Fish

EXISTING CONDITIONS

NATIVE FISH POPULATIONS

The Snohomish River estuary supports populations of Chinook, coho, chum, and pink salmon, sea-run cutthroat trout, steelhead salmon, bull trout char and mountain whitefish.

Juvenile starry flounder and Peamouth chub are widely distributed and abundant non-salmonid species within the estuary. Also widely distributed in the project area are the Pacific staghorn sculpin and Prickly sculpin which are relatively abundant in tidally-influenced parts of the lower estuary. Three-spined sticklebacks, shiner perch, juvenile smelts, Pacific and river lampreys are also found in the project vicinity. Less abundant species include candlefish, Pacific herring, white sturgeon and sunfish. See Glossary of Terms for Latin name associations.

USE OF THE SNOHOMISH RIVER ESTUARY BY SALMONIDS

Salmonids in the Snohomish River pass through the estuary at least twice during their lifecycle, first as juveniles as they head out to saltwater, then as adults returning to spawn in freshwater. Up-stream migration of adult salmonids occurs every month of the year, but primarily August through March. Migrating adult salmon generally pass quickly through the estuary, with most fish moving to upstream holding and spawning areas.

Estuarine tidal marshes provide critical rearing habitat for salmon. An estimated 43,000 salmon smolt will use the restored project area annually.

Juvenile Chinook salmon have the most complex life history of all the salmonid species and are the most estuarine dependent species. The longer juvenile Chinook reside in the estuary, the better their growth out in the ocean (Beamer and Larson 2004). Juvenile pink and coho salmon tend to move quickly through the estuary concentrating along the shorelines and feeding on small crustaceans and insects. In contrast, juvenile chum salmon may remain in the estuary up to four or five weeks before entering Port Gardner Bay, moving in and out of wetlands with the tide and feeding extensively on copepods and insects. Sea-run cutthroat trout, steelhead salmon, and bull trout are present in the estuary and Port Gardner Bay. For these species, relatively little is known regarding residence periods and habitat utilization of estuarine areas compared to Pacific salmon.

THE IMPORTANCE OF ESTUARIES TO SALMON

Juvenile salmon use estuaries for feeding and growth, predator avoidance, adjusting physiologically to salt water and as migratory corridors (Simenstad et al., 1982; Macdonald et al., 1988; Moser et al., 1991; Thorpe, 1994; Emmett and Schiewe, 1997). The estuary is an important source of primary production for the food chain that supports salmonids as well as other species.

All juvenile salmonids passing through the estuary are affected by habitat loss. The quantity and quality of salmon rearing habitat available to Snohomish River Basin salmon populations is a small fraction of pre-development conditions. Historically, the estuary included a rich complex of tidal channels and productive marshes. Currently, only one-sixth of the historic tidal marsh area downstream of the head of Ebey Slough remains intact and accessible to salmonids (Haas 2001).

The current lack of critical estuarine tidal marsh habitat is considered a limiting factor for Chinook salmon recovery (SFSRF 2005) and has potentially serious implications for survival and recovery of ESA-listed salmon populations in Snohomish County.

In an analysis of hatchery coded-wire tag data from the west coast, Magnusson and Hilborn (2003) found average Chinook salmon survival rates in estuaries with fully intact habitat is more than three times higher than survival rates in estuaries with no pristine habitat. This study documents the importance of estuaries in boosting juvenile salmon survival and highlights that hatchery fish also need functioning habitat. There is no doubt that restoration of rearing habitat in the large mainstem rivers downstream of key spawning areas and in the estuary will result in substantial gains in population viability for Chinook salmon and other salmonid species.

OBSTACLES TO FISH USE OF THE PROJECT AREA

The project area is currently blocked from salmonid use by the existing dike and tide gate system. The remnant tidal channels in the project area are controlled by tide gates which work to drain it. The tide gates function to withhold tidal water from entering the Smith Island project area but allow water to drain from the island when water levels drop in Union Slough. Habitat within the tidal channels is limited due to high temperatures, low dissolved oxygen levels, and other factors such as altered hydrology, water quality, and riparian vegetation.

In 1997, using electrofishing techniques, a reconnaissance level inventory of fish use in relict tidal channels within the Snohomish River estuary documented only three-spine stickleback and sunfish (Haas personal communication, 2009). The use of the remnant tidal channels by three-spine stickleback has been confirmed on several occasions by County staff during site investigations.

