LUMMI NATION
NONPOINT-SOURCE ASSESSMENT REPORT

December 2001

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EXECUTIVE SUMMARY

The goal of the Lummi Nation Nonpoint-Source Assessment Report (NPSAR) and Nonpoint-Source Management Program (NPSMP) is to provide guidance for future efforts to effectively and efficiently control nonpoint sources of pollution on the Lummi Indian Reservation (Reservation) and to coordinate with appropriate jurisdictions to control nonpoint sources of pollution in the watersheds that drain onto the Reservation. The objectives of the NPSAR are (1) to determine the current and potential impairments of Reservation waterbodies due to nonpoint-source (NPS) pollution, (2) to identify the primary nonpoint sources responsible for this pollution, and (3) to list the resources available to address nonpoint-source pollution. The objectives of the NPSMP are (1) to identify management practices that will reduce NPS pollution on the Reservation, (2) implement those NPS management practices on the Reservation, and (3) coordinate with appropriate jurisdictions to reduce off-Reservation NPS pollution that adversely affects Reservation surface- and ground-water resources.

The Lummi Nation finds that contamination of surface- and ground-water resources on the Reservation has a direct, serious, and substantial effect on the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation. Further, the Lummi Nation finds that those activities posing threats of such contamination, if left unregulated, could cause such adverse effects. Accordingly, the Lummi Natural Resources Department (LNR) is developing the NPSMP for the Reservation based on the foregoing findings and the following considerations:

- The Lummi Nation goal for surface waters of the Reservation is that these waters comply with the federal Clean Water Act.
- With the exception of evapotranspirational losses and water discharged into off-Reservation water from the two wastewater-treatment plants operated by the Lummi Nation, all water that falls onto or passes through the Lummi Reservation discharges to resource-rich tidelands and/or estuaries of the Lummi Nation. These resources, which are culturally and economically important to the Lummi Nation and its members, surround the Reservation uplands along the shoreline. Intertidal and/or estuarine resources include salmon, shellfish, surf smelt, sand lance, waterfowl, raptors, other wildlife, extensive eelgrass beds, spawning grounds for herring, and water-supply intakes for salmon and shellfish hatcheries.
- Population projections, planned economic and institutional growth on the Reservation, and the small percentage of Reservation land that has been developed all suggest that portions of existing forested and agricultural lands will be converted to residential, commercial, or community uses in the coming years. Where forested or agricultural lands are converted to residential, commercial, or community uses, surface-water quantity and quality will be affected.
- In general, development affects vegetation and soil properties in a manner that results in greater storm-water volumes, higher peak discharges, and lower water

quality. Minimizing these adverse effects from development and maximizing the protection of sensitive and important natural resources is necessary to protect the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation.

- Ample supplies of high-quality ground water are essential to serve the purposes of the Reservation as the permanent homeland of the Lummi Nation and its members.
- Over 95 percent of the residential water supply for the Reservation is pumped from local ground-water wells; contamination of wellheads carries the risk of adversely affecting the health of persons drinking or using water from these supplies.
- The salmon-hatchery program on the Reservation, which is culturally and economically significant to the Lummi Nation and its members, is dependent on high-quality ground and surface water.
- As a finite resource, ground water is one of the most important and critical of the Lummi Nation's resources. Storm water is an important source of ground-water recharge and a potentially significant source of ground-water contamination.
- Ground-water resources are vulnerable to contamination by pollutants introduced on or near the ground surface by human activities. Agricultural, residential, community, commercial, and industrial land uses increase the potential for ground-water contamination.
- Reservation ground-water resources are particularly vulnerable to pollution because of geographic and hydrogeologic conditions, which may be exacerbated by future growth and development on the Reservation. The Reservation is located in a coastal area along the inland marine waters of Puget Sound and Georgia Strait. Most of the existing water-supply wells on the Reservation are located within a half-mile of marine waters. Progressive saltwater intrusion already has led to the closure of several of these public water-supply wells. Increased pumping, possible future reductions in ground-water recharge areas as the forested Reservation uplands are converted to residential and other uses, and rapid economic and population growth could further threaten the Lummi Nation's ground-water resources if such activities are not managed effectively. Managing surface water to minimize water-quality impacts and to maximize ground-water recharge will help to protect the limited and vulnerable ground-water resources on the Reservation.
- Ground-water contamination could lead to the loss of the primary water-supply source for the Reservation because water-supply wells are difficult to replace, ground-water contamination is very expensive to treat, and some damages to ground water caused by contamination may be impossible or unfeasible to mitigate.
- Alternative water sources to serve the needs of the Reservation are expensive and may not be available in amounts sufficient to replace existing supplies and to provide for anticipated tribal economic and residential growth in the future. Moreover, alternative water sources would require substantial amounts of funding for the infrastructure upgrades that would be necessary to import larger volumes

of water onto the Reservation. Finally, alternative water sources may be subject to service interruptions over the long term because of natural or human-generated disasters.

Analysis of available water-quality data and potential sources of NPS pollution shows that surface waters on and flowing onto the Reservation are currently or potentially affected by all types of NPS pollutants. These types of pollution include bacteria/pathogens, fine sediment, nutrients, oxygen-demanding substances (which result in low dissolved-oxygen levels), pH, temperature, metals, pesticides, household and industrial chemicals, and oil and grease. Nonpoint-source pollution currently and/or potentially impairs the four major waterbodies (Nooksack River, Portage Bay/Bellingham Bay, Lummi River, and Lummi Bay/Strait of Georgia) and the ground water on the Reservation. The three current impairments of greatest concern to the Lummi Nation are the closure of large portions of Portage Bay to commercial harvest of shellfish, the degradation of salmonid habitat in the Nooksack River watershed and estuary, and saltwater intrusion into Reservation aquifers. The potential impairments of most concern are the threat of commercial shellfish closures in Lummi Bay (and in the remaining approved areas of Portage Bay) and the contamination of Reservation ground water. These waters require NPS control measures to restore or maintain desired water uses and/or, in the case of surface waters, to meet or maintain the Draft Lummi Water-Quality Standards[1].

The primary NPS categories responsible for the current and potential impairments of surface and ground water on the Reservation are agriculture, silviculture, hydromodification (including aquatic and riparian habitat modification), urban runoff, and ground-water withdrawal. Other source categories, in particular atmospheric deposition, highway/road runoff, construction, and land disposal, are contributors to the impairment of Reservation waterbodies, but are not known to produce significant impairment at this time. Control of each NPS category should contribute to the improvement and maintenance of water quality on the Reservation. The primary sources of impairment should be the priority targets for NPS management.

To reduce and/or eliminate the adverse effects of NPS pollution on surface and ground water and to achieve the NPS management goals, appropriate best-management practices (BMPs) must be effectively applied. Effective use of BMPs, coupled with land-use zoning, should minimize and/or eliminate the NPS pollution effects on Reservation waters. Nonpoint-source pollution on the Reservation is largely addressed, or will soon be addressed, by 13 Lummi Indian Business Council environmental programs and various Lummi Natural Resource Department activities that specifically target the primary current and potential impairments of Reservation waterbodies. The NPSMP for the Reservation will support and complement these current programs and activities and will emphasize continued involvement in off-Reservation NPS pollution issues. Community involvement will be a key element of the Lummi Nation NPSMP because

[1] The Lummi Nation is currently in the application process with the EPA to administer Sections 303(d) and 401 of the Clean Water Act.

surface- and ground-water movement does not follow property or political boundaries and because community participation in developing and implementing the NPSMP is necessary for the program to be successful. The three elements of the community-involvement plan are (1) public education and outreach, (2) interjurisdictional coordination and cooperation for activities off-Reservation that affect on-Reservation resources, and (3) working with project applicants to assure compliance with Lummi Indian Business Council ordinances. The NPSMP is targeted for completion by 11 January 2002.

1. INTRODUCTION

1.1 DEFINITION OF NONPOINT-SOURCE POLLUTION

Nonpoint-source (NPS) pollution is all pollution that cannot be identified as point-source pollution. The legal definition of a point source from Section 502(14) of the Clean Water Act (CWA) states:

> The term "point source" means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal-feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. This term does not include agricultural storm-water discharges and return flows from irrigated agriculture.

Nonpoint-source pollution is more aptly termed diffuse-source pollution because its sources are numerous and widespread. Nonpoint-source pollution occurs when water in any form (e.g., surface water, snow, rain, or fog) picks up contaminants. This can happen in lawns or fields where fertilizer or pesticides have been applied, anywhere that oil or other pollutants have leaked or spilled and come into contact with water, and anywhere that soils are exposed to erosion through activities such as construction, cultivation, or clearing. In short, NPS pollution can originate nearly anywhere. Polluting actions by individuals often appear insignificant when considered alone, but considering that many people have done, are doing, and will engage in the same activity, the pollution can add up to a significant problem. The cumulative effect of NPS pollution commonly results in impairment of surface and/or ground water.

The most effective way to reduce water pollution is to prevent contaminants from coming into contact with water. This proactive approach of pollution prevention requires proper handling, storage, and disposal of polluting materials as well as immediate clean up of spills. This in turn requires education, safe places to dispose of pollutants, and an awareness of the responsibility to do so. Where this is not possible (as with the wear of tires on roads), treatment of the water is required before it flows into a stream or infiltrates into the ground. Prevention of NPS pollution is far preferable to treatment because treatment is never 100 percent effective and can be very expensive.

Nonpoint-source pollution also includes physical modification of waterbodies through direct means (e.g., channelization, diking, or draining) and indirect means that alter the volume and timing of runoff (EPA 1993a). Impermeable surfaces (e.g., roofs, parking lots) and drainage improvements associated with most land uses increase the amount of storm-water runoff and reduce the amount of time required for the storm water to reach surface waters. The increased volume of water in the receiving waters can alter the composition of the streambed, contribute larger amounts of sediment, and erode the banks as the shape of the channel changes to accommodate more frequent high flows. In contrast, when rain water in the Pacific Northwest falls on land that is in a natural or unimproved state, the rain water only occasionally flows across the surface (i.e., overland

flow) to nearby waterbodies. Further, the rapid runoff of storm water associated with increased impermeable area and/or improved drainage decreases infiltration and results in less ground water to augment stream flow during dry periods. The resulting low flows can effectively increase the concentration of contaminants and/or the probability of violations of water-quality criteria.

In summary, NPS pollution largely results from the cumulative effects of individual actions that appear insignificant when viewed independently. Pollution prevention is the most effective method to minimize the effects of NPS pollution because individual sources are numerous and dispersed and because treatment options are expensive and can have limited effectiveness.

1.2 RESERVATION RESOURCES

The waters of the Lummi Indian Reservation (Reservation) contain significant resources for both the Lummi Nation and the region. Numerous economically and culturally important species, including herring, salmon, oyster, manila clam, little neck clam, butter clam, horse clam and dungeness crab, use the Reservation waters. Reservation waters also contain large eelgrass meadows and habitat for numerous species of waterfowl, marine birds, and raptors (including the bald eagle and peregrine falcon). Nonpoint-source pollution can result in economic and cultural hardship by decreasing the health and abundance of fish, shellfish, and wildlife; cause downgrades of commercial shellfish beds; and affect human health through consumption of contaminated fish and shellfish.

The Lummi Nation finds that contamination of surface- and ground-water resources on the Reservation has a direct, serious, and substantial effect on the political integrity, economic security, health, and welfare of the Lummi Nation, its members, and all persons present on the Reservation. Further, the Lummi Nation finds that those activities posing threats of such contamination, if left unregulated, could cause such adverse effects.

1.3 GOALS AND OBJECTIVES

This Nonpoint-Source Assessment Report (NPSAR) provides the information necessary to design a Nonpoint-Source Management Program (NPSMP) for the Lummi Reservation. The NPSMP is a part of the Comprehensive Water Resources Management Program (CWRMP), which includes the Wellhead Protection (WPP), Storm Water Management (SWMP), Wetlands Management (WMP), and Water Quality Standards (WQS) programs that are under development. The CWRMP is being developed and implemented by the Water Resources Division of the Lummi Natural Resources Department (LNR) and will address the overall management of Reservation waters. The water-quality standards will provide criteria against which impacts from NPS pollution can be evaluated.

The goal of the NPSAR and NPSMP is to provide guidance for future efforts to effectively and efficiently control nonpoint sources of pollution on the Lummi

Reservation and to coordinate with appropriate jurisdictions to control nonpoint sources of pollution in the watersheds that drain onto the Reservation. The specific objectives of the NPSAR are (1) to determine the current and potential impairments of Reservation waterbodies due to NPS pollution, (2) to identify the primary nonpoint sources responsible for this pollution, and (3) to list the resources available to address NPS pollution.

1.4 ORGANIZATION OF REPORT

This report is divided into 12 sections:

- Section 1 is this introductory section.
- Section 2 describes the methods used to assess NPS pollution for this report.
- Section 3 describes the land use and physical characteristics of the assessment area.
- Section 4 summarizes the quality of surface and ground waters on the Reservation.
- Section 5 presents an inventory of potential sources of NPS pollution, a description of the impacts of NPS pollutants, and an assessment of the impairment of Reservation waters.
- Section 6 identifies the primary impairments of Reservation waterbodies and discusses the source categories responsible for these impairments.
- Section 7 describes the existing NPS pollution reduction programs on the Reservation.
- Section 8 describes the process for selection of best-management practices that will address NPS pollution.
- Section 9 lists all potential NPS control programs available on and off the Reservation.
- Section 10 presents the conclusions of the NPSAR.
- Section 11 lists the references cited in this report.
- Section 12 lists the acronyms and abbreviations used in this report.

2. METHODS

The surface-water impairments of greatest concern to the Lummi Nation are the Portage Bay Shellfish Closure, potential Lummi Bay shellfish restrictions, and salmonid impairment in the Nooksack River watershed. Since the major sources of these impairments extend beyond the Reservation in the Lummi River and Nooksack River watersheds (as explained in Sections 3.5, 3.6.1, 4.6, 5, and 6), impairment of these two rivers was assessed on a watershed-wide basis. Data from the LNR Surface Water Quality Monitoring Program (SWQMP) was used to assess the condition of surface waters on the Reservation. These data were collected starting in 1993 under CWA Section 106 grants and the General Assistance Program (GAP) grants awarded to the Lummi Nation by the U.S. Environmental Protection Agency (EPA). The condition of surface waters off-Reservation was determined from both the 1998 Washington State 303(d) list (Ecology 2000a) and the Unified Watershed Assessment (Appendix A) prepared by the LNR.

Surface waters on the Reservation that did not meet the Draft Lummi Water-Quality Standards (DLWQS, which are numerically the same as the current Washington State standards) and surface waters off the Reservation that were placed on the 303(d) list were considered impaired by NPS pollution, unless a point source was specifically identified as the cause of the impairment. In addition, if the watershed of a waterbody contained substantial sources of a type of nonpoint pollution (e.g., nutrients or metals) that can negatively affect salmonids, the waterbody was also considered impaired by that type of nonpoint pollution. In this report, a high degree of impairment equates to non-attainment of, or a lack of support for, a designated use at some point in time and in some portion of the watershed. Moderate impairment is associated with interference with designated uses that falls short of non-attainment, but is nonetheless significant. A low degree of impairment means that interference with designated uses is likely, but probably not significant. Table 2.1 summarizes these definitions of degrees of impairment.

Non-attainment of DLWQS (on-Reservation) or a 303(d) listing (off-Reservation) for more than three tributaries or for the mainstem of the Lummi or Nooksack rivers (including the three forks of the Nooksack) resulted in a determination of a high degree of impairment of the waterbody. A DLWQS non-attainment or 303(d) listing for three or fewer tributaries was generally judged a moderate degree of impairment. If substantial sources of a pollutant are present in the watershed, but DLWQS non-attainments or 303(d) listings were lacking (possibly because of a lack of sampling or testing), the determination of the degree of impairment was based on the available literature that addresses the pollution potential of land uses in the contributing watershed. In all cases, the degree of impairment (listed in Table 5.2) reflects documented impacts as well as literature-based assessment of undocumented potential impacts and of the degree of impact associated with individual pollutants (Table 2.1). The relative contributions of documented impacts and potential impacts in the determination of waterbody impairment varied for each waterbody.

The contamination of Reservation ground water by salt water or other pollutants is a current and/or potential impairment of great concern to the Lummi Nation. Data from the LNR Ground Water Monitoring Program (GWMP) was used to assess the condition of ground waters on the Reservation. Saltwater intrusion constituted impairment of ground water because it makes the ground water unpotable. (Though salty water can be treated to some degree, continued pumping is not recommended because it could maintain the problem, or make it worse.) Impairment of ground water by other contaminants was determined by non-compliance with Safe Drinking Water Act requirements or by a literature-based assessment of potential pollution from land uses in the affected watershed. The definitions of high, moderate, and low degrees of ground-water impairment used in this report are the same as those described in the second paragraph of this section for surface water. The degree of impairment (listed in Table 5.2) was determined based on the number and productivity of affected wells and review of the current and/or potential impacts associated with individual pollutants (Table 2.1).

Table 2.1 Summary of Degree of Impairment Definitions

Applicable Waters	High Impairment Criteria	Moderate Impairment Criteria	Low Impairment Criteria
All Waters	Non-attainment of or a lack of support for a designated use at some point in time and in some portion of the watershed or aquifer	Interference with designated uses that falls short of non-attainment but is nonetheless significant	Interference with designated uses is likely, but probably not significant
Surface Water	(1) Non-attainment of DLWQS (on-Reservation) or a 303(d) listing (off-Reservation) for more than three tributaries or for the mainstem of the Lummi or Nooksack rivers (including the three forks of the Nooksack), or (2) Literature-based assessment of the pollution potential of land uses in the contributing watershed(s)	(1) Non-attainment of DLWQS or 303(d) listing for three or fewer tributaries, or (2) Literature-based assessment of the pollution potential of land uses in the contributing watershed(s)	Literature-based assessment of the pollution potential of land uses in the contributing watershed(s)
Ground Water	Saltwater intrusion, non-compliance with Safe Drinking Water Act requirements, or an assessment based on the number and productivity of affected wells and an assessment of the current or potential impacts associated with individual pollutants		

Nonpoint-source categories (e.g., agriculture, silviculture, hydromodification, and urban runoff) contributing pollutants to Reservation waters were ranked in Table 6.1 based on the estimated impact their associated pollutants have on designated water uses. In this report, a high level of impact means that the NPS category contributes the majority of the NPS pollution responsible for a high degree of waterbody impairment. A moderate level of impact is associated with a significant, but not primary, source category or a moderate degree of impairment. A low level of impact is associated with a minor source of NPS pollution or a low degree of impairment. These impacts were determined using the criteria listed in Section 6.2 and a literature-based assessment of the pollution potential of land uses/NPS categories in the contributing watersheds. Table 2.2 lists the NPS categories and subcategories used in this report and the types of NPS pollution assessed for this report. (Table 2.2 does not list the NPS subcategories judged negligible or non-existent in the Reservation watersheds.)

Table 2.2 Nonpoint-Source Categories, Subcategories, and Pollution Types

NPS Category[1]	NPS Subcategory[1]	Types of NPS Pollution
Agriculture	Non-irrigated Crop Production	Bacteria/Pathogens
	Irrigated Crop Production	
	Specialty Crop Production	Fine Sediment
	Pasture Grazing	
	Confined Animal Feeding Operations	Habitat Alteration
Silviculture	Harvesting, Restoration, Residue Management	Metals
	Forest Management	Nutrients
	Road Construction/Maintenance	
Construction	Highway/Road/Bridge	Oxygen-Demanding Substances (Organic Enrichment)
	Land Development	
Urban Runoff/ Storm Sewers	Non-industrial Permitted	
	Industrial Permitted	Pesticides, Household and Industrial Chemicals, and Oil and Grease
	Other Urban Runoff	
	Highway/Road/Bridge Runoff	
	Erosion and Sedimentation	
Resource Extraction	Surface Mining (sand/gravel)	pH
Land Disposal	Landfills	
	On-site Wastewater Systems	Saltwater Intrusion
Hydromodification/ Habitat Modification	Channelization	
	Flow Modification	Temperature
	Removal of Riparian Vegetation	
	Streambank Modification or Destabilization	
	Draining/Filling of Wetlands	
Marinas and Recreational Boating		
Atmospheric Deposition		
Waste Storage/ Storage Tank Leaks		
Highway Maintenance and Runoff		
Spills		
Natural Sources		
Recreation Activities	Golf Courses	
Ground-Water Withdrawal		

[1]"Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates: Supplement," EPA-841-B-97-002B, 1997

3. ASSESSMENT AREA DESCRIPTION

The Lummi Indian Reservation is located at the mouth of the Nooksack River and along the western border of Whatcom County, Washington (Figure 3.1). The Nooksack River drains a 786 square mile watershed, flows through the Reservation near the mouth of the river, and discharges to Bellingham Bay (and partially to Lummi Bay during high flows). Approximately 26 miles of highly productive marine shoreline surround the Reservation on all but the north and northeast borders. Most of the high density development to date has occurred along the marine shoreline. The Reservation includes the Nooksack and Lummi river deltas, tidelands, and largely forested uplands. The Reservation also features relatively low topographic relief and a temperate marine climate.

The land uses, topography, climate, hydrogeology, soils, watersheds, and surface-water resources on the Reservation affect the distribution of NPS pollution. This section briefly describes each of these elements.

3.1 LAND USE AND SOCIOECONOMIC CONDITIONS

Like most places, land-use changes on the Reservation have generally been associated with changes in vegetation types, decreases in the areas covered by vegetation, changes in natural drainage patterns, and increases in impervious surfaces. After their arrival, Euro-Americans logged, cleared, and drained forested land for agricultural, residential, and commercial development. Natural drainage patterns on the Reservation were substantially altered by the road system, agricultural drainage ditches, and dikes.

Historic, current, and projected future land uses in the Reservation watersheds and socioeconomic conditions on the Reservation are described below. Much of the information about historic land uses and socioeconomic conditions comes from the *Lummi Nation Comprehensive Environmental Land Use Plan: Background Document* (LIBC 1996).

3.1.1 Historic Land Use

Before the arrival of Euro-Americans, the Lummi people were a fishing, hunting, and gathering society. Based on the accounts of Lummi Elders, early European explorers, and early photographs of the region, old-growth forests of massive Douglas fir, western hemlock, spruce, and western red cedar dominated the Lummi Reservation before 1850. Deciduous trees such as western big leaf maple, black cottonwood, red alder, and western paper birch were also likely present along the rivers, streams, and open areas. Understory vegetation probably included vine maple, Oregon grape, several different willows, ocean spray, salmon berry, thimbleberry, soapberry, and many others. Wetlands, streams, and rivers supported a unique array of plants adapted to wet environments. The marine shoreline was also a unique environment, where only plants adapted to a saltwater-influenced environment thrived.

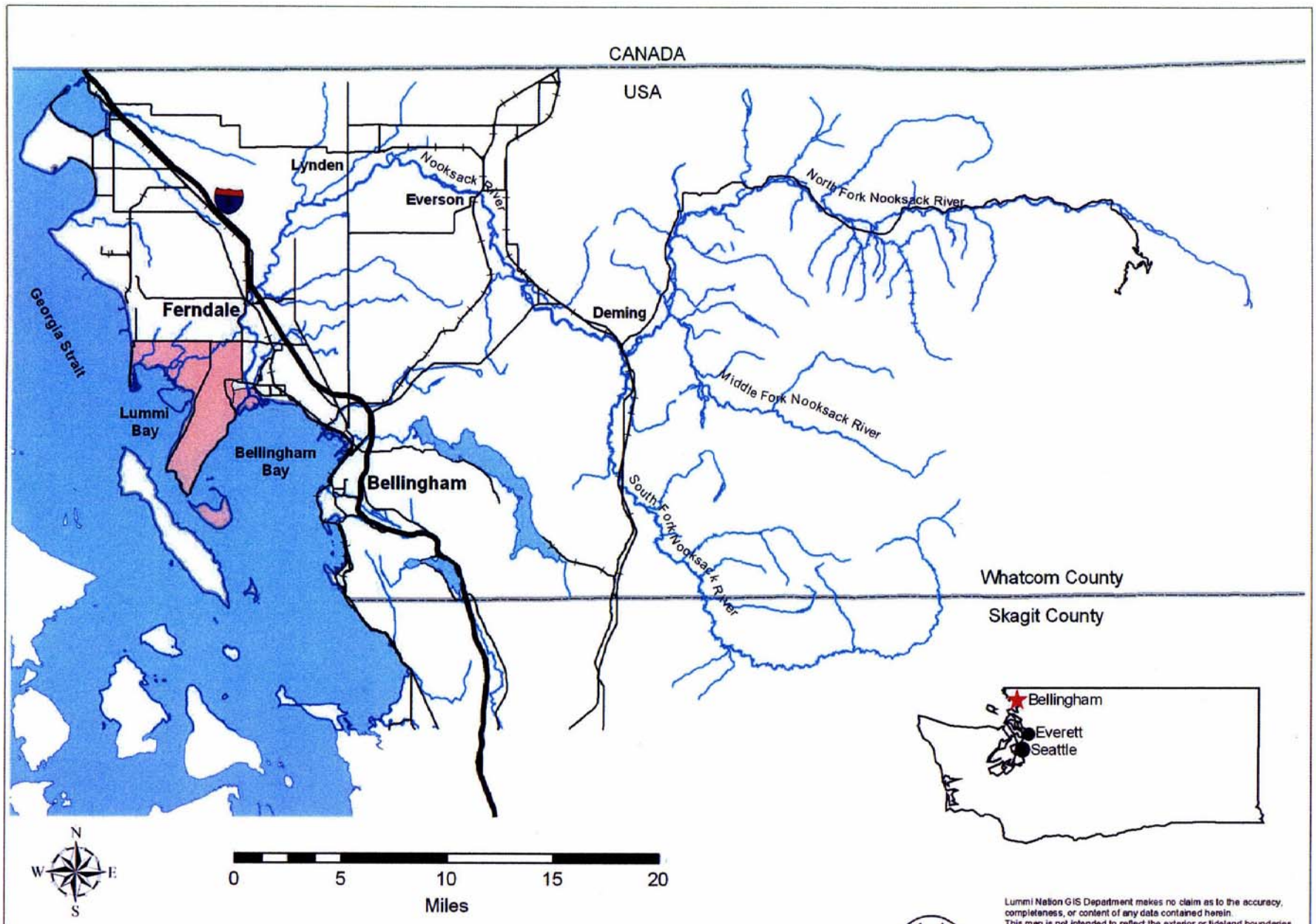

Figure 3.1 Regional Location of the Lummi Indian Reservation

The forces that shaped vegetation patterns in the Northwest before the arrival of Euro-Americans were forest succession, fires, wind storms, ice storms, floods, and traditional use of natural vegetation by the indigenous peoples. Native American uses of vegetation included the gathering of medicinal plants, the use of willows and other shrubs for fishing, and the extensive use of western red cedar trees for many things, including clothing, baskets, buildings, and canoes. Many plants were also sources of food to complement the traditional diet of fish, shellfish, elk, and deer. Native Americans cultivated some of these plants, such as ferns, camas, and wapato, in prairies along the Nooksack River.

Similar to most areas in the lower Nooksack River watershed downstream from Everson, conversion of forestland to agricultural land occurred on the Lummi Reservation following the arrival of Euro-Americans. In 1896, approximately 1,222 acres were reportedly under cultivation on the Reservation. Along with clearing the forested land for agriculture, Euro-Americans constructed ditches, drained wetland areas, cleared logjams, diverted the Nooksack River to drain into Bellingham Bay, built a dike that cut off the Lummi River delta from the Nooksack River, and built a seawall along Lummi Bay. As detailed in Sections 3.2 and 3.6, these changes in the natural hydrology of the Reservation changed the distribution and patterns of watercourses and of wetland- and riparian-associated plant communities.

Much of the cedar on the Reservation was cut into shingle bolts and shipped to local shingle mills. The old-growth trees on Portage Island were cut down to fuel steamboats traveling the Nooksack River. One or more large fires swept through the Lummi Reservation between 1850 and 1900. These fires destroyed nearly all of the remaining old-growth forests. Since reforestation was not practiced during the early logging period, pioneer tree species, such as alder, willows, and cottonwoods, soon replaced the conifer forests and dominated the landscape. Although there are conifer groves and Douglas fir plantations, the present day forests on the Reservation are largely comprised of deciduous trees.

Historically, the Nooksack River flowed (alternately or simultaneously) to both Lummi and Bellingham bays (effectively making the Lummi Peninsula an “island”). Before 1860, the Nooksack River discharged primarily into Lummi Bay by way of the present Lummi River channel, with smaller distributaries flowing into Bellingham Bay (WSDC 1960; Deardorff 1992). In 1860 a logjam blocked the Nooksack River and diverted it to a small stream that flowed into Bellingham Bay (WSDC 1960). Since that time, considerable effort has been expended to keep the Nooksack River discharging into Bellingham Bay because of the increased commercial value of the river that resulted from its proximity to sawmills along Bellingham Bay (Deardorff 1992). Until the early 1900s, the Nooksack River was also the primary transportation corridor for Ferndale, Deming, and Lynden residents traveling to Bellingham. The stream remaining in the old channel of the Nooksack River has been called the Lummi or Red River (WSDC 1960).

In the 1920s, a reclamation project was initiated both to construct a dike/seawall to keep back the sea along the shore of Lummi Bay and to construct a levee along the west side

of the Nooksack River (Deardorff 1992). This project, which was started in 1926 and completed in 1934, initially resulted in the nearly complete separation of the Lummi River from the Nooksack River. However, when saltwater intrusion onto the newly reclaimed farmlands and damage to the dam at the head of the Lummi River occurred during flooding, the dam was replaced with a dam and spillway structure (Deardorff 1992). This spillway structure was also damaged over the years during high-flow conditions and was replaced in 1951 by a five-foot-diameter culvert that allowed flow from the Nooksack River into the Lummi River (FEMA 1999). Currently a four-foot culvert (Deardorff 1992) allows flow to the Lummi River only during relatively high-flow conditions (greater than 10,000 cfs). Levees were also constructed along the Lummi River to prevent saltwater intrusion onto adjacent farmlands.

The dike and levee construction activities were accompanied by agricultural ditching to drain fields and wetland areas. Based on 1887-88 topographic surveys, Bortleson et al. (1980) estimated that wetlands located landward of the general saltwater shoreline in the lower Lummi River watershed have decreased by approximately 95 percent from approximately 2.0 square miles (mi^2) to 0.1 mi^2.

3.1.2 Current Land Use

As part of the SWMP study (LWRD 1998a), a LANDSAT satellite image from 15 August 1991 was used to estimate the extent of various land uses in the watersheds that drain to the Reservation tidelands. The Whatcom County Planning and Development Services had classified the image into different land-cover types (Whatcom County is adjacent to the Reservation). The land uses in the Nooksack River basin were characterized based on information presented in the Whatcom County Comprehensive Plan (Whatcom County 1997).

