Nisqually Watershed Bacteria and Dissolved Oxygen Total Maximum Daily Load (Water Cleanup Plan)

Submittal Report

June 2005
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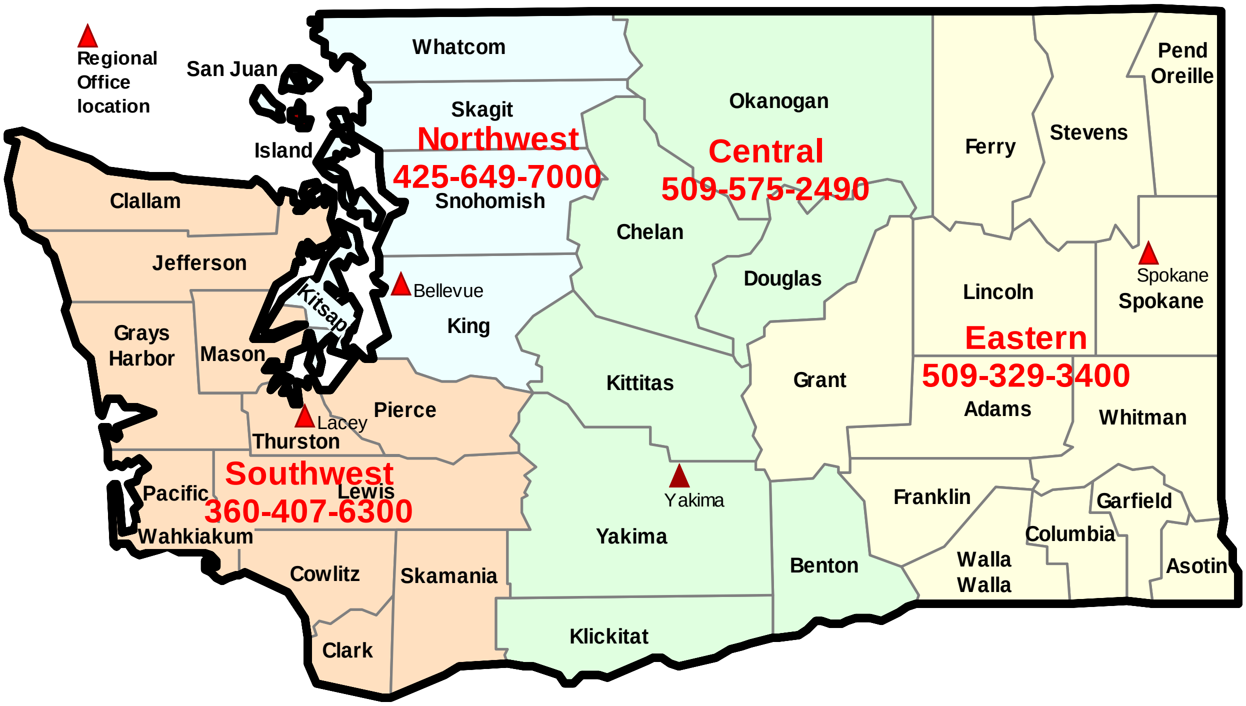

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Introduction

The Washington State Department of Ecology (Ecology) is required by the federal Clean Water Act to conduct a total maximum daily load (TMDL) study for water bodies on the 303(d) list. The 303(d) list is a set of water bodies that are not meeting water quality standards.

The TMDL evaluation begins with a water quality technical study. The technical study determines the loading capacity of the water body to absorb pollutants and still meet water quality standards. The loading capacity is allocated among *load* and *waste load* sources.

- If pollution comes from diffuse (nonpoint) sources, that share of the load is called a *load* allocation.
- If the pollutant comes from a discrete (point) source, such as a wastewater treatment plant discharge, that facility share of the loading capacity is called a *waste load* allocation.

The TMDL must also consider seasonal variations and include a margin of safety that takes into account any lack of knowledge about the causes of the water quality problem or a water body's loading capacity. The sum of the load and wasteload allocations and the margin of safety must be equal to or less than the loading capacity of the system.

The study also evaluates the likely sources of those pollutants and the amount of pollutant sources that needs to be reduced to reach that capacity. The technical study becomes the basis for water-quality-based controls. This document recommends total maximum daily pollutant loads based on the results of the study. Ecology will work with other agencies and local citizens to identify best management practices and actions needed to control water pollution, based on the sources found in the study.

