comm., Skagit River System Cooperative, 2008) and approximately 10,000 acres of unvegetated intertidal flats. Padilla Bay lies to the north of the project area. In historic times, floodwaters from the Skagit reached Padilla Bay on a regular basis; however, dikes constructed along the river now prevent Skagit River flows from reaching the bay. This change results in sedentary conditions within the bay, causing an increase in size of eelgrass beds. Padilla Bay now has approximately 8,000 acres of eelgrass, making it one of the largest eelgrass concentrations on the west coast of North America.

Climate change, and the associated changes in precipitation and groundwater patterns, may result in large scale changes to freshwater wetland complexes and the functions they provide. Increased intensity of flood events may alter the sedimentation deposition and erosion patterns. Changes in precipitation patterns may alter groundwater recharge/discharge rates and locations, and reduced summer river flow may alter the vegetation communities and animal habitats in these wetlands (Kusler, 2005). Sea level rise will likely shift the eelgrass beds, mudflats, and salt, brackish, and freshwater marshes landward. This shift may result in an overall decline in brackish and freshwater wetland areas as the landward shift is constrained by exisiting development in the floodplain. Most of the brackish marsh in Skagit Bay today would be converted to salt marsh (Glick et.al., 2007). It is speculated that the acreage of eelgrass beds may increase due to an increase in shallow saltwater habitat (Greg Hood, per. comm., Skagit River System Cooperative, 2008)

C. Water Resources

12. Water Quantity

a. Flood Characteristics

Because of its geographic location, the Skagit River Basin is subject to winter rain floods and annual high water due to snowmelt runoff during the spring or early summer as a result of a seasonal rise in temperatures. The snowmelt is characterized by its relatively slow rise and long duration. High water from snowmelt reached damage flood stage in 1937, 1939, and 1959. During the snowmelts, reservoirs that are used for power fill, frequently reducing the peak discharges. Floods resulting from severe rain events usually occur in November or December, but may occur as early as October or as late as February. In the winter, a light snowpack is frequently formed over most of the basin. A heavy rain fall, accompanied by warm winds, completes the sequence which produces major floods. The heavy rain fall and accompanying snowmelt result in a high rate of runoff, as the ground is already nearly saturated from earlier precipitation.

Runoff patterns were fundamentally altered in many portions of the basin due to urbanization, road building, near-eradication of beaver populations, and timber harvesting. All of these activities tend to change water infiltration and storage within the watershed such that high flows become flashier, and low flow conditions are exacerbated. Widespread logging, particularly in the headwaters, appears to have contributed to more severe effects of rain-on-snow events that have repercussions throughout the channel systems and floodplains of the basin. Many smaller flood events that once scoured the river and inundated the adjacent flood plain no longer occur (Collins, 2000). Expected changes in precipitation due to climate change, as described above in section A5 “Climate”, could intensify the pattern of flooding in the fall and winter and extreme low flow conditions in the summer.

b. Water Rights

In 2001, the Washington State Department of Ecology (Ecology) adopted an in-stream flow rule for the Skagit River basin that establishes minimum flows for the Skagit River at the Mount Vernon gauge. The minimum flows vary from 10,000 cfs to 13,000 cfs, depending on the time of year. The rule requires all surface water and groundwater users in the Skagit Basin, with a priority date later than the effective rule date, to curtail water use during times of year when the minimum flows are not achieved, unless it can be shown that such diversions or withdrawals do not affect flows in the Skagit River. These minimum flows are commonly not achieved during various times of the year, particularly in late summer and early fall. The rule effectively prohibits all new water uses throughout much of Skagit County. This rule was appealed in Thurston County Superior

Court. By court order, Ecology issued two proposed amendments to the rule to address future water needs in the County. An amended rule was adopted in May 2006 calling for the creation of reservations of a limited amount of water for specific future uses that are not subject to the existing instream flows and allowing for future withdrawal even when minimum flows are exceeded (WDOE, 2006).