SPECIAL STATUS OF FISH SPECIES IN THE PROJECT VICINITY

Puget Sound Chinook, Puget Sound steelhead, and bull trout are listed as federally threatened species under the ESA. River lamprey may be present within Union Slough and is a federal species of concern and a state candidate species.

The Magnuson-Stevens Act mandates identification of essential fish habitat for managed species and requires measures to conserve and enhance the habitat needed by fish to carry out their life cycles. Union Slough is mapped as critical habitat for Chinook salmon and bull trout. Steelhead trout, which are listed as threatened under ESA have not had critical habitat designated, but Union Slough is likely to be designated as critical steelhead habitat.

Section 7 of the ESA requires federal agencies to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species or their critical habitats. There is federal action associated with the Smith Island Restoration Project: a Section 404 wetland permit from the Corps that would be required for proposed wetland fill.

Because listed endangered or threatened species are known to occur in the project vicinity, the project must prepare a Biological Assessment (BA) describing how the project would affect the species. If the evaluation determines that a listed species is likely to be harmed by the project, project proponents would need to enter into formal consultation with U.S. Fish and Wildlife Service (USFWS) or National Marine Fisheries Service (NMFS) to ensure that its actions will conserve the species and its critical habitats. If effects are lesser, informal consultation would occur.

The Priority Habitat and Species (PHS) List is a state catalog of habitats and species considered to be priorities for conservation and management. Priority species require protective measures for their survival due to their population status, sensitivity to habitat alteration, and/or recreational, commercial or tribal importance. Priority species include State Endangered, Threatened, Sensitive, and Candidate species. The following table lists federal and state status of species found in the project vicinity.

TABLE 6 – SPECIAL STATUS OF FISH SPECIES OCCURRING IN THE PROJECT VICINITY

Species	Scientific Name	Federal and State Status
River lamprey	Lampetra ayresi	Federal Species of Concern, State Candidate Species
Bull trout	Salvelinus confluentus	Federally Threatened, State Candidate Species
Cutthroat trout	Oncorhynchus clarki	None for Puget Sound Evolutionarily Significant Unit
Steelhead/resident rainbow trout	Oncorhynchus mykiss	Federally Threatened (only steelhead)
Chinook salmon	Oncorhynchus tshawytscha	Federally Threatened, State Candidate Species
Coho salmon	Oncorhynchus kisutch	Federal Species of Concern

? HOW WILL THE PROPOSED PROJECT HELP RECOVER SALMON IN THE SNOHOMISH RIVER BASIN?

The Smith Island Restoration Project, one of the larger tidal marsh restoration projects in the 2005 Plan, is an integral part of the strategy for restoring healthy salmon runs in the Snohomish River Basin and Puget Sound (Snohomish Forum, 2005; Puget Sound Partnership, 2009). In all, the Forum set a goal of approximately 1,200 acres of tidal marsh

restoration and over 66,000 returning adult fish. The recovery goal relies upon actions such as the Smith Island Restoration Project being implemented in concert with changes in harvest management, hatchery management, protection of existing intact habitat, and restoration of habitat across the entire watershed.

? HOW MANY SALMON WILL THE PROJECT PRODUCE?

The Smith Island Restoration Project will provide significant value to productivity and survival of listed Chinook salmon. Restoration of the project area will restore approximately 400 acres of tidal marsh, which will result in over 43,000 surviving smolts produced by the project per year.

Although fraught with many complexities relative to number of spawning fish to survival, from redds to ocean survival, finding an exact number of Chinook salmon returning due to this one action alone is highly speculative. Despite this unpredictability, Snohomish County calculated a potential return of 900 salmon harvest per year for the project, valued at over $185,000 per year using existing values for harvest, fish size, and market values (see Appendix C, Salmon Productivity Calculations for Smith Island Restoration Project).

ANTICIPATED FISH USE OF THE RESTORED AREA

While it may take decades for a restored marsh to develop similar elevations and vegetation communities to areas that were never diked (Thom et al. 2002), fish use of restored areas is comparable and immediate.