Background

The Nisqually River, Nisqually Reach, and McAllister and Ohop creeks are on the 303(d) list of water bodies that do not meet water quality standards; these are all listed for fecal coliform bacteria, with McAllister Creek listed for dissolved oxygen as well. In addition, review of historical data on Red Salmon Creek, a tributary to Nisqually Reach, shows that Red Salmon Creek does not meet water quality standards for fecal coliform bacteria.

Table 1 lists the water bodies in the Nisqually Reach and basin that are on the 303(d) list or do not meet water quality standards. The table also shows the water quality parameters of concern for each waterbody.

Table 1. Nisqually basin water bodies on the 303(d) list or not meeting water quality standards

Water Body	Parameter	Location	New ID #	Old ID #
WRIA 11 Marine Water		*Latitude/Longitude*		
Nisqually Reach	Fecal coliform bacteria	47.115, 122.695	390KRD	WA-PS-0290
WRIA 11 Freshwater		*Township/Range/Section*		
Nisqually River	Fecal coliform bacteria	18N 01E 08	OE72JI	WA-11-1010
McAllister Creek	Fecal coliform bacteria, dissolved oxygen	18N 01E 37	LD26OX	WA-11-2000
McAllister Creek	Fecal coliform bacteria, dissolved oxygen	18N 01E 38	LD26OX	WA-11-2000
Ohop Creek	Fecal coliform bacteria	16N 03E 25	MW64EV	WA-11-1024
Red Salmon Creek	Fecal coliform bacteria	19N 01E 01 19N 01E 09	No ID	WA-PS-0290

WRIA – Water Resource Inventory Area

Nisqually River

The Nisqually basin covers 761 square miles within the greater Puget Sound watershed (Watershed Professionals Network, 2002) (Figure 1). The basin includes portions of Thurston, Pierce, and Lewis counties. The Nisqually River flows generally in a northwesterly direction. At its origin, the Nisqually River is formed from the melt waters of the Nisqually and other glaciers on Mount Rainier. From the headwaters to the Nisqually River discharge to Puget Sound, the river is approximately 78 miles long. Two dams in the upper Nisqually River watershed regulate river flow for electrical power generation for the city of Tacoma. The United States Geological Survey (USGS) has maintained a continuous discharge record for the Nisqually River at McKenna since 1947. The average annual discharge is 2100 cubic feet per second (cfs), providing approximately half the total freshwater discharge to southern Puget Sound (Whiley et al., 1994).

