Section 4
Existing Impacts

This section describes, to the best extent possible, existing impacts to water quality, covered species, and habitat of the agricultural activities and infrastructure described in Section 2. The assessment of impacts provided in this section is based on the available data and information summarized in previous sections of this CIDMP document, as well as on the professional opinions of the Technical Advisory Team (TAT).

As part of this assessment process, it is important to identify data gaps related to impacts that may be occurring in the Planning Area. The identification of data gaps is a key component of the CIDMP process. These data gaps are identified in the discussion of impacts below. Data gaps are addressed, where feasible and appropriate, by including actions over time to collect new information. These actions are included in the action plan described in Section 5 of this CIDMP document.

4.1 Overview of Impacts

Table 4-1 provides an overview of the relationship between the facilities, operations, and activities described in Section 2 and the associated impacts to water quantity, water quality, covered species, and habitat. The impacts summarized in Table 4-1 are described in the subsections below. The discussion of impacts is organized by grouping types of activities and infrastructure and discussing the various impacts of each type. The subsection associated with each type of activity or infrastructure is noted in Table 4-1.

Impacts to covered fish species or their habitat that could result in population declines are assumed to have an associated indirect impact to the bird and marine mammal species covered in this CIDMP document. This indirect impact would result from a reduction in prey base for these species. Additional impacts to either the bird or marine mammal species are unlikely due to the proximity of populations and/or habitat to the Planning Area. Any activity-specific impact to these species is discussed in the subsection associated with that activity. Impacts specific and unique to the two lamprey species are unknown at this time.

4.2 Impacts Related to Water Diversion and Withdrawal

This section describes the impacts of water diversion and withdrawal for irrigation purposes, including volume, timing, and duration of the diversion or withdrawal. The location, rate, and volume of diversion and withdrawal activities, as described in water right documents, are described in Section 2.4.2.

4.2.1 Impacts on Flow

A useful analysis of the impact of agricultural diversion on streamflow is a comparison of agricultural water use to streamflow and to instream flow requirements. The data available for this type of analysis are presented in Sections 1 and 2. Table 4-2 presents a summary of the quantity of water subject to diversion and withdrawal under paper water rights, pending applications, and water right claims (see Section 2.4.2 for further detail).

Table 4-1. Overview of Potential Impacts

District Activities and Infrastructure	Potential Impacts																					
	Water Quantity	Water Quality						Habitat Access	Habitat Elements									Channel Conditions and Dynamics		Population Impacts		
	Change in Peak/ Base Flow	Fecal Coliform	Pesticides	Oil, Grease, Fuel, Metals	Turbidity/ Sediment	Temp	Nutrients	Barriers	Spawning Habitat	Rearing Habitat	Migrational Corridor	Intertidal Interface	Near-shore/ Estuary	Riparian Vegetation	Wetlands	Sloughs/ Off-channel Habitat	Width/ Depth	Bank Condition	Floodplain Connectivity	Fishes	Birds	Mammals
Water Diversion and Withdrawal (Section 4.2)																						
Volume	X				X	X		X	X	X	X	●	●	X	X	X	X	X	X	X	●	●
Duration	X				X	X		X	X	X	X	●	●	X	X	X	X	X	X	X	●	●
Timing	X				X	X		X	X	X	X	●	●	X	X	X	X	X	X	X	●	●
Drainage Network (Section 4.3)																						
Drainage network	X	●	●	●	●	X	●	X	X	X	X	X	X	X	X	X	X	X	X	X	●	●
Tide Gates (Section 4.4)																						
Tide gates					X	X	●	X		X	X	X	X	X	●	X	X	X	X	X		
Drainage Related Facilities (Section 4.5)																						
Dikes	X				●	●		X	X	X	X	X	X	X	X	X	X	X	X	X	●	●
Check dams					X	X								X				X				
Drainage tiles					X										X							
Culverts								X	X	X	X			X	X		X	X	X	X		
Flood gates					X			X		X	X			X	X	X	X	X	X	X		
Trash racks								X												X		
Pump stations					X			X		X	X	X	X		●		X		X	X		
Bridges				●				X		X	X			X	X		X	X	X	X		
Irrigation Related Facilities (Section 4.7)																						
Diversion intake								X		X	X			X			X	X	X	X		
Fish screens																				X		
Pumps and pipe				X														X		X		
Water storage (check dams)						X	X					X	X	X		X	X	X	X	X		
Equipment														X								
Maintenance Activities (Section 4.6)																						
Dike Maintenance				X	X		X			X		X	X	X	X	X	X	X		X	●	●
Ditch Maintenance			X	X	X		X			X		X	X	X	X	X	X	X		X	●	●
Equipment repair				X																		
Debris removal					X		●			X		X		X		X	X	X		X	●	
Tide gate repair				●	X					X		X	X	X		X				X	●	
On-Farm Activities (Section 4.8)																						
V-ditches					X		●					X			X					X		
Pesticide use			X							X	X	X	X	X	●	X				X	X	●
Livestock grazing		X			X	●	X		X	X	X			X	X	X			X	X		
Fertilizer application		X			●		X			●	●	●	●	●	●	●				●	●	●
Field tilling/preparation					●		●							●				●		●	●	●
Planting														●						●	●	●
Harvest					●									●						●	●	●
Cover crops					●									●						●	●	●

X = Direct Impacts ● = Indirect Impacts

Table 4-2. Summary of Water Diversion and Withdrawal in the Planning Area

Category	Number of Diversions	Instantaneous Rate (Qi) (cfs)	Annual Quantity (Qa)[1] (afy)
Total Surface Water Rights – Skagit River	6	3.35	361
Total Surface Water Rights – Samish River	11	5.69	1,043
Total Surface Water Rights – Other Surface Watercourses	37	14.55	2,053
Total Surface Water Rights – All Surface Watercourses	54	23.59	3,457
Total Water Rights – Groundwater	166	81.81	11,661
Total Water Rights – Surface and Ground	220	105.40	15,118
Total Water Right Claims – Surface and Ground	53	24	2,621
Total Pending Applications – Surface and Ground	44	51	6,518

Source: Ecology, 2005b; previous tables

[1] In cases where annual quantity was not reported for water rights in the Water Right Tracking System (WRTS), acre-feet per year (AFY) estimate was calculated using reported irrigated acres multiplied by 2 acre-feet / acre. AFY estimate for applications was calculated using reported irrigated acres multiplied by 1.5 acre-feet / acre.