The focus of the LANDSAT image-classification effort by Whatcom County was to analyze forest-cover types and structure in the foothills of Whatcom County (rather than to analyze the lowlands). Urban and agricultural classifications were not field-validated to the extent of the forest-cover types. Consequently, classification errors for these two cover types are apparent in the map of land-cover types shown in Figure 3.2. For example, locations known to be agricultural fields were sometimes classified as urban/residential areas. Locations that had been incorrectly classified as urban/residential/industrial were generally attributed to grasses/agriculture land use, except for Portage Island. On Portage Island, this classification was interpreted to be rocks in the beach areas.

Wetland areas were not a separate land-cover classification in the satellite image, but were added to the list of land covers by LNR during the SWMP study (LWRD 1998a). Using wetland information derived from existing GIS coverages of wetland locations, the initial extent of land-cover types estimated from the LANDSAT image were adjusted (LWRD 1998a) to reflect the presence of wetlands. The GIS coverages of wetland locations used in this 1997-1998 analysis were derived from the National Wetland

Inventory maps (USFWS 1987) and from wetland location maps developed by a tribal consultant (Arnett 1994).

The estimated distribution of land-cover/land-use types on the Lummi Reservation is summarized in Table 3.1, and the locations of the various land-cover types are shown in Figure 3.2. As evident in Table 3.1, which excludes both the tribal tidelands and the land-cover/land-use types in the portion of the Nooksack River watershed that extends outside the Reservation, approximately 91 percent of the Reservation lands are either agricultural, forested, or wetlands. A comprehensive inventory of Reservation wetlands conducted in 1999 (Harper 1999; LWRD 2000a) found that portions of the grass/agricultural and forest areas listed in Table 3.1 are also wetlands. The percentages in Table 3.1 do not reflect the 1999 inventory information.

Table 3.1 Current land-cover/land-use types on the Lummi Reservation[1]

Land Cover/Land Use	Percent of Area[1]
Grasses/Agricultural	51.55
Deciduous Forest	25.13
Wetlands	9.79
Coniferous and Mixed Forest	4.60
Scrub-Shrub	2.87
Residential/Urban/Industrial	2.75
Fallow Fields/Exposed Soil	2.07
Water	1.20
Rock	0.04

[1] Does not include the Nooksack River watershed (off-Reservation) or tribal tidelands

Figure 3.3 presents an analysis of land use/land cover on the Reservation that is more specific than that of Figure 3.2. Figure 3.3 also depicts the developed areas on the Reservation more accurately than Figure 3.2. Figure 3.3 was derived from interpretation of aerial color photos taken in 1983; this interpretation was updated with information from black and white aerial photos taken in 1991 (Caplow 1993). Information from National Wetland Inventory maps (USFWS 1987) was also used to identify wetlands. The predominance of agriculture in the floodplain that is depicted in Figure 3.3 has not changed to this date, though a gas station/mini-mart is currently located at the southeast corner of Haxton Way and Slater Road. A new casino is currently under construction adjacent to the gas station. Figure 3.3 provides a clear indication of the extensive residential development of the shorelines along the Sandy Point and Lummi peninsulas.

The 2000 Census found 1,749 housing units on the Reservation, of which 1,455 (83.2%) were occupied year-round and 221 (12.6%) were for seasonal or occasional use. The remaining 73 (4.2%) housing units were vacant. The total population of the Reservation was 4,193 in the 2000 Census, a dramatic increase from 721 in 1960 (note: the 1960 census may have had a significant undercount).

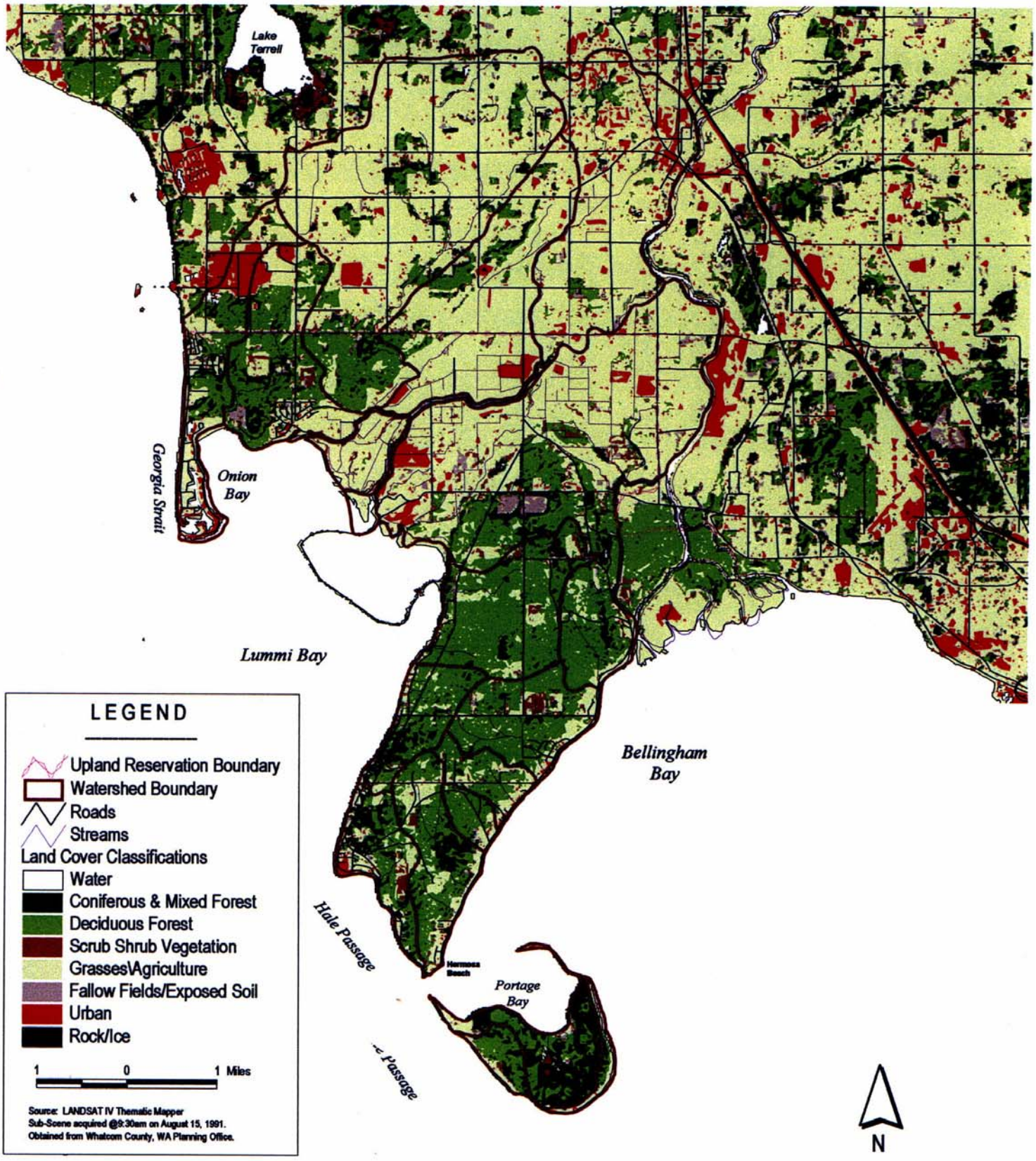

Figure 3.2. Land Cover Types of the Lummi Reservation and Environs

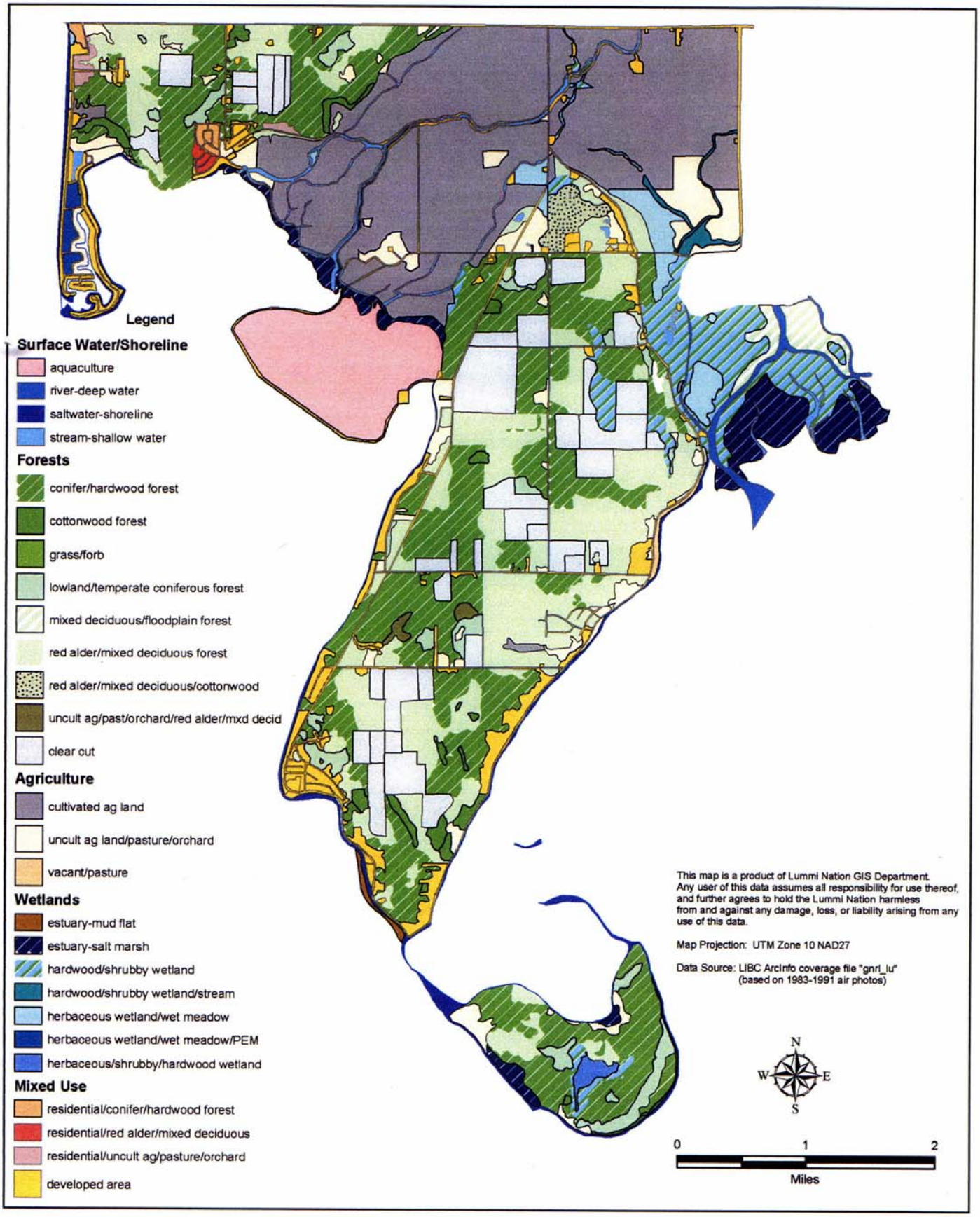

Figure 3.3 Land Use/Land Cover on the Lummi Reservation

Based on estimates of land cover in Whatcom County (Whatcom County 1997), land cover/use in the Nooksack River watershed is generally dominated by forested areas upstream from the town of Deming and agricultural lands downstream from Deming. Population centers such as Ferndale, Lynden, Everson, and Deming are located adjacent to the Nooksack River.

3.1.3 Future Land Use

The Lummi Planning Department used demographic profile data from the 1990 Census and projected that between 3,800 and 4,350 housing units will be needed on the Reservation by the year 2010 (LIBC 1996). Population projections for the year 2020 range from 6,661 to 11,433. Population growth over the past decade (33%) points to the low end of this range. However, an increase in the availability of affordable housing could push the population into the upper half of the projected range (LIBC 1996). These population projections, planned economic and institutional growth on the Reservation, and the small percentage of tribal land that has been developed suggest that portions of presently forested or agricultural lands on the Reservation will be converted to residential and commercial uses in the coming years.

Similarly, future land use in the Nooksack River watershed is projected to include more residential, commercial, and urban development to accommodate projected population increases (Whatcom County 1997).

3.1.4 Socioeconomic Conditions

Fishing, logging, and other natural resource work has historically provided most of the jobs for Lummi tribal members. Until the 1974 Boldt Decision, Lummi tribal members were systematically precluded from the profitable salmon fishery in Puget Sound. Once the treaty fishing right was upheld by the U. S. Supreme Court, commercial fishing and fish processing began to expand on the Reservation, with increasing numbers of fishermen, fish processing, and increased overall tribal revenue from salmon fisheries. The Lummi Nation is currently the largest fishing tribe in Puget Sound. However, the recent declines in salmon stocks have dramatically altered the tribal dependence on salmon fishing as an economic mainstay. In 1985, the average Lummi fisherman made $22,796. In 1993, the average income from fishing was only $5,555. At that time, about 30 percent of the tribal work force relied on fishing for their sole source of income. Since 1993, further reductions in salmon stocks have resulted in closure of some fisheries and a further reduction in tribal fishery incomes (LIBC 1996). In recent years, the annual value of the Lummi Nation fishery has declined from a high of over $13 million in 1985 to approximately $3 million in 1999.

In addition to catching fish and harvesting shellfish, the Lummi Nation owns and operates three fish-hatchery facilities. These facilities produce millions of young salmon each year and help offset the decline of fish stocks due to loss of natural habitat and historic over-fishing. The tribe also owns an on-Reservation shellfish hatchery, producing over one billion oyster and clam seeds annually. The tribe owns 8,000 acres

of tidelands, much of which is suitable for productive shellfish beds (LIBC 1996). Approximately 220 acres of these tidelands in Portage Bay are currently closed to commercial harvest of shellfish because of elevated levels of fecal coliform bacteria. The cause of the closure has been attributed to poor dairy-waste-management practices in the Nooksack River watershed (DOH 1997).

The Lummi Casino project began in 1983 in an effort to diversify the Reservation economy. The program was upgraded significantly in 1994 with the opening of the Lummi Casino at Fisherman's Cove. The casino flourished initially, employing approximately 400 people, 65 percent of whom were Native American (LIBC 1996). However, competition and changing economic conditions resulted in the closure of the casino on 26 August 1997. With 238 workers losing their jobs, the Lummi unemployment rate grew to approximately 50 percent. A new casino is scheduled to open during April 2002 at a new location (the corner of Haxton Way and Slater Road) that is closer to Interstate 5. The casino is projected to employ approximately 200 people in a range of positions paying from $16,000 to $60,000 per year.

Adjacent to the proposed casino site, the Lummi Indian Business Council (LIBC) operates a gas station and mini-mart. Other employment opportunities exist at the two oil refineries and the aluminum smelter just north of the Reservation and nearby in the communities of Ferndale and Bellingham. In addition, 15 to 20 small businesses are located on the Reservation, some of which are listed in Table 5.1.

The LIBC is the 13th largest employer in the Whatcom County area and a major employer on the Reservation today. The LIBC provides community, administrative, education, and health services to the tribal population in order to help achieve the important tribal economic and social development goals. These goals include job creation for tribal members, income generation to fund community development programs, and diversification and stabilization of the local economy by creating alternatives to fishing. Revenue generation is needed in order for the Lummi Nation to develop economic self-sufficiency.

Most of the LIBC and Northwest Indian College employees are tribal members. However, in 1993, 56 percent of the 2,500 working-age Lummi tribal members were unemployed, under-employed, full-time students, or no longer seeking work (LIBC 1996). Since 1993, the combined effect of the decline in the fishery and the closure of the original casino has had a substantial negative impact on the Lummi economy. The current unemployment rate on the Reservation is estimated to be approximately 37 percent. The new casino jobs are expected to reduce this unemployment rate by an estimated 20 percent.

3.2 TOPOGRAPHY

The Lummi Reservation is comprised of two relatively large upland areas of low relief on the mainland, a smaller upland area on Portage Island, and two distinct lowland areas (the floodplains of the Lummi and Nooksack rivers and the Sandy Point Peninsula). The maximum elevation of the northwestern upland area of the Reservation is about 220 feet above mean sea level (ft msl). The southern upland area is the Lummi Peninsula with a maximum elevation of about 180 ft msl. The maximum elevation on Portage Island is about 200 ft msl. The floodplain of the Lummi and Nooksack rivers, with an average elevation of approximately 10 ft msl, lies between the northern and southern upland areas. The Nooksack River and the Nooksack River delta are located along the northeastern extent of the Reservation. The Sandy Point Peninsula lies to the southwest of the northwestern upland. Figure 3.4 displays these geographic locations, the topography, and the major roads on the Reservation.

The upland and lowland areas of the Reservation total about 12,500 acres; there are approximately 8,000 acres of Reservation tidelands. Individual tribal members or the LIBC own approximately 75 percent of the upland area; 100 percent of the tideland areas are held in trust by the United States for the Lummi Nation.

3.3 CLIMATE

Based on climate data collected at the Bellingham Airport, the average annual precipitation on the Reservation over the 1960-1990 "normal" period is approximately 36.2 inches. On average, November, December, and January are the wettest months; June, July, and August are the driest months. About 75 percent of the average annual precipitation occurs from October through April; the remaining 25 percent occurs from May through September.

Temperature data collected at the Bellingham Airport over the 1960-1990 period indicate that the warmest months are July and August. During these months the average maximum daily temperature is approximately 71 degrees Fahrenheit (°F). December and January are the coldest months. During December and January, the average minimum daily temperature is about 32°F.

The growing season is "the portion of the year when soil temperature (measured 20 inches below the surface) is above biological zero (5°Celsius [C] or 41°F). This period can be approximated by the number of frost-free days (Corps 1987)." For the Reservation, the growing season is 227 days long, beginning on April 8 and ending on October 30 (USDA 1992).

Evapotranspiration has not been measured on the Reservation but has been estimated. Phillips (1966) estimated the average annual evapotranspiration for a 6-inch water holding capacity soil at the Marietta 3 NNW station to be approximately 18.8 inches. This estimate represents about 52 percent of the mean annual precipitation. A review of

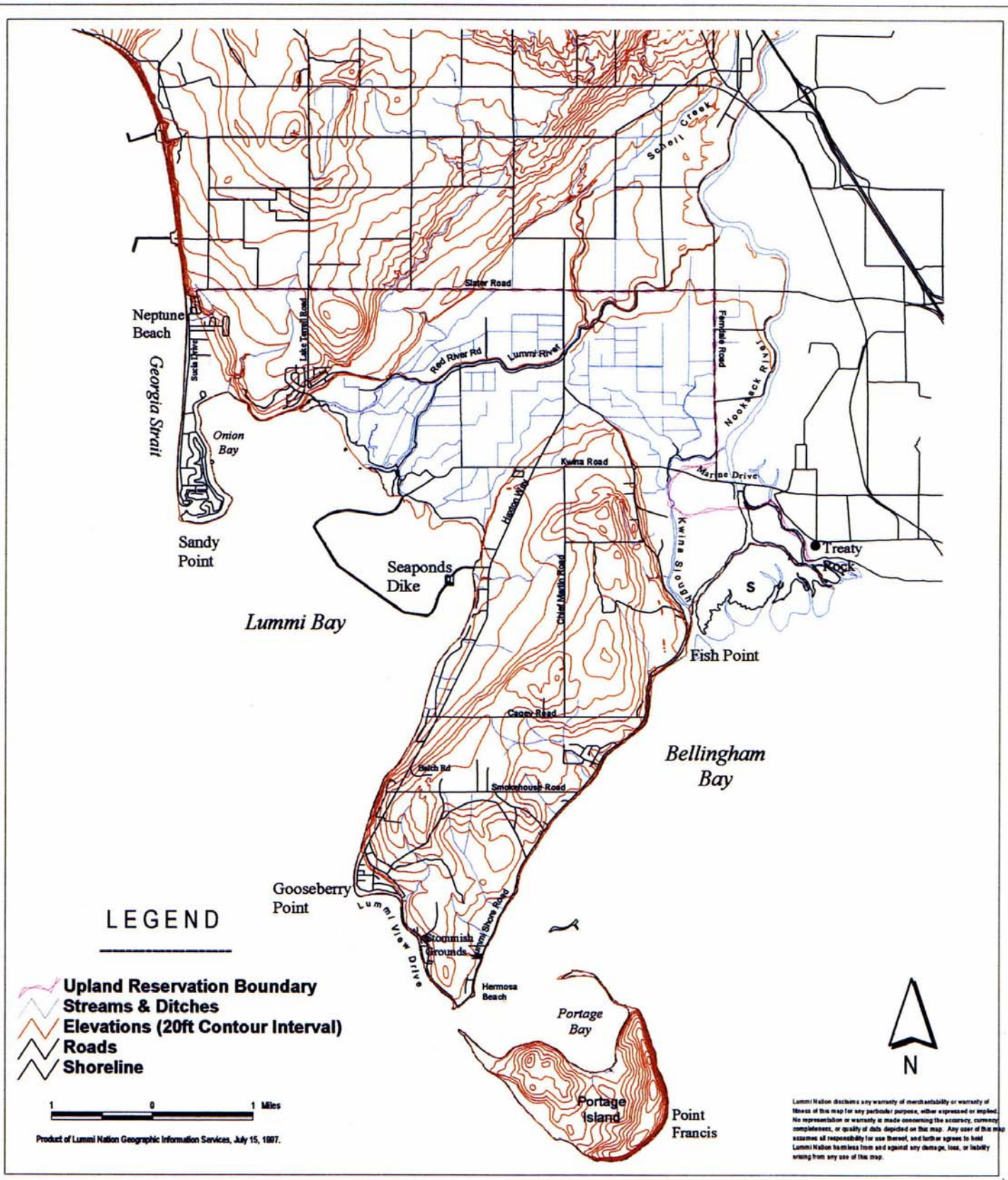

Figure 3.4 Topography, Surface Water Drainages, Place Names, and Roads of the Lummi Reservation

evapotranspiration estimates from 27 studies that were conducted in the Puget Sound Lowland (Bauer and Mastin 1997) suggests an average evapotranspiration rate of around 17.3 inches. On average, the estimated mean annual evapotranspiration from the 27 studies compiled by Bauer and Mastin (1997) was about 46 percent of the mean annual precipitation.

Wind data for Bellingham indicates that the prevailing wind direction on the Reservation is from the south and southwest with gusts upward of 80 miles per hour. Winds from the west are not as common and generally not as strong (Corps 1997).

The Reservation experiences a variety of infrequent weather patterns. A typical but infrequent weather pattern is generated from the northeast by cold air masses moving down the Fraser River valley. Strong winds from this pattern, blowing across the Fraser and Nooksack river basins, has caused damage to the residents and businesses of the Reservation (USDA 1992). Another typical but infrequent weather pattern involves continental air masses from the east that bring unusually dry weather that can last a few days or weeks (USDA 1992). During the summer, these air masses bring unusually warm temperatures (mid to upper 90s Fahrenheit). During the winter, these air masses usually bring cold temperatures (0°F and colder).

Because most of the precipitation occurs during the winter months when evapotranspiration demand is low, most of the ground-water recharge and storm-water runoff occurs during this season. After the rainy season and during the summer months when evapotranspiration demand is high and vegetation slows the movement of storm water, the amount of water available for ground-water recharge or surface-water runoff is small. Because of the accumulation of debris between infrequent summer storms, resultant pollutant loading in storm-water runoff can be higher during the summer months (and at the onset of the rainy season) relative to the runoff during the rainy season.

3.4 HYDROGEOLOGY

The hydrogeologic conditions on the Lummi Reservation have been described previously by the USGS and others (Washburn 1957, Cline 1974, Easterbrook 1973, Easterbrook 1976). In general, the Reservation is underlain by unconsolidated sediments deposited as glacial outwash, glaciomarine drift, glacial till, and floodplain or delta deposits of Quaternary age (Washburn 1957). The unconsolidated deposits consist of clay, silt, sand, gravel, and boulders. Because the composition of the deposits commonly change over short vertical and horizontal distances, it is difficult to distinguish the different stratigraphic units from the existing well log data.

3.4.1 Reservation Aquifers

Ground water in Reservation aquifers is obtained primarily from outwash deposits of sand and gravel in the unconsolidated glacial sediments, which are generally recharged by local precipitation. Glaciomarine drift is at or near the ground surface over much of

the upland areas on the Reservation. The glaciomarine drift overlays the outwash deposits and contains substantial amounts of clay. This clay restricts the recharge to the underlying aquifer and promotes storm-water runoff.

Two (apparently separate) potable ground-water systems occur on the Reservation. One system is located in the northern upland area. This northern system appears to flow onto the Reservation from the north and drains to the west, south, and east. The second potable ground-water system is located in the southern upland area of the Reservation (Lummi Peninsula) and is completely contained within the Reservation boundaries (LWRD 1997). The floodplain of the Lummi and Nooksack rivers, which contains a surface aquifer that is saline (Cline 1974), separates the two potable water systems. A third potable water system may exist on Portage Island, but information on the water quality and the potential yield of this system is limited and inconclusive.

In general, both the northern and southern ground-water systems contain two aquifer types (Washburn 1957, Easterbrook 1976). The upper aquifer type is comprised primarily of lenses of sand or sand and gravel that are in or above the glaciomarine drift. These relatively permeable lenses are not continuous throughout the area. The lower aquifer layer is comprised of advance outwash sand and gravel. The thickness of the lower aquifer, which appears to be semi-confined in places and unconfined in other places, is not known. The pebbly clay in the drift sediments and scattered deposits of till greatly slow the downward percolation of water to the lower aquifer and may act locally as a confining layer.

Because the hydrogeologic conditions on the Reservation vary considerably over short distances, the precise locations of the aquifer-recharge zones are not definitively known at this time. It is likely that aquifer-recharge areas are distributed over the upland areas. However, given the high runoff potential of the glaciomarine drift that covers much of the Reservation upland, it is also possible that aquifer-recharge areas are of limited areal extent and are located primarily in only a few locations around the Reservation. Until information that is more precise is developed, all of the northern and southern upland areas on the Reservation are assumed to be aquifer-recharge zones.

3.4.2 Hydrologic Soil Groups

The United States Department of Agriculture-Natural Resources Conservation Service (USDA-NRCS) identified and described 39 different soil map units on the Reservation. As part of the USDA-NRCS characterization, each soil type was assigned to one of four hydrologic soil groups based on their runoff-producing characteristics (USDA 1992).

The primary consideration in assigning a soil to a hydrologic soil group is the inherent infiltration capacity of the soil with no vegetation (USDA 1992). The hydrologic soil groups, which are labeled A, B, C, or D, are described in Table 3.2. In essence, Group A soils have a low runoff potential and a correspondingly high infiltration potential, whereas Group D soils have a high runoff potential and a low infiltration potential. The

runoff and infiltration potentials of Group B and Group C soils are between those of Group A and Group D soils.

As shown in Table 3.2, about 13 percent of the soils on the Reservation have a low or moderately low runoff potential (Group A or Group B). The remaining 87 percent of the soils on the Reservation have a moderately high or high runoff potential (Group C or Group D). These soil characteristics suggest that less than 15 percent of the Reservation uplands have a good aquifer-recharge potential.

As shown in Figure 3.5, the Group A and Group B soils are generally found along some of the shoreline areas and the glacial outwash terraces of the Reservation. These soils are concentrated along the Sandy Point Peninsula, along Haxton Way south of Balch Road, along Lummi View Drive near the Stommish Grounds, on Portage Island, and along Lummi Shore Road near Fish Point. There is an isolated area of Group B soils along the west side of Chief Martin Road near the abandoned landfill. The Group C and D soils are found in much of the upland areas and in the floodplains of the Lummi and Nooksack rivers. Most of the northern and southern upland areas on the Reservation have a moderately high or high runoff potential. A review of the soil map units in the areas north of the Reservation suggests that most of these soils also have a moderately high or high runoff potential.

3.5 RESERVATION WATERSHEDS

Reservation watersheds were delineated and mapped during the development of the Lummi Reservation Storm Water Management Program Technical Background Document (LWRD 1998a). The watershed boundary map developed as part of the SWMP is a working map that is intended to change as new information is acquired. The working map was modified (Figure 3.5) to account for field observations made during the field verification element of the Comprehensive Reservation Wetland Inventory (Harper 1999; LWRD 2000a). Further modifications are anticipated as new Digital Elevation Models are obtained and additional field research is conducted on the Reservation and in the watersheds that extend off-Reservation.

Alphabetic letters (A through S) identify the Reservation watersheds on an interim basis (Figure 3.5). It is anticipated that names will be assigned to the watersheds over time. Nineteen watersheds drain the Reservation uplands into Lummi and Bellingham bays, Hale Passage, and Georgia Strait. Seven of these watersheds originate off-Reservation and the remaining twelve occur entirely within the Reservation.