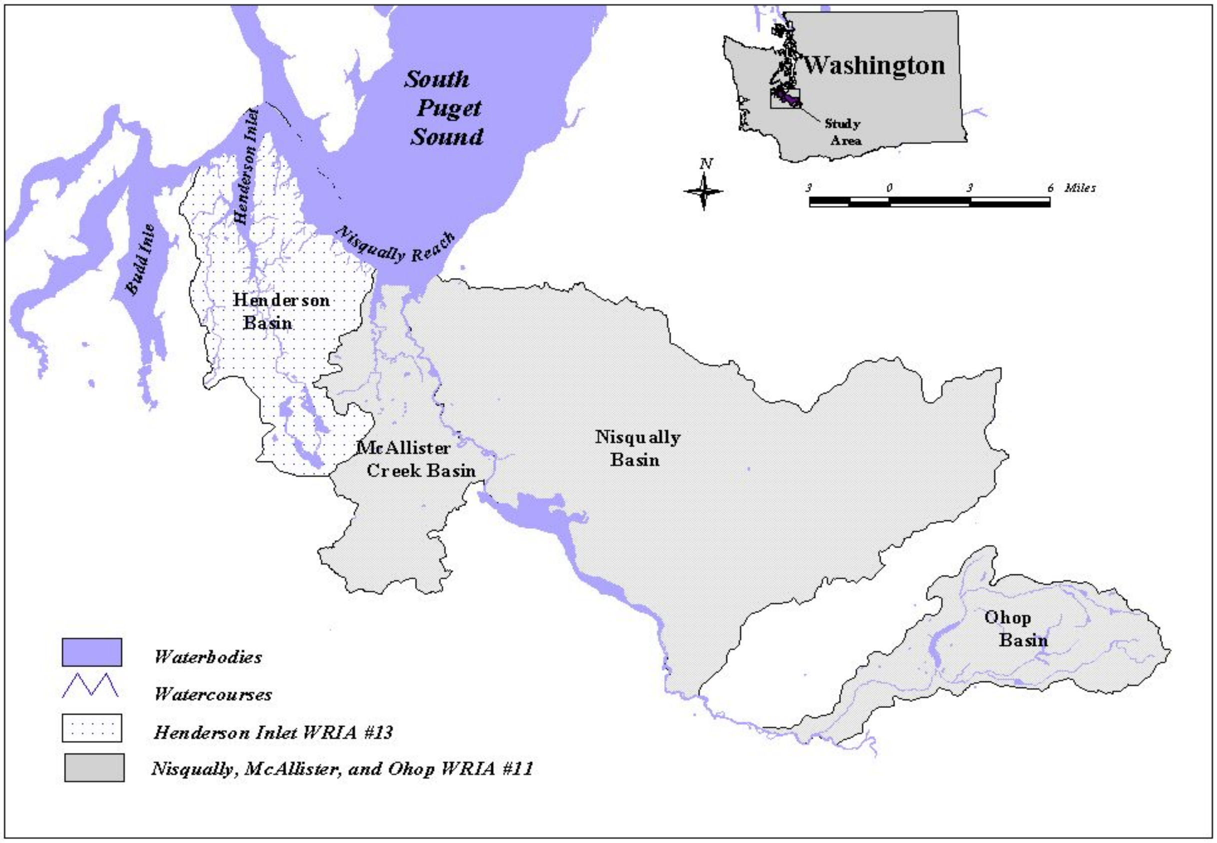

Figure 1. Nisqually TMDL study area.

For this study, the area of interest is primarily Ohop Creek, a tributary to the Nisqually River (Figure 2). In addition, a site on the lower Nisqually River, at river mile (RM) 3.4, was sampled to verify that fecal coliform water quality standards are being met (Figure 3).

Nisqually Reach

The Nisqually Reach is the area where the Nisqually Delta and deeper waters of Puget Sound meet. The reach includes those waters inside a line from Johnson Point to Gordon Point, Anderson Island, Ketron Island, and Drayton and Balch passages (Figure 1). The Nisqually Delta, formed by the Nisqually River, consists of broad mudflats and salt marsh. Three smaller creeks flow into the Nisqually Reach in water resource inventory area (WRIA) 11: McAllister, Red Salmon, and Sequalitchew creeks.

The Fort Lewis wastewater treatment plant discharges northeast of the Nisqually Reach approximately four miles from the Nisqually River mouth. The U.S. Environmental Protection Agency (EPA) administers the National Pollution Discharge Elimination System (NPDES) permit for this federal facility (permit number WA0021954).

Ohop Creek

Ohop Creek joins the Nisqually River at RM 37.3. It is the second largest tributary in the lower Nisqually basin in terms of flow, and third in drainage area (Figure 2). The average annual discharge is 67 cfs, and the basin covers 44 square miles. The main tributaries include Twenty-five Mile and Lynch creeks. The dominant hydrologic feature in this sub-basin is Ohop Lake (RM 6.3).