For the purpose of comparison with streamflow, only water rights for surface water diversions from the Skagit and Samish Rivers have been considered in this analysis. The analysis was limited to surface water diversions since they have a clear, direct effect on streamflow. While it is likely that groundwater use in this area affects streamflow, the magnitude and significance of that effect is not clear since the extent of hydraulic connection between the aquifer and surface water bodies is unknown (see Section 1.2). Additionally, any such indirect effect from pumping groundwater would be delayed based on factors such as proximity to the stream, well depth, soil type, and underlying geology.

The analysis was further limited to the Skagit and Samish Rivers, where adequate streamflow data were available for comparison purposes. Unfortunately, streamflow data for smaller watercourses in the Planning Area were largely unavailable. Since is it likely that diversions would have a relatively greater impact on water quality and habitat conditions in these small watercourses, this lack of information represents a significant data gap. Information on pending water right applications and water right claims was included in an effort to demonstrate the extent of potential impacts.

The results of the analysis of impacts of water diversion on streamflow are presented in Tables 4-3 and 4-4. Table 4-3 presents a comparison of the total number and quantity of diversions from the Skagit River (including the South Fork), and the mean monthly streamflow in September. Table 4-4 presents a similar comparison for the Samish River.

The data presented in Tables 4-3 and 4-4 do not directly demonstrate the impact of agricultural water diversions on streamflows in the Skagit and Samish Rivers; due to the location of diversion points in relation to the stream gages, it is not possible to directly associate specific diversions with impacts on the flow at the gages. In fact, the entire Planning Area is located downstream of the Skagit and Samish gages. However, comparing diversion with streamflow data is useful in assessing the overall impact of surface water diversions for agricultural irrigation on the Skagit and Samish Rivers.

The impact of agricultural surface water diversions in the Planning Area is relatively minor when compared to streamflow in the Skagit River main stem; the total amount of 3.35 cubic feet per second (cfs) allocated under water rights represents 0.03 percent of the mean monthly streamflow in September, which is the lowest recorded mean monthly flow in the Skagit River. When pending applications and water right claims are included, the total potential impact to streamflow in the Skagit River is 27.94 cfs, or less than 0.3 percent of the mean monthly flow in September.

Table 4-3. Comparison of Irrigation Surface Water Diversions within the Planning Area and Streamflow in the Skagit River

	Number of Diversions	Instantaneous Rate (Qi) (cfs)	Annual Quantity (Qa) (acre-feet)
Total State-Issued Water Rights – Skagit River	6	3.35	361.50
Total Water Rights and Pending Applications – Skagit River	15	22.04	1,787.93
Total Water Rights, Pending Applications, and Water Right Claims – Skagit River	22	27.94	2,336.93
Mean Monthly Streamflow (September) USGS 12200500 SKAGIT RIVER Near Mount Vernon, WA	-	9,469	-

Source: Ecology, 2005b; USGS, 2005

The total quantity of surface water diversions for irrigation from the Samish River of 5.69 cfs allocated under water rights comprises 14 percent of the mean monthly streamflow in August, the month at which the lowest mean annual flow is recorded. There were no pending applications identified in the Planning Area for agricultural diversions from the Samish River; one presumed valid water right claim was identified. The total potential impact from water rights and claims to streamflow in the Samish River is 6.09 cfs, or 15.5 percent of the mean monthly streamflow in August.

Table 4-4. Comparison of Irrigation Surface Water Diversions within the Planning Area and Streamflow in the Samish River

	Number of Diversions	Instantaneous Rate (Qi) (cfs)	Annual Quantity (Qa) (acre-feet)
Total Water Rights – Samish River	11	5.69	1,043
Total Water Rights and Pending Applications – Samish River	11	5.69	1,043
Total Water Rights, Pending Applications, and Water Right Claims – Samish River	12	6.09	1,143
Mean Monthly Streamflow (August) USGS 12201500 SAMISH RIVER near Burlington, WA	-	39.1	-

Source: Ecology, 2005b; USGS, 2005

4.2.2 Impacts on Water Quality

The primary water quality issue associated with irrigation water diversion is temperature. The diversion of surface water may increase temperature in the stream from which water has been diverted. If water is stored after diversion, or if check dams are used to store water in drainage ditches, the temperature of the stored water is likely to increase. This increase in the temperature of stored water may present a water quality problem if the water is not used for irrigation, but is discharged instead to a stream or marine water body. The degree of impact is dependent on the volume of the watercourse and the diversion from that watercourse; the more significant the amount of water being diverted, the more significant the impact on water quality.

In addition to temperature, other water quality issues associated with water diversion are turbidity and sediment. Water can become more turbid and sediment may be suspended when diverted water erodes and carries soil or stream bed materials.

An emerging issue is the increase in development of urban growth areas (UGAs) outside the Planning Area that contribute stormwater runoff to the drainage system intended to serve the agricultural community. This runoff from non-agriculture related sources impacts peak flows during storm events and contributes additional pollutants to the system; the result is that the agricultural drainage system changes to more closely resemble urban stormwater runoff.

4.2.3 Impacts on Habitat Elements and Covered Species

Water withdrawal for crop irrigation can reduce the availability of suitable fish habitat. Within the Planning Area, the majority of the fish habitat is comprised of rearing habitat and migrational corridors. Limited spawning habitat is present within the Planning Area, and is restricted to short segments of two watercourses at the eastern boundary of the Planning area (and continuing upstream of the Planning Area). The review of impacts in this CIDMP document focuses on effects on rearing habitat and migrational corridors.