13. Water Quality

The Skagit River is designed for aquatic life uses as core summer salmonid habitat (WAC 173-201A-602). This use is characterized by use from June 15 to September for salmonid spawning or emergence, or adult holding; use as important summer rearing habitat by one or more salmonids; or foraging by adult and sub-adult native char. Other common characteristic aquatic life uses for waters in this category include spawning outside of the summer season, rearing, and migration by salmonids. Water quality standards (i.e., temperature, dissolved oxygen, and turbidity) are established based on this aquatic life use designation. In addition, the Skagit River is designated for primary contact recreational uses, all water supply uses, and all miscellaneous uses.

Currently, areas of the Skagit River are designated as a category 5 for presence of PCBs and high pH and Skagit Bay is listed for fecal coliform. Several sloughs in the delta are designated as category 5 for fecal coliform, pH, dissolved oxygen, and temperature. A category 5 designation means that data show that these water quality standards were violated and there is no total maximum daily load (TMDL) or pollution control plan in place. Category 5 sites become a part of the Washington Department of Ecology's 303d list submitted to the EPA. In addition, several of the tributaries to the Skagit River (including Nookachamps Creek, Carpenter Creek, and Hansen Creek) are on the 303d list for temperature and dissolved oxygen (WDOE, 2008).The North Fork, South Fork, and several tributaries of the Skagit River are designated as category 4A for fecal coliform. A designation of 4A means that this water body has a pollution problem that is being addressed by an approved TMDL. The Skagit River is designated as a category 2 for PCBs and 2,3,7,8 TCDD. A designation of category 2 means that data show that these standards are of concern in this water body.

Data collected from Skagit County's 2007 monitoring report indicate that many Skagit County streams, within and outside of the agricultural areas, do not meet state water quality standards for fecal coliform, temperature, and/or dissolved oxygen. Most of the substandard water quality occurs in tributaries to the Skagit River and in the Samish Basin, while the Skagit River itself meets standards on most occasions (Skagit County Public Works, 2007).

a. Temperature

The maximum temperature criterion for the Skagit, as a designated core summer salmonid habitat, is 16°C (7-day average of the daily maximum temperatures). Mainstem temperatures are within a suitable range for salmonids. However, there are several sloughs in the delta area that are on the 303d list for temperature (WDOE, 2008). According to Skagit County's 2007 water quality report most watercourses in the Skagit

County Monitoring Program exceeded state temperature standards at some point during the summer (Skagit County Public Works, 2007).

b. Fecal coliform

Various waste sources affect the quality of the Skagit River. High coliform counts are usually the result of failing on-site sewage systems, municipal wastes, livestock operations, and pets. On occasion wildlife can contribute to elevated levels of fecal coliform (Ecology, 1997 and Skagit County Public Works, 2007). Ecology initiated a water quality study in 1995 as part of the TMDL process, and produced a Cleanup Plan in 2000. The Cleanup Plan concluded that reduction in combined sewer overflows (CSOs) from municipalities in the basin was the single most important needed action (Ecology 2000). Since that time, CSOs have been reduced by at least 90% and data collected by Skagit County in 2007 indicates that fecal coliform levels met state standards in the Skagit River (Skagit County Public Works, 2007). As a result of the TMDL, the lower Skagit River and tributaries have been removed from the 303d list (now called Category 5) for fecal coliform and placed in Category 4b, indicating ongoing TMDL activities. However, there are still areas in Skagit Bay and sloughs in the delta that are on the 2008 are designated as category 5 for fecal coliform (WDOE, 2008).