Juvenile salmonids have been documented using a restored tidal marsh on Spencer Island directly across from the Smith Island project area in the Snohomish River estuary (Tanner et al. 2002, Cordell et al. 1999) and at the Smith Island/Union Slough mitigation project just downstream (Pentec 2001, 2002, 2003, 2006). In the Chehalis River estuary, fish use and species richness was comparable and potentially greater in a tidal channel within the restored marsh relative to fish use within the reference marsh (Simenstad et al. 1992). Likewise, fish densities were equivalent between the restored and undiked marsh areas in the Salmon River estuary, Oregon (Gray et. al 2002). Monitoring results from the Deepwater Slough tidal marsh restoration project also indicated use of the restored marsh comparable to other sites within the Skagit River estuary (Beamer et al. 2006).

Salmonids return quickly to take advantage of restored tidal marsh habitat such as this area on Spencer Island in the Snohomish River estuary.

Based on density and survival estimates developed for the Skagit River estuary, Haas (2001) estimates smolt capacity for the Smith Island project area of 250,000 smolts per year. Based on Chinook densities observed within the vicinity of the Smith Island project area (Mindy Rowse, personal communication, 2009), 43,000 to 125,000 smolts per year may be a better estimate of probable fish use following full restoration. Density and survival from year to year, site to site, and estuary to estuary, however, is highly variable and a function of a variety of factors.

? HOW SOON WILL SALMON START USING THE RESTORED PROJECT AREA?

Regardless of the uncertainty of specific fish-use estimates for the restored Smith Island project area in a given year, the body of research on fish use and restoration of west coast estuaries strongly supports the conclusion that the project will yield immediate and significant benefits to threatened salmon populations in the Snohomish River basin.

IMPACTS TO FISH

PROJECT CONSTRUCTION

Construction disturbances may impact fish species that are currently in the project area or are in the vicinity of active dike removal work. Fish could be temporarily impacted by construction noises and vibrations. Filling the linear ditch network and removal of shrubs along the tidal channel will impact stickleback habitat and reduce shade that provides hiding places. Bare soils in the project area could potentially be eroded and cause muddy waters, or turbidity. Fish that use Union Slough could be impacted during removal of the dike by increased water turbidity and by disturbances from construction noises and vibrations.

MITIGATION FOR IMPACTS TO FISH

Construction impacts will be minimized by fish's natural behavioral response to this disturbance (leaving the project area).

Although the project may cause temporary impacts to fish species, mitigation will be in the form of BMPs to minimize the effects of construction disturbance. Fish that are within the ditch network may not have the ability to leave and avoid construction-related disturbances. To minimize the potential of a prolonged impact from construction, fish will be relocated to the larger tidal channels or Union Slough away from areas of construction disturbance.

Removal of the existing dike will be done during low tides so that when waters are first introduced to the project area, they flow in and carry the turbid waters into the site. The existing grassy vegetation in the project area will trap some sediment but some will also settle out of the water column during the slack tide.

As the project moves towards construction, BMPs will be proposed to comply with federal, state, and local regulations and ensure fish resources are protected during construction of the project.

BMPs that are likely to be employed include but are not limited to the following: marking clearing limits, seeding and mulching, plastic covering, silt fencing, straw wattles, dust control, filter bags, stabilizing construction entrances, continuous berms, temporary sediment pond/sediment trap, silt mats (in series), and preserving existing vegetation. In areas where construction is occurring, every effort will be made to capture and relocate fish that are unable to escape by their own means.

EFFECT OF NO ACTION ALTERNATIVE TO FISH

The No Action Alternative would result in a lost opportunity to implement a key component of the 2005 Plan. Failure to implement one of the key action items identified in the 2005 Plan's strategy to restore salmon habitat would be expected to have a significant adverse impact on the effort to recover salmonid species, especially Chinook salmon. Without restoration in the estuary, juvenile salmon would continue to have limited rearing habitat during their transition from fresh to salt water conditions. The present threat to endangered fish populations in the Snohomish River basin would not be lessened.

Wildlife and Vegetation

EXISTING CONDITIONS

VEGETATION IN THE PROJECT AREA

The majority of the Smith Island project area is dominated by open areas with pasture grasses and herbaceous species including creeping bentgrass, reed canary grass, quackgrass, tall fescue, and Kentucky bluegrass. Soft rush, common cattail, and creeping buttercup are dominant in wetter areas. Patches of Pacific silverweed, brass buttons, and spike rush were observed in the horse pastures in the southwestern portion of the project area.