If the use of water for irrigation is substantial in relation to the instream flow, the resulting reduced flow can result in migrational restrictions, increased water temperature, and impacts to riparian vegetation. Water fluctuations between the irrigation and non-irrigation seasons can also reduce the area that can support riparian vegetation. The loss of riparian vegetation not only reduces riparian-associated wildlife but further reduces the quality of instream habitat in terms of woody and organic debris, stream temperature, and filtration of sediments and artificial chemicals (Knutson and Naef, 1997).

Impacts from changes to instream flow for many of the watercourses in the Planning Area are likely minimal due to the limited volumes of water diverted. However, the extent of the impact to covered species and habitat is not known due to the lack of streamflow data for many watercourses in the Planning Area. Since it is likely that diversions would have a relatively greater impact on smaller watercourses, this lack of information reflects a significant data gap.

Section 4.2.1 describes flow impacts within the Skagit and Samish Rivers where instream flow data are available. Within the Samish River, up to 14 percent of the mean monthly streamflow (based on lowest recorded mean monthly streamflow in August) could be diverted from the river if all water rights were utilized to their full extent. Impacts to rearing habitat and migrational corridors may occur from this water use. Fish species likely to be present during August include: bull trout/Dolly Varden, Chinook, steelhead, coho, sockeye, cutthroat trout, and lamprey.

An increase in instream temperature could occur from the water diversion from the Samish River during the low flow conditions in August. No data are available to demonstrate a direct correlation between agricultural use and river temperature.

The potential impact of fish screens and other equipment related to water diversion are discussed in Section 4.7.3.

4.2.4 Data Gaps

Data gaps for impacts related to water diversion and withdrawal include:

- Watercourse streamflow data for small watercourses in the Planning Area.
- Location of unnamed watercourses and locations of points of diversion.
- Location of surface water points of diversion and volume of withdrawals.
- Hydrologic modeling of groundwater / surface water connectivity in the Skagit Basin.
- Impact of groundwater withdrawal and connectivity to surface water bodies.

4.3 Impacts Related to Drainage Network

For the purposes of this discussion, the drainage network includes ditches, sloughs, creeks, and rivers within the Planning Area. Sections 1.2, 2.2, and Section 3 describe these watercourses in detail.

4.3.1 Impacts on Flow

The primary functions of the drainage network are to remove water from the land and make the land farmable, reduce risk associated with flooding, and protect residential and agricultural infrastructure such as buildings and septic systems. As such, this network may increase the rate at which water moves from the land to the receiving bays, and the volume of water being discharged at a given point.

The drainage network also serves a secondary function by providing water for irrigation. In some cases, water rights allow for diversion of water from the drainage network for irrigation purposes. Check dams are also sometimes used to impound water for surface diversions and for sub-irrigation in some areas. These practices may retard flow in the affected watercourses. As discussed in Section 4.2, the extent of this impact is not known due to the lack of streamflow data for many watercourses in the Planning Area.

4.3.2 Impacts on Water Quality

In a discussion of the drainage network's impacts on water quality, it is important to distinguish between the pollutant loading potential of agricultural activities and that of non-agricultural activities. The drainage network may convey a variety of materials that are contributed from both agricultural and non-agricultural sources, both within and outside the Planning Area. This distinction is useful in identifying actions the agricultural community may take to protect water quality (see Section 5). The agricultural community has control over its own activities and actions, but limited or no control over the activities or actions of others. An effort has been made in this section to briefly summarize pollutant loading sources associated with both agricultural and non-agricultural activities that could impact water quality in the Planning Area.

Fecal Coliform

The drainage network may convey a variety of materials in addition to water. Fecal coliform bacteria, for example, may be conveyed via the drainage system. This can occur if animals gain access to the ditches, or if runoff occurs from land applications of livestock waste. Fecal coliform may also be contributed by non-agricultural sources such as failing residential septic systems, waste from pets or livestock (hobby farms), and wildlife such as waterfowl and shore birds.

The loading of fecal coliform (or other pollutants) into ditches is not an intended outcome of the drainage system, and on-farm Best Management Practices (BMPs) exist to reduce the likelihood of this loading from agricultural activities (see Sections 2.2.3 and 2.2.4). However, the potential exists for contamination.

As described in Section 3.1, fecal coliform has been and remains a water quality concern in several water bodies within the Planning Area, and is the focus of a Samish Watershed Total Maximum Daily Load (TMDL) study. At the time of this writing, there are not sufficient data available to determine the extent of the impact of agricultural activities and infrastructure with regard to fecal coliform contamination. WWAA and the agricultural community are working with Ecology to coordinate and assist with the Samish TMDL study, which will result in an improved understanding of the agricultural impact on fecal coliform loading.

Pesticides and Herbicides

The drainage network may convey pesticides or herbicides from farm fields or non-agricultural sources such as domestic gardens, road and utility rights-of-way, and golf courses. As discussed in Section 3.1.5, a review of WSDA water quality data collected between 1995 and 2004 found no significant concentrations of pesticides in the Planning Area (WSDA, 2005). WWAA and the agricultural community are working with WSDA and Ecology to assist with a study to assess the use of pesticides in fish-bearing waters in the Skagit Basin.

Oil, Grease, Fuel, and Metals

Oil, grease, fuel, and metals from vehicles are transported from roads, parking lots, and other impervious surfaces via stormwater. In some cases, watercourses are located along the side of roads. As a result, these watercourses are susceptible to non-agricultural loading of these pollutants from vehicles on the road. These pollutants could also come from operation of farm and drainage maintenance equipment if the equipment is not properly used or maintained.

Turbidity and Sediment

The drainage network may contribute sediment to water bodies, and thereby affect turbidity. Water can become more turbid or sediment may be suspended when drained water erodes soil or streambed materials. Sediments may also be contributed to network watercourses by non-agricultural sources such as roads and parking lots, construction or development activities, and domestic animal or wildlife access to ditches. This contribution of sediments is of particular concern when the ditches contain water, although sediments loaded into dry ditches may contribute to increased turbidity once ditches gain water.