The 2008 Skagit County Monitoring Report indicates that all four Skagit River sites and Swinomish Channel met the state standard for fecal coliform for all four years of the project (2004-2007). However, most of the other sites in the Skagit County Monitoring Program did not meet the standard. The were no sampling sites in Skagit Bay during the course of this study (Skagit County Public Works, 2007).

c. Dissolved Oxygen

Dissolved oxygen is often affected by both temperature and algal blooms. Algal blooms occur due to increased light and nutrients input causing diurnal variation in dissolved oxygen levels. When algal blooms die off decomposition can lead to very low oxygen levels. Increased nutrient inputs are often a result of agricultural practices (Spatharis et. al, 2007; Makarewicz et.al, 2007; and Barlow, 2007). Several sloughs in the delta and other tributaries along the Skagit are on Ecology’s 303d list (category 5) for 2008. A section of the Skagit River around river mile 55 is designated as a category 2 (waters of concern) for 2008 (WDOE, 2008).

According to the Skagit County 2008 monitoring report many streams in the Skagit County Monitoring Program meet oxygen standards all or most of the year. In some of the streams, oxygen levels show steep declines in summer. These declines are usually associated with very low flows. Roughly 25% of the sites monitored in the study fell consistently below the state standard over the course of 4 years. However, many of these sites are sloughs and ditches (Skagit County Public Works, 2007).

d. Sediment/Turbidity

Increased turbidity is a result of logging practices and urban development in the watershed that increases surface runoff. In recent years, sediment inputs have been a significant problem in the watershed with the main contributors being forest practices, agricultural practices, and development and urban runoff from development. Downstream reaches of the Skagit River have been aggrading in recent years (Cherry and Jackson, 2002), and changes in river hydraulics and flow has affected sediment transport.

During periods of summer warm temperatures and rain, high turbidity in the Skagit River can be attributed further to a natural condition of “glacial flour”. Glacial flour consists of clay-sized particles of rock suspended in the river water, giving the water a cloudy appearance. Heavy turbidity in Skagit Bay is largely due to excessive siltation from the surface water runoff of the Skagit and Samish Rivers that results from flood events and glacial melt.

The Skagit Watershed Council’s (SWC) Strategy Application found that 23% and 46% of the basin is likely impaired in regards to peak flow hydrology and sediment supply, respectively. Numerous sub-basins and tributaries in the lower Skagit have been found to have poor or degraded riparian, peak flow, road density, and sediment supply conditions in both the Conservation Commission’s Limiting Factors report and the SWC’s Strategy Application (Beamer et al., 2000a, WCC 2003). These assessments also found degraded conditions in the Lower Skagit sub-basins, particularly for sediment supply and riparian conditions, but not to the same extent as the Upper Skagit, primarily because of less intense human development and the extensive amount of federally protected land. Large increases in coarse sediment supply tend to fill pools and aggrade channels, resulting in reduced habitat complexity and reduced rearing capacity for some salmonids (Beechie et al., 2003). Large increases in total sediment supply to a channel also tend to increase the proportion of fine sediments in channel beds, which may reduce survival of incubating eggs and change benthic invertebrate production (Beechie et al., 2003). Increased peak flows result in an increased frequency of channel forming and bed mobilizing flow events leading to channel destabilization (widening, aggradation, or incision), less complex habitat, and increased bed scour depths significantly affecting salmonid and other aquatic organisms (SWC 1998). Research shows these impaired watershed processes (sediment supply and peak flow hydrology) are limiting egg to fry survival for Chinook and likely other species (Seiler et al, 1998; Beamer and Pess 1999; Beamer et al., 2000a).

e. Chemical Contamination/Nutrients

Non-point source pollution is the primary source of contamination for the lower basin, and results from agricultural practices, onsite sewage disposal, birds, wildlife, development and urban runoff, and livestock waste. Chronic, and in some cases acute levels of total recoverable lead, copper, zinc and cadium were found at various sites in the lower Skagit Basin. The relatively low levels found could have adverse effects on salmonids. However, the low levels detected cannot necessarily be attributed to anthropogenic sources. The Skagit River is also a category 5 (303d) list for PCB’s in fish tissue and ammonia, and a category 2 (area of concern) for 2,3,7,8 TCDD. The Skagit County 2007 Annual Monitoring Report indicates that state exceedences may occur for ammonia on rare occasions.