Shrub habitat is scattered throughout but is most prevalent in the northern portion, along the landward toe of the existing dike and in areas adjacent to the remnant tidal channels and constructed ditches. Upland shrub areas are dominated by red elderberry and Himalayan blackberry and/or evergreen blackberry. Douglas spirea is dominant adjacent to wet forested areas located mostly within the eastern half of the project area.

The project area is dominated by open areas with heavy concentrations of non-native and invasive weed species.

The largest grouping of trees is located in the northeastern portion and is dominated by the non-native Scots pine and native Sitka spruce with an understory of evergreen and Himalayan blackberries. Forested areas along the east side of 51st Avenue NE, a dirt road running north-south through the middle of the project area, include the non-native Norway spruce and native Douglas-fir. Red alder and black cottonwood are dominant along the landward toe of the existing dike adjacent to Union Slough. Individual trees are also scattered within the eastern half of the project area near the remnant tidal channels. Understory vegetation within the forested areas is typically dominated by evergreen and Himalayan blackberry, Douglas spirea and salmonberry. The remnant tree nursery located on County land contains rows of ornamental deciduous, evergreen, and fruit tree species.

There are several non-native and invasive weed species established throughout the project area. One species in particular, reed canary grass, is predominant throughout. Evergreen and Himalayan blackberry are also present and are predominant understory species within the forested areas. See Glossary of Terms for common name to Latin name associations.

No rare plants have been observed in the project area. The Washington State Department of Natural Resources Natural Heritage Information System contains no records for rare plants, high quality freshwater wetlands, or high quality plant communities in the project area.

WILDLIFE IN THE PROJECT AREA

In order to determine wildlife use of the project area, Snohomish County conducted a wildlife assessment based on existing habitat types (see Appendix E, Current and Future Wildlife Use of the Project Area). Habitat types are typically comprised of a combination of vegetation, elevation and water resources. Based on the variety of vegetation types, water resources and the project area's location within the Snohomish River estuary, there are multiple habitat types in the project area including emergent, herbaceous (pasture), scrub-shrub, forested, open water (remnant tidal channels) wetlands, and shrub and forested riparian areas on the existing dike (see Figure 17, Existing Vegetation). Each of these habitat types supports a wide range of wildlife species.

BIRDS IN THE PROJECT AREA

During the wildlife assessment and other project site visits, many bird species were observed in the project area. During public outreach for the project, local bird-watching enthusiasts also commented on the diversity of birds that frequent the area.

The Snohomish River estuary provides important habitat for many bird species and is an important stopover on the Pacific Flyway, a regional flight corridor for migratory birds. The Pacific Flyway extends from Alaska south to Mexico and South America; estuaries are an important wintering area for migrating birds.

Multiple species of small birds, including chickadees, American robins, Stellar's jay, Northern flickers, swallows, sparrows, kinglets, spotted towhees, dark-eyed juncos, and wrens, were observed using the shrub and forest habitats along the existing dike. Other bird species observed include sharp-shinned hawk, merlin, peregrine falcon, turkey vulture, Cooper's hawk, bald eagle, killdeer, Canada geese, red-breasted sapsucker, belted kingfisher, Virginia rail, pileated woodpecker, and red-winged blackbird. Barn owls are known to nest in the project area and great horned owls have been seen hunting.

A wide variety of waterfowl and shorebirds use the wetland habitats in the project area. Mallards, green-winged teals and northern shovelers were observed in areas of open water. Several species of shorebirds use the project area during seasonal migrations and commonly winter over. These include dunlin, western sandpiper, long-billed and short-billed dowitcher, Wilson's snipe, and greater and lesser yellowlegs.