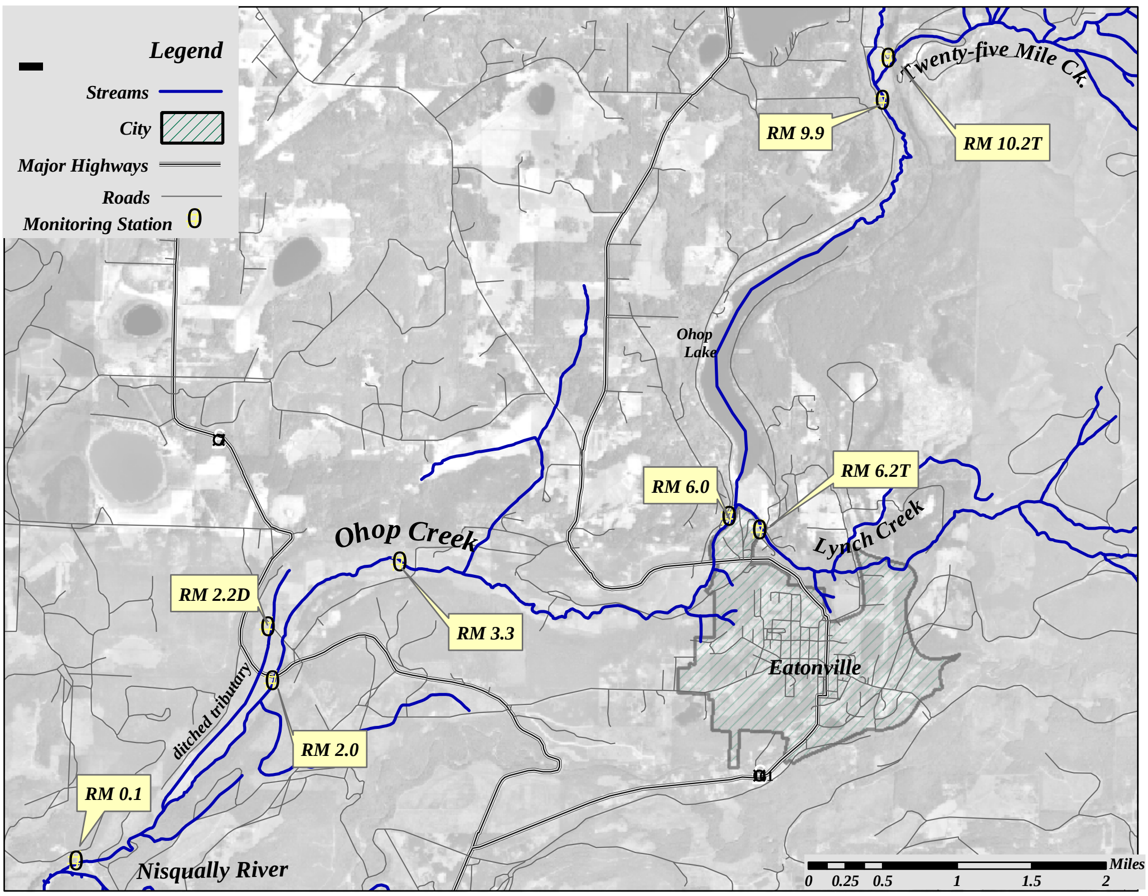

Figure 2. Ohop Creek study area.

Relatively dense residential development has occurred around Ohop Lake. The lower Ohop valley, downstream of Ohop Lake, is currently in transition from commercial agricultural use (primarily dairy farms) to non-commercial farms and rural residential development. The lower valley reach is low gradient with no intact natural riparian zone. The lower 0.3 miles include some hardwood forests.

Lynch Creek joins Ohop Creek at RM 6.2, flowing from commercially owned timberlands to rural residential and non-commercial farms in the lower mile. The town of Eatonville stormwater collection system discharges into Lynch Creek. Eatonville will not be considered for a Phase II municipal stormwater NPDES permit as an individual entity. However discharges will be covered by Pierce County's Phase I municipal stormwater NPDES permit. Twenty-five Mile Creek flows from commercially owned timberlands through an area of non-commercial farms and a recently abandoned clay mining operation before joining Ohop Creek at RM 9.9 (Kerwin, 1999).

Red Salmon Creek

Red Salmon Creek is a small independent tributary on the eastern edge of the Nisqually Delta (Figure 3). The creek originates from a series of diffuse springs and seeps in wetlands north of Interstate-5 (I-5). From its origin, the creek flows westerly through an area of low-density residential houses, non-commercial farms, and agricultural lands before flowing under the Burlington Northern railroad tracks. It is joined by a small tributary that drains agricultural lands from the west and south. The creek drains to the eastern portion of the Nisqually River delta as well as being connected to the Nisqually River though an eastern tributary of the mainstem Nisqually River. The saltwater wedge penetrates at least up to RM 1.2, with tidal influence extending above this point (Kerwin, 1999).