Table 3.2 Descriptions of Hydrologic Soil Groups on the Lummi Reservation

Hydrologic Soil Group	Description[1]	Percent of Reservation Soils
A	Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep (3-6+ ft), well- to excessively drained sands (loamy sands, sandy loam, and sands) and/or gravel. These soils have a high rate of water transmission and a low runoff potential.	2.7
B	Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep (20+ inches) and moderately well- to well-drained soils with moderately fine to moderately coarse textures (loam, silt loam). These soils have a moderate rate of water transmission and a moderately low runoff potential.	10.0
C	Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water and (2) soils with moderately fine to fine texture (sandy clay loam) and a slow infiltration rate. These soils have a slow rate of water transmission and a moderately high runoff potential.	40.4
D	Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential, (2) soils with a high permanent water table, (3) soils with clay pan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission and a high runoff potential.	46.9

[1] USDA 1970

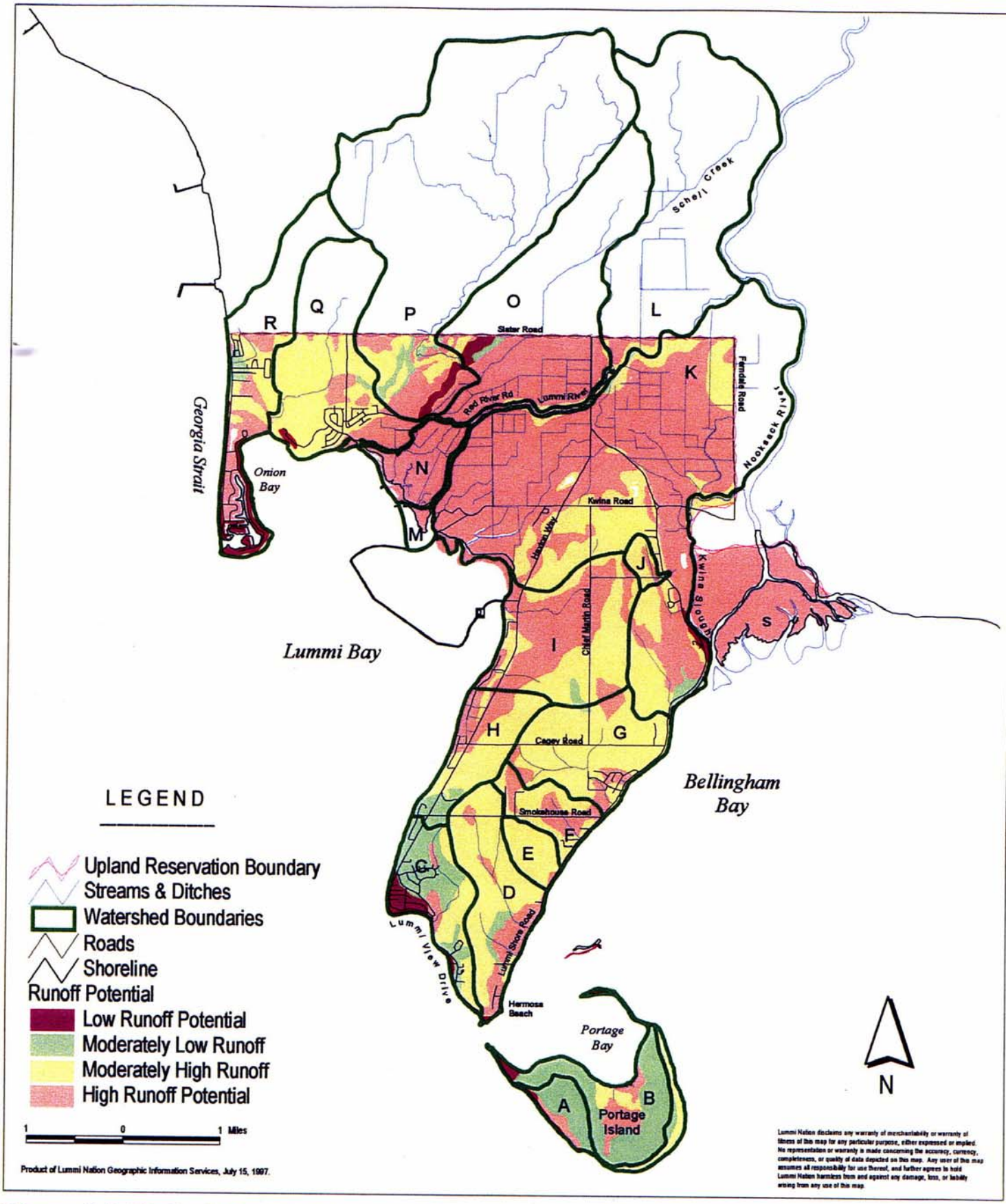

Figure 3.5 Hydrologic Soil Groups, Watersheds, and Surface Waters of the Lummi Reservation

The characteristics of the 19 watersheds on the Lummi Reservation are summarized in Table 3.3. In this section, the dominant land use, the occurrence of storm water and public water-supply wells, and other characteristics of the 19 watersheds are summarized. In describing the dominant land use, the coniferous and mixed forest class and the deciduous forest class were combined into a single, "forested," land-cover/land-use category.

Watershed A: Watershed A is crescent-shaped and located along the southern and eastern sides of Portage Island. The watershed drains into either Hale Passage or Bellingham Bay. About 59 percent of the watershed is forested. Forested uplands and steep bluffs characterize the eastern part of the watershed. The southern side is comprised of forested uplands and a mix of grasslands, wetlands, and ponded water located in low-lying areas. A small herd of beef cattle grazes on Portage Island. There are currently no people living on Portage Island and there are no active ground-water wells in this watershed.

Watershed B: Watershed B is dominated by forested land (about 71 percent) and located on the northern and western sides of Portage Island. Storm water from Watershed B discharges primarily into Portage Bay, although a small amount of storm water from along the western extent of the watershed also drains to Hale Passage. Portage Bay is an important shellfish growing area for the Lummi Nation. Relatively large wetland areas in the central part of Watershed B comprise approximately 19 percent of the total drainage area. These wetlands support one intermittent stream that discharges into Portage Bay. A small herd of beef cattle grazes on Portage Island. There are no active ground-water wells in this watershed.

Watershed C: Watershed C is dominated by forested land (55 percent) and includes the Gooseberry Point area. Water from this watershed discharges into Hale Passage and to Lummi Bay. Gooseberry Point is one of the more densely populated and heavily used areas on the Reservation. The former Lummi Casino (now LIBC office space), Fisherman's Cove (boat storage, launching, and repair), Fisherman's Cove Marina (retail grocery), the Northwest Indian College vocational training facility, a ferry terminal (operated by Whatcom County), the Lummi Tribal Enterprises seafood processing plant, Finkbonner Shellfish Incorporated, the *Wex Li Em* Community Center, the Lummi Assisted Living Center, the Stommish Grounds, and the Gooseberry Point Wastewater-Treatment Plant are all located in this watershed. Watershed C also contains a relatively dense residential development along the lowlands (i.e., Gooseberry Point) and in the adjacent upland areas. Saltwater intrusion has occurred in the aquifer in the western part of Watershed C. Several public-supply wells near Gooseberry Point have been closed because of high chloride levels induced by overpumping in this watershed. The Lummi Nation currently operates a single public-supply well in this watershed. Two non-tribal water associations (Gooseberry Point and Georgia Manor) also operate water-supply wells in the watershed. There are also several community and individual domestic-supply wells in the watershed.

Watershed D: Watershed D is about 65 percent forested and drains largely to Portage and Bellingham bays. Residential development is concentrated along Lummi Shore Road in the Hermosa Beach area, adjacent to the tribally owned, rich, shellfish-growing areas of Portage Bay. Hermosa Beach residents rely primarily on shallow, private, domestic, water-supply wells. The upland areas of this watershed are currently largely undeveloped for residential or other uses. Wetlands extend over large areas along the shoreline north of Hermosa Beach. The Lummi Nation does not operate any public water-supply wells in this watershed. In the past, poor storm-water management along Lummi Shore Road contributed to the collapse of the road into Bellingham Bay in places.

Watershed E: Watershed E is about 79 percent forested and drains to Bellingham Bay. Residential development is clustered along Lummi Shore Road (i.e., the shoreline); the upland area of this watershed is largely undeveloped. The Lummi Nation does not operate any public water-supply wells in this watershed. In the past, poor storm-water management along Lummi Shore Road contributed to the collapse of the road into Bellingham Bay in places.

Watershed F: Watershed F, a largely forested watershed (about 58 percent of the land area), drains to Bellingham Bay. Residential development is concentrated along Smokehouse and Lummi Shore roads. The Lummi Nation currently operates its most productive public water-supply well (Kinley Way) in this watershed. In the past, poor storm-water management along Lummi Shore Road contributed to the collapse of the road into Bellingham Bay in places.

Watershed G: Watershed G is about 63 percent forested and drains to Bellingham Bay. This watershed contains the Kel Bay housing development and Lummi Auto Recyclers. The area north of Cagey Road and east of Chief Martin Road is a large wetland area that discharges to a wetland area south of Cagey Road and then through the drainage network of the largely unbuilt Kel Bay housing development. Residential development is concentrated along Lummi Shore Road, Cagey Road, and Lightening Bird Lane. The Lummi Nation does not operate any public water-supply wells in this watershed; one non-tribal water association (Kel Bay) operates a well in the watershed. The shoreline areas around the Kel Bay development, north of Smokehouse Road, are susceptible to saltwater intrusion (Cline 1974). In the past, poor storm-water management along Lummi Shore Road contributed to the collapse of the road into Bellingham Bay in places.

Watershed H: Watershed H is about 80 percent forested and drains to the resource-rich tidelands of Lummi Bay. The shoreline areas of this watershed are relatively dense residential areas. The Balch Road housing project and the Eagle Haven recreational vehicle park are located in the southern upland area of this watershed. The Lummi Nation currently operates two public water-supply wells (Balch and Horizon) in Watershed H. Two non-tribal water associations (Sunset and Northgate-Leeward) also operate water-supply wells in the watershed. In addition, there are at least ten individual, private, domestic, water-supply wells clustered along the shoreline of this watershed, north of Smokehouse Road. The Lummi Nation operates a biosolids application site along Haxton Way, north of Cagey Road, in Watershed H.

Watershed I: Watershed I is about 83 percent forested, with residential areas concentrated along the shoreline areas and Haxton Way. This watershed drains to Lummi Bay. The Lummi Nation does not currently operate any public water-supply wells in this watershed; one non-tribal water association (Harnden Island) operates several water-supply wells near the shoreline of this watershed.

Watershed J: Watershed J is a small forested watershed that drains to wetland areas west of Kwina Slough in the Nooksack River floodplain. The Lummi Nation does not currently operate any public water-supply wells in this watershed.

Watershed K: About 58 percent of Watershed K is covered with grasses and agricultural lands. This watershed contains several dairy operations (some on and some off the Reservation). A large portion of the grass and agricultural areas is land in the former Lummi River delta that was formerly wetland and is now protected by the seawall along Lummi Bay and by the Lummi River levee. As mitigation for the new Lummi Casino, about 17 acres of this land was restored to a saltwater marsh condition by lowering the soil level down into the intertidal range. Water that enters the Reservation watersheds west of the Nooksack River levee largely drains to the resource-rich tribal tidelands in Lummi Bay. The divide between drainage to Bellingham Bay or Lummi Bay appears to be close to Marine Drive. The location of this divide varies with the tide, Nooksack River flow, and antecedent conditions. The area south of Marine Drive and west of Kwina Slough is part of the former Nooksack River delta; it is now a large wetland area with numerous beaver dams and beaver lodges. Ground water in the floodplain is generally saline. The Lummi Nation does not currently operate any public water-supply wells in this watershed.

Watershed L: Watershed L, which is about 78 percent grasses and agricultural land, drains to the Lummi River. The Lummi (a.k.a. "Red") River discharges to the resource-rich tidelands of Lummi Bay. This watershed contains several dairy operations, the City of Ferndale, and the City of Ferndale's wastewater-treatment plant (which discharges to the Nooksack River). All of these facilities are located north of the Reservation boundary. The Lummi Nation does not currently operate any public water-supply wells in this watershed.

Watershed M: Watershed M is comprised of the Lummi River, between its levees, from the Schell Creek/Ditch confluence downstream to "Plover Island" in Lummi Bay. Watershed M discharges to Lummi Bay. There are no known ground-water wells in this watershed.

Watershed N: Watershed N is dominated by grasses and agricultural lands in the former delta area of the Lummi River. This watershed drains to the resource-rich tidelands of Lummi Bay and does not contain any ground-water wells.

Watershed O: Watershed O, which is about 81 percent grasses and agricultural land, drains to the resource-rich tidelands of Lummi Bay via the remnants of what was shown on some historic maps as McComb Slough. Seeps have been observed along terraces just north of Slater Road. There are several dairy operations and a gas station north of the Reservation boundary in this watershed. There is also a gas station and the Lummi Casino (currently under construction) within the Reservation in this watershed. Although there are several wells north of the Reservation boundary, there are no active wells within the Reservation in Watershed O.

Watershed P: Watershed P is about 70 percent grasses and agricultural lands and drains to Lummi Bay. The portion of the watershed on the Lummi Reservation is largely forested. There are several dairy operations and numerous water-supply wells in the watershed, north of the Reservation. There is reportedly a productive spring within the Reservation, but there are currently no active water-supply wells in the portion of the watershed located on the Reservation.

Watershed Q: Watershed Q is about 52 percent forested and drains to Onion Bay. This watershed contains portions of the Esso (formerly Tosco) petroleum oil refinery and Barlean's Fish packing operation, which are north of the Reservation. The Sandy Point Heights residential development is located in the watershed and within the Reservation. The Lummi Nation does not currently operate public water-supply wells in this watershed.

Watershed R: Watershed R is not dominated by a single land use, but rather contains a mix of forested (23 percent), grasses/agricultural (32 percent), urban/residential/industrial (14 percent), and wetland areas (18 percent). This watershed drains to Georgia Strait and to Onion and Lummi bays. The Lummi Nation operates the Sandy Point Wastewater-Treatment Plant and the Sandy Point Fish Hatchery in this watershed. A sand- and gravel-transport company is also located within the Reservation in Watershed R. Portions of the Esso petroleum oil refinery are located north of the Reservation in this watershed. The Lummi Nation operates a single ground-water well in this watershed to supply the tribal salmon hatchery. (Two test wells recently drilled nearby will be used for production in the near future.) Two non-tribal water associations (Sandy Point Improvement Company and Neptune Beach) operate multiple water-supply wells on the Reservation in Watershed R.

Watershed S: Watershed S, which is the Nooksack River basin, is largely located upstream from the Reservation boundary. As noted previously, the Nooksack River drains primarily into Bellingham Bay, with flow discharging to Lummi Bay only during relatively high-flow conditions (greater than about 10,000 cfs) and/or when the levee fails. Land-use activities upstream from where the Nooksack River enters the Reservation affect both the quality and quantity of water available for tribal uses. For example, the closure of tribal shellfish beds near Portage Bay in late 1996 has been attributed to the poor quality of Nooksack River water (DOH 1997). Water-quality data that was collected at the Washington State Department of Ecology (Ecology) monitoring station near Brennan (Slater Road) indicates that Nooksack River water quality does not

meet the lowest standard (Class D) for water reclamation and reuse (LWRD 1998b). Use of Nooksack River water for the incubation of salmon eggs resulted in a mortality rate of about 80 percent at the Seaponds hatchery. The poor water quality led to the development of an egg-incubation facility just north of the Sandy Point Peninsula that is supplied by well water. The mortality rate for salmon eggs decreased to about 10 percent when the egg-incubation facility was moved to the Sandy Point area. The depleted quantity of river water also limits the Lummi Nation's ability to support a salmon-rearing pond along Kwina Slough (Parker 1974) and the salmon hatchery along the Seaponds Dike.

Table 3.3 Watershed Characteristics

Basin ID	Drainage Area (acres)	Receiving Water Bodies	Hydrologic Soil Group[1,2]				Number of Storm-Water Facilities[3]	Number of Ground-Water Wells	Land Use/Land Cover[4]								
			Group A (%)	Group B (%)	Group C (%)	Group D (%)			Water (%)	Coniferous and Mixed Forest (%)	Deciduous Forest (%)	Scrub/ Shrub (%)	Grasses and/or Agricultural (%)	Fallow Fields/ Exposed Soils (%)	Urban, Residential, Industrial (%)	Wetland (%)	Rock (%)
A	307	Bellingham Bay, Hale Passage	5.33	62.09	22.40	10.19	0	0	9.50	20.41	38.29	2.79	18.73	1.68	0.00	7.49	1.12
B	634	Portage Bay, Hale Passage	5.03	70.53	7.45	16.99	0	1	3.28	50.93	19.78	1.91	2.29	1.91	0.00	19.35	0.55
C	583	Hale Passage, Lummi Bay	12.54	51.16	28.35	7.95	12	33	0.00	17.64	37.58	4.46	28.35	3.87	3.87	4.24	0.00
D	791	Portage Channel, Bellingham Bay	0.47	4.90	71.41	23.23	14	28	1.98	10.24	54.30	2.42	25.22	0.88	0.00	4.95	0.00
E	183	Bellingham Bay	0.00	0.00	96.19	3.81	3	2	1.85	8.33	71.30	1.85	15.74	0.00	0.93	0.00	0.00
F	340	Bellingham Bay	0.00	0.00	62.93	37.07	12	11	1.03	1.24	56.91	2.58	30.62	1.03	1.03	5.57	0.00
G	798	Bellingham Bay	0.00	0.77	83.38	15.85	19	14	1.96	2.17	60.99	5.66	21.34	1.96	0.65	5.26	0.00
H	574	Lummi Bay	0.00	13.87	60.23	25.89	16	20	0.30	17.54	62.15	1.80	13.05	2.10	0.00	3.06	0.00
I	1,136	Lummi Bay	0.30	1.82	45.90	51.98	11	16	0.00	6.17	77.25	1.52	9.06	0.61	0.15	5.24	0.00
J	87	Nooksack River Floodplain	0.00	0.00	81.14	18.86	3	0	0.00	13.98	55.98	8.00	21.98	0.00	0.00	0.05	0.00
K	4,696	Bellingham and Lummi Bays	0.59	1.11	27.29	71.01	68	42	0.67	0.57	19.21	3.74	57.70	3.19	0.39	14.53	0.00
L	2,384	Lummi	0.00	0.41	49.45	50.14	5	29	0.29	0.11	4.19	2.62	77.90	1.68	9.18	4.03	0.00

Table 3.3 Watershed Characteristics

Basin ID	Drainage Area (acres)	Receiving Water Bodies	Hydrologic Soil Group[1,2]				Number of Storm-Water Facilities[3]	Number of Ground-Water Wells	Land Use/Land Cover[4]								
			Group A (%)	Group B (%)	Group C (%)	Group D (%)			Water (%)	Coniferous and Mixed Forest (%)	Deciduous Forest (%)	Scrub/ Shrub (%)	Grasses and/or Agricultural (%)	Fallow Fields/ Exposed Soils (%)	Urban, Residential, Industrial (%)	Wetland (%)	Rock (%)
		River, Lummi Bay															
M	145	Lummi Bay	0.12	1.22	46.51	52.14	6	0	9.76	0.00	2.44	2.44	27.53	3.66	0.00	54.17	0.00
N	333	Lummi Bay	0.00	0.00	0.00	100.00	0	0	4.12	0.00	1.03	4.12	80.21	1.03	0.00	9.48	0.00
O	1,964	Lummi Bay	4.63	2.80	6.32	86.25	10	8	0.09	0.20	8.91	2.31	80.63	1.24	0.46	6.07	0.09
P	4,257	Lummi Bay	8.23	12.38	29.83	49.56	4	63	0.12	0.93	11.15	2.28	69.39	1.67	2.60	11.86	0.00
Q	1,209	Onion and Lummi Bays	1.46	1.14	76.07	21.34	31	21	0.29	9.38	42.14	3.86	32.41	3.72	4.15	4.06	0.00
R	1,078	Lummi Bay and Georgia Strait	17.49	6.26	41.68	34.57	25	37	8.46	1.03	22.49	1.30	32.41	1.95	13.98	18.37	0.00
S	548,800	Bellingham and Lummi Bays	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[1] Hydrologic soil groups for portions of watersheds that extend beyond the Reservation boundary (i.e., Watersheds K, L, O, P, Q, R, and S) generally approximated by distribution of hydrologic soil groups within the Reservation boundary.
[2] ND = Not Determined
[3] Storm-water facilities (culverts, catch basins, and bridges) inventoried on-Reservation only.
[4] Land uses/land-cover types largely estimated from LANDSAT image acquired at 9:30 am on August 15, 1991, and classified by Whatcom County Planning Department. Estimates from the LANDSAT image were modified to incorporate information on the location and areal extent of wetland locations as identified by the National Wetland Inventory (USFWS 1987) and by a tribal consultant (Arnett 1994).

3.6 SURFACE-WATER RESOURCES

Surface waters in the assessment area include the Nooksack River, the Lummi River, sloughs, small streams, roadside and agricultural ditches, springs, wetlands, estuaries, and marine waters. Short intermittent streams and numerous springs drain the uplands. The springs occur both above and below the high tide line. These streams and springs discharge onto tribal tidelands along Bellingham Bay, Portage Bay, Hale Passage, Lummi Bay, Onion Bay, and Georgia Strait, or to the floodplain of the Lummi and Nooksack rivers. The floodplain is drained by a network of agricultural drainage ditches and by the Lummi and Nooksack rivers (Figure 3.4). These surface waters are described in this section. The locations of most of these features are shown in Figures 3.4, 3.5, and 3.6.

3.6.1 Rivers, Sloughs, Streams, and Ditches

The Nooksack River drains most of western Whatcom County and currently discharges to Reservation waters before entering the marine water of Bellingham Bay near the eastern extent of the Reservation. The Nooksack River reach located on the Lummi Reservation is tidally influenced. Streamside levees are in place to protect agricultural lands from flooding and saline water. Several named sloughs, which are the remains of former river channels, have been incorporated into the agricultural drainage network built on the floodplain of the Lummi and Nooksack rivers. Kwina Slough, a distributary channel on the Nooksack River delta, is the water source for the Seaponds salmon hatchery.

In general, the Lummi River currently carries storm-water runoff from the Ferndale upland as well as the drainage from a complex network of agricultural ditches in the floodplain. Tidal waters enter the Lummi River from Lummi Bay twice daily and, during the late dry season, saline water extends as far upstream as Slater Road. Although Nooksack River water currently flows through a four-foot culvert into the Lummi River channel only during high-flow events (greater than approximately 10,000 cfs), available data indicate that the Lummi River flow was around 200 cfs as recently as June 1955 (WSDC 1964), when a five-foot culvert allowed fresh water to flow from the Nooksack River into the Lummi River channel (Deardorff 1992).

There are several mapped and previously unmapped streams on the Reservation. Most of the unmapped streams have poorly defined channels and contain surface flow only during the October through May period. The approximate locations of these streams were identified as part of the inventory of storm-water facilities. No flow was observed during a field survey of all Reservation streams in late August 1996.

3.6.2 Springs and Wetlands

Upland springs, which are commonly ground-water discharge zones for shallow, perched aquifers, are found throughout the Reservation. A seep or spring occurs if the land surface intercepts the aquifer, and wetlands may occur at the seep or spring if conditions

are favorable (e.g., clayey soils, shallow slope). In addition to upland springs, springs occur along the shoreline, below the ordinary high water line (vegetation line), at numerous locations on the Reservation.

Historically, springs emerging in the uplands served as a water supply for the Lummi people. In many cases, they are part of a wetland system in which the water reinfiltrates along the lower terraces to return to ground water. The springs are important for wildlife habitat and for aquifer recharge and protection. Upland aquifers, which provide the primary Reservation drinking-water supply as well as the water for salmon egg incubation and rearing in the hatchery program, have experienced depletion and saltwater intrusion. Where it occurs, the infiltration of fresh water above the shorelines provides a buffer against saltwater intrusion.

The 1999 comprehensive wetland inventory (Figure 3.6; Harper 1999; LWRD 2000a) on the Reservation indicated that approximately 43 percent of the Reservation land area is either wetlands or wetland complexes. Wetland complexes are areas where wetlands and uplands form a highly interspersed mosaic. During the wetland inventory, boundaries were drawn around the outer edges of the mosaic of upland and wetland areas and the entire area was labeled as a "wetland complex". Consequently, the estimated wetland area identified in the inventory represents more wetland area than actually exists. Some of the wetlands and wetland complexes found in the comprehensive inventory were classified as agricultural and forest land-cover areas (instead of as wetlands) in Table 3.1. Of the total area of wetland and wetland-complex identified on the Reservation in 1999, about 50 percent is located in the floodplain of the Lummi and Nooksack rivers. Approximately 60 percent of the floodplain on the Reservation was classified as wetland or wetland complex (Lynch 2001).

The wetlands in the upland areas are palustrine (i.e., marshes, wet meadows, swamps, and small shallow ponds), generally forested, and often seasonally rather than permanently wet. Most Reservation wetlands occur on silty loams deposited by glacial processes (Whatcom County 1992; Caplow and Plake 1992). Logging and road construction have altered the hydrologic processes of many of these wetlands by either draining them or impounding more water. Historic fires, logging activities, and conversion to agriculture have also transformed Reservation wetlands to their current hydrologic and vegetative composition.

The upland wetlands on the Reservation perform significant functions, including attenuation of storm-water peak flows, water-quality enhancement, aquifer recharge, and aquifer protection from seawater intrusion. They are also valuable for wildlife habitat and the presence of plants with traditional cultural significance. Protection of wetland functions is important for protecting the Reservation water supply and tideland resources.

Most of the once extensive floodplain wetlands of the Lummi and Nooksack rivers have been diked, drained, filled, and cultivated since the late 1800s. Low areas near some of the sloughs still reflect the rich and complex wetland habitat that covered most of the lower floodplain before human alteration. Small estuarine wetlands lie in sheltered, low

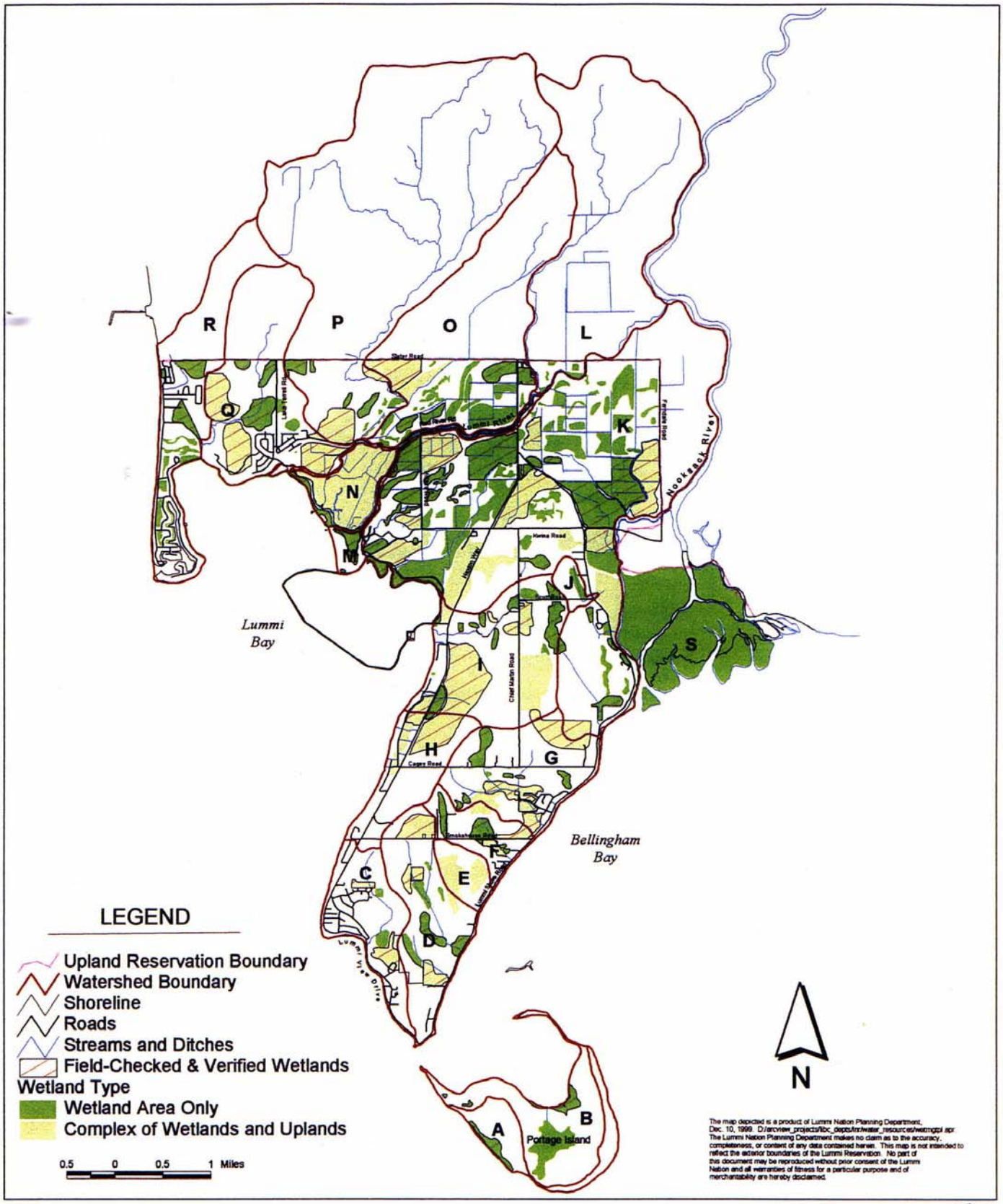

Figure 3.6 Wetlands and Surface Waters of the Lummi Reservation

energy areas at Onion Bay, Neptune Beach, Portage Island, the Lummi River floodplain, the Nooksack River delta, and adjacent to the Seaponds dike.

Road construction and agricultural activity have altered the wetlands that are north of Marine Drive and adjacent to the Nooksack River. South of Marine Drive, many of the wetlands in the Nooksack River delta have been physically altered by the accumulation of sediment at a high rate. The Nooksack River delta was identified as the fastest growing delta relative to its basin size in Puget Sound, with a progradation of approximately one mile over the 1888 - 1973 period (Bortleson et al. 1980). Consequently, a large area that was once intertidal is now supratidal and new wetlands have been formed. In addition to the delta progradation, the wetlands of the Nooksack River delta are likely affected by the low instream flows and poor water quality that characterizes the river during some times of the year.

Remnants of what were once extensive, high-value wetlands are located on the Sandy Point Peninsula between Sucia Drive and the private, non-tribally owned Sandy Point Marina. Road construction and drainage facilities now limit tidal inundation, but wildlife and wetland vegetation is abundant. Plants of traditional cultural significance have been identified in this area. Further north on Sucia Drive, formerly dry and seasonally wet areas are now permanently flooded as a result of road construction that blocked natural drainage.

These palustrine/estuarine emergent wetlands of the lowlands/floodplains are significant for storm-water attenuation, flood reduction, water-quality enhancement, fish habitat, wildlife habitat, and for plants with traditional cultural importance. The estuarine wetlands provide critical juvenile-rearing habitat for migrating salmon, herring, smelt, and other finfish and shellfish. The significance of these wetlands is increasing as wetlands upstream from the Reservation are altered and destroyed. These Reservation wetlands reduce the water-quality impacts of off-Reservation land uses on Lummi commercial and subsistence shellfish beds in Portage and Lummi bays. Protecting and enhancing floodplain and estuarine wetlands is essential to preserving and/or restoring interdependent fish, shellfish, and wildlife habitats.

3.6.3 Estuarine and Marine Waters

Brackish estuarine waters grade to marine waters of the Reservation in Lummi Bay, Portage Bay, portions of Bellingham Bay and Hale Passage, and the shoreline along Georgia Strait. Saline water moves across tideflats and into the Lummi and Nooksack river channels twice daily with the tidal cycle. The salt water underlies the less dense fresh water and moves as a wedge upstream. Salt water has been measured upstream as far as Slater Road in the Lummi River and nearly to the fork between the west and east distributaries of the Nooksack River. Tidal effects on the water level (backwater effects) in the Nooksack and Lummi rivers have been observed even further upstream (and possibly occur as far upstream as Ferndale).

Estuarine waters of the Nooksack and Lummi river deltas form the interface between marine and fresh water. Estuarine waters are important habitat for juvenile and adult salmon as they acclimate to either saline or fresh waters during their seaward and landward migrations, respectively. Estuaries also serve as habitat for juvenile and adult individuals of many other important aquatic species.

The complex and rich aquatic resources that provide feeding grounds for fish also attract a large variety of wildlife. The estuaries of the Lummi and Nooksack rivers are a part of a major Pacific Coast flyway for ducks, geese, swans, and shorebirds. These estuaries are also habitat for the threatened bald eagle and formerly listed peregrine falcon.