D. Cultural Resources

The Skagit Delta contains important cultural resources associated with the original native use of the region, potentially represented in archaeological sites and traditional cultural properties, as well as historic era settlement patterns expressed primarily as domestic, agricultural, and commercial buildings and structures.

The Delta and adjacent uplands have been used and occupied by human populations for a considerable span of time. Although the exact duration is not known precisely, evidence that supports an estimate of 12,000 years was discovered elsewhere in the Puget Sound region and on the Olympic Peninsula. The oldest cultural resources found in the Skagit Delta area date to less than 5,000 years ago.

Before the 1850s, the Skagit Delta constituted a part of the territory associated with several culturally similar Indian groups. The northern delta was occupied by the Swinomish and Samish. The North Fork and adjacent areas were inhabited by the Lower Skagits. The South Fork was Kikiallu territory. The Upper Skagits resided in the area north and east of Mount Vernon. Euro-American settlement and dislocation of the resident Indian populations did not begin until the late 1850s. The Point Elliot Treaty of 1855 required most of the local Indians to resettle outside the delta on either the Swinomish or Tulalip Reservations.

The first Euro-American homestead along the Skagit River was settled in 1859. In 1863, the first trading post in the delta was opened at the point of divergence between the North and South Forks of the river. Six years later, the post became the site of Skagit City, the earliest river town. As the area's population grew, many additional towns were founded. Today, Mount Vernon, Burlington, and Sedro-Woolley remain as important centers of population and commerce. The early settlers quickly recognized the need for dikes to protect their holdings against the Skagit River's frequent floods. Initially, levees were the responsibility of individual land owners, but the magnitude of the task soon prompted collective action and diking districts were formed in the late 1890s. As the levee system developed, the crests of these structures served as paths and later roads. Private ferries provided cross river transport. The Great Northern Railroad, now the Burlington Northern Santa Fe, was extended to Conway in 1889. Agriculture was initially, and continues to be, the principal economic activity in the delta. Logging operations began around 1865, but on the lowlands the resource was expended before 1920.

Reconnaissance, survey, and excavation of prehistoric cultural resources have been carried out sporadically in the Skagit Delta, although the vast potential of the delta's cultural resources, both prehistoric and historic, has largely remained unexplored. Although numerous project-related cultural resources projects have occurred in the Skagit Valley, no systematic survey has produced a comprehensive inventory of prehistoric or historic archaeological sites, or traditional cultural properties. Owing to cultural resources work associated with a prior Corps study and other work along the river, more sites have been recorded along the river downstream of Mt. Vernon on the North and South Forks than in other reaches or in proposed diversion areas. Currently, two properties within the Skagit Delta are listed in the National Register of Historic Places:

the town of La Conner and the Skagit City School. In addition, the Fishtown Archeological District, a constellation of three prehistoric sites at the mouth of the North Fork, was nominated to the register. The Washington State Register of Historic Places includes the Old Skagit County Courthouse in Mount Vernon and the Methodist Church in Fir. The Washington State Inventory of Historic Places includes the town sites of Fir, Sterling, and Skagit City. During the summer and fall of 1978, the Corps contracted with Seattle Central Community College to conduct a cultural resources reconnaissance of the project area of the proposed Skagit River Levee Project. The reconnaissance identified 54 cultural resource sites, 20 prehistoric sites, and 34 historic sites. The prehistoric sites are largely habitation shell middens; the historic sites include elements of towns, farms, refuse areas, a cemetery, granary, and logging establishments.

Delta formation processes of meandering and progradation and other land forming processes have been active since human occupation of the region first began after the glaciers departed from the lowlands. Shifting of the river channel and deposition of sediment mean that sites on older buried landforms and surfaces can be expected nearly anywhere within the floodplain. Given the incomplete coverage of the Skagit Valley, there is a high likelihood that additional sites will be discovered. Due to the counterclockwise migration of the main channel from north to south, the northern portion of the delta potentially contains a greater age range of sites (e.g., older lithic sites on ridges and terraces and older buried sites near the Samish River) than the relatively younger deposits associated with the current North and South Fork. In addition, there is the potential for well preserved sites capped by lahars from Glacier Peak and sites with important information about paleo-seismic events (Lawr Salo: personal communication on 12 April 2001).