A segment of the Samish River is listed as requiring a TMDL for turbidity (see Table 3-2). At the time of this writing, sufficient data are not available to assess the impact of agricultural activities on sediment loading or turbidity in the Samish River or other water bodies in the Planning Area, although BMPs currently exist to address any negative impacts that are identified.

Temperature

The drainage network discharge may affect temperature in the receiving water body. Discharged water is often warmer than receiving water bodies and may increase the temperature of receiving waters. This is true not only due to the lack of shade and low velocity of water in the watercourse, but because the volume of discharge is generally smaller than the receiving water, and therefore heats more quickly. However, the greater volume of the receiving water may result in quick dilution of the discharged water with little measurable effect on temperature. Higher temperatures can also result in lower dissolved oxygen levels. As discussed in Section 3, natural background conditions may also play a role in temperature variations in receiving waters.

As with other pollutants, non-agricultural contributions to the network may affect temperature, such as drainage of stormwater from nearby impervious surfaces.

Several watercourses in the Planning Area are listed as requiring a TMDL (Category 5) for temperature. These include Carpenter Creek, Edison Slough, and Unnamed Creek (see Table 3-2).

Nutrients

The drainage network may provide opportunities for nutrient loading, which could impact the receiving water body. Animal access to ditches and other watercourses can contribute nutrients. Lack of shade, low velocity of water, and increased water temperature can all result in nutrient loading, potentially resulting in algal blooms that can eventually decompose and reduce dissolved oxygen.

4.3.3 Impacts on Habitat Elements and Covered Species

As discussed above, the drainage network has resulted in water quality changes that may impact the aquatic species within the Planning Area. Introduction and transportation of contaminants, and increases in turbidity, sediment, and temperature all have deleterious effects on aquatic species. Discharge of water from the drainage system can result in an impact to fish-bearing watercourses. This condition can have an impact on populations and their ability to maintain themselves.

Agricultural practices have resulted in changes to the hydrologic balance of the Skagit Basin. The drainage network increases peak flows and velocities, and flushes sediments that historically would have been deposited in wetlands into Skagit Bay. This has contributed to the build-up of the tidal flats beyond the levees (USFWS, 2004a).

4.3.4 Data Gaps

Data gaps for impacts related to the drainage network include:

- Quantitative data or assessment of the effects of direct and indirect discharge of water from agricultural lands.
- More complete water quality monitoring data for drainage ditches and most other watercourses.

4.4 Impacts Related to Tide Gates

Tide gates facilitate the flow of water out of the drainage network and into marine receiving waters during low tides, and prevent tidal inundation during high tides. The structure, function, and maintenance of tide gates are described in Sections 2.2.1 and 2.2.3.

4.4.1 Impacts on Flow

The impact of tide gates on flow is related to both the design and function of the tide gate, and the tidal influence in the marine waters outside of the drainage network. Physical factors such as the material of the gate (metal or fiberglass) or the hinge type (side or top mounted) affect the performance of each gate. The weight of the gate and hinge location can affect the opening speed, and in turn, the rate of water discharge. The tide gate works as a one-way check valve to keep salt water from entering the agricultural drainage system. When the water level outside the dike, or the tide, is higher than the water level inside the dike, pressure closes the tide gate, preventing salt water from entering the drainage system. The tide gate opens when the tide recedes to a level lower than the water level inside the dike, allowing water to drain from agricultural land into the receiving water. This regulation of flow from the drainage network can impact groundwater levels, and may have an impact on flow in other watercourses. The extent of this impact is unknown.

4.4.2 Impacts on Water Quality

Tide gates may contribute to or exacerbate water quality issues related to the drainage ditch network. For example, tidal fluctuation may result in impoundment of water behind tide gates between tidal cycles. This water may then be subject to increases in temperature and nutrient loads, and decreased dissolved oxygen levels. The design and function of a tide gate can also affect water quality.

4.4.3 Impacts on Habitat Elements and Covered Species

The presence and operation of tide gates has physical, chemical, and biological effects on habitat and covered species. The physical effects include elimination of upland tidal flooding, and changes in velocity and pattern of freshwater discharge. These changes in water movement result in alterations in water temperature, sediment transport, soil moisture content, and channel morphology (Giannico and Souder, 2004). Effects on the upstream side of the tide gate include increases in nutrient concentration, turbidity, heavy metal suspension, and reductions in dissolved oxygen and pH (Giannico and Souder, 2004). Soil salinity is also reduced from the restriction of marine waters past the dikes and gates, and because the fresh water that drains from the system removes salts from the soils over time (Giannico and Souder, 2004). The biological effects of tide gates are restriction of fish migration by preventing or minimizing access to historic rearing areas, changes to aquatic plant composition, and pulses of coliform bacteria during low tides (Giannico and Souder, 2004). Fish passage at tide gates is influenced by the physical configuration of the gates and tubes. Fish passage is likely prevented by the velocity of discharging water, and the type, size, shape, and invert elevation of the tide gate and tube.

One type of tide gate, the self-regulating tide gate (SRT), is thought to allow fish passage; however, the potential impacts to agricultural lands have not been systematically assessed in the Skagit Basin. The House Bill 1418 Report (Smith and Manary, 2005) notes that a SRT was installed in Edison Slough in 2000, and has been blamed for a rise in the water table and saltwater intrusion in nearby farm land (Smith and Manary, 2005). Projects are being undertaken within the Planning Area to further investigate SRTs (e.g., on Fornsby Creek).