Estuarine wetland ecosystems in general, including saltwater marshes, are considered among the most productive (in biomass production per unit area) natural ecosystems on earth. In addition to providing rearing habitat for juvenile salmonids and other species, these ecosystems export a large amount of biomass to estuaries. This biomass can form a large portion, sometimes the majority, of the base of the estuarine food web (Mitsch and Gosselink 1993, as described in LWRD 2000b). Small estuarine marshes in Lummi Bay occur in sheltered fringes of diked areas. As mitigation for wetland filling at the new casino site north of the Lummi River, a 17.1-acre saltwater marsh was restored along the waterway adjacent to the Lummi Bay seawall in August 2001. As shown in Figure 3.3, larger saltwater marshes occur in the Nooksack River delta along Bellingham Bay.

Lummi Bay tideflats are extensive and rich in resources for tribal subsistence and as feeding areas for wildlife. Less extensive tideflats at Gooseberry Point, the Stommish Grounds, and Portage Bay are also important to the tribal economy and culture.

3.7 STORM-WATER RUNOFF

As shown in Figures 3.3 and 3.4, there are numerous intermittent streams, roadside drainage ditches, and agricultural drainage ditches on the Reservation. These channels convey storm water either to the surrounding marine waters or to the floodplains of the Lummi and Nooksack rivers (which discharge to tribal tidelands). As described previously, 87 percent of the soils on the Reservation are in Hydrologic Soil Groups C or D (soils with moderately high to high runoff potential). The presence of these soil types on the Reservation, coupled with the drainage enhancements, suggest that a large percentage of the winter precipitation becomes storm-water runoff.

Unit runoff maps that were developed as part of a study of the Nooksack River Basin by the Washington State Department of Conservation (WSDC 1960) estimated that the mean annual runoff from the Reservation is about 15 inches per year. This estimate represents about 42 percent of the mean annual precipitation and about half of the precipitation that occurs from October through May.

4. WATER-QUALITY SUMMARY FOR SURFACE AND GROUND WATER

In response to the Clean Water Action Plan, the Lummi Natural Resource Department developed and submitted a Unified Watershed Assessment (Appendix A) to the EPA. This large-scale assessment found the Nooksack River and Strait of Georgia watersheds to be Category 1 watersheds in need of restoration. The water-quality data and information summarized below support this assessment.

Table 4.1 presents a summary of the 1996 water-quality data collected monthly under the CWA Section 106 grant that was awarded to the Lummi Nation by the EPA. Conventional water-quality parameters (temperature, pH, conductivity, salinity, dissolved oxygen, turbidity, and fecal coliform bacteria) were measured at ten stations on the Lummi Reservation (Appendix B). (Station No. 4, on the Nooksack River at the Slater Road bridge, is monitored monthly by Ecology.) Sample-site locations were chosen to determine water quality in waters entering the Reservation, to evaluate suspected impacts from adjacent land uses (e.g., agriculture), to monitor waters over or contributing to important fish and shellfish areas, and to monitor water quality at a hatchery intake.

Waters of the Lummi Reservation are complex and variable. The water at five of the stations monitored during 1996 ranges from fresh to marine and most stations are influenced by the tides. All of the land-accessible sites and Portage Bay had samples that violated at least one of the two criteria in the Draft Lummi Water Quality Standards (DLWQS) for fecal coliform bacteria. High water temperatures were observed during the summer, particularly in Lummi Bay and the tributaries to Lummi Bay. Dissolved-oxygen levels varied from very high to very low, primarily at the sample stations that drain into Lummi Bay. Very high dissolved-oxygen levels (e.g., 250 percent of saturation) were observed in Lummi Bay and Jordan's Creek at Red River Road. The pH at all stations did not violate the DLWQS and there is not a sufficient record to determine compliance of the sample stations with the turbidity criteria in the DLWQS.

Table 4.1 Lummi Reservation Water-Quality Summary for 1996

Station No.	Location (Notes)	Parameter	Minimum	Maximum	Mean	% of Samples not compliant[1,2]
1	Sandy Point Marina (Rarely stratified; marine waters from the Strait of Georgia)	Temperature (C)	5.5	17.8	11.4	21
		Conductivity (micromhos/cm)	27,000	38,500	31,933	n/a
		Salinity (ppt)	25.5	30.5	28	n/a
		Turbidity (NTU)	1.1	3.4	2.41	n/a
		Dissolved Oxygen (% saturation)	84	124	100	17[3]
		Fecal Coliform (# of col./100 ml)	0	10	1.7[4]	0
		pH	7.63	8.44	7.97	0
2	Lummi Bay (Shallow embayment/tideflat at the mouth of the Lummi River; in late spring and summer, direct exposure to solar radiation during low tide results in elevated temperatures)	Temperature (C)	5	21.3	10.7	38
		Conductivity (micromhos/cm)	20,500	41,500	31,088	n/a
		Salinity (ppt)	18.5	30	27	n/a
		Turbidity (NTU)	0.65	108	14.2	n/a
		Dissolved Oxygen (% saturation)	84	250	117	33[3]
		Fecal Coliform (# of col./100 ml)	0	70	1.9[4]	0
		pH	7.71	8.43	8.08	0
3	Jordan's Creek at the Red River Road (Shallow; varies tidally and seasonally from fresh to estuarine to marine)	Temperature (C)	0.75	22	12	34
		Conductivity (micromhos/cm)	146	48,100	13,128	n/a
		Salinity (ppt)	0	34.6	10.5	n/a
		Turbidity (NTU)	1.35	92	18.2	n/a
		Dissolved Oxygen (% saturation)	26	250	91.4	22[3]; 34[5]
		Fecal Coliform (# of col./100 ml)	1	>30,000	57.8[4]	Exceeded[6]
		pH	6.9	8.63	7.61	0
5	Silver Creek (Near confluence with the east distributary of the Nooksack River; flow at site varies with tides)	Temperature (C)	0.25	19.5	10.3	8
		Conductivity (micromhos/cm)	57	1530	20	n/a
		Salinity (ppt)	0	0	0	n/a
		Turbidity (NTU)	5.05	32	13.2	n/a
		Dissolved Oxygen (% saturation)	16	120	83	8[3]; 23[5]
		Fecal Coliform (# of col./100 ml)	10	520	62.7[4]	90% criteria[7]
		pH	6.6	7.57	7.1	0

Table 4.1 Lummi Reservation Water-Quality Summary for 1996 (continued)

Station No.	Location (Notes)	Parameter	Minimum	Maximum	Mean	% of Samples not compliant[1,2]
6	Portage Bay, upper strata (Influenced by Nooksack River discharge; typically stratified)	Temperature (C)	3.5	17	9.35	23
		Conductivity (micromhos/cm)	1,470	34,500	13,767	n/a
		Salinity (ppt)	1.75	26.2	11.8	n/a
		Turbidity (NTU)	1.7	39	18.8	n/a
		Dissolved Oxygen (% saturation)	87	124	98	13[3]
		Fecal Coliform (# of col./100 ml)	0	72	7.9[4]	90% criteria[7]
		pH	6.85	8.1	7.64	0
6	Portage Bay, lower strata	Temperature (C)	5.75	16.8	10.8	See upper, above
		Conductivity (micromhos/cm)	25,100	35,100	29,930	n/a
		Salinity (ppt)	23.7	28.2	26.4	n/a
		Dissolved Oxygen (% saturation)	82	129	95	See upper, above
7	Kwina Slough (Distributary of the Nooksack River; water level fluctuates with the tides, but flow has always been downstream during sampling)	Temperature (C)	2.75	17.7	9.58	0
		Conductivity (micromhos/cm)	47	390	91	n/a
		Salinity (ppt)	0	0	0	n/a
		Turbidity (NTU)	2.2	> 200	20.6	n/a
		Dissolved Oxygen (% saturation)	86	131	101	11[3]
		Fecal Coliform (# of col./100 ml)	4	2,700	96.6[4]	90% criteria[7]
		pH	6.7	7.83	7.23	0
8	Lummi River at Hillaire Road Bridge (Shallow; varies tidally and seasonally from fresh to estuarine to marine)	Temperature (C)	0.25	24.3	12	35
		Conductivity (micromhos/cm)	91	42,500	19,713	n/a
		Salinity (ppt)	0.2	29	16.4	n/a
		Turbidity (NTU)	6.3	100	30.9	n/a
		Dissolved Oxygen (% saturation)	25	150	77.7	14[3]; 29[5]
		Fecal Coliform (# of col./100 ml)	5	3,500	88.5[4]	Exceeded[8]
		pH	6.83	8.57	7.49	0

Table 4.1 Lummi Reservation Water-Quality Summary for 1996 (continued)

Station No.	Location (Notes)	Parameter	Minimum	Maximum	Mean	% of Samples not compliant[1,2]
9	Lummi River at Slater Road (Smaller channel and less influenced by the tides than Station No. 8; stratification of the water column has not been observed)	Temperature (C)	1.5	20	10.8	34
		Conductivity (micromhos/cm)	38	35,200	7,471	n/a
		Salinity (ppt)	0	27.8	5.9	n/a
		Turbidity (NTU)	1.8	136	32.4	n/a
		Dissolved Oxygen (% saturation)	18	131	65.1	13[3]; 26[5]
		Fecal Coliform (# of col./100 ml)	0	23,000	1,235[4]	Exceeded[8]
		pH	6.85	7.52	7.15	
10	East Fork Jordan's Creek at Slater Road (Converted to a drainage ditch for a network of smaller ditches that drain agricultural lands upstream; flow directions vary, but upstream flow is rarely observed; stratification of the water column does occur)	Temperature (C)	1.5	21	12	33
		Conductivity (micromhos/cm)	221	44,900	12,614	n/a
		Salinity (ppt)	0	36.9	9.9	n/a
		Turbidity (NTU)	1.1	114	27.4	n/a
		Dissolved Oxygen (% saturation)	1	131	39.6	5[3]; 25[5]
		Fecal Coliform (# of col./100 ml)	6	130,000	232.6[4]	Exceeded[8]
		pH	6.5	8.59	7.15	0
11	West Fork Jordan's Creek at Slater Road (Drains the Mountain View Upland; in late summer, the flow is essentially zero, with water in isolated pools at the station and a few drops of water passing through the culvert under Slater Road.	Temperature (C)	1.25	17.8	10.3	0
		Conductivity (micromhos/cm)	87	412	183	n/a
		Salinity (ppt)	0	0	0	n/a
		Turbidity (NTU)	1.5	49	8.6	n/a
		Dissolved Oxygen (% saturation)	18	145	91.5	9[3]; 21[5]
		Fecal Coliform (# of col./100 ml)	6	6,700	307.6[4]	Exceeded[8]
		pH	6.72	8.42	7.37	0

[1]Draft Lummi water-quality standards.
[2]Marine criteria applied when salinity > 10 ppt, brackish criteria applied when salinity between 1 and 10, and freshwater criteria applied when salinity < 1 ppt.
[3]Exceedence of 110 percent dissolved-gas standard.
[4]Geometric mean.
[5]Second value represents dissolved-oxygen concentrations below the standard.
[6]Both the geometric mean and 90 percent exceedence criteria were exceeded at all salinities except for the marine geometric mean.
[7]90 percent exceedence criterion was not met.
[8]Both the geometric mean and 90 percent exceedence criteria were exceeded at all salinities

The Lummi Nation SWQMP was expanded in 1998 to 37 stations (Appendix B) that were selected to more fully document Reservation water quality and to study the input of fecal coliform bacteria to Portage Bay. Three more stations were added in 1999 and a fourth station was reinstated. Although statistics have not been calculated for all parameters as was done for the 1996 data, the data in subsequent years indicate that a similar pattern of violations of water-quality criteria continue (LWRD 1999a). Summary statistics for fecal coliform bacteria are presented in Appendix B. This includes data collected as part of the Dairy-Waste Impact Study funded under the FY97 GAP award from the EPA.

The following discussion of the water quality that was measured on the Reservation during the 1999 water year (October 1 through September 30) is divided into the following four geographic areas: Portage Bay and the contributing environs; marine waters of Lummi Bay and the Sandy Point Marina; estuarine waters of the Lummi River watershed; and freshwater streams. Ground-water quality and Nooksack River water quality are also discussed (though they are not parts of the SWQMP).

4.1 PORTAGE BAY AND THE CONTRIBUTING ENVIRONS

Nearly half of the sampling stations in the SWQMP are in the vicinity of Portage Bay or in areas that contribute water to Portage Bay. These locations include the Nooksack River, local storm water from Portage Island and the Hermosa Beach area, and marine waters. Water quality in this area does not appear to be substantially changed from the previous year. To date, water-quality monitoring has indicated that contributions of fecal coliform bacteria from the Reservation uplands surrounding Portage Bay are not significant, but that there are a few sources that need to be addressed (e.g., culverts with high fecal coliform counts but low volumes of flow). Nooksack River water quality (including Kwina Slough, a distributary of the Nooksack River) was generally good, but there were several occurrences of high densities of fecal coliform and *Escherichia coli* (*E. coli)* bacteria.

The drainages from Hermosa Beach dry up in the summer. The report *Preliminary characterization of fecal coliform contributions to Portage Bay from the Hermosa Beach area* (LWRD 1999b) examines the bacteria contributions from these sources. In general, the bacteria contributions from these drainages decrease as the rainy season progresses, and there is substantial die-off of bacteria when they reach marine waters. The drainage with the largest flow (Station 31; see map in Appendix B) generally had fewer bacteria than the adjacent marine waters (Station 32) during the winter.

The stations on Portage Island (24 - 28) reflect the presence of cattle on the island. Although elevated bacteria densities were common at these stations, the discharges (loading) to marine waters were low. Impacts from elevated bacteria densities in the Portage Island streams were not detected at the two marine stations in Portage Bay (6 and 23). Two of the Portage Island stations (24 and 25) are located where roads come down to the beach; both sites are typically a trickle of water during the wet season. The remaining sites are tidally influenced and all the sites either become saline or dry out

during the dry season. Bacteria densities were generally greatest at the lowest flows, which ranged from tenths to thousandths of a cubic foot per second.

4.2 LUMMI BAY AND SANDY POINT MARINA

Water quality in Lummi Bay and the Sandy Point Marina (Stations 2 and 19 - 22) was generally good. Fecal coliform densities were generally low and salinities were high. Within the Sandy Point Marina, testing of the water column for selected metals showed that zinc was detectable in the water column and that copper was detectable once. Arsenic and tin were below detection limits (BDL) for all of the samples. Total petroleum hydrocarbons (TPH) were also BDL for all samples.

4.3 ESTUARINE WATERS OF THE LUMMI RIVER WATERSHED

The estuarine waters of the Lummi River watershed (Stations 9, 10, 12, 13, 15 -17, and 51 - 53) are quite variable because of freshwater, marine, and/or tidal influences. The waters can be fresh, saline, stratified, or well mixed, as well as flowing downstream, flowing upstream, or being slack. However, most of the stations become saline by the end of the summer dry period, or they dry out. The quality of these waters is poor. Fecal coliform densities are usually elevated, temperatures are high during the summer, and dissolved-oxygen levels vary from very low to very high. Bacteria densities generally decreased after the onset of the rainy season, although several stations (e.g., Stations 8, 9, and 12) had chronically elevated bacteria levels. There appears to be substantial die-off of bacteria between the northern Reservation boundary (along Slater Road) and Lummi Bay. There are too few nutrient samples (Stations 3, 9, and 15) to provide insight into the nutrient dynamics of the area.

4.4 FRESHWATER STREAMS

Only three stations (11, 14, and 29) are located in non-tidally influenced reaches of streams on the Reservation (not including Portage Island streams). All of these streams cease flowing during the dry season. Bacteria counts at these sites increase during the onset of surface-water flow, and, in general, decrease over time as the rainy season progresses. In a few instances, elevated bacteria densities were found during the spring and summer. Samples for TPH at Station 14 were all BDL. Chromium and lead were detected in the fall and winter at Station 14. Copper and zinc were detected in September at Station 14.

4.5 GROUND WATER

Because the Reservation is located in a coastal area and most of the existing water-supply wells are within a half-mile of marine waters, saltwater intrusion is a major threat to the ground-water resources of the Lummi Nation. Available evidence suggests that the fresh ground-water resources underlying the Reservation consist of a lens that overlies salt water (LWRD 1997). These conditions indicate that protection is required for both vertical and lateral migration of seawater. Several public water-supply wells in the

Gooseberry Point area have been closed because of progressive saltwater intrusion induced by overpumping of nearshore wells. Lummi Tribal Water District wells on the Reservation currently meet all drinking-water standards; water from the Sandy Point Water System also meets all standards, except for manganese exceeding the maximum contaminant level through erosion of natural deposits (LTWD 1999). The ground water found in numerous other areas on the Reservation, especially the Nooksack and Lummi river floodplains, is too saline for most uses.

4.6 NOOKSACK RIVER WATERSHED

Various federal, tribal, state, and local programs monitor water quality in the Nooksack River watershed. In its 1998 303(d) list of impaired waters, Ecology listed segments of the Nooksack River and/or its tributaries as impaired by fecal coliform bacteria, high temperature, fine sediment, low instream flow, low dissolved oxygen, pH, and/or ammonia (Ecology 2000a). All listings were due to failures to meet Class A water-quality standards or other specific criteria.

5. RESULTS

5.1 POTENTIAL SOURCES OF NONPOINT-SOURCE POLLUTION

Many types of activities contribute to NPS pollution on the Lummi Reservation. These activities are conducted both on the Reservation and within the watersheds that drain to the Reservation (including the entire Nooksack River basin). Table 5.1 lists the potential sources of NPS pollution, the potential contaminants, and the affected watersheds and waterbodies on the Reservation.

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
1. Potential Construction Sources				
Machinery, earthmoving, soil compaction, vegetation removal	Oils, waste oils, solvents, grease, hydraulic fluids, transmission fluids, antifreeze, acids, paints, miscellaneous cutting oils, miscellaneous wastes, and sediment	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Temporary sources • Location and size of construction activity varied
2. Potential Agricultural Sources				
Farm lands used for raspberry, strawberry, blueberry, silage, forage, grain, potato, hybrid poplar, and other row crops	Pesticides (e.g., insecticides, herbicides, fungicides), fertilizers, pesticides and fertilizer residue from containers or storage areas; automotive wastes (e.g., gasoline, antifreeze, transmission fluid, battery acid, engine and radiator flushes, engine and metal degreasers, hydraulic fluids, and motor oil); sediment; temperature	F, K, L, N, O, P, Q, R, S	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River	• Substantial agricultural lands upstream from the Reservation boundaries and on the Reservation in the floodplain of the Lummi and Nooksack rivers • Small areas of agricultural land in the upland areas of the Reservation
Horses, goats, cattle, sheep, pigs and/or llamas	Livestock sewage wastes (oxygen-demanding substances); nitrates; phosphates; chloride; coliform and non-coliform bacteria; viruses; chemical sprays for controlling insect, bacterial, viral, and fungal pests on livestock; antibiotics; hormones; sediment	A, B, D, K, L, O, P, Q, R, S	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay	• Substantial dairy operations upstream from the Reservation boundaries and on the Reservation in the floodplain of the Lummi and Nooksack rivers • Smaller numbers of livestock elsewhere, including the Hermosa Beach and Neptune Beach residential areas

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
3. Potential Residential Sources				
Single or multi-family homes	Household cleaners, oven cleaners, drain cleaners, toilet cleaners, disinfectants, metal polishes, jewelry cleaners, shoe polishes, synthetic detergents, bleach, laundry soil and stain removers, spot removers and dry cleaning fluid, solvents, lye or caustic soda, pesticides, photochemicals, printing ink, paints, varnishes, stains, dyes, wood preservatives (creosote), paint and lacquer thinners, paint and varnish removers and deglossers, paint brush cleaners, floor and furniture strippers, automotive wastes, waste oils, diesel fuel, kerosene, #2 heating oil, grease, degreasers for driveways and garages, metal degreasers, asphalt and roofing tar, tar removers, lubricants, rustproofers, car and boat wash detergents, car and boat waxes and polishes, rock salt, refrigerants, fertilizers, herbicides, insecticides, fungicides, septage, coliform and non-coliform bacteria, viruses, nitrates, heavy metals, synthetic detergents, cooking and motor oils, bleach, septic tank cleaner chemicals, effluents from barnyards, feedlots, septic tanks, gasoline, water treatment chemicals, and well pumping that induces landward migration of sea water	C, D, E, F, G, H, I, J, K, L, O, P, Q, R, S	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Many residential areas are concentrated along the shorelines of the Reservation • Residential areas also concentrated along the Nooksack River in towns such as Ferndale, Lynden, Everson, and Deming
4. Potential Municipal Sources				
Roads	Automotive wastes (e.g., gasoline, antifreeze, transmission fluid, battery acid, engine and radiator flushes, engine and metal degreasers, hydraulic fluids, and motor oil), herbicides along road right-of-ways	C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River,	• Roads through all of the Reservation watersheds except for those on Portage Island • Similar potential contaminants associated with the Whatcom County ferry terminal at

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
			Portage Bay, Hale Passage	Gooseberry Point (Watershed C)
Northwest Indian College	Automotive wastes, general building wastes	C, K	Lummi Bay, Bellingham Bay, Hale Passage	• Curriculum is expanding and student housing is being added • Off-campus facility at Gooseberry Point
Tribal Schools	Automotive wastes, general building wastes	C (future), K	Lummi Bay, Bellingham Bay, Hale Passage	• New school expected in Watershed C on the Lummi Peninsula in the coming years
Lummi Tribal Health Center	Automotive wastes, general building wastes	K	Lummi Bay, Bellingham Bay	• Expansion to include an ambulatory care facility is underway
Tribal governmental offices	Solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline or diesel fuel from storage tanks, general building wastes	C, K	Lummi Bay, Bellingham Bay, Hale Passage	• Addition of new archives building and fitness center during 1998 • Office opened at Gooseberry Point (former casino location)
Biosolids application site	Organic matter, nitrates, inorganic salts, coliform and non-coliform bacteria, parasites, and viruses	H	Lummi Bay	• Complies with 503 Regulations regarding avoiding applications during saturated conditions
Stommish Grounds	Automotive wastes, general building wastes	C	Hale Passage	• None
Community Center	Automotive wastes, general building wastes	C, D	Hale Passage, Bellingham Bay	• None
Wastewater-Treatment Plants	Wastewater, biosolids (oxygen-demanding substances), treatment chemicals (e.g., chlorine) , automotive wastes, general building wastes	C, L, R, S	Hale Passage, Lummi River, Lummi Bay, Georgia Strait, Nooksack River, Bellingham Bay	• None
Cemeteries	Leachate, lawn and garden maintenance chemicals, automotive wastes	K, O, S	Lummi Bay, Bellingham Bay	• None
Abandoned landfills	Leachate, organic and inorganic chemical contaminants, wastes from households and	I, K, S	Lummi Bay, Bellingham Bay	• Types and quantities of contaminants unknown

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
	businesses, nitrates, oils, metals			• Hazardous nature of contaminants unknown
Sewer lines (break or malfunction)	Sewage, coliform and non-coliform bacteria, viruses, nitrates, heavy metals, synthetic detergents, cooking and motor oils, bleach, pesticides, paints, paint thinner, photographic chemicals	C, D, E, F, G, H, I, J, K, L, O, P, Q, R, S	Lummi Bay, Bellingham Bay, Georgia Strait, Hale Passage	• Potential public health hazard
5. Potential Commercial Sources				
Ray Beck Construction	Oils, waste oils, solvents, grease, hydraulic fluids, transmission fluids, antifreeze, acids, paints, miscellaneous cutting oils, and miscellaneous wastes	K	Lummi Bay, Bellingham Bay	• None
Lummi Auto Recyclers	Waste oils, solvents, acids, paints, and automobile wastes	G	Bellingham Bay	• Large number of potential contaminants • Storm-water management plan under development
Eagle Haven recreational vehicle (RV) park	Septage, gasoline, diesel fuel, pesticides, automotive wastes, and household wastes	H	Lummi Bay	• None
Fisherman's Cove Marina (retail grocer)	Automotive wastes, general building wastes	C	Hale Passage	• None
Fisherman's Cove (boat storage, launching, and repair)	Diesel fuel, oil, septage from boat waste disposal areas, wood preservative and treatment chemicals, paints, waxes, varnishes, automotive wastes	C	Hale Passage, Lummi Bay	• None
Sandy Point Marina	Diesel fuel, oil, septage from boat waste disposal areas, wood preservative and treatment chemicals, paints, waxes, varnishes, automotive wastes	R	Georgia Strait, Lummi Bay	• None
The Lummi Tribal Enterprises seafood-processing plant	Automotive wastes, general building waste, process wastes	C	Hale Passage	• None
Finkbonner Shellfish Inc.	Automotive wastes, general building wastes, process wastes	C	Hale Passage	• None
Native American	Automotive wastes, general building wastes, process	K	Bellingham Bay	• None

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
Shellfish Inc.	wastes			
Warrior Construction	Oils, waste oils, solvents, grease, hydraulic fluids, transmission fluids, antifreeze, acids, paints, miscellaneous cutting oils, and miscellaneous wastes	Q	Onion Bay	• None
Arnold Finkbonner and Sons (sand and gravel hauling company)	Oils, waste oils, solvents, grease, hydraulic fluids, transmission fluids, antifreeze, acids, paints, miscellaneous cutting oils, and miscellaneous wastes	R	Georgia Strait	• None
Barlean's Fish Packing	Automotive wastes, general building wastes, process wastes	Q	Onion Bay	• None
Woodland Nursery	Pesticides (e.g., insecticides, herbicides, fungicides), fertilizers, pesticides and fertilizer residue from containers or storage areas; automotive wastes	P	Onion Bay	• None
Texaco Food Mart	Automotive wastes, general building wastes, vehicle servicing wastes, gasoline or diesel fuel from storage tanks	O	Lummi Bay	• None
Lummi Casino	Automotive wastes, general building wastes	O	Lummi Bay	• Expected opening in Spring 2002
Golf Courses	Lawn and garden maintenance chemicals, automotive wastes	Q, S	Lummi Bay, Bellingham Bay	• None
Utilities	PCBs from transformers and capacitors, oils, solvents, sludges, acid solution, metal plating solutions (chromium, nickel, cadmium)	C, D, E, F, G, H, I, J, K, L, O, P, Q, R, S	Lummi Bay, Bellingham Bay, Georgia Strait, Hale Passage	• Potential public health hazard
6. Potential Industrial Sources				
Esso Refining and Marketing (petroleum oil refinery – formerly Tosco)	Hydrocarbons, solvents, metals, miscellaneous organics, sludges, oily metal shavings, lubricant and cutting oils, degreasers, metal marking fluids, corrosive fluids, other hazardous and non-hazardous materials and wastes, diesel fuel, herbicides for rights-of-way, creosote for preserving railroad ties	Q, R	Lummi Bay, Georgia Strait	• Large number of potential contaminants • Potential hazard of contaminants

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
Miscellaneous Industries in the Nooksack River Basin	Hydrocarbons, solvents, metals, miscellaneous organics, sludges, oily metal shavings, lubricant and cutting oils, degreasers, metal marking fluids, corrosive fluids, other hazardous and non-hazardous materials and wastes, diesel fuel, herbicides for rights-of-way, creosote for preserving railroad ties	S	Bellingham Bay	• Large number of potential contaminants • Potential hazard of contaminants
7. Potential Sources of Atmospheric Deposition				
Mobile and Area Sources (e.g., cars, trucks, buses, road dust, small combustion engines, wood stoves, general burning, and pesticide spraying)	Criteria Pollutants: Volatile Organic Compounds (VOCs), fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants
BP Cherry Point Refinery (formerly ARCO Product Company) (petroleum oil refinery)	Criteria Pollutants: VOCs, fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur Toxic Pollutants: benzene, cyclohexane, ethylbenzene, sulfuric acid, toluene, trimethylbenzene, xylenes, and other toxins in quantities less than 2,000 lbs per year	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants
Encogen NW Cogeneration Plant	Criteria Pollutants: VOCs, fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur Toxic Pollutants: ammonia, formaldehyde	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River,	• Large number of potential contaminants • Potential hazard of contaminants

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
			Nooksack River, Portage Bay, Hale Passage	
Georgia-Pacific West, Inc (pulp [now closed] and paper mill)	Criteria Pollutants: VOCs, fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur Toxic Pollutants: acetaldehyde, acetone, barium, chlorine, chloroform, dichlorodifluoromethane, ethanol, formaldehyde, hydrochloric acid, methylethyl ketone, methanol, sulfuric acid, and other toxins in quantities less than 3,000 lbs/year	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants
GN Plywood, Inc. (plywood manufacturer)	Criteria Pollutants: VOCs, fine particulate matter, oxides of nitrogen, carbon monoxide Toxic Pollutants: acetaldehyde, acetone, barium, benzene, chlorine, formaldehyde, manganese, naphthalene	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants
Intalco Aluminum Corporation (aluminum plant)	Criteria Pollutants: VOCs, fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur Toxic Pollutants: gaseous fluorine	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants
RECOMP of Washington Inc. (waste disposal, incinerator [now	Criteria Pollutants: Fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur Toxic Pollutants: aluminum, barium, cadmium, chlorobenzene, cobalt, copper, hydrogen fluoride,	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait,	• Large number of potential contaminants • Potential hazard of contaminants

Table 5.1 Inventory of Potential Nonpoint Contaminant Sources in Reservation Watersheds

Potential Contaminant Sources	Potential Contaminants[1]	Watershed(s)	Receiving Water Bodies	Comments
closed])	hydrogen chloride, lead, manganese, mercury, and silver		Lummi River, Nooksack River, Portage Bay, Hale Passage	
Esso Refining and Marketing (petroleum oil refinery – formerly Tosco)	Criteria Pollutants: Volatile Organic Compounds (VOCs), fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur Toxic Pollutants: benzene, butanes, cyclohexane, ethylbenzene, pentanes, toluene, trimethylbenzene, xylene, and other toxins in quantities less than 3,000 lbs per year	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants
Other Industrial, Commercial, and Municipal Sources	Criteria Pollutants: Volatile Organic Compounds (VOCs), fine particulate matter, oxides of nitrogen, carbon monoxide, oxides of sulfur	All 19 watersheds	Bellingham Bay, Lummi Bay, Onion Bay, Georgia Strait, Lummi River, Nooksack River, Portage Bay, Hale Passage	• Large number of potential contaminants • Potential hazard of contaminants

[1] Potential contaminant listings based on literature (EPA 1993b, 2001) and 1995 emission-inventory information provided by the Northwest Air Pollution Authority. Other than emission inventories, site-specific inventories of potential contaminants at each location were not conducted.

5.2 IMPACTS OF NONPOINT-SOURCE POLLUTANTS

This section describes many of the actual and potential impacts on Reservation waters of the main types of NPS pollution. These impacts may be acute (sudden or high intensity) or chronic (long-term or low intensity) in nature. In addition, while the individual impacts of each type of pollutant are described below, it is important to note that these pollutants likely have combined impacts on water quality and biotic communities as well. Although the individual impact of each pollutant may not be significant, the combined and cumulative impacts of all pollutants could, for example, make stream habitats unsuitable for rearing salmonids or make ground water undesirable for use as drinking water.