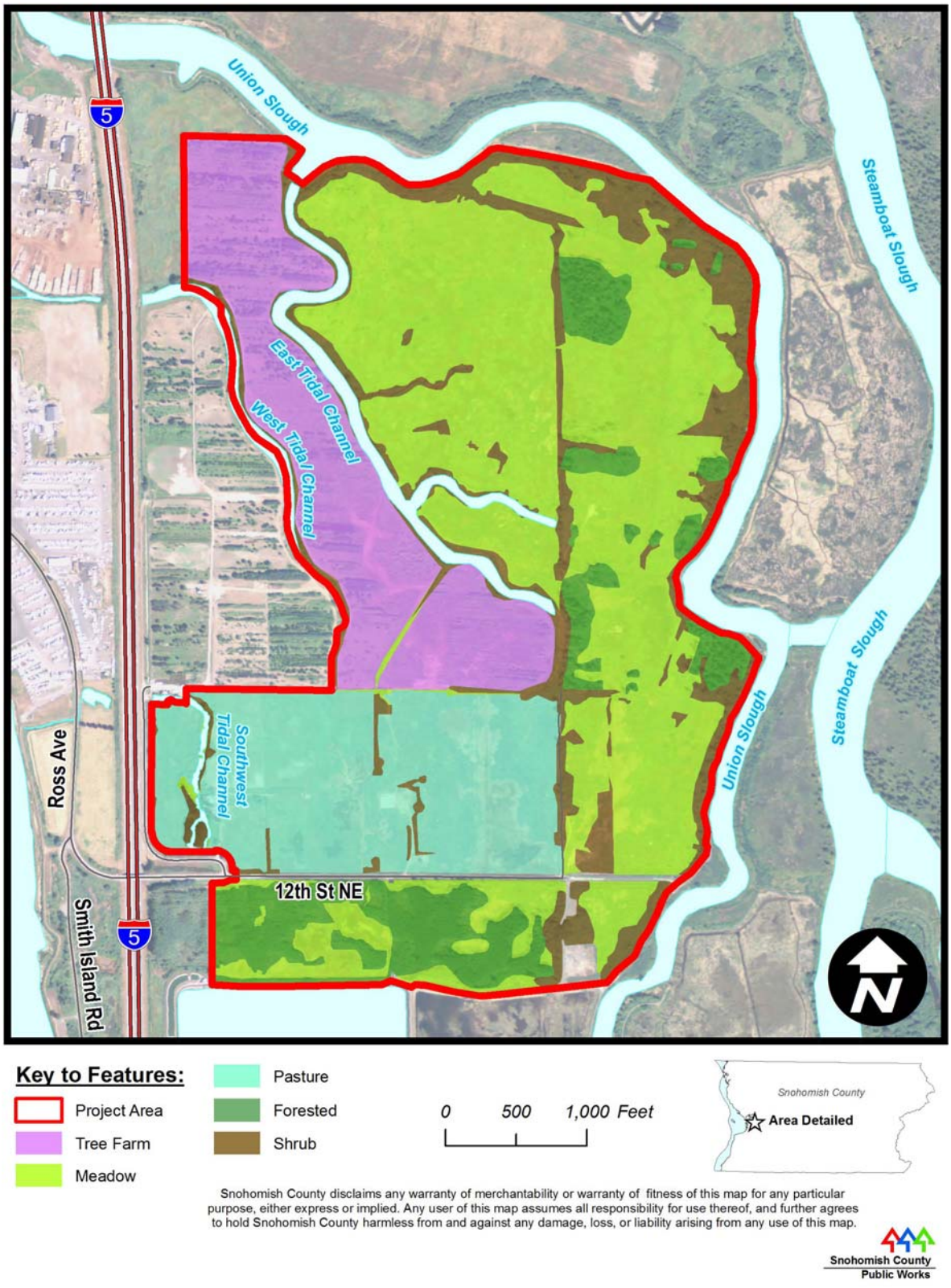

FIGURE 17. EXISTING VEGETATION

Several rare and uncommon bird species have been seen as well. Based on the available habitat types, it is possible that a variety of other bird species that were not observed use the area including American bittern, green heron, short-eared owl, western screech owl, American goldfinch, and savannah sparrow (see Appendix D, Current and Future Bird Use of the Project Area and Glossary of Terms).

MAMMALS IN THE PROJECT AREA

A wide range of mammals inhabit or may inhabit the project area. Voles are known to exist based on vole tunnels that were observed throughout areas dominated by pasture grasses, except within the wetter portions of the project area. Voles likely provide the main food source for predators such as coyotes, northern harriers, and red-tailed hawks. A black-tailed deer was observed near the forested area adjacent to 12th Street NE.

As evidenced by tooth marks and wood chips found around the remnant tree nursery, it is apparent that beavers are present in the project area. Based on public input (meetings, discussions, personal communications), bobcat, cougar, snowshoe hare, striped skunk, weasels, rats, raccoon, and opossum are also present. There is a possibility that a variety of other wildlife species may use this area including muskrat and river otter due to the habitat types available (see Appendix E, Current and Future Wildlife Use of the Project Area and Glossary of Terms).