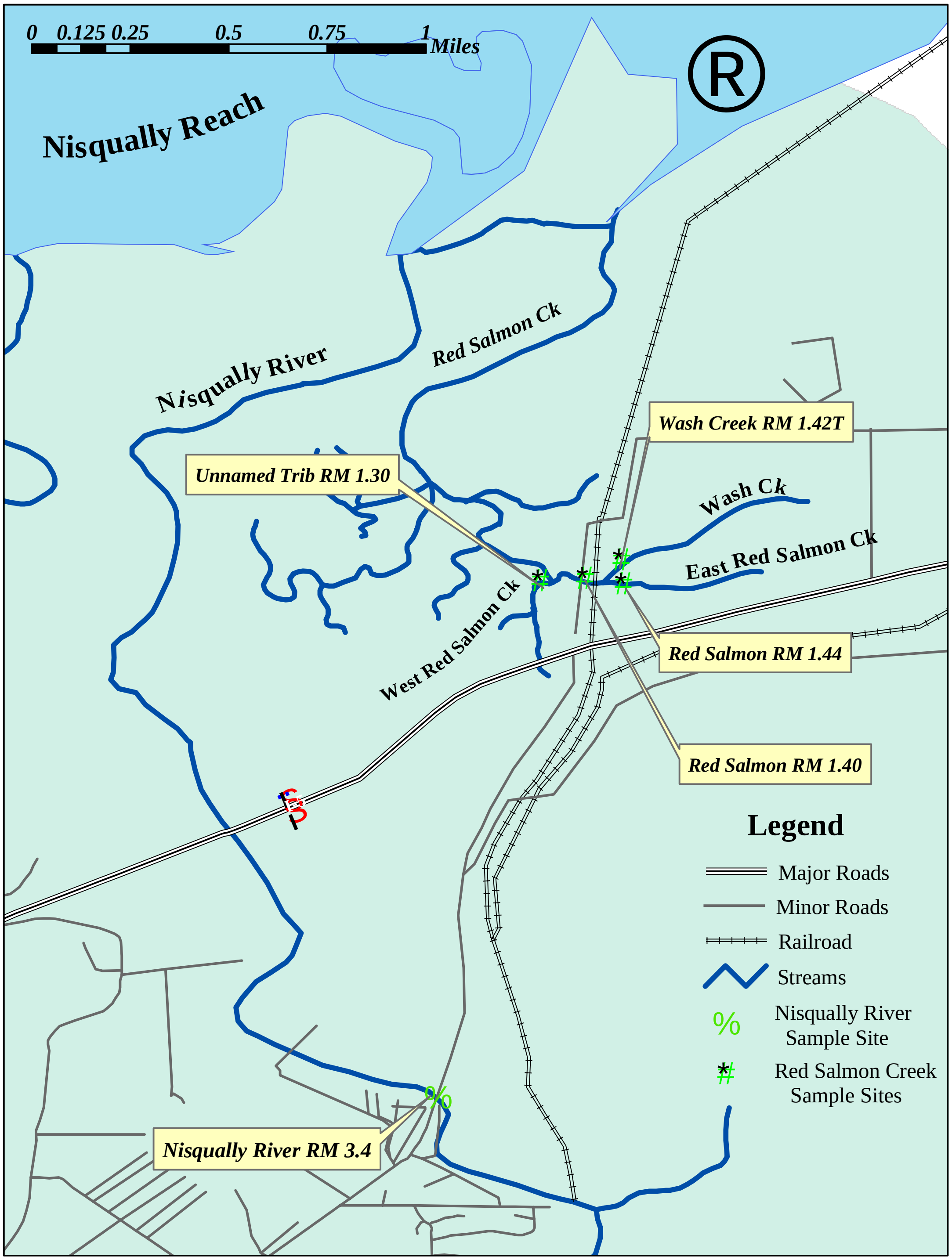

Figure 3. Red Salmon Creek and Nisqually River sample sites.

McAllister Creek

McAllister Creek (Figure 4) originates in a low-lying, horseshoe-shaped basin fed by three large springs and many small ones. The estimated average annual discharge is 62 cfs, and the basin covers 39.2 square miles (Watershed Professionals Network, 2002). The creek flows north for 6.3 miles to empty into Nisqually Reach near Luhr Beach. McAllister Springs, at the stream's headwaters, is the major source of drinking water for the city of Olympia, providing approximately 80 percent of the city's total water demand. The springs are only 6.7 feet above mean sea level. From the springs to RM 5.6, the creek flows through a large undisturbed wetland owned by the city of Olympia. Several springs join McAllister Creek in this stretch, including the larger Abbott and Lodge springs.

Between RM 5.6 and 4.3, the creek flows through agricultural pasture until it reaches the Steilacoom Road Bridge. This reach is lined by dikes with almost no tree or shrub cover for most of its length. The dikes and tide gates prevent saltwater from entering the adjacent agricultural lands. Numerous agricultural ditches drain into the creek on both banks in this reach. The flow direction changes with the tide from RM 5.6 to the mouth, and water level fluctuates up to five feet at RM 4.3. Little McAllister Creek enters McAllister Creek in this stretch at RM 5.3 through a double tide gate. Its flow originates from springs near the Meadows subdivision at the top of the bluff and from wetland drainage to the south of Highway 510. The Meadows stormwater detention ponds contribute flow to the creek during peak storm periods. The combined flow travels down a heavily eroded ravine to the lower valley. Once there, the Little McAllister Creek has been routed through a drainage ditch to McAllister Creek. Just upstream of Steilacoom Road is the McAllister Creek Fish Hatchery owned by Washington Department of Fish & Wildlife (WDFW). Due to budget constraints, this hatchery closed operations in June 2002.