5.2.1 Bacteria/Pathogens

Fecal coliform bacteria are indicators of the presence of pathogens and therefore of the sanitary quality of water. Human health can be affected by exposure to pathogens through either direct contact or ingestion of contaminated water or shellfish. When fecal coliform counts in the waters over shellfish beds exceed the National Shellfish Sanitation Program (NSSP) criteria, those beds are closed to commercial harvest. For this reason, commercial harvest of shellfish in Portage Bay has been significantly restricted in the last few years. In 1997, 60 acres of shellfish beds were downgraded from approved to prohibited; in 1998, an additional 160 acres were downgraded from approved to prohibited. This closure has had significant economic and cultural impacts on the Lummi population. The Washington State Department of Health (DOH) has attributed the fecal coliform contamination of Portage Bay to poor dairy-waste-management practices in the Nooksack River watershed (Watershed S; DOH 1997).

In its 1998 303(d) list of impaired waters, Ecology listed Bellingham Bay, the Nooksack River, and the Lummi River (upstream of the Reservation boundary) as impaired by fecal coliform bacteria (Ecology 2000a). Thirty-nine segments of 16 Nooksack tributaries were also listed as impaired by bacteria. To address these listings, Ecology prepared a total maximum daily load (TMDL) evaluation for bacteria on the lower Nooksack River in which it proposed reducing bacterial loads at the mouth of the Nooksack River by 48 percent and in Nooksack tributaries by up to 98 percent (Ecology 2000b). In this report, Ecology found that sub-basins with a high density of dairies, animal-feeding operations, and manure-sprayed fields delivered significant bacteria loads to the Nooksack River; Bertrand and Fishtrap creeks, two tributaries with adjacent land use that is dominated by dairy operations, together accounted for 44 percent of the fecal coliform load in the Nooksack River (Ecology 2000b). The DOH identified agricultural wastes in the Nooksack River basin as the only high-probability source of fecal coliform bacteria to Portage Bay (DOH 1997). The Portage Bay Closure Response Team identified improper dairy-waste management as the largest potential contributor of fecal coliform pollution in the Nooksack River watershed (WCD 1998). Other potential sources of fecal coliform bacteria include on-site septic systems, storm-water runoff from residential areas, municipal wastewater-treatment effluent, and wildlife (DOH 1997).

Substantial dairy operations also occur in the Lummi River watershed, including two of the farms cited by the EPA for fecal coliform contamination of surface waters. Though its tributaries frequently fail to meet Class A standards, Lummi Bay is not currently impaired by fecal coliform bacteria based on the Lummi SWQMP and the draft Lummi WQS as well as DOH monitoring under the Shellfish Consent Decree (Order Regarding Shellfish Sanitation, *United States v. Washington [Shellfish]*, Civil Number 9213, Subproceeding 89-3, Western District of Washington, 1994. Under this decree, the DOH is responsible to the federal Food and Drug Administration [FDA] to ensure that the NSSP standards for certification of shellfish growing waters are met on the Reservation.) However, if the Lummi River is re-established as a distributary of the Nooksack River and the density of fecal coliform bacteria in the Nooksack River is not reduced, the approved status of Lummi Bay for the commercial harvest of shellfish could be downgraded.

5.2.2 Sediments

Increased loads of fine sediment in streams can result in decreased growth and survival of fish through reduced feeding efficiency, diminished food sources, smothering of eggs, and reduced habitat availability and complexity. Reduced survival-to-emergence for salmonids due to the deposition of fine sediments in streambeds is of particular concern because it is a source of density-independent mortality that can have very significant negative effects on salmon populations (CRITFC 1994). Increased concentrations of fine sediment also increase the amount of treatment necessary for drinking water because of the color and texture of the water as well as the ability of pollutants (e.g., bacteria, metals, pesticides, nutrients, and petroleum hydrocarbons) to attach (adsorb) to sediments.

The North Fork and South Fork of the Nooksack River, as well as three Nooksack River tributaries, are listed as impaired by fine sediment on the Washington State 303(d) list (Ecology 2000a). Given the probability of undocumented impairment of other streams in the watershed, fine sediments are likely one of the factors limiting salmon production in the Nooksack River watershed (NMFS 1996; CRITFC 1994). In addition, the large sediment load carried by the Nooksack River has altered estuarine habitat by producing rapid growth of the Nooksack delta. Increased sedimentation is also a potential problem for the Lummi River and Lummi Bay, especially if Nooksack River flow is re-established in the Lummi River. In addition to natural river processes, sources of sediments in the Nooksack River watershed include forestry practices, agricultural practices, construction, and urban runoff.

5.2.3 Oxygen-Demanding Substances

Decaying organic matter (e.g., manure, grass clippings, or die-off from alga blooms) can consume the oxygen that is dissolved in the water column. Low dissolved-oxygen levels can cause fish and invertebrate kills, aesthetic impairment, and the release to the water column of metals and other pollutants that were previously attached (adsorbed) to sediments. Sources of oxygen-demanding substances (organic enrichment) are

widespread – anywhere that decaying organic matter can be carried into a waterbody – and have been found in runoff from urban areas, agricultural lands, forestlands, and marinas.

The water-quality monitoring stations at Jordan's Creek, Silver Creek, and Lummi River all showed low dissolved-oxygen levels during 1996 sampling. The proportion of samples violating the draft Lummi WQS ranged from 21 to 34 percent of the samples collected at the six stations. Twenty-one waterbody segments in 13 Nooksack River tributaries are listed as impaired for low dissolved oxygen on the Washington State 303(d) list (Ecology 2000a). Agricultural, urban, and natural activities/processes are probably the main sources of oxygen-demanding substances in Reservation waters.

5.2.4 Temperature

Increased water temperatures affect water quality and biotic communities in several ways. As water temperature increases, saturation concentrations for dissolved gases decrease. Thus, the reduced dissolved oxygen available in warmer water can be a potential source of respiratory stress for fish and invertebrates. In addition, warmer water diminishes the efficiency of enzymes in cold water species and increases metabolic rates and demands. Higher water temperature also increases the solubility of most metals and chemicals and reduces their adsorption to sediment particles. Increases in water temperature can therefore be expected to increase pollutant concentrations in the water column. When combined, these changes in temperature and water quality alter the habitat and species composition of the biotic community, resulting directly and indirectly in reduced survival of salmonids and other species.

Thirteen waterbody segments in the Nooksack River watershed, including the Middle Fork and South Fork of the Nooksack River, are listed as impaired by high water temperature on the Washington State 303(d) list (Ecology 2000a). In addition, the seven marine or estuarine water-quality monitoring stations on the Reservation exceeded the temperature criteria in 21 to 38 percent of their samples in 1996. One freshwater station, Silver Creek, had temperature exceedances in 8 percent of its samples. Low flow and/or shallow water that has flowed over sun-warmed sediments or tideflats likely produced many of these violations. Reduced shading, altered channel structure (e.g., wide, shallow streams), and loss of contributions from ground-water base flow, all three of which are due to agricultural practices, forestry, and land development, are likely the primary causes of increased water temperatures in the Nooksack River watershed and on the Reservation.

5.2.5 pH

Alteration of pH (acidity) levels can have significant effects on water quality and biotic communities. Changes in pH can degrade water quality by increasing the solubility of metals and other polluting chemicals. Since pH controls many biochemical reactions, extreme pH levels can alter the biochemistry and physiology of all organisms. The resulting impacts on reproduction or respiration, for example, can reduce the viability of

many species, including fish. With its many possible effects likely acting in combination, pH alteration can have significant impacts on the biotic community, resulting directly and indirectly in reduced survival of salmonids and other species important to the ecosystem.

There were no pH violations of draft Lummi WQS during the 1996 monitoring program on the Reservation. However, six waterbody segments in three Nooksack River tributaries are listed as impaired by pH on the Washington State 303(d) list (Ecology 2000a). Agriculture, urban runoff, land disposal, and atmospheric deposition are probably the main sources of pH alteration in Reservation waters.

5.2.6 Nutrients

Phosphorus and nitrogen are the primary nutrients of concern because they are usually the nutrients limiting algal growth. Nutrient-induced increases in algal growth (blooms) or changes in the species composition may result in a less suitable food source for fish and filter feeders (e.g., shellfish) and aesthetic impairment through foul odors and unsightly mats of scum. In addition, the die-off of elevated densities of algae often results in the depression of dissolved-oxygen concentrations as the organic material decomposes and consumes oxygen. Ammonia can be directly toxic to aquatic life and the oxidation of ammonia lowers dissolved-oxygen concentrations in receiving waters. Ammonia is volatile and can form a significant portion of the nitrogen deposited across the landscape from the atmosphere. Nitrate can interfere with the ability of blood to carry oxygen. Infants are acutely sensitive to high nitrate levels in drinking water (EPA 2001).

Animal and human waste, urban runoff, fertilizers, detergents, and natural sources contribute nutrients to Reservation surface waters and, potentially, ground waters. Nutrient impacts are probable, but currently undocumented, in the Lummi and Nooksack estuaries. Two Nooksack River tributaries are listed as impaired for ammonia on the Washington State 303(d) list (Ecology 2000a). Agricultural practices and urban runoff are likely the largest sources of nutrients entering Reservation waters.

5.2.7 Pesticides, Household and Industrial Chemicals, and Oil and Grease

Pesticides, household and industrial chemicals (e.g., antifreeze, solvents, and cleaning agents), and oil and grease may result in direct mortality or reduction of growth and reproductive capacity in fish, shellfish, wildlife, invertebrates, and aquatic flora (e.g., eelgrass), depending on the intensity and duration of exposure. Some of these substances can accumulate in sediments, increasing the duration and degree of exposure for bottom-dwelling or bottom-feeding organisms. Another important factor is that chemical pollutants that alone are not toxic to aquatic life may become toxic in the presence of other pollutants (i.e., the chemicals have synergistic effects). In addition, chemical concentrations can increase through the food chain by the processes known as bioaccumulation and biomagnification. Bioaccumulation occurs when a substance becomes more concentrated in plant and animal tissue than in the surrounding

environment; biomagnification is the progressively (often exponentially) higher chemical concentrations that develop in the tissues of animals at higher trophic levels in the food chain. Through synergistic effects, bioaccumulation, biomagnification, and the persistence of many chemical pollutants and their breakdown products, a relatively low level of chemical pollution can have significant long-term effects on individual organisms, populations, or communities. Chemical pollution may directly or indirectly affect human health through direct exposure to contaminated surface waters or consumption of contaminated animals and plants.

Impacts of pesticides, household and industrial chemicals, and oil and grease on Reservation waters are probable, but largely undocumented. A documented case of pesticide impacts on Reservation waters involved the Sandy Point Improvement Company golf course (which lies on non-member-owned fee lands on the Reservation, along the north shore of Lummi Bay). In April 1995, ducks were found dead on the golf course. At the request of the Lummi Nation, the EPA investigated and found that improper use of the pesticide Diazinon caused the death of the ducks. The golf course is in close proximity to shellfish beds and a salmon-rearing facility. In addition, raptors, which prey on ducks, use the areas surrounding the golf course for foraging. Both wildlife and fishery uses were potentially impaired. The LNR temporarily closed nearby subsistence and commercial shellfish beds to avoid potential health effects on harvesters and consumers. Agricultural practices, land disposal, atmospheric deposition, road runoff, and urban/residential runoff and are the main probable nonpoint sources of chemicals entering Reservation waters.

5.2.8 Metals

Metals are persistent and bioaccumulative toxins that generally have a high affinity for fine sediment (e.g., clay). In addition to adversely affecting animals and plants, metals may severely affect the health and welfare of people who consume contaminated terrestrial or aquatic species. Sources of metals include pesticides, wear from automobile tires, improperly disposed motor oil, corrosion of copper pipes, paints and stains, leaded gasoline, industrial activities, and antifouling agents for boats.

Zinc and copper were both detected during 1999 in the Sandy Point Marina and at Station 14 (on a small creek where it crosses the northern Reservation boundary, directly south of the Esso refinery and just west of Lake Terrell Road). Sediment contamination by low levels of metals is probable but undocumented in Reservation tidelands/estuaries. Possible nonpoint sources of metals entering Reservation waters are land disposal, atmospheric deposition, and urban and road runoff.

5.2.9 Habitat Alteration

Habitat alteration is a change in the characteristics of a habitat, which generally produce a change in the biotic community. When the source of an adverse alteration is anthropogenic, the results can be considered NPS pollution. These changes can interfere with designated uses such as reproduction and growth of salmonids and shellfish. The

pollutants described above can have direct and indirect effects on aquatic habitats. However, in the context of this report, consideration of habitat alteration as an NPS "pollutant" will be limited to adverse alterations resulting directly from activities associated with the source categories of NPS pollution (as opposed to alterations produced via the other pollutants). Examples of such activities include the alteration of small creeks into agricultural or roadside drainage ditches, the channelization of streams, the draining or filling of wetlands, and the disruption of aquatic habitats by construction activities.

Aquatic habitat alterations in the Lummi and Nooksack river watersheds are typical of those associated with human activities elsewhere. The examples listed above are widespread in these watersheds. Other common habitat alterations occurring in Reservation watersheds include flow modification (e.g., agricultural and municipal withdrawals, diversion of the Middle Fork Nooksack River to Lake Whatcom, and the Lummi Bay seawall), removal of riparian vegetation, streambank modification, and isolation of the rivers from their floodplains and side channels by levees. These alterations and activities can completely change channel morphology and cause the loss of important habitat components such as the quantity and quality of pools, gravel beds, large woody debris, and off-channel habitat. Habitat alterations in the Lummi and Nooksack river watersheds are presumably contributing to the reduction of salmonid populations that are native to these stream systems (NMFS 1996; CRITFC 1994).

Aquatic habitat alteration also occurs in the estuarine and shoreline areas of the Reservation. The rapidly growing Nooksack River delta (largely a product of sediments that would have been deposited on the floodplain if levees were not present) alters the estuarine habitats of salmonids and shellfish. The Lummi Bay seawall alters and restricts access to estuarine habitats. Shoreline modification, in particular by bulkheads along the Sandy Point shoreline, causes erosion and subsequent change of the shoreline habitat. These changes likely have negative effects on juvenile salmonids and on the prey species on which salmonids depend for survival.

5.2.10 Saltwater Intrusion

Elevated chloride content in ground water can result in the water being unfit for domestic and other purposes. Most wells on the Reservation are located near the shoreline, which makes them particularly vulnerable to saltwater intrusion that would render them unusable. Several public water-supply wells, primarily in the Gooseberry Point area, have been closed because of progressive saltwater intrusion induced by overpumping of nearshore wells. Since future residential development will likely produce an increase in the demand for ground water, the potential for future saltwater intrusion is high.

5.3 IMPAIRMENT OF RESERVATION WATERBODIES

Table 5.2 lists the NPS pollutants, the source categories for each NPS pollutant (EPA 1997a), and the degree of impairment due to each pollutant for each of the primary waterbodies and the ground water on the Reservation. The listed degree of impairment reflects documented impacts and a literature-based assessment of potential but undocumented impacts as well as the degree of impact associated with individual pollutants.

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Nooksack River and its tributaries	Fecal Coliform Bacteria	▪ Agriculture (pasture grazing, confined animal feeding operations, manure lagoons) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Waste storage or storage tank leaks ▪ Spills ▪ Natural Sources	High	303(d) list (39 segments in 16 tributaries) Portage Bay Shellfish Closure Potential Lummi Bay Shellfish Closure
	Fine Sediment	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Silviculture (harvesting, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Highway Runoff ▪ Natural Sources	High	303(d) list (main stem, South Fork, and 3 segments in 3 tributaries) Salmonid impacts Shellfish impacts in Portage Bay
	Habitat Alteration	▪ Agriculture (crop production [all types], pasture grazing) ▪ Silviculture (harvesting, road construction) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank modification, draining/filling of wetlands) ▪ Recreation Activities (golf courses)	High	Salmonid impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Nooksack River and its tributaries	Metals	▪ Urban Runoff ▪ Land Disposal (landfills) ▪ Atmospheric Deposition ▪ Highway Maintenance and Runoff	Low	Salmonid impacts Shellfish impacts in Portage Bay
	Nutrients	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations, manure lagoons) ▪ Silviculture (restoration, residue management, forest management) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Hydromodification/Habitat Modification (channelization, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Moderate, Possibly High	303(d) list (ammonia: 2 segments in 2 tributaries) Salmonid impacts
	Oxygen-Demanding Substances (organic enrichment)	▪ Agriculture (pasture grazing, confined animal feeding operations, manure lagoons) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Natural Sources	High	303(d) list (21 segments in 13 tributaries) Salmonid impact

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Nooksack River and its tributaries	Pesticides, Household and Industrial Chemicals, and Oil and Grease	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations, manure lagoons) ▪ Silviculture (harvesting and restoration, forest management, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Atmospheric Deposition ▪ Storage Tank Leaks ▪ Highway Maintenance and Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Moderate, Potentially High	Potential for high degree of impact from spills, excessive use, and increasing development Salmonid impacts Shellfish impacts in Portage Bay
	pH	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations, manure lagoons) ▪ Silviculture (harvesting) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Hydromodification/Habitat Modification (removal of riparian vegetation, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Storage Tank Leaks ▪ Highway Runoff ▪ Spills	Moderate	303(d) list (6 segments in 3 tributaries) Salmonid impact

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Nooksack River and its tributaries	Temperature	▪ Agriculture (crop production [all types], pasture grazing) ▪ Silviculture (harvesting, forest management, road construction) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank modification, draining/filling of wetlands) ▪ Highway Runoff ▪ Recreation Activities (golf courses) ▪ Ground-Water Withdrawal	High	303(d) list (11 segments in 11 tributaries) Salmonid impacts
Lummi River, its tributaries, and Jordan's Creek	Fecal Coliform Bacteria	▪ Agriculture (pasture grazing, confined animal feeding operations, manure lagoons) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Waste storage or storage tank leaks ▪ Spills ▪ Natural Sources	High	303(d) list (Lummi River, upstream from Reservation) Draft Lummi WQS Violations Potential shellfish impacts in Lummi Bay
	Fine Sediment	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Silviculture (harvesting, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Highway Runoff ▪ Natural Sources	Moderate, Possibly High	Salmonid impacts Potential shellfish impacts in Lummi Bay

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Lummi River, its tributaries, and Jordan's Creek	Habitat Alteration	▪ Agriculture (crop production [all types], pasture grazing) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Hydromodification/Habitat Modification (channelization, flow modification [levee/seawall], removal of riparian vegetation, streambank modification, draining/filling of wetlands) ▪ Recreation Activities (golf courses)	High	Salmonid impacts Shellfish impacts
	Metals	▪ Urban Runoff ▪ Land Disposal (landfills) ▪ Atmospheric Deposition ▪ Highway Maintenance and Runoff	Low	Salmonid impacts Shellfish impacts
	Nutrients	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations, manure lagoons) ▪ Silviculture (restoration, residue management, forest management) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Hydromodification/Habitat Modification (channelization, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Moderate, Possibly High	Salmonid impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Lummi River, its tributaries, and Jordan's Creek	Oxygen-Demanding Substances (organic enrichment)	▪ Agriculture (pasture grazing, confined animal feeding operations, manure lagoons) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Natural Sources	High	Draft Lummi WQS Violations Salmonid impact
	Pesticides, Household and Industrial Chemicals, and Oil and Grease	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Silviculture (harvesting and restoration, forest management, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Atmospheric Deposition ▪ Storage Tank Leaks ▪ Highway Maintenance and Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Moderate, Potentially High	Potential for high degree of impact from spills, excessive use, and increasing development Salmonid impacts Shellfish impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
	Temperature	▪ Agriculture (crop production [all types], pasture grazing) ▪ Silviculture (harvesting, forest management) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank modification, draining/filling of wetlands) ▪ Highway Runoff ▪ Recreation Activities (golf courses) ▪ Ground-Water Withdrawal	High	Draft Lummi WQS Violations Salmonid impacts
Portage Bay (and Bellingham Bay)	Fecal Coliform Bacteria	▪ Agriculture (pasture grazing, confined animal feeding operations, manure lagoons) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Waste storage or storage tank leaks ▪ Spills ▪ Natural Sources	High	Closure of 220 acres to commercial harvest of shellfish 303(d) list Draft Lummi WQS Violations
	Habitat Alteration	▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank modification, draining/filling of wetlands)	Moderate	Salmonid impacts Shellfish impacts
	Metals	▪ Urban Runoff ▪ Land Disposal (landfills) ▪ Atmospheric Deposition ▪ Highway Maintenance and Runoff	Low	Salmonid impacts Shellfish impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
	Nutrients	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations, manure lagoons) ▪ Silviculture (restoration, residue management, forest management) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Hydromodification/Habitat Modification (channelization, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Low	Salmonid impacts
Portage Bay (and Bellingham Bay)	Pesticides, Household and Industrial Chemicals, and Oil and Grease	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Silviculture (harvesting and restoration, forest management, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Atmospheric Deposition ▪ Storage Tank Leaks ▪ Highway Maintenance and Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Moderate, Potentially High	Potential for high degree of impact from spills, excessive use, and increasing development Salmonid impacts Shellfish impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Lummi Bay (and Strait of Georgia, Hale Passage)	Fecal Coliform Bacteria	▪ Agriculture (pasture grazing, confined animal feeding operations, manure lagoons) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Marinas and Recreational Boating ▪ Waste storage or storage tank leaks ▪ Spills ▪ Natural Sources	Low, Potentially Higher	Potential flow from Nooksack River Potential Shellfish impacts
	Habitat Alteration	▪ Hydromodification/Habitat Modification (channelization, flow modification, removal of riparian vegetation, streambank modification, draining/filling of wetlands)	Moderate	Salmonid impacts Shellfish impacts
	Metals	▪ Urban Runoff ▪ Land Disposal (landfills) ▪ Marinas and Recreational Boating ▪ Atmospheric Deposition ▪ Highway Maintenance and Runoff	Low	303(d) list (Strait of Georgia: sediments below Intalco Aluminum Plant) Salmonid impacts Shellfish impacts Herring impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Lummi Bay (and Strait of Georgia, Hale Passage)	Nutrients	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations, manure lagoons) ▪ Silviculture (restoration, residue management, forest management) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Hydromodification/Habitat Modification (channelization, removal of riparian vegetation, streambank destabilization, draining/filling of wetlands) ▪ Atmospheric Deposition ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Low	Salmonid impacts
	Pesticides, Household and Industrial Chemicals, and Oil and Grease	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Silviculture (harvesting and restoration, forest management, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Marinas and Recreational Boating ▪ Atmospheric Deposition ▪ Storage Tank Leaks ▪ Highway Maintenance and Runoff ▪ Spills ▪ Recreation Activities (golf courses)	Moderate, Potentially High	Potential for high degree of impact from spills, excessive use, and increasing development 303(d) list (Strait of Georgia: tideland sediments below Intalco Aluminum Plant) Salmonid impacts Shellfish impacts Herring impacts

Table 5.2 Impairment of Reservation Waterbodies and NPS Pollution Source Categories for Each Type of Pollutant

Waterbody	Pollutant	Source Category (subcategory)	Degree of Impairment	Comments
Ground Water	Fecal Coliform Bacteria	▪ Agriculture (pasture grazing, confined animal feeding operations) ▪ Urban Runoff ▪ Land Disposal (on-site wastewater systems) ▪ Waste storage or storage tank leaks ▪ Spills ▪ Natural Sources	Low	Potential public health risk
	Nutrients	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Atmospheric Deposition ▪ Waste storage or storage tank leaks ▪ Highway Runoff ▪ Spills	Low	Potential public health risk
	Pesticides, Household and Industrial Chemicals, and Oil and Grease	▪ Agriculture (crop production [all types], pasture grazing, confined animal feeding operations) ▪ Silviculture (harvesting and restoration, forest management, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Resource Extraction (surface mining of sand and gravel) ▪ Land Disposal (landfills, on-site wastewater systems) ▪ Atmospheric Deposition ▪ Storage Tank Leaks ▪ Highway Maintenance and Runoff ▪ Spills	Low, Potentially Higher	Potential for high degree of impact from spills, excessive use, and increasing development Potential public health risk
	Saltwater Intrusion	▪ Silviculture (harvesting, road construction and maintenance) ▪ Construction (highway/road/ bridge, land development) ▪ Urban Runoff ▪ Hydromodification/Habitat Modification (channelization, removal of riparian vegetation, draining/filling of wetlands) ▪ Ground-Water Withdrawal	Moderate (Locally and Potentially High)	Gooseberry Point wells closed Documented potential along Bellingham Bay and the Sandy Point Peninsula

6. DISCUSSION

6.1 PRIMARY IMPAIRMENTS OF MAJOR WATERBODIES

The information in Table 5.2 demonstrates that the four major waterbodies and the ground water on the Reservation are currently and/or potentially impaired by NPS pollution. The three current impairments of greatest concern to the Lummi Nation are the closure of 220 acres of shellfish beds in Portage Bay to commercial harvest of shellfish, the degradation of salmonid habitat in the Nooksack River watershed and estuary, and saltwater intrusion into Reservation aquifers. The potential impairments of most concern are the threat of commercial shellfish closures in Lummi Bay and in the remaining approved areas of Portage Bay and the contamination of Reservation ground water by various pollutants. These waters require NPS control measures to restore or maintain desired water uses and to meet or maintain water-quality standards.

6.2 NONPOINT-SOURCE CATEGORIES RESPONSIBLE FOR IMPAIRMENT

In order to rank the NPS categories affecting surface and ground water on or flowing onto the Reservation, the level of impact due to each contributed pollutant was estimated for each source category listed in Table 5.2. Table 6.1 lists these impact levels. The source categories in Table 6.1 descend from the category producing the greatest estimated overall impairment of Reservation water resources to that producing the least estimated impairment. The following criteria were used to estimate the levels of impact:

(1) The number of waterbody segments listed on the Washington 303(d) list or having violations of the Draft Lummi Water-Quality Standards (DLWQS);
(2) Current and potential impacts on shellfish;
(3) Current and potential impacts on salmonids;
(4) Approximate proportion of land area represented by the source category (both on- and off-Reservation);
(5) Literature-based assessment of the amount of pollution produced by each source; and
(6) Literature-based assessment of the relative, overall impact of each pollutant on water resources (both on- and off-Reservation).

Based on Tables 5.2 and 6.1, the NPS categories primarily responsible for the current and potential impairments of Reservation water resources are agriculture, silviculture, hydromodification/habitat modification, urban runoff, and ground-water withdrawal. Although construction, atmospheric deposition, highway/road runoff, and land disposal may be significant contributors to the impairment of Reservation water resources, these four sources and the remaining source categories listed in Table 6.1 do not appear to be major sources at this time. However, control of each NPS category should contribute to the improvement and the preservation of water quality and aquatic habitats both on and off the Reservation. The following discussion describes how the major and potentially significant NPS categories contribute to the impairment of Reservation water resources. These primary sources of impairment will be the high priority targets for NPS management.

Table 6.1 Estimated Pollutant Impacts[1] by Nonpoint-Source Category

Source Category	Bacteria/ Pathogens	Fine Sediment	Habitat Alteration	Metals	Nutrients	Oxygen-Demanding Substances	Pesticides, Oil, Grease, and Other Chemicals	pH	Saltwater Intrusion	Temperature
Agriculture	H	M/H	M/H		M/H	H	M	M	L	H
Hydromodification/ Habitat Modification	M	H	H		L/M	M		L	L/M	M/H
Silviculture		H	L/M		L		L	L	L	H
Urban Runoff	L/M	L/M	L/M	L/M	L/M	L/M	M/H	L	L	L/M
Construction		L/M	L/M		L	L	L/M	L	L	L/M
Atmospheric Deposition		L		L/M	L/M		L/M	L/M		
Highway Maintenance and Runoff		L/M		L	L	L/M	L/M	L		L
Land Disposal	L/M			L, ~H	L/M	L	L, ~H	L		
Ground-Water Withdrawal									L/M, ~H	L/M
Resource Extraction (sand/gravel mining)		L, ~M	L, ~M				L	L	L	L
Spills	L, ~H				L, ~H		L, ~H	L, ~H		
Waste Storage or Storage Tank Leaks	L				L	L	L, ~H	L		
Recreation Activities (golf courses)			L		L		L, ~H			L
Marinas and Recreational Boating	L, ~H			L, ~H						

[1]L = Low Impact; M = Moderate; H = High; L/M = Low to Moderate; M/H = Moderate to High; ~ = Potentially. (Blank = no, or insignificant, impact)

6.2.1 Agriculture

Agricultural land uses, especially by dairy operations, have been identified as the major source of the fecal coliform bacteria that are responsible for the closure to commercial harvest of Portage Bay shellfish beds (DOH 1997; WCD 1998; Ecology 2000b) and the potential closure of Lummi Bay shellfish beds. The agricultural activities that allow bacteria to reach surface waters in the Nooksack and Lummi river watersheds include dairy-waste application to fields, leaking manure lagoons, direct animal access to surface water, direct discharge to waterways, and runoff from pastures, feedlots, and animal holding areas.

Agriculture is also a significant source of all the other types of pollutants, except for metals, that are responsible for salmonid and shellfish impacts in the Nooksack and Lummi river watersheds and estuaries. Reduced summer flows, removal of shade-providing riparian vegetation, and organic enrichment due to animal wastes contribute to low dissolved-oxygen levels in Nooksack and Lummi river tributaries. Land clearing, soil disturbance, and removal of riparian vegetation combine to increase storm-water runoff and fine sediment loads to the streams and rivers. Higher peak flows due to the increased runoff results in greater streambank erosion. Increased nutrient levels in streams are largely due to input of fertilizers, animal wastes, and crop residues from farm lands. Agricultural chemicals, including insecticides, herbicides, fungicides, and their degradation products, are one of the sources of chemical contamination of surface and ground water in the watersheds. The Nooksack tributaries on the 303(d) list for pH violations all flow through agricultural areas. Removal of shade-providing riparian vegetation and reduced summer flows resulting from agricultural land uses contribute to elevated water temperatures in the streams of the Lummi and lower Nooksack river watersheds. In addition, the loss of riparian vegetation, alteration of creeks into channeled drainage ditches, and livestock access to streams damage and alter stream habitats (EPA 1997b). Hydromodification in agricultural areas, particularly drainage activities, affects the timing of the annual hydrograph (an earlier peak) and contributions to streams during the low flow season by removing water from the system. Many of these agricultural effects on water quality are combined with the effects arising from other NPS pollutant sources, which are described in the following subsections.