REPTILES AND AMPHIBIANS IN THE PROJECT AREA

Based on the extensive amounts of wetland habitat types in the project area, there are likely a wide variety of amphibians. Pacific chorus frogs and garter snakes have been heard and/or seen during site visits. It is likely that the following species may be found based on the available habitat types: northwestern salamander, long-toed salamander, rough-skinned newt, ensatina, western redback salamander, red-legged frog, and bullfrog (see Glossary of Terms).

THREATENED AND ENDANGERED WILDLIFE SPECIES IN THE PROJECT AREA

No federally threatened or endangered wildlife species were observed in the area during the 2009 site visits. The project area does not contain suitable habitat that would support the wildlife species that are listed under the Endangered Species Act. Other federal or state-protected species that have been observed, or are assumed to use, the project area based on available habitat types are listed in Table 7.

TABLE 7 – SPECIAL STATUS WILDLIFE SPECIES THAT MAY OCCUR IN THE PROJECT AREA

Species	Status[1]	Range and Habitat[2]	Likely Occurrence in Project Area
Vaux's swift	SC	Forage in open areas over water. Nests in old growth forest snags or chimneys.	May forage during summer months over project area.
Bald eagle	FCo, SS	Forages in marine waters, lakes, wetlands and open uplands. Nests in large trees near water.	Documented nest site over 1 mile away from project area. May forage in the project area.
Northern goshawk	FCo, SC	Rare non-breeding occurrence in western Snohomish County. Prefers mature coniferous forests and mixed coniferous and deciduous forests.	Rarely occurs in project area during winter.
Peregrine falcon	FCo	Forages in open areas near water for ducks. Nests on cliffs, bridges, and buildings.	Closest nesting habitat within 0.5 mile of the project area. Forages within the project area.
Pileated woodpecker	SC	Generally mature and old growth western hemlock and western red cedar with trees large enough for roosting and nesting.	Forages in snags along dike.
Olive-sided flycatcher	FCo	Uses areas that have been logged, as well as other clearings and edges.	May breed along the forest edges in the project area.
Long-eared myotis	FCo, SM	Forested habitats throughout Washington	May occur in forested areas and forage in project area.
Long-legged myotis	FCo, SM	Forested habitats throughout Washington	May occur in forested areas and forage in project area.
Pacific Townsend's big-eared bat	FCo, SC	Range covers western Snohomish County. Uses caves, mines, and buildings for hibernacula.	May forage in project vicinity but no known hibernacula exist.
Western toad	FCo, SC	Variety of terrestrial habitats	May breed in wetlands and disperse to forested areas.

1 FCo = Federal Species of Concern, FT = Federally Threatened, SC = State Candidate Species, SS= State Sensitive, SM= State Monitor

2 Sources:
Birds - www.birdweb.org/birdweb/index.aspx
Mammals - www.washington.edu/burkemuseum/collections/mammalogy/mamwash/mamwash.html
Amphibian - www.dnr.wa.gov/nhp/refdesk/herp/speceismain.html

IMPACTS TO WILDLIFE AND VEGETATION

WILDLIFE

During construction, wildlife in the area will be impacted through the loss of habitat from clearing and grading activities. Construction disturbances will temporarily disturb wildlife uses such as foraging and nesting. Voles and other small mammals will lose nesting areas and cover from cleared and or graded fields. The reduction in small mammal habitat would reduce foraging habitat for species that prey on these animals including coyotes, northern harrier, and red-tailed hawks. Black-tailed deer will have substantially reduced foraging areas.

Amphibians and reptiles will lose upland and marsh breeding areas. Restoring the tidal influence to the project area would reduce the extent of freshwater wetlands. This would impact breeding habitat currently used by amphibians and reptiles. It is expected that most wildlife currently using the area would either adapt to the new conditions or relocate to surrounding areas with similar habitat.

VEGETATION

During project construction, vegetation in areas that will be cleared and graded for construction purposes will be temporarily impacted. Most species would re-establish in time, however the project will permanently impact some vegetation by restoring tidal and seasonal river flooding conditions. Breaching the existing dike would introduce prolonged periods of surface inundation that would at first reduce vegetative cover, as many of the species of vegetation are not adapted to this condition. Impacted vegetation includes fallow pasture, forest, shrub and herbaceous communities along with the abandoned stock in the former tree nursery.