Impacts to estuary habitat result from the restriction in water flow between the freshwater source and the estuary. Changes to water temperature, channel morphology, and species composition of aquatic plants and invertebrates all result in impacts to juvenile fish and their habitat. Aquatic plants provide cover and refuge for juvenile fish and the aquatic invertebrates are an important food source. Transport of organic debris (e.g., dead vegetation or leaf litter) is restricted by the presence of tide gates. This organic debris is the base for further food production of detritus by microorganisms. Detritus is the foundation of life in estuarine ecosystems (Giannico and Souder, 2004).

The lack of two-way flushing results in an accumulation of sediments upstream of the tide gates. Filling of the upstream channel results in changes to the channel morphology, the hydrograph of the channel, storage capacity, and downstream impacts to the estuary. When sediment and detritus are deposited in the upland channels, they are removed from the estuary and render the estuary less productive (Giannico and Souder, 2004). The reduction in transport of detritus and sediments has been documented on Joe Leary Slough (Bulthuis, 1996). The amount of suspended sediment in waters above tidal influence decreased by 75 percent when the tide gate on Joe Leary Slough was closed (Bulthuis, 1996).

4.4.4 Data Gaps

Data gaps for impacts related to tide gates include:

- Site-specific study of potential impacts to agricultural land from conversion of existing tide gates to a tide gate type that allows a different pattern of water exchange and fish passage, such as the SRT.

4.5 Impacts of Drainage-Related Facilities

Other drainage-related facilities, such as culverts, check dams, drainage tiles, and flood gates are critical to the function of the drainage network and tide gates. See Section 2.2.1 for descriptions of these drainage-related facilities.

4.5.1 Impacts on Flow

Drainage-related facilities complement the function of the drainage network and tide gates to regulate the flow of water from the land.

4.5.2 Impacts on Water Quality

Drainage-related facilities may contribute to or exacerbate water quality issues related to the drainage ditch network. These components of the drainage network may contribute to increases in temperature and nutrient loads, and decreases in dissolved oxygen levels.

4.5.3 Impacts on Habitat Elements and Covered Species

Dikes

Of all agricultural activities and infrastructure, it is likely that dike construction in the past century for the prevention of flooding and creation of farmland within the lower Skagit Basin has resulted in the greatest impacts to aquatic species. While removal of site-specific dike structures are occurring on an individual project and landowner basis, removing significant portions of the dikes within the Skagit Basin and thus allowing these lands to return to tidally and flood-influenced lands is not anticipated within the foreseeable future. Section 5.3.8 further addresses this issue.

Maintenance of existing dikes typically includes stabilization of banks, due to either natural failure or from impacts caused by wildlife that burrows into the dike or feeds on vegetation growing on the banks, causing destabilization of the slope. The current practice of maintaining the dike to Army Corps of Engineers standards requires removing woody stem vegetation to the waterline. This practice pre-empts the establishment of riparian habitat and its associated benefits. Bank repair actions have the potential to temporarily increase the turbidity and sediment within the repair activity area and downstream. The length of watercourse impaired by the maintenance action depends upon water volume and velocity within the watercourse, and method of repair. To minimize negative impacts of the repair actions, BMPs, as presented within the Drainage and Fish Initiative's Drainage Maintenance Plans, should be followed.

Within the Skagit Basin, watercourse banks are impacted from feral populations of nutria (*Myocastor coypus*), an invasive, semi-aquatic rodent native to South America. Nutria were introduced almost worldwide in the early 1900s for fur farming and, in some areas, weed control. Nutria were imported into Washington State in the late 1930s and early 1940s for fur farms. Feral populations of nutria in Skagit County were unknown until recently (Davidson and Bohannon, 2005). Nutria usually occur in or adjacent to lakes, marshes, rivers, sloughs, slow-moving streams, drainage canals, and temporarily flooded fields. Although nutria prefer fresh water, they can occur in both brackish and saltwater marshlands (Davidson and Bohannon, 2005). The feeding and digging habits of nutria pose a significant risk to public safety, the agricultural and natural resource-based economy, native fish and wildlife, and wetland habitat in Skagit County (Davidson and Bohannon, 2005). The three main types of damage caused by nutria are: damaging levees and banks by burrowing, depredation on agricultural crops, and over-utilization of marsh vegetation (Davidson and Bohannon, 2005). Nutria burrows can undermine roadbeds, stream banks, dams, and dikes, which may collapse when the soil is saturated or when subjected to the weight of heavy objects on the surface (such as vehicles, farm machinery, or grazing livestock). A removal and eradication effort is occurring within Skagit County in cooperation with a number of local groups, including some dike districts. Though not a direct agricultural action, the agricultural community is impacted by the presence of this nuisance species, and a portion of the agricultural community's maintenance action impacts are a result of damage caused by this species.

Check Dams

The use of check dams for retaining water to sub-irrigate land has potential impacts to the aquatic habitats within the Skagit Basin. Check dams result in a change of the hydrologic pattern by interrupting drainage and retaining water. With the impoundment of water, the organic material and sediments are retained or drop out and become deposited within the impounded watercourse. These materials need to be removed mechanically or may be flushed from the system once check dams are removed and higher flows occur. Removal of accumulated sediments may contribute to the reduction of organic materials within the estuary areas and may impact productivity within that habitat. Flushing of accumulated sediments can impact water turbidity and possibly dissolved oxygen levels if a large amount of decaying organic matter is discharged in bulk. The annual placement and removal of check dams has the potential to impact water quality by disturbing sediments and discharging suspended materials downstream.

Drainage Tiles

As drainage tiles on farmed parcels are utilized to remove water from a specific area to allow cultivation, they can impact wetland habitats. By altering the hydrologic balance, wetland characteristics and functions can be disrupted. They also can serve as a conduit for transporting water of impaired quality.

Culverts

The presence of culverts can result in a number of impacts to the aquatic system including: creating a fish passage barrier, restricting flow, and producing scour and erosion. During cleaning, repair, or replacement of culverts, impacts can occur and should be minimized by following BMPs presented within the Drainage Maintenance Plans. Anticipated impacts include: an increase in turbidity and sediment movement, watercourse bank alterations, loss of riparian vegetation during repair or replacement, change in hydrologic regime, and channel morphology changes.