The only residential development adjacent to the creek is below Steilacoom Road, located along its west side between RM 4.7 and 4.4. Large trees shade most of this reach and vegetation is fairly undisturbed. There is agricultural land along the east side of the creek that is drained by tide gates. Medicine Creek enters the creek at RM 4.4. Medicine Creek is 3.5 miles long. The creek has been extensively ditched and altered. The creek has been highly disturbed as it passes through nine culverts in an area used for agriculture and residences. Currently, there is almost no canopy cover, and the channel is narrow, weed-choked, and frequently dry above the Steilacoom Road crossing (Thurston County WWM, 1993).

Just downstream of RM 4.3, McAllister Creek enters a diversion channel that flows under Martin Way, then flows into a newer diversion channel under Interstate-5, and finally re-enters the natural channel at RM 2.4. Rock rip-rap lines the channel throughout this reach. Occasional trees provide some high cover, but there is almost no low overhanging vegetation. Land use in this reach includes a recreational vehicle park and commercial development located near I-5. Two stormwater discharges enter the creek in this reach. Thurston County stormwater discharge from Martin Way and the surrounding area drains to a stormwater pipe that enters the creek just upstream of Martin Way. Washington State Department of Transportation (WSDOT) stormwater discharge from I-5 flows into the creek under the I-5 bridge.