Regarding historic era resources, some inventory work has been undertaken in the County, and some investigations have been conducted by Certified Local Governments. While historic property inventories – and register listings – have occurred mostly within urban areas and commercial historic districts, less attention has been focused on the rural agricultural properties of the Delta. A significant oral history project on historic land use in the Skagit watershed was undertaken with a series of volunteers provided through the Earthwatch Institute, and with the support of the Skagit Environmental Endowment Commission. This study produced audio and transcript records of these interviews.

E. Socioeconomics

Data from 2004 identified that 93.8 % of the Skagit County population as white. The remainder of the population identified themselves as black, American Indian, Alaska Native, Native Hawaiian, Pacific Islander, Asian, or a combination. In 2007, the largest population centers in the study area were Mt. Vernon (30,700), Burlington (8,629) and Sedro-Woolley (10,660). Total county population in 2006 was estimated to be 115,700.

A 2005 study identified 12,544 residential and 1,639 non-residential (i.e., agricultural, commercial, public, and industrial) properties with a total floor space of 11,210,860 square feet in the floodplain of the study area (Corps, 2005).

The study area contains over 71,000 acres of agricultural lands that are subject to flooding. The average proportion of agricultural land harvested is approximately 68.8%, based on the most recent 2002 U.S. Department of Agriculture Census of Agriculture and 2003 Extension Office reports. During the initial analysis, eleven crops were listed as the principal types for Skagit County (based on the 1996 report from the Washington Agricultural Statistics Service) comprising a total 45,360 harvested acres. Since that report, the harvested acreage and crop type have changed. Harvested acreage is down to 45,200 acres and both carrots and sweet corn have gone out of production. Production of green peas has been reduced by over 50%, while production of crops such as potatoes, cucumbers and raspberries has increased in total acreage. Approximately 50 percent of the acreage is in potatoes and hay.

F. Air Quality and Noise

14. Air Quality

According to Environmental Protection Agency (EPA) Region X records, Skagit County is in attainment for the six criteria air pollutants. Although Skagit County has good air quality, there are periods when localized air quality can deteriorate. This usually occurs during times of stable weather when there is an absence of wind. Periodically, particulates can become an air pollutant of concern.

15. Noise

Noise levels in the project area vary widely. The urban areas of the study, Mt. Vernon, Burlington, and Sedro-Woolley, have higher noise levels associated with larger populations and associated commercial and residential development and traffic. The agricultural areas in the delta have lower noise levels associated with rural areas

G. Solid and Hazardous Waste (HTRW)

As of 2008, there were numerous sites identified in the lower basin as “Hazardous Sites” by the Washington Department of Ecology. Most of these sites are located in or near Mount Vernon and Anacortes, and are associated with fuel or diesel pollutants, most likely leaky tanks or pipelines at gas stations or similar. The majority of sites are awaiting remedial action or in the process of clean-up but it is not yet complete.

No US EPA superfund sites are located in the Skagit River Basin.

III. DATA GAPS

Existing wetland inventories of the Skagit Basin are deficient and need to be updated. The only known survey was conducted in 1978. Do to extreme changes in population and land use in the lower basin the existing data is likely to contain significant errors.

Sediment data is lacking for high flow events. This information needs to be collected to help refine the sediment budget for the river and the geomorphic and hydraulic analysis of the system.

A cultural resources inventory will need to be conducted along project alignments to compensate for gaps in existing surveys. The likelihood of finding significant cultural resources will be high. Historic structures in the project area will also have to be identified in the inventory.

IV. EXPECTED WITHOUT-PROJECT FUTURE CONDITIONS - ENVIRONMENTAL

Estimation of future without project conditions is based on extrapolation of current trends, and does not account for changes in policy. Environmental change (e.g. climate change) will have to be considered in flood damage reduction planning as it impacts flow regime, major flooding events, and restoration strategies.