Agriculture in the Reservation watersheds occurs largely on the floodplain of the Nooksack and Lummi rivers. The floodplain is a sensitive area in regard to water quality because it is periodically inundated by flood waters and the soil, which may contain accumulated contaminants, can be eroded and transported to areas with important aquatic resources. There is little opportunity for retention of pollutants during flooding because of the proximity of farm lands to surface waters and the lack of riparian vegetation. In addition, ground water under the floodplain is generally in hydraulic connection with adjacent streams, providing another potential route for pollutants to reach surface waters.

Since some agricultural activity presumably occurs in the recharge zones that have been generally identified for Reservation aquifers (Section 3.4.1; LWRD 1997), the potential exists for impacts on the aquifers below the Reservation uplands. Crop production or

over-grazing could reduce ground-water recharge by increasing surface runoff. This would increase the probability and magnitude of saltwater intrusion. The use of fertilizers and agricultural chemicals generally contributes to ground-water contamination. These impacts, however, are probably not significant in the Reservation aquifers because of the limited extent of agriculture in the recharge zones.

6.2.2 Hydromodification/Habitat Modification

Hydromodification, including aquatic and riparian habitat modification, is a significant source of salmonid and shellfish impairment in the lower Nooksack and Lummi river watersheds and estuaries. Its main impacts on habitat and water quality in streams are due to direct alteration of channel morphology and salmonid habitat, isolation of streams from floodplains and side channels, input of fine sediment, drainage activities that reduce the amount of water available to support instream flows during the low flow season (July – October), and elevated water temperatures; other impacts include reduction of dissolved oxygen, increased nutrient levels, and pH alterations. In Lummi Bay, the main impacts of hydromodification on habitat and water quality in estuarine habitats are due to the sea wall that physically separates nutrient sources in upland areas from the estuary and that results in a decrease in salt marsh habitat. The Lummi and Bellingham bay estuaries can also be affected by increased input of fine sediment resulting from hydromodification.

Hydromodification can be a less obvious source of NPS pollution relative to other sources because some of its effects are generated indirectly. For example, several forms of hydromodification indirectly affect dissolved-oxygen levels: channelization often reduces the turbulence that mixes oxygen into the water column; reduced flow due to flow modification also reduces turbulence as well as the dilution of oxygen-depleting substances; removal of riparian vegetation produces elevated water temperatures that in turn reduce dissolved-gas saturation concentrations; loss of riparian vegetation and streambank destabilization also result in increased loading of sediment and other oxygen-depleting substances in runoff; and the draining/filling of wetlands results in reduced streamflow and less removal of oxygen-demanding substances from runoff.

Other significant impacts of hydromodification include the effect of increased streambank erosion due to channelization, removal of riparian vegetation, and streambank destabilization. The draining/filling of wetlands and isolation of streams from their floodplains due to channelization reduces opportunities for fine sediments to be deposited outside of the streambed. In addition to the effect of removal of riparian vegetation, reduced streamflow due to flow modification and draining/filling of wetlands also results in higher water temperatures in streams. All of these processes have smaller effects on the nutrient and pH levels in streams (EPA 1997b).

6.2.3 Silviculture

Forestry activity is probably the primary source of impairment to salmonids in the upper Nooksack River watershed (i.e., along the North, Middle, and South Forks of the Nooksack River and their tributaries) and is a contributing source of NPS pollutants affecting, or potentially affecting, shellfish in Portage and Lummi bays. The main impacts to streams are increased sediment and elevated water temperature; lesser impacts result from habitat alteration and the input of nutrients and pesticides. Harvesting, road construction, and road use and maintenance are the activities that generate sediment contributions to streams; mass-wasting events from roads and harvested areas, however, are the main source of sediment. Harvest of shade-providing trees results in elevated stream temperatures. The removal of potential large woody debris during harvests and bridge construction both alter stream habitats. Fertilizers used during reforestation and leaching of nutrients from soils exposed by harvest activity result in nutrient inputs to streams. Silvicultural chemicals, including pesticides and their degradation products, are also carried to streams by runoff and by leaching into the ground water that feeds streams (EPA 1997b).

Since much of the Reservation uplands are forested, future harvesting of these forests may have impacts on ground water. Harvest-induced alteration of forest hydrology could reduce ground-water recharge by increasing surface runoff during storm events. This could increase the probability and magnitude of saltwater intrusion, depending on whether the land was retained in forestry or converted to another use. The use of fertilizers and silvicultural chemicals during reforestation and forest management activities could contribute to ground-water contamination.

6.2.4 Urban Runoff

Urban runoff is a source of all the types of pollutants (bacteria, fine sediment, habitat alteration, metals, nutrients, oxygen-demanding substances, pesticides and other chemicals, pH, and temperature) that are responsible for salmonid and shellfish impacts in the Lummi and Nooksack river watersheds and estuaries. Oxygen-demanding substances, such as pet waste, oil, grease, detergents, waxes, and other household chemicals, and reduced streamflow due to hydrologic alterations likely contribute to low dissolved-oxygen levels in Nooksack and Lummi tributaries. The increase of impervious surfaces (e.g., driveways, roads, parking lots, and roofs) associated with development can significantly increase storm-water runoff and fine sediment loads to the streams and rivers in the watersheds. Higher instream flows due to the increased storm runoff result in greater streambank erosion. Creeks channelized into roadside ditches and streambed scouring due to storm runoff result in habitat alterations. In addition, pollutants that accumulate on surfaces and in the atmosphere between precipitation events can produce high pollutant levels in the initial runoff from a storm. These runoff pollutants include the nutrients derived from fertilizers, automotive wastes, failing septic systems, and other sources. Also included are the significant levels of heavy metals, petroleum hydrocarbons, and various other chemicals, including pesticides and their degradation products, that are derived from automotive wastes and various residential, commercial,

and industrial sources (EPA 1997b). Many of these sources (e.g., leaking batteries) can alter the pH in watershed streams. Loss of shade-providing riparian vegetation and reduced streamflow due to hydrologic alterations contribute to elevated stream temperatures in the Lummi and lower Nooksack river watersheds.

Streams and storm runoff transport some of the pollutants described above, especially metals, pesticides, and other chemicals, from urban areas to the resource-rich tideland habitats along the Reservation shorelines. With the highest housing density on the Reservation occurring along the shorelines, contaminated storm water can flow directly onto the resource-rich tidelands. Because freshwater will generally "float" over denser seawater before gradually mixing with the seawater, species that reproduce, live, or feed in the intertidal zone or in the upper portion of the water column are particularly vulnerable to contaminated freshwater input. These species include juvenile salmon, herring, other small forage fish, shellfish, great blue herons, and bald eagles. This marine exposure pathway also exists for pollutants that enter surface waters from other source categories (e.g., agriculture, silviculture, atmospheric deposition, and highway runoff).

Although much lower than agriculture, urban runoff is a contributing source of fecal coliform bacteria responsible for the closure of Portage Bay shellfish beds and potential closure of Lummi Bay shellfish beds (Ecology 2000b). Exposure of pet waste and failing septic systems to surface runoff of storm water are the routes through which bacteria reach surface waters in the Reservation watersheds. The pathway described in the previous paragraph acts to expose the shellfish in the tidelands of Bellingham, Portage, and Lummi bays to bacterial contamination with the ebb and flow of each tide.

Since urban runoff occurs in the generally identified recharge zones for Reservation aquifers, the potential exists for impacts on the ground water where surface waters contribute to aquifer recharge. The nutrients, metals, and chemicals present in urban runoff can contribute to ground-water contamination. In addition, increased storm-water runoff due to impervious surfaces results in reduced ground-water recharge. This will potentially increase the probability and magnitude of saltwater intrusion.

6.2.5 Construction

Land development and associated construction activities are contributing, possibly significant sources of seven of the nine types of pollutants (fine sediment, habitat alteration, nutrients, oxygen-demanding substances, pesticides and other chemicals, pH, and temperature) that are responsible for salmonid and shellfish impacts in the Lummi and Nooksack river watersheds, other Reservation watersheds, and in the marine waters on or adjacent to the Reservation. The impacts of land development and construction activities are very similar to those of urban runoff and the details may again be found above. These impacts are those that occur during the development and construction of buildings and roads; once construction is completed, the land area becomes a source of urban or highway runoff. The contaminants associated with construction are also similar to those of urban runoff with the exception of bacteria and metals. Construction chemicals, such as paints, acids, cleaning solvents, asphalt products, soil additives,

concrete-curing compounds, and pollutants in wash water from concrete mixers (EPA 1997b), largely match or replace the various commercial and industrial chemicals found in urban runoff. Pollution from construction differs from that of urban runoff in that soil erosion is generally greater (EPA 1997b). Control of soil erosion is therefore a high priority at construction sites.

6.2.6 Atmospheric Deposition

Though significant quantities of atmospheric pollutants are generated in (NWAPA 1999) or pass through the region (USGS 1999), the amount of atmospheric deposition within Reservation watersheds is unknown. The levels of impact from atmospheric deposition listed in Table 6.1 are estimated relative to the impacts determined for the other source categories. Pollutants deposited regionally from the atmosphere in significant amounts include nitrogen, mercury and other heavy metals, fine particulate matter, sulfuric and hydrochloric acids, pesticides, and various organic chemicals (NWAPA 1999; USGS 1999). The major sources of atmospheric pollutants are exhaust from combustion of fuels, waste incineration, pesticide applications, commercial and industrial processes, and natural sources such as volcanism. Industrial sources relatively close to the Reservation include four oil refineries, an aluminum smelter, a pulp (now closed) and paper mill, and a waste incineration facility (now closed). Since their distribution is widespread, the deposition of atmospheric pollutants can potentially, if not currently, affect salmonids, shellfish, surface-water quality, and ground-water quality both on and off the Reservation.

6.2.7 Highway Maintenance and Runoff

Storm-water runoff from highways and roads is a contributing, possibly significant source of seven of the nine types of pollutants (fine sediment, metals, nutrients, oxygen-demanding substances, pesticides and other chemicals, pH, and temperature) that are responsible for salmonid and shellfish impacts in the Lummi and Nooksack river watersheds, other Reservation watersheds, and in the marine waters on or adjacent to the Reservation. Since this category is a component of the urban runoff source category, the impacts of highway runoff on surface and ground water are the same as for urban runoff and the details may be found above. The contaminants in highway runoff, however, are limited to those found in atmospheric deposition and in automotive wastes, including rubber worn from tires (oxygen-demanding substance), heavy metals, phosphorus, acids, oil, grease, and various other automotive chemicals.

6.2.8 Land Disposal

Nonpoint-source pollution due to land disposal of wastes is a contributing, possibly significant source of six of the nine types of pollutants (bacteria, metals, nutrients, oxygen-demanding substances, pesticides and other chemicals, and pH) that are responsible for salmonid and shellfish impacts in the Lummi and Nooksack river watersheds, other Reservation watersheds, and in the marine waters on or adjacent to the Reservation. The main sources of these pollutants in Reservation watersheds are failing

septic systems and abandoned landfills. Both of these sources may leach organic material, bacteria, nutrients, pesticides, and household chemicals into ground water; landfills may also leach metals, petrochemicals, and various commercial and industrial chemicals, depending on what was placed in the landfill. If ground water from these sites reaches the surface, streams may also become contaminated. For on-site septic systems, this could result in a contribution to bacterial contamination of Portage and Lummi bays, but on a far smaller scale than that due to agricultural sources (Ecology 2000b).

6.2.9 Ground-Water Withdrawal

Saltwater intrusion due to excessive pumping of ground water is a current threat to Reservation aquifers. Most of the active water-supply wells on the Reservation are located within a half-mile of marine waters. Progressive saltwater intrusion has already led to the closure of several public and private water-supply wells. Since future residential development would both increase the demand for ground water and potentially decrease the area available for ground-water recharge, the potential for further saltwater intrusion is high. Increased pumping due to future economic and population growth could further threaten the ground-water resources of the Lummi Nation if such activities are not managed effectively.

7. EXISTING NONPOINT-SOURCE POLLUTION REDUCTION PROGRAMS

In this section, the existing LIBC environmental programs directed toward managing nonpoint sources of pollution on the Reservation are identified and described. Following this description, a summary of how the various programs address the five primary NPS pollution issues on the Reservation is presented.

7.1 LIBC ENVIRONMENTAL PROGRAMS

Fourteen LIBC environmental programs on the Reservation directly relate to managing Reservation water quality. Other programs may indirectly protect Reservation water quality (e.g., Public Health and Safety). These programs are part of the LIBC's efforts to protect the political integrity, economic security, health, and welfare of the Lummi Nation. The LNR administers eleven of the programs and the Lummi Planning Department (LPD) administers three programs. These fourteen LIBC environmental programs address the current and potential impairments of water quality on the Reservation. The LNR administers the following environmental programs:

- Surface Water Quality Monitoring Program (SWQMP)
- Ground Water Monitoring Program (GWMP)
- Comprehensive Water Resources Management Program (CWRMP)
    - Storm Water Management Program (SWMP)
    - Wellhead Protection Program (WPP)
    - Wetland Management Program (WMP)
    - Water Quality Standards (WQS) Program
- Investigation of Storm-Water Contributions to Portage Bay
- Case-Specific Investigations of Water-Quality Problems
- Nooksack Estuary Recovery Project (NERP)
- Coastal Zone Management Plan (CZMP)
- Tidelands Management
- Natural Resources Ordinance (Forest Management)
- Flood Damage Reduction Plan (FDRP)
- Spill Prevention and Response Plan

The LPD administers the following programs:

- General Land Use Plan (GLUP)
- Technical Review Committee (TRC)
- Sewer District and Sewer Code

7.1.1 Surface Water Quality Monitoring Program

The Lummi Nation SWQMP has been in place since 1993. The SWQMP currently consists of monthly sampling at 48 sample stations (sites) on and around the Reservation. The number of sites has increased significantly since 1993 in response to the downgrade of shellfish beds in Portage Bay by the National Shellfish Sanitation Program and to address concerns about Lummi Bay and its watershed. In addition, bacteria sampling

was expanded in 1998 from standard membrane filtration of fecal coliform bacteria to membrane filtration with recovery steps for both fecal coliform bacteria and *E. coli*. In 2000, *Enterococcus* enumeration was added to the bacteria analysis. The SWQMP is an on-going program.

For all sites, air temperature, water temperature, conductivity, salinity, salinity-based stratification, flow and/or current direction, water depth, and dissolved oxygen are measured and recorded. Secchi depth is measured at the marine sites. In addition, fecal coliform, *E. coli*, and *Enterococcus* samples are collected at 44 of the 48 sites and analyzed at a laboratory certified by Washington State. In the 2001 calendar year, turbidity, pH, and redox will possibly be added to the parameters measured at each site (equipment problems have limited pH and turbidity measurements). On a quarterly basis at selected sites, samples for nutrients, total petroleum hydrocarbons, and metals are collected for analysis at a laboratory certified by Washington State. All measurements are performed and recorded in accordance with a Quality Assurance and Quality Control (QA/QC) plan most recently approved by the EPA in February 2000.

The SWQMP is intended to collect baseline information about the quality of Reservation surface waters and to identify and locate point- and nonpoint-source pollution problems. It also supports development of the Lummi WQS program. Bacteria data from sample stations along the Reservation boundary are shared with Ecology on a regular basis to identify and address water-quality problems that originate off-Reservation. Information from the SWQMP has also been used to assist the DOH with shoreline surveys.

7.1.2 Ground Water Monitoring Program

The GWMP has been in place since 1993. The GWMP currently consists of monthly monitoring of 23 wells on the Reservation. Two of these wells are monitored weekly or more frequently, depending on water use and environmental factors. Depending on access to the well and whether the well is still in use, some or all of the following parameters are measured at each well: pump rate, water level, conductivity, water temperature, and chloride concentration. All measurements are performed and recorded in accordance with a QA/QC plan. The GWMP is an on-going program.

The purpose of the GWMP is to collect baseline information about the quality and quantity of Reservation ground water. Specifically, the GWMP provides information to support management decisions related to protecting the Reservation aquifers from saltwater intrusion and ground-water mining.

7.1.3 Comprehensive Water Resources Management Program

The CWRMP is an effort to ensure that the planning and development of Reservation water and land resources are safeguarded against surface- and ground-water degradation. The Lummi Water Code, which is currently under revision as part of the CWRMP, will improve the administrative infrastructure for water-resources management on the Reservation. The water code is intended to provide for knowledge-based, integrated,

efficient, and equitable management of Reservation waters. The CWRMP includes the SWMP, the WPP, the WMP, the WQS program, and administrative procedures. These programs involve assessments of resource conditions as well as conservation, public-education, and regulatory mechanisms to protect water resources for future generations. Nonpoint-source pollution assessments and reduction efforts are integral to the CWRMP.

The CWRMP is under development using a three-stage approach for each component. Technical background documents are developed initially, a literature review of ordinances and regulations from other tribal, federal, state, and local jurisdictions is conducted, and then ordinances and regulations are developed based on the technical background documents and literature reviews. The technical background documents are based on field data, literature reviews, and scientific investigations. Community education and outreach occur during the ordinance development phase (and will continue to occur after adoption of the respective ordinances). Appendix C contains fact sheets describing the CWRMP.

7.1.3.1 Storm Water Management Program

The purposes of the Lummi Reservation SWMP are to (1) protect Reservation surface waters, ground water, and tidelands from contamination and (2) protect downstream property owners from upstream development. A technical background document (LWRD 1998a) and a literature review of storm-water ordinances developed by other jurisdictions have been completed. The draft ordinance has been developed and the community education phase is in progress. The ordinance is tentatively scheduled for adoption in the winter of 2002. Appendix C contains a fact sheet describing the program.

In general, the SWMP will help protect against NPS pollution by (1) identifying receiving waters using maps of storm-water facilities and the Reservation stream and ditch network (LWRD 1998a); (2) identifying and analyzing potential pollutant sources and impacts; and (3) identifying and applying appropriate best-management practices and/or other conditions (e.g., changing a project to avoid an impact) to prevent pollution of Reservation surface waters.

7.1.3.2 Wellhead Protection Program

The purpose of the Lummi Nation WPP is to protect the Reservation ground-water supplies from contamination. A technical background document (LWRD 1997, 1998c) and a literature review of wellhead-protection ordinances developed by other jurisdictions have been completed. The draft ordinance has been developed and the community education phase is in progress. The ordinance is tentatively scheduled for adoption in the winter of 2002. Appendix C contains a fact sheet describing the program. In general, the WPP will protect against NPS pollution through mapping specific wellhead protection areas, identifying potential pollutant sources, and identifying and applying best-management practices to prevent pollution of Reservation ground waters at the scale of both the overall recharge area as well as the specific wellhead areas.

7.1.3.3 Wetland Management Program

The goals of the Lummi Nation WMP are to (1) protect Reservation ground-water supplies; (2) protect surface-water resources, including tidelands and estuaries; (3) protect both the functions and values of Reservation wetlands; and (4) accommodate the interests of businesses and property owners by providing defined wetland-management standards, requirements, and mitigation alternatives for efficient and effective project planning. A Reservation wetland inventory and a technical background document have been completed (LWRD 2000a), and the community education component has begun. A literature review of wetland-management ordinances from other jurisdictions was also completed, and adoption of an ordinance is scheduled for the winter of 2002. Appendix C contains a fact sheet describing the program.

In general, the WMP will protect against NPS pollution by (1) identifying receiving waters using maps of wetland locations (LWRD 2000a); (2) identifying wetland functions and values in need of protection; and (3) identifying and applying best-management practices and/or other conditions to protect the beneficial functions of wetlands vis-à-vis NPS pollution reduction.

7.1.3.4 Water Quality Standards Program

The purpose of the Lummi Nation WQS program is to attain the goals of the CWA for Reservation surface waters. The draft Lummi WQS and the application to administer the WQS have been submitted to the EPA. The WQS for the Lummi Reservation have the same numerical criteria as the Washington State WQS (but need to be revised to incorporate changes to the Washington WQS). It is anticipated that the application to administer the program will be approved by the EPA in 2001 and that the WQS will be adopted by the LIBC and approved by the EPA in late 2001. Appendix C contains a fact sheet describing the WQS program. In general, the WQS and associated anti-degradation policies will provide an administrative and legal mechanism to ensure attainment of the water quality needed to support beneficial uses.

7.1.4 Investigation of Storm-Water Runoff to Portage Bay

In 1998, a three-year targeted sampling program (also known as the Dairy Waste Impact Study) was initiated to characterize storm-water contributions from the Hermosa Beach area of the Lummi Peninsula to Portage Bay. The winter of 2001 was the last sampling period of the program. The targeted sampling program included daily or more frequent sampling along Hermosa Beach and a few other sites for two weeks during the onset of flow in the fall. The sampling was repeated for two weeks in the winter when the intermittent streams were supported by baseflow. During each two-week period, 11 sites were sampled daily or more frequently, and 14 additional sites were sampled twice (i.e., all culverts discharging to or near Portage Bay were sampled at least twice during each 14-day period). For all sites, water temperature, conductivity, salinity, depth, flow or current, fecal coliform bacteria, and *E. coli* were measured or enumerated. Bacteria samples were enumerated at a laboratory accredited by Washington State. All

measurements were performed and recorded in accordance with a QA/QC plan most recently approved by the EPA in February 2000.

In general, this investigation is intended to evaluate NPS pollution from the uplands immediately adjacent to Portage Bay and to assess to what extent these sources contribute to the shellfish downgrade in Portage Bay.

7.1.5 Case-Specific Investigations of Water-Quality Problems

The staff of the Lummi Nation Water Resources Division conduct water-quality investigations when specific items or problems are identified that threaten Reservation waters. Sample bottles for metals, nutrients, total petroleum hydrocarbons, and bacteria are maintained specifically for these investigations and arrangements have been made with a contracted, accredited, analytical laboratory to accept samples during holidays and weekends if necessary. These investigations are intended to provide information needed to evaluate identified threats and to determine appropriate responses to address the threat.

7.1.6 Nooksack Estuary Recovery Project

The NERP is a project to restore coastal wetlands and marshes on the Lummi Reservation, including the possible reconnection of the Lummi and Nooksack rivers (instead of the Lummi River only receiving Nooksack water at high flows). One issue limiting the possibility of reconnection of the rivers is that the introduction of substantial Nooksack River water to Lummi Bay could cause decertification of the shellfish beds in the bay. A major goal of this project is to facilitate the recovery of salmonids in the Nooksack River system. The NERP is in the preliminary phases of project evaluation and feasibility. In cooperation with the U.S. Army Corps of Engineers (Corps), a Section 22 Planning Study to evaluate the environmental benefits and costs of alternative restoration actions in the estuary was completed in mid-2000. Planning is currently underway to conduct baseline habitat assessments in the estuary. In the near future, an Environmental Impact Statement may be prepared, at which point specific action items will be identified and targeted for implementation. In general, the NERP will address hydromodification in the Lummi River and Nooksack River estuaries.

7.1.7 Coastal Zone Management Plan

The purpose of the Lummi Nation's 1979 CZMP is threefold: to protect and preserve the shoreline areas of the Lummi Nation, to implement the United States Coastal Zone Management Act of 1972, and to cooperate with the state of Washington in the implementation of the Washington State Shoreline Management Act. The CZMP provides guidelines for reviewing development proposals according to sound environmental principles. The policies are developed around the elements found in the guidelines for the Washington State Environmental Policy Act and the Washington State Shoreline Management Act. A Coastal Zone Management Permit (a.k.a. coastal zone permit) must be obtained from the LNR for all non-exempt permitted uses and conditional uses before any construction or other activities take place within 200 feet of

Reservation shorelines (i.e., the coastal zone). The Lummi CZMP is intended to minimize NPS pollution along Reservation shorelines by prohibiting or limiting certain activities in the coastal zone and ensuring the application of best-management practices intended to prevent pollution.

7.1.8 Tidelands Management

The Lummi Nation Title 13 Tidelands Code establishes rules and regulations related to uses of tribal tidelands. Tidelands are defined as any lands, including beaches, seaward of the line of natural vegetation or the meander line, whichever be more landward along all salt water bordering the Reservation, including all such lands east of the Point Francis/Treaty Rock line. The Reservation tidelands extend to the Extreme Lower Low Water line (-4.5 feet mean lower low water). In general, the tidelands code minimizes NPS pollution along Reservation tidelands by prohibiting or limiting certain activities on Reservation tidelands.

7.1.9 Natural Resources Ordinance

The Lummi Nation Title 10 Natural Resources Ordinance establishes rules and regulations related to seafood harvesting, hunting, and forestry. The primary portions of Title 10 that apply to Reservation water quality relate to shellfish harvest and forestry activities. Any activity that produces a forest product requires that a permit be obtained from LNR before the harvest activity. As part of the permitting process for timber harvests, best-management practices intended to protect water quality are required.

7.1.10 Flood Damage Reduction Plan

The LNR has developed a FDRP to complement the Lummi Nation Title 15A Flood Damage Prevention Code and the eligibility of the Reservation for the National Flood Insurance Program administered by the Federal Emergency Management Agency. Title 15A establishes construction requirements for development in flood hazard areas; new construction that meets these requirements can be insured under the National Flood Insurance Program. The large portion of the Reservation that lies in the floodplains of the Lummi and Nooksack rivers and the coastal areas of the Reservation (especially the Sandy Point Peninsula and Gooseberry Point) are vulnerable to flood damage and the resulting transport of NPS pollutants to the Reservation tidelands and estuaries. The FDRP proposes actions that will reduce the vulnerability to floods of the Reservation and its waters. By reducing flood damage, these actions will reduce the transport of NPS pollution to Reservation waters.

7.1.11 Spill Prevention and Response Plan

An integrated Spill Prevention and Response Plan for the Reservation is expected to be completed in early 2002. This plan will identify measures the Lummi Nation can take to prevent spills of polluting material on the Reservation and actions the Lummi Nation

should take in response to spills on or off the Reservation that threaten Reservation waters.

Lummi Law and Order, in cooperation with the Whatcom County Division of Emergency Management (in the county Sheriff's Department) and local fire and police agencies, is trained and prepared to respond to minor spills or releases of some hazardous materials. Small quantities of hazardous materials are known to be used and transported through the Reservation on a regular basis. The most significant operations using hazardous materials are the two oil refineries and one aluminum smelter located just north of the Reservation. The main transportation route to and from these operations is Slater Road, which follows the northern boundary of the Reservation. In response to a major spill, experts from the EPA, Ecology, and local industries would be called in to help control the damage. The Spill Prevention and Response Plan will further describe emergency response capabilities of these agencies.

7.1.12 General Land Use Plan

The Lummi Planning Department is developing a GLUP for the Lummi Reservation. The plan will show, in general, how land on the Reservation will be used over the next 20 years. The GLUP will identify areas that will be developed for residential, commercial, industrial, and agricultural purposes, as well as showing areas that require protection (e.g., wetlands and aquifer-recharge zones). To date, a technical background document (LIBC 1996) has been developed, public-opinion surveys conducted, a preliminary version of the GLUP drafted, a second round of maps developed, and focused planning workshops and meetings with commissions and community groups have occurred. The GLUP will be codified in the Lummi Nation Title 15 Zoning Code. The GLUP and the revised zoning code will prevent NPS pollution by ensuring that land use is compatible with the landscape, that infrastructure is developed in a coordinated fashion, and that development should have the overall effect of minimizing land-disturbing activities.

7.1.13 Technical Review Committee

The TRC was established by the LIBC in 1997 in response to increasing development pressure on the Reservation and the need for coordinated review of Reservation development projects. The TRC consists of representatives from the following departments or divisions of departments: Cultural, Economic Development, Lummi Indian Family Enrichment Center (public health), Law and Order, Maintenance, Tribal Employment Rights Office, Natural Resources, Lummi Education, Lummi Sewer and Water Districts, Construction/Engineering, Housing, and Land Development. The TRC meets weekly to review land-use applications distributed to committee members before the meeting. At the TRC meeting, comments and conditions are stated and the application either is delayed for further information or a Lummi Land Use Permit is approved, approved with conditions, or denied. In addition, where necessary, Environmental Assessments and/or Environmental Impact Statements are required before a decision. Development of a Tribal Environmental Policy Act (TEPA) is scheduled for completion by December 2002. The Lummi TEPA will complement the TRC efforts.

Land-use activities can affect many people. Without careful planning, future opportunities for development may be lost to current land-use activities. The TRC is providing for comprehensive and balanced review of proposed land-use activities on the Reservation. Participation of the LNR in the TRC provides for the protection of natural resources as well as an opportunity to provide information to applicants that can improve their projects.

7.1.14 Sewer District and Sewer Code

The Lummi Sewer District, which is administratively within the Lummi Planning Department, operates a comprehensive, Reservation-wide, sewage-collection and treatment system that serves the majority of households on the Reservation. The sewer facilities consist of sewer collectors, sewer interceptors, 26 lift stations, and two treatment plants (LIBC 1996). For residences not on a sewer line, the Lummi Nation Title 16 Sewer Code regulates sewage disposal for public health and safety and establishes criteria for the design, construction, alteration, and operation of on-site septic systems. The Lummi Sewer District enforces the sewer code and inspects on-site septic systems. The sewer district and sewer code serve to minimize NPS pollution by ensuring that appropriate sanitary sewer facilities are used by Reservation residents and that the systems are operated and maintained in a manner that protects public health.

7.2 Programs and Activities Addressing Primary NPS Pollution Issues

Each of the five current or potential primary impairments of Reservation waters identified in this report is currently being addressed by LIBC programs and by specific activities that are designed to help resolve the impairments. This section summarizes how these programs and activities address each impairment.

7.2.1 Shellfish Closure in Portage Bay

The shellfish-closure problem in Portage Bay is being addressed in several ways:

(1) the SWQMP was expanded to include 17 new stations in and around Portage Bay;
(2) the targeted sampling program along Hermosa Beach was implemented;
(3) the LNR is developing the WQS, WPP, and SWMP, which will provide regulatory mechanisms to address Portage Bay water quality.
(4) the LNR has been working with the EPA to address the sources of pollution;
(5) the LNR has been working with Ecology to develop and implement the Nooksack River Watershed Bacteria TMDL;
(6) the LNR is working with the DOH to conduct and coordinate water-quality sampling;
(7) the LNR worked with the DOH and the EPA to conduct a dye study of the Gooseberry Point Sewer Treatment Plant outfall;
(8) the LNR and Northwest Indian College (NWIC) obtained an Environmental Justice grant from the EPA to address the interaction of the Nooksack River and Portage Bay and to conduct fecal coliform sampling in the Nooksack River watershed;

(9) the LNR and NWIC have worked cooperatively with the EPA, Ecology, and Portage Bay Shellfish Protection District to obtain grants to conduct fecal coliform sampling in the lower Nooksack River basin; and
(10) the LNR has been participating in the Portage Bay Shellfish Protection District.

In 1996-97, the EPA increased their enforcement presence in the Nooksack River basin to prevent dairy farmers from polluting surface waters. In response to the stepped-up EPA enforcement, the Washington State legislature passed the Dairy Nutrient Management Act (ESSB 6161) in 1998, which mandates inspections of dairy operations and the development and implementation of farm plans. In addition, Whatcom County passed an ordinance preventing dairy-waste application to bare ground or corn stubble during the wet season.