MITIGATION FOR IMPACTS TO WILDLIFE AND VEGETATION

IMPACTS TO BIRDS AND OTHER WILDLIFE

Along with salmonid species, the restored estuarine tidal marsh will benefit certain bird species including water birds, shorebirds and falcons. Some resident and migratory birds will continue to use the project area as they do adjacent natural and restored tidal marshes. Bird species that are expected to benefit from an increase in foraging and nesting habitat include waterfowl, shorebirds, raptors, and some songbirds. An increase in the number and variety of fish species will attract bird species that prey on these fish including mergansers, loons, terns and grebes. See Appendix D for additional information on birds that will benefit from the project.

The Smith Island Restoration Project is expected to benefit certain mammal species including raccoon, river otter, muskrat, and bats by increasing foraging habitat. As shrubs and trees become established on the new dike and remaining sections of the old dike, smaller birds such as sparrows will return to nest and forage. Many species of birds not typically found in estuarine habitat will forage in the mudflats. Construction of hummocks and shallow slopes in the tidal marshes would provide roosting areas for shorebirds during high tides, and as vegetation grows, shrub habitat for smaller birds.

? WILL MITIGATION BE PROVIDED FOR DISPLACING BIRDS AND WILDLIFE IN THE PROJECT AREA?

While the primary purpose of the project is to restore estuarine tidal marsh to support Chinook salmon recovery, it is expected that restoring this area will also benefit a wide variety of other fish and wildlife through habitat enhancement. The project is considered to be self-mitigating for impacts to wildlife.

IMPACTS TO VEGETATION

Establishment of native plant species on both the new dike and remaining sections of the existing dike will minimize the loss of habitat. Vegetation communities will change as tidal marsh functions return. Species will either adapt to these new habitats or move to adjacent areas where more favorable habitat exists. The existing vegetation communities are expected to be replaced by mudflats, emergent wetlands, tidal channels, and upland vegetated areas. Existing trees will be left to die back, form snags, and provide nesting habitat for cavity dwellers and perching locations for raptors. Over time, these trees will fall and provide a source of woody debris that will help form structural diversity within the project area.

Restoring tidal inundation would recruit a large number of native plants, wildlife, and microorganisms from adjacent tidal marshes. These species would colonize the project area and help develop functioning estuarine habitats.

? WILL MITIGATION BE REQUIRED FOR IMPACTS TO EXISTING VEGETATION?

Snohomish County considers the project to be self-mitigating for impacts to vegetation as it will foster a more diverse vegetation community than presently exists, and will consequently increase the overall ecological functions and values of the project area.

EFFECT OF NO ACTION ALTERNATIVE ON WILDLIFE AND VEGETATION

As there are no disturbances associated with the No Action Alternative, existing wildlife will not be impacted. However, the No Action Alternative would not provide the benefits to wildlife that are associated with the Action Alternative. See Appendix E containing the wildlife matrix with details about which species would benefit from the Proposed Action Alternative.

Cumulative and Indirect Impacts

Cumulative impacts, or effects, are defined as the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions that are similar in nature regardless of what agency or person undertakes such other actions.

Indirect impacts are impacts caused by a project, but which are either further removed from the project in distance or could occur at a later time. These impacts typically happen as a result of the initial project construction, and can include changes in land use, water quality, and economic vitality.

CUMULATIVE IMPACTS

The Smith Island Restoration Project is one of a suite of restoration projects in the Snohomish River estuary (see Table 1). The assessment of cumulative impacts will be based on these projects as they represent past, present and reasonably foreseeable future actions that are similar in nature.

FLOOD PROTECTION

A potential cumulative effect of the suite of estuary restoration projects completed or proposed for the Snohomish River basin is improved flood protection to adjacent and nearby critical infrastructure and facilities such as I-5, the City of Everett's Water Pollution Control Facility, farmland, commercial businesses, and residential developments, as many of these projects propose to construct new, more robust dikes set back from channels.

TIDAL MARSH FORMATION

The cumulative effect of setting new dikes back further from channels is the estuary-wide erosion and deposition of soils, as mud flats and tidal channels form and adjust in the natural process of establishing tidal marshes.

ESTUARINE HYDROLOGY

Cumulatively, the suite of restoration projects will influence water circulation patterns in the estuary by opening up large areas for the exchange of tidal waters and increase flows in Union Slough, Ebey Slough, Steamboat Slough and the Snohomish River main stem.