Flood Gates

Use and operation of flood gates result in changes to the hydrologic regime by preventing the intrusion of flood flows onto farmlands and by allowing drainage of surface water from the fields to the drainage network. Once the high water event has subsided, water behind the flood gate is discharged. Pump stations can also work in association with flood gates to discharge accumulated water from behind the flood gate. Impoundment of water can result in the settling of sediment that can then be discharged once the flood gate opens. If water is held for a sufficient duration, an increase in water temperature may occur. Discharging water that is elevated in temperature to a receiving watercourse containing fish can result in thermal shock. The resulting impact depends on the volume of water discharged compared with the size of the receiving water and the range in temperature differences between the two watercourses.

Trash Racks

If fish are present within the vicinity of trash racks, there is potential for impingement if the trash racks are not properly and routinely cleaned. Because trash racks are designed to collect debris traveling downstream within the watercourse, their use may result in the removal of vegetative material and woody debris from the river or estuary system. As previously discussed in Section 4.4, the supply of vegetation and debris to the estuary is essential to the health of that ecosystem.

Pump Stations

If fish are present within the vicinity of the pump station intake, there is potential for entrainment or impingement if the pump intake is not properly screened and routinely maintained. Cleaning of the intake screen must occur to maintain the open surface area of the screen. The screen area is typically sized to maintain fish protection criteria at the pumping rate of the facility. Several of the pump stations within the Planning Area are currently not screened. Screening the pump stations in fish-bearing waters is required by Washington State law, and the parties to the Skagit Drainage and Fish Initiative are working together to either screen the pump stations or replace the existing pumps with fish friendly pumps.

Water quality impacts to fish habitat can occur from the discharge of pulses of stored water. It is likely that stored water varies in temperature from the receiving water. Water temperature differences can induce thermal shock in fish in the receiving waters. Water discharged from pump stations may also be laden with sediment if erosion has occurred on farmed land or if the station is discharging flood flows that have not been stored. The converse is also likely to occur; that is, flood flows or drainage water that is impounded lacks natural sediment or detritus content as organic material and sediment have settled out.

Bridges

Bridges are a potential source of sediment and bank destabilization if scouring of footings is occurring. If the bridge is undersized or the footings are within the high water area of the watercourse, the bridge has the potential to restrict flow and alter the channel morphology both upstream and downstream of the structure. If the bridge constricts the watercourse channel sufficiently, water velocity may increase to a point that the bridge is a barrier to fish migration. Bridge repair or replacement can be a source of increased turbidity and sedimentation. Repair or replacement actions can also result in loss of riparian vegetation, bank impacts through hardening (to prevent erosion) or change in slope, reduction in floodplain connectivity, and change in channel morphology (width and depth). Bridge repair or replacement should be conducted under the BMPs presented in the Drainage Maintenance Plans.

4.5.4 Data Gaps

Data gaps for impacts of drainage related facilities include:

- Inventory or assessment of fish passage at all culverts and bridges within Planning Area watercourses containing fish species.

4.6 Impacts of Maintenance Activities

Maintenance activities include dike maintenance, ditch cleaning and herbicide application, debris removal, and repair of equipment and structures such as tide gates, culverts, and dikes. See Section 2.2.3 for a description of maintenance activities.

4.6.1 Impacts on Flow

As described in Section 2.2.3, proper maintenance of ditches is critical to the function of the drainage network. Ditch cleaning, herbicide application, and debris removal activities improve flow in the ditches, which may increase the rate and volume of discharge to receiving waters.

4.6.2 Impacts on Water Quality

Herbicides

As discussed in Section 2.2.3, drainage ditches are occasionally maintained with an approved aquatic herbicide to reduce the occurrence of nuisance vegetation in the ditches and minimize the need for manual vegetation removal.

The use of all pesticides, including herbicides, is strictly regulated by WSDA. In addition, application of any pesticide or herbicide to water requires a National Pollution Discharge Elimination System (NPDES) permit from Ecology. This permit requires the development of an Integrated Pest Management program. Herbicides used on waterways, including drainage ditches, must be approved for aquatic use. Individuals applying herbicides must have a pesticide application license. Obtaining a license requires a self-study program, administered by Washington State University (WSU), and multiple exams. License holders must complete 40 hours of continuing education over 5 years. Licensees not completing their continuing education are required to re-test every 5 years. The applicator must maintain records of applications. The records are quite detailed, and include the exact application site, total area treated, quantity of pesticide used, pesticide concentration, and other information.

Oil, Grease, Fuel, and Metals

Maintenance of drainage ditches sometimes requires the use of heavy equipment alongside ditches. This use of heavy equipment near ditches could contribute small quantities of grease, oil, fuel, or metals to the water, as well as contributing sediment by disturbing and loosening soils.

Turbidity and Sediment

Sediment may be dislodged during maintenance of ditches or debris removal. This contribution of sediments is of particular concern when the ditches contain water, although sediments loaded into dry ditches may contribute to increased turbidity once ditches gain water. BMPs are included in the districts' Drainage Maintenance Plans (DMPs) which are designed to minimize disturbance of soils during ditch maintenance activities and reduce the risk of sediment loading (see Section 2.2.3).

4.6.3 Impacts on Habitat Elements and Covered Species

All in-water activities have the potential to affect aquatic species through the re-suspension or introduction of sediment resulting in increased turbidity. Typically, the impact from small-scale in-water actions is confined to a limited distance downstream of the action. It is anticipated that ditch cleaning, weed control, and debris removal will have only localized impacts to the aquatic system as long as BMPs are followed (see Section 2.2.3). Tide gate repair has the potential to affect the freshwater, intertidal, and estuarine environments, depending on location and extent of repairs required. Limited repairs such as hardware replacement may have negligible effects, whereas tube replacement will have a greater potential impact. BMPs are set forth in the Drainage Maintenance Agreements and application of these practices will minimize impacts to the extent possible. Note that the BMPs set forth in the Drainage Maintenance Agreements cover tide gate repair, but specifically exclude tide gate replacement.