The LNR cooperation in the TMDL resulted in the TMDL addressing storms (a significant source of fecal coliform loading to the Nooksack River) and in assuring that the NSSP shellfish criteria would be met in the marine waters of Bellingham and Portage bays (which receive Nooksack River water). Working with the DOH has provided for collection of duplicate samples during the DOH monitoring as well as coordination of sampling in the Nooksack River basin while DOH is sampling Portage Bay. Collaboration with NWIC, EPA, and the Portage Bay Shellfish Protection District (items 7, 8, and 9 above) has provided data to evaluate where and when much of the bacteria are entering the Nooksack River system (not to a specific source, but to tributaries, or reaches of tributaries). The Lummi Nation, in cooperation with the Whatcom Conservation District, has led tours on the Reservation focused on shellfish production and harvest. If other measures are not successful, adoption of WQS by the Lummi Nation could lead to the development of a TMDL to address fecal coliform bacteria in Portage Bay. Many of the actions listed above are included in the Memorandum of Agreement (MOA) between the EPA, Lummi Nation, Ecology, and DOH (Appendix D).

7.2.2 Shellfish Concerns in Lummi Bay

The water-quality threats to Lummi Bay are being addressed through several means:
(1) the SWQMP was expanded to include a total of 12 sample stations in the Lummi Bay watershed and five stations in Lummi Bay;
(2) LNR is developing the WQS, WPP, and SWMP, which will provide regulatory mechanisms to protect Lummi Bay water quality;
(3) LNR coordinates with Ecology farm inspectors when potential problems are observed off-Reservation in the Lummi River watershed;
(4) LNR coordinates with EPA inspectors when potential problems are observed on-Reservation in the Lummi River watershed; and
(5) the NERP may provide a mechanism to treat contaminated runoff from the watershed through created or enhanced wetlands.

7.2.3 Salmonid Impairment in the Nooksack River Watershed

Salmonid impairment in the Nooksack River watershed is being addressed in the following ways:

(1) LNR is monitoring and protecting estuarine water quality and habitat via the SWQMP, the CWRMP, the CZMP, and tidelands management;
(2) LNR conducts case-specific investigations of water-quality problems;
(3) LNR is evaluating the improvement of estuarine habitat via the NERP;
(4) LNR conducts restoration projects to improve salmonid habitat in the Nooksack River watershed;
(5) LNR conducts research on and monitors populations of salmonids in the Nooksack River watershed; and
(6) LNR is participating as an initiating government in the WRIA 1 Watershed Management Project.

7.2.4 Saltwater Intrusion into Reservation Aquifers

The saltwater intrusion problem is being addressed in several ways, some of which are beyond the scope of environmental programs:

(1) the LIBC purchased and retired the wells of one water system that had experienced saltwater intrusion;
(2) the LIBC has shut down or curtailed production from tribal water-supply wells when conditions that could lead to saltwater intrusion are observed (based in part on the GWMP);
(3) the LIBC offered to take over the operation of the private water systems on the Reservation and connect them to the Lummi Water District, which would allow individual wells to be shut down if saltwater intrusion occurred or was imminent, while still providing water to customers (only one private system became part of the Lummi Water District);
(4) the GWMP provides information for effective management of ground-water resources;
(5) development of the SWMP and WPP will provide regulatory mechanisms to protect aquifers from saltwater intrusion; and
(6) to protect the resource for future use, the LIBC helped initiate and was actively involved in federal-tribal-state water-rights negotiations for on-Reservation ground water since 1995. Despite substantial progress toward achieving a settlement that would have provided water for all parties (from an off-Reservation surface-water source), the negotiations collapsed during the summer of 1999. In January 2001 the U.S. Department of Justice filed a lawsuit to quantify and protect the Lummi Nation's rights to ground water on the Lummi Peninsula.

7.2.5 Contamination of Reservation Ground Water

The following programs and activities are protecting ground-water quality:
(1) the GWMP provides information for effective management of ground-water quality;
(2) LNR is developing the WQS, WPP, WMP, and SWMP, which will provide regulatory mechanisms to protect aquifers from contamination;
(3) LNR conducts case-specific investigations of water-quality problems;
(4) LNR works with the EPA to address the on-Reservation sources of pollution;
(5) LNR coordinates with Ecology inspectors when potential problems are observed off-Reservation; and
(6) LPD administers the GLUP and the TRC, which protect ground-water quality by ensuring that land use and development occur with minimal impacts.

8. SELECTION OF BEST-MANAGEMENT PRACTICES

During development and implementation of the NPSMP, the staff of the LNR Water Resources Division (LWRD) will be responsible for the process of selecting best-management practices to control NPS pollution. The BMP selection process falls within the mission of the LWRD: to protect, restore, and manage the Lummi Nation water resources, including Reservation shorelines, in accordance with the policies, priorities, and guidelines of the LIBC. LWRD staff will select appropriate BMPs after reviewing pertinent publications on NPS management measures (e.g., LWRD 1998a; Ecology 1992; EPA 1992; MWCOG 1992; EPA 1993a; IDHW 1996; EPA 1996) and consulting, as needed, with other LIBC departments and local NPS management agencies (USDA-NRCS, WSU Cooperative Extension Service, Whatcom Conservation District, Ecology, EPA, U.S. Forest Service, WA Department of Natural Resources).

Of the existing BMPs in use on the Reservation, the BMPs addressing land disposal of sewage in on-site septic systems are the only currently codified BMPs. These BMPs are found in the Lummi Nation Title 16 Sewer Code. Other BMPs, addressing nonpoint sources such as silviculture, hydromodification, construction, and urban and road runoff, are implemented through the review process for land-use permits conducted by the Lummi TRC. In the near future, anticipated passage of ordinances developed in the CWRMP will promulgate BMPs addressing NPS pollution from resource extraction, construction, and urban- and road-runoff. The EPA may require BMPs for the control of all nonpoint sources through the Section 401 (CWA) certification process. (After the adoption of WQS and the authorization for the Lummi Nation to administer the 401 certification process, the LNR will be responsible for certifying that proposed projects that potentially affect Reservation waters will not cause exceedences of water-quality standards.) The U.S. Army Corps of Engineers implements hydromodification BMPs both on and off the Reservation through the Section 404 (CWA) and Section 10 (River and Harbors Act) permit process. The primary impairments of Reservation waters will continue to be addressed through the activities described in Section 7 of this report.

The primary nonpoint sources affecting Reservation waters from outside the Reservation boundaries are agriculture, silviculture, hydromodification/habitat modification, and urban runoff. BMPs addressing these sources are developed and implemented by other government agencies (e.g., USDA-NRCS, WSU Cooperative Extension Service, Whatcom Conservation District, Portage Bay Shellfish Protection District, Ecology, EPA, U.S. Forest Service, and WA Department of Natural Resources); the LNR has been involved in the selection process and has encouraged the implementation of off-Reservation BMPs.

Because surface- and ground-water movement does not follow private property or political boundaries and because community participation in developing and implementing the management plan is necessary for a successful program, community involvement will be a key element of the Lummi Nation NPSMP. The two elements of the community-involvement plan are (1) public education and (2) interjurisdictional coordination and cooperation for activities off-Reservation that affect on-Reservation resources. Agency and public involvement in this process will be openly solicited as required by the EPA and LIBC and as specified in 40 CFR 25 and Lummi Title 27, respectively. Since a large portion of the NPS pollution within the Reservation is addressed in the SWMP, the public participation process of the NPSMP will be integrated with that of the SWMP.

The Lummi Nation NPSMP will emphasize continued involvement in NPS pollution issues off the Reservation and implementation of BMPs and other actions identified in the CWRMP for nonpoint sources on the Reservation. The activities and programs described in Section 7 of this report should result in the maintenance or improvement of surface- and ground-water quality on the Reservation.

9. NONPOINT-SOURCE CONTROL PROGRAMS

In this section, all available programs for NPS control are listed under the NPS category that is primarily addressed by the NPS control program. General programs that address many or all NPS categories are listed separately under "all NPS categories." Programs that apply to Reservation lands are listed under "On-Reservation;" some of these programs (e.g., Federal programs) may apply off-Reservation as well. Programs that do not apply to Reservation lands but do apply to the watersheds that flow to the Reservation are listed under "Off-Reservation." Each program is listed once. Responsible agencies are enclosed in parentheses; program acronyms are bracketed.

All (or Multiple) NPS Categories

On-Reservation:

- Lummi Surface Water Quality Monitoring Program
- Lummi Ground Water Monitoring Program
- Lummi Comprehensive Water Resources Management Program
  - Storm Water Management Program
  - Wellhead Protection Program
  - Wetland Management Program
  - Water Quality Standards Program
- Lummi Case-Specific Investigations of Water-Quality Problems
- Lummi Investigation of Storm-Water Input to Portage Bay (sampling completed)
- Lummi General Land Use Plan
- Lummi Technical Review Committee
- Lummi Sewer District
- Lummi Nation Sewer Code
- LIBC Funding for the LNR WRD and Environmental Protection Programs
- Tribal Habitat Restoration Projects (Lummi and Nooksack)
- Portage Bay Shellfish Protection District: Closure Response Plan
- Shellfish Certification Program (DOH)
- Clean Water Action Plan (various federal departments and agencies)
- Clean Water Act Section 319 Grants (EPA)
- Clean Water Act Section 106 Grants (EPA)
- Clean Water Act Section 404 Permit Process (Corps and EPA)
- Clean Water Act Section 401 Permit Process (EPA)
- Tribal Watershed Assessment and Planning Process (EPA)
- EPA General Assistance Program
- EPA Multi-Media Grants
- ESA Section 4(d) Rules for Nooksack Chinook Salmon (NMFS)
- ESA Section 7 or Section 10 Consultation (NMFS, USFWS)
- National Environmental Policy Act [NEPA]
- Consolidated Pesticide Compliance Monitoring Program (EPA)
- National Water Quality Assessment Program (USGS)
- Bureau of Indian Affairs [BIA] Water Resources Grant Programs

- Public Law 93-638 Indian Self-Determination Contracts
- Centennial Clean Water Act Grant Program (Ecology)

Off-Reservation:

- Nooksack Salmon Enhancement Association (Stream-monitoring, restoration, and enhancement projects)
- Whatcom County Land Trust
- Whatcom Watershed Information Network
- WAC 400-12: Local Planning and Management of Nonpoint-Source Pollution
  - Nonpoint Watershed Action Plans for Kamm, Tenmile, and Silver creeks
- Local Wellhead Protection Programs
- State Watershed Planning Act (RCW 90.82): WRIA 1 Watershed Management Project
- Clean Water Act Section 303(d) Process (Ecology/EPA)
  - TMDL studies on the Nooksack River and its tributaries
- Pollution Prevention Incentives to States [PPIS] Grant Program (EPA)
- Whatcom County Comprehensive Plan
- Whatcom County Critical Areas Ordinance
- State Growth Management Act
- Puget Sound Water Quality Management Plan
- Puget Sound Water Quality Authority Grants and PIE projects
- Salmon Recovery Act [SRA] (SB 5595)
- Centennial Clean Water Fund
- State Revolving Loan Fund [SRF]
- State Water Pollution Control Act (Ecology)
- State 208 Water Quality Management Plan (Ecology)
- State Coordinated Water System Plans (Ecology)
- State Ground Water Management Program (Ecology)
- State Wetland Mitigation Banks Rule (Ecology)
- Habitat Conservation Plans
- SEPA review of proposed projects

<u>Agriculture</u>

On-Reservation:

- Cooperative Extension Service (USDA)
- Natural Resources Conservation Service (USDA):
  - Environmental Quality Incentive Program [EQIP]
  - Conservation Reserve Enhancement Program [CREP]
  - Wetlands Reserve Program [WRP]
  - Wildlife Habitat Incentive Program [WHIP]
  - Resource Conservation and Development Program
  - Public Law 566 (Small Watershed Protection and Flood Prevention Act)

    - Conservation Technical Assistance Program
- Emergency Conservation Program (USDA Farm Service Agency)
- Agricultural Stabilization and Conservation Service (USDA):
    - Agricultural Conservation Practices Program
    - Conservation Reserve Program
- Rural Clean Water Act/Program (USDA)
- Farmers Home Administration (USDA)
- Rural Development Administration (USDA)
- Sustainable Agriculture Research and Education (USDA)
- Farmers Home Administration (USDA)
- Agriculture in Concert with the Environment Program (EPA and USDA)
- National Water Quality Assessment Program (USGS)
- Rural Economic and Community Development Service

Off-Reservation:

- Whatcom County Manure Ordinance
- Whatcom Conservation District
- Washington State Dairy Nutrient Management Act

Silviculture

On-Reservation:

- Lummi Title 10 Natural Resources Ordinance
- BIA Forest Management Program

Off-Reservation:

- State Forest Practices Rules and Regulations, including the Forests and Fish Report/Plan
- State Forest Land Management Program
- 1987 Timber, Fish, and Wildlife Agreement
    - Watershed Analysis
- Northwest Forest Plan (USFS)

Hydromodification

On-Reservation:

- Nooksack Estuary Recovery Project (LNR)
- Lummi Coastal Zone Management Plan
- Lummi Title 13 Tidelands Code: Tidelands Management
- Lummi Title 15A Flood Damage Prevention Code
- Lummi Flood Damage Reduction Plan
- Hazard Mitigation Grant Program (FEMA)

- Clean Water Act Section 404, Corps of Engineers Dredge and Fill Permit Program
- River and Harbors Act Section 10 Permit Process (Corps)
- Clean Water Act Section 10 (EPA)
- Wetlands Protection Development Grants (EPA)
- Endangered Species Act (NMFS, USFWS)
- U.S. Fish and Wildlife Service Grants (U.S. Department of the Interior)

Off-Reservation:

- South Fork Nooksack River Engineered Log Jam Project (LNR)
- South Fork Nooksack Dike Removal Project
- Whatcom County Comprehensive Flood Hazard Management Plan
- State Shoreline Management Act (Ecology)
- Hydraulic Project Approval Program (WDFW)
- Washington Conservation Corps (Ecology)
- Jobs for the Environment Program

Urban Runoff

On-Reservation:

- Environmental Justice to Small Community Groups (EPA)

Off-Reservation:

- Municipal Storm-Water Management Plans
- Disposal of Toxics Program (Whatcom County)
- Small Business Hazardous Waste Reduction Program (Whatcom County Public Health Department)
- Model Litter Control and Recycling Act (Ecology)
- Hazardous Waste Management Program (Ecology)

Resource Extraction

Off-Reservation:

- Sand and Gravel General Permit Program (Ecology)
- State Surface Mining Act

Atmospheric Deposition

On-Reservation:

- Northwest Air Pollution Control Authority
- Air Quality Program (EPA)

Highway Maintenance and Runoff

On-Reservation:

- Federal Intermodal Surface Transportation Act of 1991

Off-Reservation:

- Road maintenance (Whatcom County Public Works Department)

Land Disposal

On-Reservation:

- Inspections of on-site septic systems (Lummi Sewer District)

Off-Reservation:

- Inspections of on-site septic systems (Whatcom County Public Health Department)

Ground-Water Withdrawal

On-Reservation:

- Lummi Ground Water Monitoring Program

Off-Reservation:

- State Water Right Permit Process

The NPS categories that are not listed above are largely addressed by the NPS programs listed in the "all categories" section. Most of these NPS control programs are described elsewhere (Ecology 1989; CTCR 1992; FPAST 1993; EPA 1997c; Ecology 2000c; LWRD 2000a); the remaining programs are described in Section 7 or are self-explanatory.

10. CONCLUSIONS

Analysis of available water-quality data and potential sources of NPS pollution shows that surface waters on and flowing onto the Reservation are currently or potentially affected by all classes of NPS pollutants. These pollutants include bacteria/pathogens, fine sediment, nutrients, oxygen-demanding substances (low dissolved oxygen), pH, temperature, metals, pesticides, household and industrial chemicals, and oil and grease. The four major waterbodies (Nooksack River, Portage Bay/Bellingham Bay, Lummi River, and Lummi Bay/Strait of Georgia) and the ground water on the Reservation are currently and/or potentially impaired by NPS pollution. The three current impairments of greatest concern to the Lummi Nation are the closure of large portions of Portage Bay to commercial harvest of shellfish, the degradation of salmonid habitat in the Nooksack River watershed and estuary, and saltwater intrusion into Reservation aquifers. The potential impairments of most concern are the threat of commercial shellfish closures in Lummi Bay (and in the remaining approved areas of Portage Bay) and the contamination of Reservation ground water by various pollutants. These waters require NPS control measures to restore or maintain desired water uses and to meet or maintain Draft Lummi Water-Quality Standards.

The NPS categories primarily responsible for the current and potential impairments of surface and ground water in the Reservation watersheds are agriculture, silviculture, hydromodification/habitat modification, urban runoff, and ground-water withdrawal. Although construction, atmospheric deposition, highway/road runoff, and land disposal may be significant contributors to the impairment of Reservation waters, these four sources and the remaining source categories listed in Table 6.1 do not appear to be major sources at this time. However, control of each NPS category should contribute to the improvement and the preservation of water quality and aquatic habitats both on and off the Reservation. The primary and potentially significant sources of impairment should be the high priority targets for NPS management.

To reduce the impacts of NPS pollution on surface and ground water and achieve the NPS management goals, appropriate BMPs must be effectively applied. Effective use of BMPs, coupled with land-use zoning, should minimize the effects of NPS pollution on the Reservation. Thirteen LIBC environmental programs, as well as specific LNR activities aimed at the five current and potential primary impairments, already address, or will address, NPS pollution on the Reservation. The NPSMP will support and complement these current programs and activities.

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12. LIST OF ACRONYMS AND ABBREVIATIONS

Programs and Terms:	
BDL	Below Detection Limit
BMP	Best-Management Practice
CWA	Clean Water Act
CWRMP	Comprehensive Water Resources Management Program
CZMP	Coastal Zone Management Plan
DLWQS	Draft Lummi Water Quality Standards
ESA	Endangered Species Act
GAP	General Assistance Program
GIS	Geographic Information System
GLUP	General Land Use Plan
GWMP	Ground Water Monitoring Program
MOA	Memorandum of Agreement
NERP	Nooksack Estuary Recovery Project
NPS	Nonpoint Source
NPSAR	Nonpoint Source Assessment Report
NPSMP	Nonpoint Source Management Program
NSSP	National Shellfish Sanitation Program
QA/QC	Quality Assurance/Quality Control
SWMP	Storm Water Management Program
SWQMP	Surface Water Quality Monitoring Program
TMDL	Total Maximum Daily Load
TPH	Total Petroleum Hydrocarbons
TRC	Technical Review Committee
WMP	Wetland Management Program
WPP	Wellhead Protection Program
WQS	Water Quality Standards
WRIA	Water Resource Inventory Area

Agencies and Organizations (Parent Organization):	
BIA	Bureau of Indian Affairs
Corps	U.S. Army Corps of Engineers
CTCR	Confederated Tribes of the Colville Reservation
DOH	Department of Health, Washington State
Ecology	Department of Ecology, Washington State
FDA	Food and Drug Administration
FEMA	Federal Emergency Management Agency
FPAST	Fort Peck Assiniboine and Sioux Tribes
IDHW	Idaho Department of Health and Welfare
LIBC	Lummi Indian Business Council
LNR	Lummi Natural Resources Department

LTWD	Lummi Tribal Water District
LWRD/WRD	Lummi Water Resources Division (LNR)
MWCOG	Metropolitan Washington Council of Governments
NMFS	National Marine Fisheries Service (NOAA)
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service (USDA)
NWAPA	Northwest Air Pollution Authority
NWIC	Northwest Indian College
USDA	US Department of Agriculture
USDI	US Department of the Interior
USEPA/EPA	US Environmental Protection Agency
USFWS	US Fish and Wildlife Service (USDI)
USGS	US Geological Survey (USDI)
WCD	Whatcom Conservation District
WDFW	Washington State Department of Fish and Wildlife
WSDC	Washington State Department of Conservation
WSU	Washington State University

Appendix A:

Unified Watershed Assessment for Watersheds within the Boundaries of the Lummi Nation

LUMMI INDIAN BUSINESS COUNCIL
2616 KWINA ROAD • BELLINGHAM, WASHINGTON 98226-9298 • (360) 384-1489
DEPARTMENT _____ EXT._____

September 24, 1998

The Unified Watershed Assessment Working Group (4503F)
U.S. Environmental Protection Agency
401 M. Street, S. W.
Washington, D.C. 20460

Subject: Unified Watershed Assessment for the Lummi Indian Nation

Dear Working Group Members,

Enclosed for your use, please find the unified watershed assessment completed for watersheds within the boundaries of the Lummi Nation. Both of the watersheds (HUC 17110002 and 17110004) were classified as Category I watersheds. The classification assigned to these two watersheds by the Lummi Nation is consistent with the watershed classifications assigned by the State of Washington in their parallel process.

Lummi Nation staff has coordinated our efforts with the Washington State Department of Ecology (lead agency for the Clean Water Action Plan in Washington State), the local Natural Resources Conservation Services office, and the Whatcom County Water Resources Manager.

Please do not hesitate to call Leroy Deardorff, Lummi Nation Environmental Protection Program Director (360-384-2272), if you would like additional information regarding the enclosed assessment.

Sincerely,

Merle Jefferson

Merle Jefferson, Executive Director
Lummi Natural Resources Department

cc Christine Hempleman, Department of Ecology
John Gillies, Natural Resources Conservation Service
Sue Blake, Whatcom County Water Resources Manager

Unified Watershed Assessment For
Watersheds Within the Boundaries of the Lummi Nation

Final September 1998

Introduction

The U.S. Environmental Protection Agency (EPA) and the U.S. Department of Agriculture (USDA) issued the Clean Water Action Plan (CWAP) in February 1998. The CWAP calls for tribal and state governments to work with appropriate agencies, governments, and the public to assess the conditions of water resources in their areas and to classify watersheds within their boundaries into one of four categories. The four categories are:

- **Category I.** Category I watersheds are in need of restoration. These watershed do not now meet, or face imminent threat of not meeting, clean water and other natural resource goals.
- **Category II.** Category II watersheds are meeting clean water and other natural resource goals and standards and support healthy aquatic systems. All such watersheds need the continuing implementation of core clean water and natural resource programs to maintain water quality and conserve natural resources.
- **Category III.** Category III watersheds have exceptionally pristine water quality, other sensitive aquatic system conditions, and drinking water sources. These areas include currently designated and potential candidate Wilderness Areas, Outstanding Natural Resource Waters, and Wild and Scenic Rivers.
- **Category IV.** Category IV watersheds lack significant information, critical data elements, or the data density needed to make a reasonable assessment at this time.

Although watersheds can be evaluated at various geographic scales (e.g., lake, wetland, stream, river, small bay), a common scale is needed for the national objectives of the CWAP. As defined in the CWAP, watershed boundaries for the purposes of the CWAP are defined by the U.S. Geological Survey (USGS) 8-digit hydrologic unit code. In western Washington State, tribal lands can be generally characterized as having small reservations and large usual and accustomed (U&A) fishing, hunting, and gathering areas where the tribal governments are co-managers of the natural resources with state and federal governments. Because of the large size of the U&A areas and work load/staffing constraints, the Lummi Nation has focused its natural resources management efforts throughout the Nooksack River watershed and Georgia Strait. A similar limited geographic area approach is being used to conduct the unified watershed assessments called for in the CWAP. The two 8-digit hydrologic unit code watersheds that will be addressed in the Lummi Nation unified watershed assessments are:

- 17110002 (Strait of Georgia - 955 square miles) and
- 17110004 (Nooksack River - 795 square miles).

The remainder of this document will describe the process, participants, rationale, and information used to classify these two watersheds into one of the four categories identified in the CWAP. As will be described further below, both of these watersheds were classified as Category I watersheds.

Classification Process

The selection factors identified in the CWAP were used as the basis for categorizing watersheds 17110002 and 17110004. The selection factors, the criteria associated with each selection factor, and the applicability of each of the criteria to the two subject watersheds are summarized in Table 1. As shown in Table 1, all of the identified selection factors and criteria applied to both of the subject watersheds. Consequently, both watersheds were classified as Category I watersheds in this unified watershed assessment.

Although all of the selection factors and criteria were applicable to both watersheds, it is important to note that the geographic scale of the assessment is large. Consequently, these watersheds have areas that meet clean water and other natural resource goals and, at a smaller scale, would result in a Category II classification for some of the subbasins that comprise the larger watershed. Similarly, each of the watersheds contain areas of pristine lands that would be classified as Category III.

Participants

Due to a lack of available staff time, development of the unified watershed assessment did not begin until early August 1998. This unified watershed assessment for tribal lands was developed primarily by the Water Resources Division of the Lummi Natural Resources Department. Staff and time limitations prevented implementation of a public review process for this assessment by the Lummi Nation.

Although a public review process was not conducted by the Lummi Nation for this unified watershed assessment, the information used to conduct the analysis was derived from scientific reports and other public documents that have included public review processes. The Lummi Water Resources Division has also worked with the Washington State Department of Ecology in the development of the draft Unified Watershed Assessment for Washington State. The two subject watersheds (17110002 and 17110004) were classified as Category I watersheds in the Washington State process. In addition, the Lummi Water Resources Division contacted the local Natural Resources Conservation Service office and the Water Resources Manager for Whatcom County to ensure that development of the unified watershed assessment did not overlap their efforts.

Rationale

The rationale for classifying watersheds 17110002 and 17110004 as Category I watersheds is summarized in Table 1.

Table 1. Classification system used by the Lummi Nation to categorize watersheds for the Clean Water Action Plan

Selection Factor	Criteria	Watershed 17110002	Watershed 17110004
1. Nonattainment of national clean water goals.	a) Watershed with a waterbody on the 1996 303(d) list.	Yes	Yes
	b) Watershed with shellfish beds that are, or continue to be, threatened with downgrade in accordance with National Shellfish Sanitation Program criteria or where shellfish areas are closed to harvesting and a closure response plan is in place.	Yes	Yes
	c) Watersheds with concerns related to nitrates in the drinking water, pesticides, and/or heavy metals.	Yes	Yes
2. Nonattainment of natural resource goals related to aquatic systems, including goals related to habitat, ecosystem health, and living resources.	a) Watershed with a waterbody that does not meet the minimum instream flows established by Washington State in 1986 as part of the Instream Resources Protection Program.	Yes	Yes
3. Other appropriate measures and indicators of degraded aquatic system conditions (e.g., wetland condition and current and historical loss rates, percent impervious surface, and other measures of aquatic habitat).	a) Watershed with a waterbody where loss of wetland areas along streams and rivers and/or in estuaries have been reported.	Yes	Yes
	b) Watershed rated above "3" on the EPA Index of Watershed Indicators	Yes	Yes
4. Decline in the condition of living and natural resources that are part of the aquatic system in the watershed (e.g., decline in the populations of rate and endangered aquatic species, decline in healthy populations of fish and shellfish, etc.)	a) Watershed with a waterbody where there is a proposed listing of spring Chinook salmon as "threatened" under the Endangered Species Act	Yes	Yes

Information Used

Bortleson, G.C., M.J. Chrzastowski, and A.K. Helgerson. 1980. Historical Changes of Shoreline and Wetland at Eleven Major Deltas in the Puget Sound Region, Washington. U.S. Geological Survey. Hydrologic Investigations Atlas HA-617.

Clean Water Action Plan: Restoring and Protecting America's Waters. February 14, 1998.

Deardorff, L. 1992. A Brief History of the Nooksack River's Delta Distributaries. Lummi Nation Fisheries Department. 33 p.

Environmental Protection Agency. October 1997. Index of Watershed Indicators. Available at http://www.epa.gov/surf/iwi/

Meriwether Frank. November 3, 1994. Sanitary Survey of Drayton Harbor. Washington State Department of Health, Office of Shellfish Programs.

Millam, Philip. May 27, 1997. Personal Communication. Letter to Henry Cagey, LIBC Chairman Transmitting the final 1996 Section 303(d) List for the State of Washington.

Portage Bay Closure Response Team. February 10, 1998. Portage Bay Initial Closure Response Strategy.

Washington Department of Ecology. October 1995. State of the Nooksack Watershed Report.

Appendix B:

Surface Water Quality Monitoring Program stations and data/statistics on sampling for fecal coliform bacteria

SUMMARY STATISTICS FOR FECAL COLIFORM, LUMMI INDIAN RESERVATION

Results of the Lummi Nation Surface Water Monitoring Program from 1993 to 1999.

APPLICABLE STANDARDS:

Draft Lummi Nation Water Quality Standards for fecal coliform (criteria are identical to Washington State Standards).

Classification	Geometric Mean	10 percent of samples used to calculate geometric mean cannot exceed
Class AA freshwater	50 col./100 ml	100 col./100 ml
Class A freshwater	100 col./100 ml	200 col./100 ml
Class AA and A marine water	14 col./100 ml	43 col./100 ml

National Shellfish Sanitation Program (NSSP) Standards

The standard for approved shellfish growing waters is a fecal coliform geometric mean not greater than 14 organisms/100 ml and an estimate of the 90th percentile not greater than 43 organisms/100 ml.

GENERAL NOTES:

1. Results of different types of tests from different laboratories included.
2. "Less than" and "greater than" adjusted in indicated direction by 1 or 0.1 (e.g., <1 is 0.9, >1600 is 1601).
3. Result of zero (0) assigned a value of 0.1.
4. Data collected in conjuction with Nooksack River Fecal Coliform Total Maximum Daily Load (TMDL) not included.