The county population will continue to increase. Currently the population of Skagit County is 116,397, most of which is located within the lower basin (Sedro Woolley and below). By 2030 the population is projected to range from 140,000-220,000 (Washington Office of Financial Management, 2007). The majority of this increase will likely take place in the lower basin due to the presence of North Cascades National Park and Mount Baker-Snoqualmie National Forest in the upper basin. However, due to the location of Mt. Vernon and Burlington, and the lack of an endless supply of developable land in the lower basin it is expected urbanization pressure will continue to be felt in the floodplain, as the urban growth boundary pushes out from the cities. Ultimately growth rates will be determined by availability of natural resources (i.e. water) and infrastructure. The recent Biological Opinion issued by the National Marine Fisheries Service regarding FEMA’s flood insurance may play a role in development as well. In this Biological Opinion NFMS lists several “reasonable and prudent measures” in which FEMA’s current flood insurance program (which has been determined to enable floodplain development) should be altered such that it doesn’t jeopardize the continued existence of Puget Sound Chinook salmon, Puget Sound steelhead, Hood Canal summer chum, and Southern resident killer whales. If FEMA chooses to comply with these measures issued by NFMS, further development in the floodplain may slow down significantly as the costs associated with building in the floodplain could increase dramatically. If FEMA does not comply, then upland agricultural land is at risk due to urbanization pressures. Wetlands are also at risk, despite future restoration actions. Increased urbanization will create more air and noise pollution; create the need for more infrastructure (including roads, water and electrical supply) and likely result in further fill of remaining wetlands and deforestation of surrounding lands.

The result of this expected development will likely negatively effect the existing environment. Agricultural land may be converted to residential or commercial use creating more stormwater runoff and declines in water quality. Development in rural areas could lead to additional septic systems which often contribute to poor water quality in streams and tributaries that drain into the Skagit. Wetlands may be filled for development and all their associated functions lost including: flood attenuation and storage, water quality improvements, and wildlife and fish habitat. Further loss of any remaining riparian vegetation in the lower basin will result in loss of wildlife and fish habitat, higher water temperatures, less organic river input which provides fish food, and an increase in the presence of invasive species. Continued maintenance and construction of levees as it exists now, by both the Corps and the County, will further constrain the river. Additional or rehabilitated levees may create even less bank complexity, eliminate benthic invertebrate habitat, increase scarcity of off-channel habitat, increase river speeds during high flow events, further reduce LWD retention and create shorter and thinner riparian corridors, particularly if existing Corps levee vegetation standards are continued. This will directly affect ESA listed species that depend on cold, clean water, organic detritus and benthic invertebrates for food, and LWD and bank complexity for cover. There will continue to be losses of salmonids due to high regulated flows and existing pressures present in the floodplain, estuary, and marine environments that are likely to persist, if not worsen due to human population growth and the effects of climate change discussed previously.

As stated previously, models from the UW Climate Impacts Group indicate that over the next century the Pacific Northwest area will likely see a trend toward wetter warmer winters and hotter dryer summers in response to climate change. However, these large scale models have difficulty resolving mountain climates such as the Cascades and the Upper Skagit basin so exact scenarios are difficult to predict. It is speculated that the Skagit River system may see higher flows in the winter as the majority of the precipitation would fall as rain and not snow, and lower flows in the summer due to lack of rain and snow melt. Initially, glacial melt would increase, but over time would decrease as the glacier retreats. Sea level rise may further alter habitat as salt water influenced ecosystems are forced farther inland by rising seas, reducing existing freshwater habitats and further constraining already limited salmonid and wildlife habitat. The extension of salt water inland may alter existing land use patterns, in particular agriculture as less land may be suitable for farming. This could lead to additional sea walls and dikes being built to exclude salt water from land that is today farmed freshwater wetland.

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