4.7 Impacts of Irrigation-Related Facilities

Irrigation-related facilities include diversion intake structures, fish screens, pumps and pipe, and irrigation equipment. See Section 2.2.2 for a description of irrigation-related facilities.

4.7.1 Impacts on Flow

Impacts of irrigation on flow are discussed in Section 4.2.1.

4.7.2 Impacts on Water Quality

As discussed above, any infrastructure that slows the velocity of water may result in increased temperature and nutrient loading, and decreased dissolved oxygen levels. Check dams or other devices utilized to store water for irrigation purposes may have this effect; however, these facilities present a potential water quality concern only if the stored water is not used, but rather is discharged to a receiving water body. In addition, equipment such as pumps and pipe used to convey water for irrigation purposes has the potential, if not appropriately maintained, to contribute oil, grease, fuel, or metals to adjacent water bodies.

4.7.3 Impacts on Habitat Elements and Covered Species

Diversion Intakes and Fish Screens

The diversion of surface water using unscreened or improperly screened intake diversions can result in a direct and critical impact to fish populations. If diversion intakes are not properly screened, entrainment and/or impingement of juvenile salmonids could occur and would result in a direct take of those species. Water rights for irrigation in the Planning Area were reviewed to determine the number of surface water diversions. Table 4-5 presents the number and quantity of water diversions from watercourses in the Planning Area where salmonids are present.

Many of the surface water diversions are seasonally placed with end-of-pipe screening systems. Insufficient data is available at this time to assess impacts from diversion equipment that is potentially out of compliance.

Table 4-5. Summary of Irrigation Surface Water Diversions from Watercourses with Fish Presence

Watercourse[1]	Total Number of Diversions (Associated with State-Issued Water Rights)	Total Instantaneous Rate (Qi) (cfs)
Browns Slough	2	2.6
Carpenter Creek	4	0.56
Dry Slough	1	0.5
Edison Slough	1	0.05
Hill Ditch	5	1.25
Joe Leary Slough	10	3.91
Samish River	11	5.69
Skagit River	3	1.01
South Fork Skagit River	3	2.34
Sullivan Slough	3	1.08
Big Ditch	1	0.892
Higgins Slough	1	0.26
Unnamed sloughs / streams	8	1.628
Total Surface Water Diversions	53	21.77

Source: Ecology, 2005b
[1] Big Indian Slough is not included in this table because no irrigation water rights were found for this watercourse.

4.7.4 Data Gaps

Data gaps for the impacts of irrigation-related facilities include:

- Inventory of all existing surface water Points of Diversion.
  - Fish screening compliance, where appropriate.
  - Bank hardening and riparian vegetation loss from permanent intake structures.
  - Unknown points of diversion that are included within the “unnamed” sloughs and streams.

4.8 Impacts Related to On-Farm Activities

On-farm activities include the use of V-ditches; pesticide, manure, and fertilizer application; livestock grazing; field tilling and preparation; and planting and harvesting of crops. It is not the intent of this CIDMP document to fully describe or seek coverage for the on-farm activities of individual landowners; however, an effort has been made to characterize the potential impacts of these activities in the Planning Area.

4.8.1 Impacts on Flow

V-ditches are temporary measures, installed by individual landowners, which are often used where seasonal surface water may accumulate in a field where there is no tile system or permanent drainage system in place. As discussed in Section 2.2.1, V-ditches are used seasonally to improve drainage from fields into the drainage network. These temporary drainage ditches contribute to volume in the drainage network; however, the extent of this contribution is not known.

4.8.2 Impacts on Water Quality

Fecal Coliform

Potential on-farm sources of fecal coliform bacteria include application of livestock waste to fields and animal access to water bodies. Livestock waste is often collected, stored, and applied to fields. The wastes may be applied in liquid form either by large sprinklers or by injection beneath the topsoil to minimize runoff. Waste may also be applied in solid form. The Dairy Nutrient Management Act (Chapter 90.64 RCW) requires every dairy farm to create and fully implement a Dairy Nutrient Management Plan. These plans address how to keep dairy waste from contaminating water bodies and groundwater. The Skagit Conservation District provides technical assistance for plan preparation and implementation. Typical structural BMPs include improved waste storage structures, such as concrete slabs and waste storage ponds; improved waste transfer and application systems; riparian exclusion fencing; and roof runoff management systems on farm buildings.

Animal access to water bodies may also contribute to fecal coliform loading. As discussed above and in Section 2, BMPs are utilized to minimize the potential for this to occur.

While not an agricultural activity, farmlands in the Skagit Basin are utilized by large populations of resident and wintering waterfowl for resting and foraging. Waste from these birds may represent a significant contribution to the fecal coliform loads in surface waters in the Planning Area and vicinity. Ecology is evaluating this issue as part of the Samish Watershed Fecal Coliform TMDL study (see Section 3.1.4).

Pesticides

Pesticides used by farmers could contribute to water quality concerns. Agricultural pesticide use is regulated by WSDA. As discussed in Section 3, a review of WSDA water quality data collected between 1995 and 2004 found no significant concentrations of pesticides in the Planning Area (WSDA, 2005).

As discussed in Section 3, WSDA has launched a comprehensive study of agricultural pesticide use throughout the state in 2006. One area of focus in this study will be the Skagit Basin. Farmers and the WWAA have volunteered to participate in this study. The WSDA study will greatly improve the understanding of pesticide use and associated impacts in the Planning Area.

Oil, Grease, Fuel, and Metals

On-farm activities may potentially contribute small quantities of oil, grease, fuel, and metals to water bodies through the use of heavy farm equipment such as tractors, harvest equipment, and mowers. If this equipment is used near the water and the equipment is leaking fluid, that fluid might gain access to the water. However, it is believed that the risk of this type of pollutant contribution is minimal.