DATA ARE DRAFT, PRELIMINARY, AND SUBJECT TO REVISIONS

Station Number	Sample Period (mo./yr.)	Number of Samples (N)	Fecal Coliform (col./100 ml) Minimum	Maximum	Average	Geometric Mean	Notes
1	7/93-6/97	12	0	10	3	1	A
2	7/93-9/99	30	0	70	4	1	
3	6/93-9/99	61	1	30,001	1,469	78	
4	–	–	–	–	–	–	B
5	6/93-9/99	62	6	520	85	52	
6	7/93-9/99	34	0	100	16	2	
7	6/93-9/99	60	4	2,700	168	69	
8	6/93-9/99	61	2	6,600	395	81	
9	6/93-9/99	60	1	23,000	2,026	458	
10	6/93-9/99	60	6	540,000	15,682	372	
11	6/93-9/99	61	6	6,700	622	219	
12	1/97-9/99	27	9	3,400	608	278	
13	4/98-9/99	21	5	1,100	174	70	
14	4/98-9/99	16	20	2,000	363	98	E
15	4/98-9/99	19	4	460	89	45	E
16	4/98-9/99	10	2	1,500	255	31	E
17	4/98-9/99	10	2	80	28	15	E
18	4/98-9/99	58	10	400	78	52	C
19	4/98-9/99	13	1	38	8	4	
20	4/98-9/99	13	1	8	3	2	
21	4/98-9/99	14	1	2	1	1	
22	4/98-9/99	13	1	11	2	2	
23	4/98-9/99	14	1	27	8	4	
24	4/98-9/99	3	52	4,200	1,744	598	D, E
25	4/98-9/99	5	1	1,100	473	125	D, E
26	4/98-9/99	10	30	8,400	1,160	280	D, E
27	4/98-9/99	14	8	12,000	2,330	364	D
28	4/98-9/99	12	1	5,200	707	144	D, E
29	4/98-9/99	37	8	6,400	311	66	C, E
30	4/98-9/99	50	1	200	42	20	C
31	4/98-9/99	36	2	1,200	135	23	C, E
32	4/98-9/99	53	1	1,700	74	17	C
33	4/98-9/99	11	2	240	34	13	C, E
34	4/98-9/99	22	1	170	17	6	C
35	4/98-9/99	14	1	460	95	36	C, E
36	4/98-9/99	24	1	90	19	8	C
37	4/98-9/99	40	1	63,000	6,683	369	C, E
38	4/98-9/99	53	1	850	62	11	C
39	4/98-9/99	23	1	1,300	73	5	C
51	6/99-9/99	6	1	16	4	2	
52	9/99	2	1	1	1	1	

TABLE NOTES:

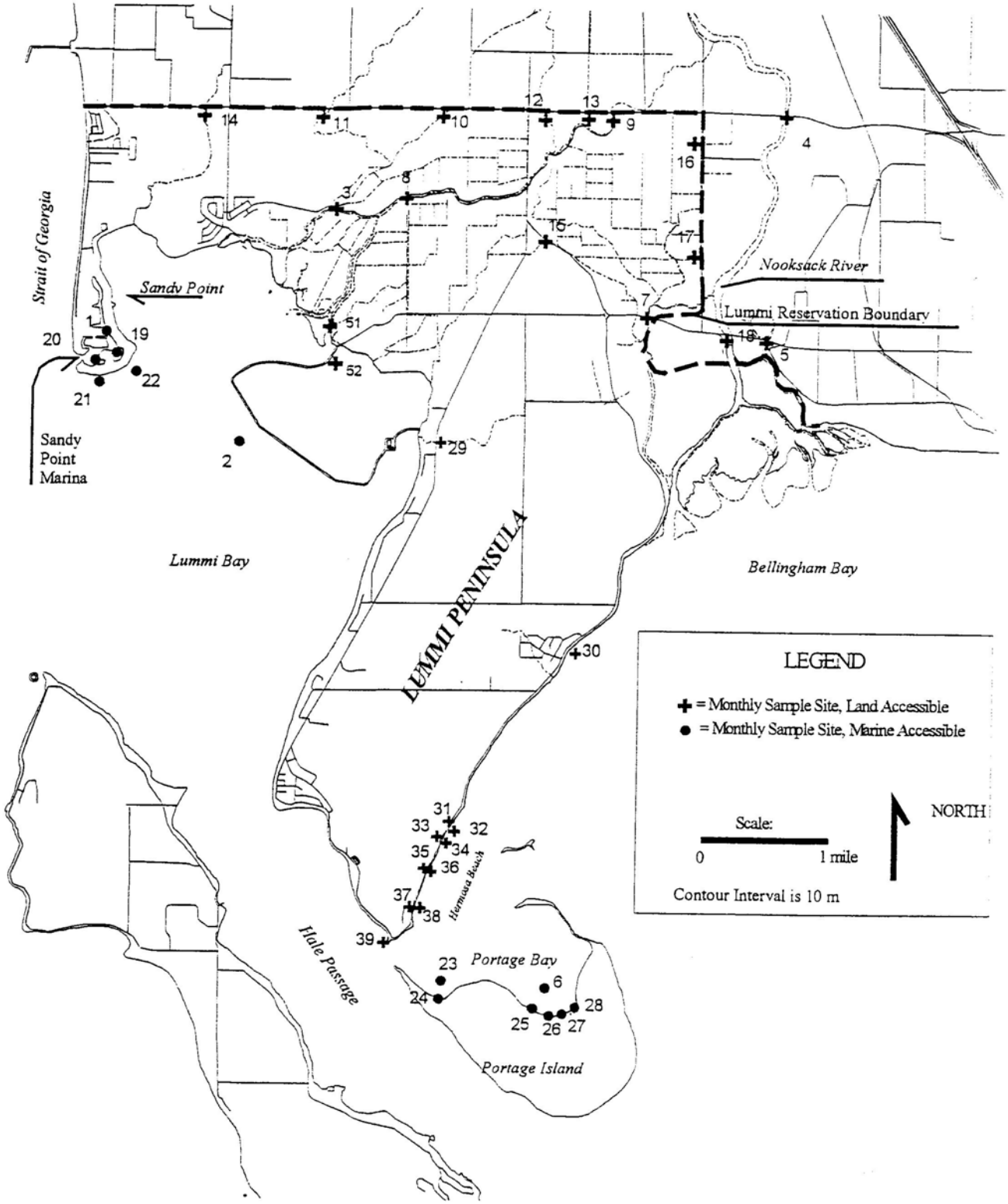
A. Station discontinued.

B. Washington Department of Ecology station.

C. Data from Dairy Waste Impact Study included for stations monitored under the surface water quality monitoring program.

D. Except for Station 28, fecal coliform densities in excess of 100 col./100 ml were associated with maximum discharges of a few tenths of a cubic foot per second (cfs). Usually the discharge was a few hundreths of a cfs or less, or there was no discharge to the marine waters. Station 28 is the outlet of a saltmarsh and had several fecal coliform densities in the mid-hundreds with flows either not measured or in excess of a few tenths of a cfs. The maximum recorded discharge at Station 28 under these conditions was 2.53 cfs. Flow is not measured at Station 35 which is tidally influenced.

E. A low "N" relative to the sample period indicates that the site was dry for portions of the sample period.


Strait of Georgia
Sandy Point
Nooksack River
Lummi Reservation Boundary
Sandy
Point
Marina
Lummi Bay
LUMMI PENINSULA
Bellingham Bay
Hale Passage
Hermosa Beach
Portage Bay
Portage Island
LEGEND
= Monthly Sample Site, Land Accessible
= Monthly Sample Site, Marine Accessible
Scale:
0
1 mile
NORTH
Contour Interval is 10 m

Appendix C:

Comprehensive Water Resources Management Program Fact Sheets

FACT SHEET
COMPREHENSIVE WATER RESOURCES MANAGEMENT PROGRAM (CWRMP)

Frequently Asked Questions	Response
Why is the Water Resources Division Developing a Comprehensive Water Resources Management Program (CWRMP)?	The Comprehensive Water Resources Management Program (CWRMP) is being developed in response to Lummi Indian Business Council (LIBC) resolutions 90-88 and 92-43. These resolutions directed the development of a CWRMP to ensure that the planning and development of Reservation water and land resources are safeguarded against surface and ground water degradation.
What is the CWRMP?	The Comprehensive Water Resources Management Program (CWRMP) is: • Based on field data, literature reviews, community involvement, and scientific investigations; • Includes a wellhead protection program, a storm water management program, a wetlands management program, water quality standards, and administrative procedures; and • Includes revision of the Lummi Nation water code to incorporate the best management practices identified during the program development and to better reflect the policies, priorities, and guidelines of the LIBC.
How is the CWRMP being Developed?	The CWRMP is being developed in stages: • Initially, background documents are being developed for the technical components (e.g., wellhead protection, storm water management, wetland management, water quality standards). These documents will be the technical foundation of the water code. • Draft ordinances are then developed for each component based on the technical background document and literature reviews of similar ordinances in other jurisdictions (federal, tribal, states, counties, and cities). • Presentation of draft ordinances to LIBC commissions and public education efforts occur to provide information and receive comments on draft ordinances. • Refinement of draft ordinances based on comments and the holding of a public hearing on each ordinance. • Refinement of ordinances based on the public hearing and adoption of final ordinance into Title 17 of the Lummi Code of Laws.

FACT SHEET
COMPREHENSIVE WATER RESOURCES MANAGEMENT PROGRAM (CWRMP)

Frequently Asked Questions	Response
What is the Current Status of the CWRMP Development Effort?	The current status of the CWRMP development efforts is: • Technical background documents have been completed for the wellhead protection program, the storm water management program, and the wetland management program. • Literature reviews of similar ordinances in other jurisdictions have been completed for the wellhead protection program, the storm water management program, the wetland management program, and the water quality standards program. Administrative procedures have also been reviewed. • Draft ordinances for the wellhead protection program and the storm water management program have been developed. • Development of a draft ordinance for the wetlands management program is scheduled for completion by Winter 2002. • Presentations of the draft wellhead protection, storm water management, wetland management, and water quality standards ordinances as well as the administrative procedures to LIBC commissions, the public education efforts, and the public hearings are scheduled to occur during Winter 2002. • Refinement of these ordinances and procedures based on the public hearing and adoption of final ordinances into Title 17 of the Lummi Code of Laws during Winter/Spring 2002.
What can I do to Help?	You can help in the CWRMP development effort if you: • Become informed about the different water resources management programs under development and provide feedback to the Water Resources Division to ensure that Title 17 meets your needs.

FACT SHEET
LUMMI NATION WELLHEAD PROTECTION PROGRAM

Frequently Asked Questions	Response
What is a Wellhead?	A wellhead is an opening in the ground (e.g., well, spring) that allows access to underground water supplies (aquifers).
Why is Wellhead Protection Important on the Lummi Reservation?	Wellhead Protection is important because: • Over 95% of Reservation residential water supply is pumped from local aquifers. • Due to the location of the Reservation, ground water resources are particularly vulnerable to contamination from sea water intrusion. • Alternative water sources are expensive. • The on-Reservation Salmon Hatchery program is dependent upon ground water. • An ample supply of good quality ground water is essential to serve the purposes of the Reservation as the permanent homeland of the Lummi people.
What is the Purpose of the Lummi Nation Wellhead Protection Program?	The purpose of the Lummi Nation Wellhead Protection Program is to protect the on-Reservation ground water supply (aquifers) from contamination.
What is being Done to Protect Our Ground Water	The Water Resources Division of the Lummi Natural Resources Department is: • Developing a wellhead protection ordinance. • Developing storm water and wetland management ordinances. • Monitoring water in wells. • Supporting federal water rights negotiations. • Conducting spill response planning.
What Actions are Planned for Reservation Wellhead Protection Program?	• Distribution of Information about Wellhead Protection to the Lummi Community (ongoing) • Public Hearing(s) and adoption of a Wellhead Protection Ordinance (Winter 2002)

WELLHEAD PROTECTION ON THE LUMMI RESERVATION

The overall purpose of the Lummi Nation Wellhead Protection Program is to protect the ground water resources of the Lummi Reservation (Reservation) from contaminants which may have an adverse effect on the health of persons or the integrity of the ground water resources of the Lummi Nation. The Wellhead Protection Program is a proactive approach by the Lummi Nation to prevent contamination of ground water resources by pollution and reduce risks that the Lummi Nation's ground water resources will become impaired or otherwise unusable as the primary water supply for the Lummi Nation and residents of the Reservation (LIBC 1997).

Similar to the storm water management and wetland management program, the Wellhead Protection Program is being developed in three phases. Phase I of the wellhead protection program is comprised of a susceptibility assessment and the development of contingency and public involvement plans. The first phase was completed in November 1997 and is documented in the Lummi Nation Wellhead Protection Program Phase I report (LIBC 1997). The Phase II report documents the implementation of the community involvement plan, the spill response planning effort, the development of wellhead protective measures, and an action plan through the year 2000. Phase III will include developing and implementing the protective measures and the public education measures identified during Phase II of the program.

The Lummi Nation Wellhead Protection Program will inform and involve the community through a variety of methods including:

- A Wellhead Protection Committee
- Slide Presentations
- Squol Quol News Articles
- Posters, Flyers, and Brochures
- Presentations at Schools and Northwest Indian College
- Community Meetings

References

Wellhead Protection Program, Lummi Indian Business Council (1997).

FACT SHEET
LUMMI NATION
STORM WATER MANAGEMENT PROGRAM

Frequently Asked Questions	Response
What is Storm Water?	Storm Water is surface water runoff that results from rain or snowmelt.
Why is Storm Water Management Important on the Lummi Reservation?	Managing Storm Water is important to: • Minimize opportunities for storm water to carry pollutants into aquifer recharge areas, as well as resource rich estuaries and tidelands of the Reservation. Contaminated storm water can adversely impact ground water and shellfish habitat. • Minimize the downstream impacts of new development on existing development and property owners (e.g. not flooding your neighbor). • Maximize the opportunities for infiltration and aquifer recharge. Storm water recharges Reservation aquifers, and over 95% of Reservation residential water supply is pumped from local aquifers
What is the Purpose of the Reservation Storm Water Management Program?	The purpose of the Storm Water Management Program is to: • Protect the on-Reservation ground water supply (aquifers) from contamination. • Protect Reservation surface water from contamination. • Protect tribal tideland resources from contamination. • Protect downstream property owners from new development.
What Actions are Planned for the Reservation Storm Water Management Program?	• Distribution of Information about Storm Water to Lummi Community (ongoing) • Public Hearing(s) and adoption of a Lummi Storm Water Management Ordinance (Winter 2002)

STORM WATER MANAGEMENT ON THE LUMMI RESERVATION

Contaminated storm water can adversely impact the tidelands, estuaries, ground water, and surface waters of the Lummi Reservation. The potential impacts of contaminated storm water threaten the health and welfare of the Lummi Nation, its members, and all person present on the Reservation. Accordingly, the Lummi Natural Resources Department, in conjunction with the Lummi Planning Department, is developing a storm water management program for the Reservation based on the potential impacts and the following considerations:

- With the exception of water discharged into Washington State aquatic lands from the two wastewater treatment plants, all water that falls onto or passes through the Lummi Reservation discharges to resource rich tidelands and/or estuaries of the Lummi Nation. These resources, which are culturally and economically important to the Lummi Nation and its members, surround the Reservation uplands. Tideland resources include salmon, shellfish, extensive eelgrass beds, herring spawning grounds, surf smelt, sand lance, wildlife, and water supply intakes for a salmon and shellfish hatchery.
- The Lummi Nation goal is for waters of the Reservation to comply with the federal Clean Water Act.
- Population projections, planned economic and institutional growth on the Reservation, and the small percentage of Reservation land that has been developed all suggest that portions of existing forested and agricultural lands will be converted to residential, commercial, or community uses in the coming years. Land use changes where forested or agricultural lands are converted to residential, commercial or community uses can be expected to affect storm water quantity and quality.
- In general, development impacts vegetation and soil properties in a manner that results in greater amounts of storm water, higher peak discharges, and lower water quality. Minimizing these adverse impacts from development and maximizing the protection of sensitive and important natural resources is necessary to protect the political integrity, economic security, and the health and welfare of the Lummi Nation, its members, and all persons present on the Reservation.
- As a finite resource, ground water is one of the most important and critical of the Lummi Nation's resources. Storm water is an important source of ground water recharge and a potentially significant source of ground water contamination. Ample supplies of ground water of good quality are essential to serve the purposes of the Reservation as the permanent homeland of the Lummi Nation and its members.

FACT SHEET
LUMMI NATION
WETLAND MANAGEMENT PROGRAM

Frequently Asked Questions	Response
What is a Wetland?	For an area to be classified as a wetland, it must exhibit three characteristics: hydrophytic (water loving) vegetation, hydric (saturated or water logged) soils, and hydrologic processes that support wetland functions. In general, a wetland is an area that is seasonally inundated (submerged under water) or has saturated soils for 23 days of the growing season (April – September).
Why is a Wetland Management Program Important on the Lummi Reservation?	A Reservation Wetland Management Program is important to: • To protect the functions and values of Reservation wetlands from the impacts of residential and commercial development; • To encourage residential development by and for tribal members as well as commercial and business growth on the Reservation for tribal employment opportunities by providing defined wetland management standards, requirements, and mitigation alternatives for effective project planning; • To protect and enhance fish and shellfish resources, wildlife resources, cultural resources, and the quantity and quality of Reservation ground water; and • To protect surface water quality and enhance storm water management.
What is the Purpose of the Reservation Wetland Management Program?	The purpose of the Wetland Management Program is to: • Protect the on-Reservation ground water supply. • Protect surface water resources including tidelands and estuaries. • Protect both wetland functions and property owners.
What is Wetland Mitigation?	Generally speaking, when development is proposed on a wetland it usually results in the loss of all or a portion of the wetland area. Mitigation replaces that wetland loss by creating more wetland than was destroyed. There are four types of Wetland Mitigation: • Creation of new wetlands, Ratio 2 or 3 : 1 • Enhancement of existing wetlands, Ratio 6 : 1 • Restoration of degraded wetlands, Ratio 1.5 : 1 • Preservation of existing wetlands, Ratio 10 : 1
What Actions are Planned for the Reservation Wetland Management Program?	• Distribution of Information about the Wetland Management Program to the Lummi Community (ongoing) • Literature Review of Wetland Ordinances (completed) • Draft Wetlands Ordinance (Winter 2002) • Public Hearing(s) and adoption of Wetland Ordinance (Winter 2002)

WETLAND MANAGEMENT ON THE LUMMI INDIAN RESERVATION

Wetlands are legally defined as, "those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (U.S. Army Corps of Engineers [Corps] 1987).

Wetlands perform important functions including: ground water recharge/discharge; flood flow storage (reduction in peak discharge); maintaining base stream flow; shoreline stabilization; food chain support by providing habitat for a variety of terrestrial and aquatic organisms; microbial control; and removal or reduction of sediment, nutrient and toxicants from waters (Brinson 1993b, Granger et al. 1996, Gersib 1997). Wetlands also provide areas of cultural significance, recreation opportunities, and outdoor education opportunities.

The goals of the Lummi Nation Wetland Management Program are to: 1) develop technical background information for a Lummi wetland management ordinance consistent with land use and resource management comprehensive plans, and 2) increase public awareness of the importance of Reservation wetlands to promote compliance with the ordinance once it is enacted.

To effectively manage Reservation wetlands, the location, extent, and function of wetlands must be known. In the early 1970s, Reservation wetlands were inventoried as part of the U.S. Fish and Wildlife Service National Wetlands Inventory (USFWS 1987). This initial inventory, which was not field verified on the Reservation, has been improved as wetland inventories have been conducted on select areas of the Reservation for various projects. To support the Lummi Reservation Wetland Management Program, during 1999 a comprehensive inventory of Reservation wetlands was contracted to a private consulting firm specializing in wetlands. As part of the contract, wetland function assessments were conducted on twelve selected Reservation wetlands.

The Comprehensive Wetlands Inventory on the Reservation classified wetlands using both the Cowardin Classification System (Cowardin et. al. 1979) and the Hydrogeomorphic Classification System (Brinson 1993b). The results of the comprehensive wetland inventory and the function assessments provide direction for long-term planning. Wetland function assessments are important for understanding what functions a wetland performs and how well those functions are performed (Brinson 1993b, Cooke 1996, Gersib 1997, Granger et. al. 1996, Roth et. al. 1993, Ecology 1998a). With this information, planners and managers can understand where wetlands should be preserved, where development will least impact wetlands, and where wetland restoration efforts should be directed.

The 1999 comprehensive inventory of wetlands on the Lummi Reservation indicated that approximately 43 percent of the Reservation upland areas are either wetlands or wetland complexes. Of these Reservation wetlands, about 60 percent are located in the flood plains of the Lummi and Nooksack rivers. Wetland complexes are areas where wetlands formed a highly interspersed mosaic with upland hummocks. During the wetland inventory, boundaries were drawn around the outer edges of the mosaic and the entire area labeled a "wetland complex". As a result, the estimated wetland area identified in the inventory generally represents more wetland area than actually exists. All wetland boundaries mapped during the comprehensive wetland inventory are general boundaries based on interpretation of color and infrared aerial photographs with some field verification. Specific wetland boundaries will be delineated on the ground as needed for specific activities.

FACT SHEET
LUMMI NATION WATER QUALITY STANDARDS PROGRAM

Frequently Asked Questions	Response
What are Water Quality Standards?	Water Quality Standards (WQS) are rules or laws that are adopted to protect the public health and welfare, enhance the quality of water, and serve the purposes of the Clean Water Act (CWA) by providing, wherever attainable, for the protection and propagation of fish, shellfish, and wildlife, and for recreation in and on the water. These uses are commonly referred to as the "fishable/swimmable" goals of the CWA.
What is the Lummi Nation Water Quality Standards Program?	The Lummi Nation works in close cooperation with federal, state, and local agencies to address water quality issues. As part of this effort, the Lummi Nation has applied to the U.S. Environmental Protection Agency (EPA) for eligibility to administer the water quality standards program under Section 518 of the Federal Clean Water Act (CWA). Approval of the application would allow the Lummi Nation to adopt, review, and revise water quality standards pursuant to Section 303(c) of the CWA, and to certify that discharges comply with the adopted water quality standards pursuant to Section 401 of the CWA. The water quality standards would apply to all surface waters within the exterior boundaries of the Lummi Indian Reservation (Reservation).
What is the Goal of the Lummi Water Quality Standards Program?	The overall goal of adoption of water quality standards is to attain fishable and swimmable waters within the Reservation.
Why is the Lummi Nation Seeking Eligibility to Administer the Water Quality Standards Program?	• To protect the quality of surface waters of the Reservation. • The Lummi Nation is governed by the Lummi Indian Business Council (LIBC) which carries out substantial duties and powers, including the protection of the natural resources, health, welfare, and safety of tribal members and other residents of the Reservation. This program is fundamental to why governments exist--protection of public health and welfare. • Implementation of water quality standards is a well-recognized tool authorized under the CWA. The Lummi Nation needs this tool to help address water quality problems that exist on the Reservation such as protecting Tribal tidelands and sensitive shellfish growing areas. • The state cannot address on-Reservation pollution sources.

FACT SHEET
LUMMI NATION WATER QUALITY STANDARDS PROGRAM

Frequently Asked Questions	Response
What does "Eligibility to Administer the Water Quality Standards Program" mean?	The EPA is responsible for administering and ensuring that the goals of the CWA are attained. If a state or tribe apply for eligibility and the EPA determines that the state or tribe has the capability to administer the water quality standards (WQS) program, the EPA delegates their authority to the state or tribe. This is a two-part process. The first part is a determination by the EPA that a state or tribe is eligible to administer the program. The second part is the adoption of the actual water quality standards. The application process to administer the WQS program is rigorous. It is anticipated that the EPA will make a decision on the Lummi Nation's eligibility in 2002. • States have been administering WQS as part of the CWA since the 1970s. Tribal administration of the WQS program is a result of Section 518 of the CWA added in 1987. • This process was formerly referred to as "Treatment as a State," and "Treatment in a manner similar to a State." The acronym "TAS" is commonly used to refer to this program. • Washington State, Puyallup Tribe, Tulalip, and the Chehalis Tribe have already been delegated this authority by the EPA. The Puyallup and Chehalis Tribes also have approved WQS. The Colville Tribe had the federal government promulgate WQS for the Colville Reservation. • The WQS will require EPA approval and a public hearing prior to implementation. Adoption of WQS is anticipated to occur in Winter 2002.
What is the Current Status of the Water Quality Standards Program?	• The initial public comment period for the Lummi Application occurred during the summer of 1999. • Nearly 500 comment letters were submitted in opposition to the application. Most of the comment letters were from fee landowners that have chosen to live on the Reservation. • If the EPA authorizes the Lummi Nation to administer the program, there will be a second comment period on the decision. • Public hearings will be held on the water quality standards. The criteria in the Lummi Nation's draft WQS are the same as those in the Washington State WQS.

Appendix D:

Memorandum of Agreement Between the U.S. Environmental Protection Agency, Lummi Nation, Washington State Department of Ecology, and Washington State Department of Health Regarding the Portage Bay Shellfish Closure

MEMORANDUM OF AGREEMENT

Between

United States Environmental Protection Agency, Lummi Nation,
Washington Department of Ecology, and Washington Department of Health

PURPOSE: The purpose of this agreement is to define the roles and responsibilities of federal, tribal, and state agencies in the effort to reclassify the shellfish beds within and adjacent to Portage Bay on the Lummi Indian Reservation as "Approved" for commercial harvest.

TERM OF AGREEMENT: From date of execution until terminated as provided herein.

OBJECTIVE: The objective of this cooperative effort is to achieve an "Approved" classification status for shellfish beds within and adjacent to Portage Bay by December 31, 2001. An Approved classification will have been achieved if the water quality bacterial standard defined under the National Shellfish Sanitation Program (NSSP) are achieved and the results of a sanitary survey show that the area is not subject to fecal contamination from human or animal sources at levels that present a public health hazard.

In addition to routine communication necessary to accomplish the purpose of this agreement, the parties will participate in a management level meeting at a time near the above target date to discuss the status of this joint effort and/or other actions necessary to fully restore and protect Portage Bay shellfish beds.

PARTIES: The federal, tribal, and state agencies with regulatory authority to ensure that the objectives of this effort are achieved or have direct authority to classify commercial shellfish growing areas are the parties to this agreement. The parties to this agreement are the United States Environmental Protection Agency (EPA), the Lummi Natural Resources Department, the Washington Department of Ecology, and the Washington Department of Health. The parties to this agreement will work with political subdivisions of the state including the Initiating Governments conducting watershed planning under RCW 90.82 and the Portage Bay Shellfish Protection District to achieve the objective.

ROLES AND RESPONSIBILITIES: The roles and responsibilities of each of the parties to this agreement are the following:

U.S. Environmental Protection Agency

The EPA will, subject to existing resource constraints and the availability of appropriated funds:

1. Continue to provide financial support for the surface water quality monitoring programs currently underway in response to the shellfish bed closure. The Lummi Nation, Washington Department of Health, and other institutions and private contractors are implementing these monitoring programs.
2. Maintain a lead contact with the responsibility and authority necessary to interact effectively with the other parties of this agreement. Continue to provide technical

support in the review and approval of quality assurance/quality control plans of the surface water quality monitoring programs.

3. Provide financial and technical support in the design and implementation of dye studies to define the travel time and dilution of Nooksack River waters from the estuary to Portage Bay as well as from Nooksack River tributaries to Portage Bay.
4. Provide technical support for research directed toward understanding the response of fecal coliform populations to salinity, temperature, and sediment. The research will also include an examination of fecal coliform survival in sediments.
5. Continue to conduct compliance and enforcement inspections of the Gooseberry Point wastewater treatment plant, dairy farms, and other potential sources of fecal contamination throughout the watershed.
6. Continue to conduct source-specific monitoring of streams and other waters of the United States to determine the spatial and temporal distribution of fecal contamination in the Nooksack River basin.
7. Pursue legal actions against concentrated animal feeding operations whose operations are in violation of the Clean Water Act, as deemed appropriate by EPA in consultation and coordination with the Washington Department of Ecology.
8. Continue to actively monitor the development and implementation of the fecal coliform total maximum daily load (TMDL) for the Nooksack River basin and ensure effective implementation of the TMDL.
9. Continue to assist the Lummi Nation in developing a water quality standards program that meets the requirements of the Clean Water Act.
10. Continue to coordinate actions in the Nooksack and certain adjacent watersheds with the other parties to this agreement.

Lummi Natural Resources Department

The Lummi Natural Resources Department will:

1. Continue to implement the surface water quality monitoring program on-Reservation with particular focus on the uplands adjacent to Portage Bay and the marine waters within and adjacent to Portage Bay.
2. Collect monthly samples of the Gooseberry Point wastewater treatment plant effluent to provide an independent review of plant operations. Samples will be collected and analyzed pursuant to the EPA/Lummi Nation Water Quality Monitoring Quality Assurance Plan.
3. Improve coordination with the Lummi Sewer District to ensure that all overflows or spills from the collection and/or treatment system are reported to the Lummi Natural Resources Department within one hour after their occurrence. Appropriate Lummi Natural Resources staff members will ensure that water quality samples are collected at the site of the overflow/spill, upstream and downstream from the spill location, and from any adjacent waters where shellfish beds could be impacted. Pursuant to the Shellfish Consent Decree (Order Regarding Shellfish Sanitation, *United States v. Washington [Shellfish]*, Civil Number 9213, Subproceeding 89-3, Western District of Washington, 1994), the Lummi Natural Resources Department will notify the Washington Department of Health Office of Shellfish Programs if it is determined that the spill discharges to shellfish beds.

4. Provide necessary coordination and support to implement dye studies designed to evaluate fecal coliform dilution and travel time from potential pollutant sources.
5. Conduct a literature review on the survival of fecal coliform in fresh and saline waters.
6. Continue to support the fecal coliform TMDL development and implementation in the Nooksack River basin.
7. Continue to develop water quality standards for the Reservation.
8. Continue to coordinate actions in the watershed with the other parties to this agreement.

Washington Department of Ecology

The Washington Department of Ecology will:

1. Continue to conduct compliance inspections of dairy farms and other potential sources of fecal contamination throughout the watershed. Timely and appropriate formal enforcement action will be initiated against operators determined to be discharging illegally.
2. Pursue as a top priority of the Bellingham Field Office the development and implementation of the fecal coliform TMDL for the Nooksack River basin.
3. Pursue enforcement against operations not implementing farm plans in accordance with the timeframes established in RCW 90.64.026.
4. Take corrective action(s) where it is demonstrated that nutrient management plans are either not effective and/or not being effectively implemented.
5. Continue to coordinate actions in the watershed with the other parties to this agreement.

Washington Department of Health

The Washington Department of Health will:

1. In consultation with the Lummi Nation and under the Shellfish Consent Decree (Order Regarding Shellfish Sanitation, *United States v. Washington [Shellfish]*, Civil Number 9213, Subproceeding 89-3, Western District of Washington, 1994), continue to be responsible to the federal Food and Drug Administration (FDA) to ensure that the National Shellfish Sanitation Program (NSSP) standards for certification of shellfish growing waters are met on the Reservation.
2. Conduct a dye study of the Gooseberry Point Wastewater Treatment Plant outfall during pertinent tidal conditions with at least one event when the tidal elevation at Portage Point is +9 MLLW.
3. Continue to coordinate actions in the watershed with the other parties to this agreement.

TERMINATION:

- Any parties to this agreement may terminate their participation with 30 days written notice of intent to terminate to each participant followed by a formal termination letter.
- No amendment or alteration of this agreement shall arise by implication, course of conduct, or change in state law. This agreement may be altered only by a subsequent

written document, signed by the parties, expressly stating the parties' intention to amend their agreement.

Lummi Nation

Date: 8/18/00
Merle Jefferson, Executive Director
Lummi Natural Resources Department

Environmental Protection Agency

Date: 8-31-00
Charles E. Findley, Acting Regional Administrator, Region 10

Washington Department of Ecology

Date: 8/23/00
Tom Fitzsimmons, Director
Washington Department of Ecology

Washington Department of Health

Date: 8/28/00
Mary Selecky, Secretary
Washington Department of Health