The cumulative effects of the Qwuloolt, Blue Heron Slough, Smith Island Restoration Project, and City of Everett's Smith Island/Union Slough restoration projects on water circulation patterns

in the estuary was modeled by Battelle (2007). This analysis also included already completed projects – Port of Everett's Union Slough project and Spencer Island. When considered together, these projects showed the following effects to water resources characteristics:

- No changes to water levels in Ebey, Steamboat, or Union Sloughs, or the Snohomish River main channel.
- An increase in volume of tidal water flowing in Ebey, Steamboat, and Union Sloughs, and the Snohomish River main channel.
- Increase in flow velocities during rise and fall of tides in Ebey, Steamboat, and Union Sloughs, and the Snohomish River main channel.

The cumulative impact on Union Slough when all nearby projects are completed will be less than when only the Smith Island Restoration Project and the City of Everett's Smith Island/Union Slough projects were modeled. This is due to more water being drawn into and through Steamboat and Ebey Sloughs by the Blue Heron Slough and Qwuloolt projects (Battelle 2007).

These water circulation changes within the estuary are not expected to cause negative impacts. As with the singular impact of the Smith Island Restoration Project, there is likely to be minor channel adjustments, primarily widening and deepening, to accommodate additional flow volume.

SALMON RECOVERY

A cumulative effect of the suite of projects is significant improvement to habitat conditions for fish species in the Snohomish River estuary. The 2005 Snohomish Basin Salmon Conservation Plan set a 10-year, net-gain target of at least 1,200 acres of estuarine tidal marsh. Depending on timelines and outcomes of the projects listed in Table 1, this target may be achieved. Achieving the goal would represent a major accomplishment for salmon recovery efforts and will provide a substantial base from which to move towards eventual recovery of threatened salmon species.

WILDLIFE HABITAT AND VEGETATION PATTERNS

Cumulative effects to wildlife and vegetation will be a reduction in upland habitat as these habitats will be restored to tidal marsh. Wildlife will adjust to the changing habitat conditions with upland-dependent species finding new habitat elsewhere. Although the suite of projects represents a significant increase to tidal marsh habitat, it represents only a minor reduction of upland habitat. Many of the displaced species should be able to find suitable habitat. The significant increase in tidal marsh habitat will allow species suited for these habitat conditions to colonize new areas. This could potentially lead to adjustments in food web dynamics as wildlife and vegetation adapt to the restored habitat conditions.

LAND USE PATTERNS

A potential cumulative effect of the suite of projects completed or proposed for the Snohomish River basin is the loss of more than 2,000 acres of designated agricultural land. While the official designation of the land will not change, these lands will become non-farmable when the restoration and mitigation projects are completed. Whether or not this will have a correlative negative effect on the county's agricultural economy is difficult to determine.

It is difficult to assess the economic significance of this cumulative impact because many of the project areas identified for habitat restoration or mitigation have not been in active agricultural use for some time, if ever. Snohomish County's agricultural land base includes 62,528 acres of designated agricultural land of which approximately 45 percent is not presently in active production. An inventory of agricultural lands conducted by the County in 2007 found that nearly 6,000 acres of the designated agricultural lands surveyed were either fallow, too wet to farm, consisted of marsh or wetland, or were being used for non-agricultural purposes. Many of the habitat restoration and compensatory mitigation sites in the Snohomish River estuary fall into one or more of these categories.

Regardless of their present condition or inactive status, the majority of these project areas are designated agricultural lands in the County's Future Land Use Map. Although habitat restoration and mitigation projects are not prohibited on designated agricultural lands, the cumulative effect of the proposed project and others similar to it in the Snohomish River estuary is that many acres of potentially usable farmland will not be usable for farming in the future.

RECREATIONAL OPPORTUNITIES

A potential cumulative effect of the suite of projects is an increase in recreational opportunities for outdoor enthusiasts who enjoy boating, fishing, bird-watching, nature walks and other similar activities. These projects will provide an opportunity for many to learn about tidal marshes and their unique ecological role.

INDIRECT IMPACTS

Over the next several years, the outcome of coordinated salmon recovery efforts such as those occurring in the Snohomish River basin should result in stabilized Chinook salmon populations in the Puget Sound region. It is important to achieve this stability within current planning timelines as future funding opportunities are certain to decrease from those of the past decade. Achieving stable native salmon populations will help sustain viable commercial and sports fisheries in the Puget Sound.