Turbidity and Sediment

On-farm activities such as tilling and animal access to water bodies can contribute sediment to water bodies, and thereby affect turbidity. Exposed field soils can potentially be eroded by rain or wind into water bodies. Stormwater may transport materials such as dirt and gravel from roads into water bodies. Animals gaining access to water bodies can trample and destabilize banks, as well as stir up sediment. Cover crops, filter strips, and fencing are commonly used to minimize the impact of these pollutant sources.

Temperature

Removal of vegetation from stream banks, resulting in a lack of shade, can result in increased temperature in adjacent water bodies. Water storage or use of check dams to retain irrigation water can contribute to higher temperatures if the water is not used for irrigation, but instead is discharged to a water body. Irrigation return flows can also be a factor if they reach surface waters, but it is unlikely that this occurs in the Skagit Basin.

Nutrients

The use of chemical fertilizers or the application of livestock waste to fields can add nutrients to adjacent water bodies. Animal access to water bodies can also contribute nutrients.

4.8.3 Impacts on Habitat Elements and Covered Species

V-ditches

Seasonal V-ditching can result in elevated sediment levels in the waterways if discharge from the V-ditches directly enters watercourses. The majority of V-ditches are contained within the field in which they are placed, or discharge to drainage ditches where fish are not present. Sediments that are transported by a V-ditch are typically deposited within a few feet downstream of the discharge point, where they are removed during regular ditch maintenance. The most immediate potential impact would be from a V-ditch that drained directly into a fish-bearing watercourse. WWAA and the parties of the Drainage and Fish Initiative are working to identify and resolve any instances where V-ditches have the potential to impact fish-bearing watercourses.

These ditches can also transport excess nutrients, which can result in amplified algal or plant growth. This can result in depleted dissolved oxygen levels. The ditches convey sub-surface water; impacts to watercourses within the Planning Area from movement of sub-surface water are unknown.

Pesticides

Impacts to aquatic species from pesticide use can occur from direct lethal interactions and from bioaccumulation via indirect absorption from prey species. Some pesticides (including insecticides, fungicides, rodenticides, and herbicides) and fertilizers (including animal wastes) can directly kill fish and wildlife and indirectly affect habitat quality when used inappropriately. Information on toxicity and the effects of specific chemical treatments on fish and wildlife is scarce (Knutson and Naef, 1997). Impacts to birds and marine mammals can also occur through bioaccumulation.

Livestock Grazing

Livestock grazing within the riparian corridor of watercourses can affect riparian vegetation, resulting in bank erosion and increased sediment and turbidity. Improper management of livestock grazing in riparian habitat can have significant negative consequences for fish and wildlife (Knutson and Naef, 1997). In riparian areas where intensive management or fencing does not occur and grazing use is high, small mammals, reptiles, amphibians, ungulates, fish, and shrub- and ground-nesting or foraging birds are likely to suffer population reductions through loss of cover, forage, and breeding structures. The vegetation composition is likely to change, perhaps simplifying the plant community, and there may be a loss in the number of canopy layers. The condition of stream banks, channels, and riparian soils deteriorates under unmanaged or heavy grazing in riparian habitat.

Significant sources of animal waste can alter stream chemistry and adversely affect fish. In addition, large quantities of animal waste can create ammonia during the decomposition process in amounts that are fatal to fish. Intact vegetation and soils in riparian areas can assist in filtering bacteria, nutrients, and salts from animal waste (Knutson and Naef, 1997).

Land Use within Riparian Corridors

The soils and natural vegetation of riparian plants can hold and filter significant amounts of sediments, pesticides, and nutrients that are generated in cropland. This filtering capacity will reduce the quantities of these substances that enter aquatic systems to the detriment of fish, wildlife, and water quality. Areas of intact riparian vegetation also provide critical cover and foraging habitat for terrestrial wildlife, enabling many species to exist in an agricultural landscape. The retention of riparian vegetation helps reduce stream bank erosion, moderates temperature, moderates upland erosion, and lessens sediments in streams (Knutson and Naef, 1997).

Loss of Topsoil, Soil Erosion, and Sedimentation

Erosion of cropland topsoil and its subsequent deposition into stream systems is an impact of agricultural practices. The extent of aquatic habitat loss as a result of increased sedimentation is related to the duration and degree of sedimentation. Because of this, it is difficult to predict the degree of population impacts; however, general trends of losses of aquatic resources with increasing soil erosion are possible.

Soil erosion from farm land in the Planning Area has not been shown to be a major contributor to sedimentation of watercourses within the dikes. Topography of this area is essentially flat, and soil erosion from the cropped fields has not been shown to produce significant amounts of turbidity, except during occasional storm events.

Fertilizer Application

Fertilizers, if applied in excess of crop uptake, eventually get into water systems, altering the water chemistry and resulting in excessive aquatic plant and algal growth. Long-term consequences of this excessive growth are detrimental and can kill fish. Oxygen depletion occurs and water acidity increases, thereby altering survival of some fish and aquatic invertebrates and causing a shift in the abundance and composition of the native fish community. Excess acidity may slow fish growth and negatively affect reproduction in some species. Additionally, the abundance and composition of bottom-dwelling organisms can change in waters receiving excess nutrients. Species diversity may decrease and the abundance of a few nutrient-tolerant species may increase (Knutson and Naef, 1997).

In the Planning Area, agricultural pesticide use has not been systematically assessed. Some chemicals, historically used and now banned, have been identified in the Planning Area in extremely low concentrations (see Section 3.1.5). Current pesticide application practices are observed to conform to labeling and application rates. This issue is being investigated further by WSDA and Ecology (see Section 3.1.5).

4.8.4 Data Gaps

Data gaps for impacts related to on-farm activities include:

- Microbial source tracking of fecal coliform loads in the Planning Area.
- Indirect hydrologic impacts to watercourses from V-ditch use.
- Pesticide impacts specific to watercourses within the Planning Area.