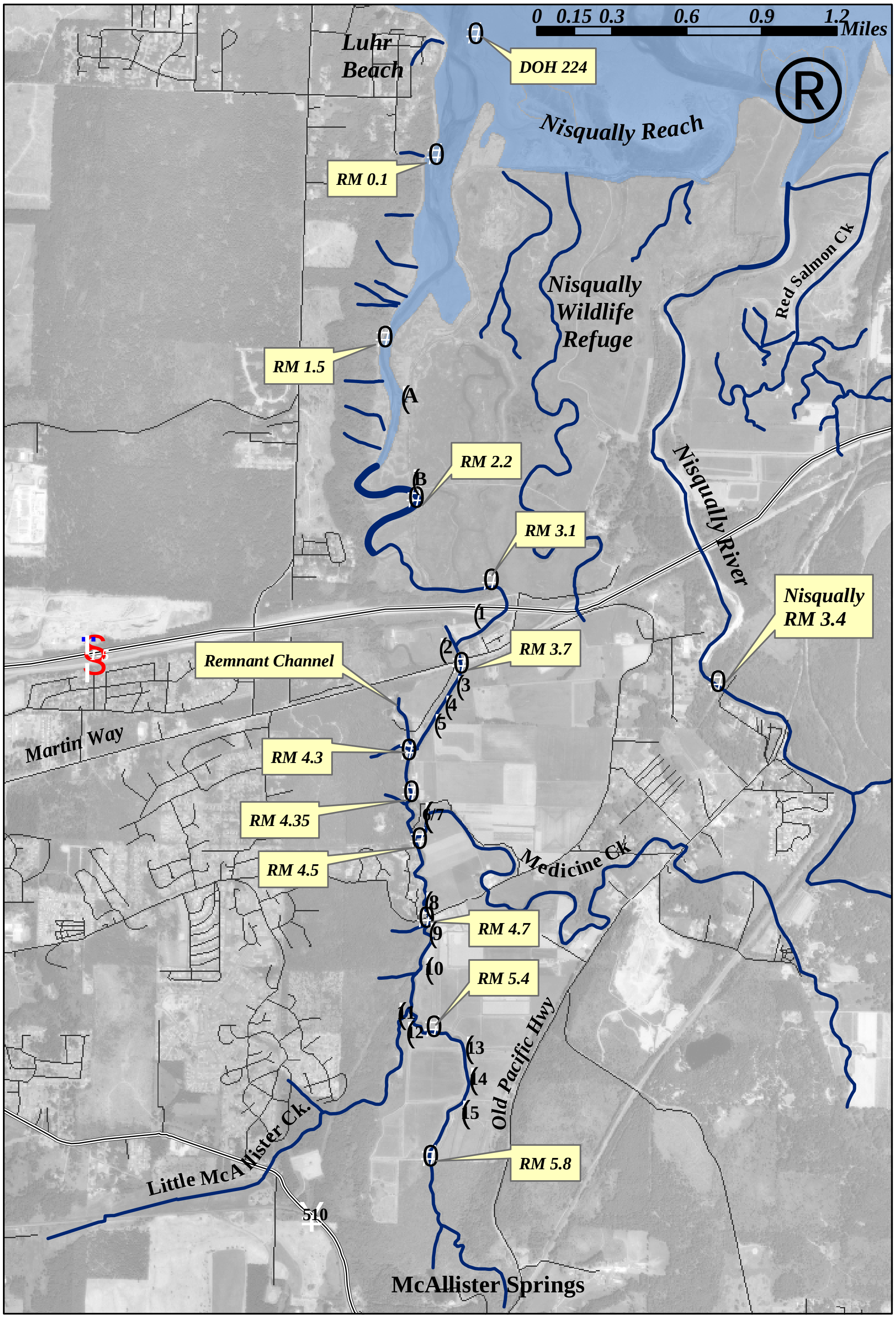

Figure 4. McAllister Creek study area.

The remnant channel enters McAllister Creek mainstem just downstream of RM 4.3. A small privately owned trout rearing operation, Nisqually Trout Farm # 1, is located at the end of the remnant channel. The trout farm receives water input from a small spring that flows off of the west bluff. The facility is divided into upper and lower ponds. Discharge from the facility flows through a tide gate (not numbered) and into the remnant channel. During TMDL sampling, the trout farm was under Ecology's threshold size requirements for a General NPDES Fish Hatchery permit, and was not a permitted facility.

At RM 2.4, after leaving the artificial channel, the creek flows through the U.S. Fish and Wildlife Nisqually National Wildlife Refuge to the mouth near Luhr Beach. The east bank is diked all the way to the mouth. Tides have a major influence on the creek in this reach. The stream opens into a broad estuarine lagoon, which becomes a network of braided distributaries and mud flats at low tide (Thurston County WWM, 1993). Two tide gates discharge to the creek in this reach, draining water from the Nisqually Wildlife Refuge.

In McAllister Creek two times a day during the flood tide, a complete flow reversal occurs. This has the effect of pushing creek water back upstream causing considerable mixing throughout the length of the creek. Tidal dynamics have required the use of drainage ditches linked to tide gates and extensive diking in order for lands lying to the east of the creek to be drained for agricultural use (Whiley and Walter, 1996). The location of the major tide gates is included in Figure 4. city of Olympia records water levels at the McAllister Springs weir, where flows averaged 16.7 cfs in the mid-1980s. During peak water-demand periods, Olympia withdraws as much as 70 percent of the springs' flow (Thurston County WWM, 1993).

USGS maintained a continuous recording gauging station near McAllister Springs from 1951 to 1964 (Thurston County WWM, 1993), with flow averaging 24 cfs, and an intermittent gage at Steilacoom Road from 1941 to 1949, where flow ranged from 48 to 132 cfs.

The geology and hydrogeology, including groundwater flow in the vicinity of Nisqually Reach and McAllister Creek, are described in *Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix A (Sargeant, Roberts, Carey, 2004).

Applicable Criteria

The water quality standards, set forth in Chapter 173-201A of the Washington Administrative Code (WAC), include designated beneficial uses, classifications, numeric criteria, and narrative standards for surface waters of the state. A revised water quality standards rule (WAC 173-201A) was adopted on July 1, 2003, (this version is not yet approved by EPA). In the revised rule, the waterbody classification system is replaced by a beneficial-use based designation.

Under the new rule, water bodies are required to meet water quality standards based on the beneficial uses of the water body. For fecal coliform bacteria, former Class AA water bodies become *Extraordinary Primary Contact Recreation* (with the same fecal coliform criterion as Class AA), and former Class A water is *Primary Contact Recreation* (same fecal coliform criterion as Class A). The same is true for the dissolved oxygen, pH, and temperature criterion with Class AA being *Extraordinary Water Quality*, and Class A becoming *Excellent Quality Water*. The criteria for *Extraordinary* and *Excellent Water Quality* for the parameters of concern in this TMDL, both fresh and marine, are summarized in Table 2.

Table 2. Fecal coliform bacteria, dissolved oxygen, pH, and temperature water quality standards.

Parameter/Class	Freshwater	Marine
Bacteria		
Extraordinary Primary Contact Recreation	Geometric mean (GM) ≤ 50 fc/100 mL, with not more than 10% of all samples for calculating the GM value > 100 fc/100 mL.	Geometric mean (GM) ≤ 14 fc/100 mL, with not more than 10% of all samples for calculating the GM value > 43 fc/100 mL
Primary Contact Recreation	Geometric mean (GM) ≤ 100 fc/100 mL, with not more than 10% of all samples for calculating the GM value > 200 fc/100 mL.	N/A
Dissolved Oxygen	*Lowest 1-day minimum*	
Salmon and Trout Spawning, Core Rearing, and Migration	≥ 9.5 mg/L	N/A
Extraordinary Quality Water	N/A	≥ 7.0 mg/L
pH	*pH shall be within the following range with a human-caused variation within the above range of < 0.2 units.*	
Salmon and Trout Spawning, Core Rearing, and Migration	6.5-8.5 units	N/A
Extraordinary Quality Water	N/A	7.0-8.5 units
Temperature		
Salmon and Trout Spawning, Core Rearing, and Migration	16°C	N/A
Extraordinary Quality Water	N/A	13°C

Puget Sound through Admiralty Inlet and South Puget Sound, south and west to longitude 122°52’30”W (Brisco Point) and longitude 122°51’W (northern tip of Hartstene Island), is designated *Extraordinary marine water*, formerly Class AA. This includes Nisqually Reach. Beneficial uses include extraordinary aquatic life use, primary contact recreation, and shellfish harvest.

Nisqually River from the mouth to Alder Dam (RM 44.2) is designated *excellent quality water,* formerly Class A water, and includes beneficial uses such as non-core salmon/trout rearing and primary contact recreation, among others. Ohop Creek does not have a specific designation as described in Table 602 (WAC 173-201A-602). In accordance with WAC 173-201A-600(1), surface waters not named in Table 602 are to be protected for the designated uses such as non-core salmon and trout rearing, spawning and migration; and primary contact recreation, among other uses.

The other tributaries to Nisqually Reach and McAllister and Red Salmon creeks are considered *extraordinary quality water*, formerly Class AA, as described in WAC 173-201A-600(a). All fresh surface waters that are tributaries to extraordinary quality marine waters are to be protected for the designated uses of salmon and trout spawning, core rearing, and migration, as well as extraordinary primary contact recreation.

If natural water quality conditions are of less quality than the criteria, then the natural condition shall constitute the water quality criteria. The standards define natural conditions or natural background levels as surface water quality that was present before any human-caused pollution.

Natural condition is a term used to describe the quality of surface water untouched by human-caused pollution or disturbance. Natural conditions are rare and exist in limited settings.

The Washington State Department of Health (DOH) classifies commercial shellfish beds in Washington State using the National Shellfish Sanitation Program criteria. To meet these criteria, a commercial shellfish harvesting area must have a geometric mean value of no more than 14 most probable number (MPN)/100mL, with an estimated 90^{th} percentile value less than 43 MPN/100mL.

Water Quality and Resource Impairments

The Nisqually River, Nisqually Reach, and Ohop Creek were on the 1996 303(d) list of water bodies that do not meet water quality standards for fecal coliform bacteria. The 1998 303(d) list included the aforementioned water bodies as well as McAllister Creek for excursions of dissolved oxygen and fecal coliform bacteria. In addition, review of historical data on Red Salmon Creek, a tributary to Nisqually Reach, shows that Red Salmon Creek does not meet water quality standards for fecal coliform. Table 1 lists the water bodies in the Nisqually Reach and basin that are on the 303(d) list or do not meet water quality standards, as well as the water quality parameters of concern for each waterbody.

Fisheries Resource

In 1992, DOH reclassified 1000 acres of commercial shellfish growing areas in the Nisqually Reach from Approved to Conditional Approved, with closures occurring after 0.50″ of rain in 24 hours. One year later DOH adjusted the closure criterion to 1″ in 24 hours based on improvements seen in water quality. In 1999, in response to declining water quality and after consultation with local shellfish growers, DOH established a one-year voluntary no harvest zone in the vicinity of the eastern-most water quality monitoring stations of the growing area.

In 2000, improved conditions at the western end of the conditionally approved area allowed DOH to upgrade 20 acres of geoduck tracts there to the approved status. At the same time, however, conditions at the east end of the area continued to decline. In November 2000, DOH reclassified about 74 acres at the east end of the area from conditionally approved to restricted. In 2002, DOH upgraded 960 acres from conditionally approved and restricted to approved (Washington State Department of Health, 2004). This change in classification was prompted by the results of a comprehensive review of shoreline sanitary conditions and marine water quality data.

About 40 acres of the commercial shellfish growing area currently remain restricted and are located west of the mouth of McAllister Creek. Also, recreational shellfish beds located in the mouth of McAllister Creek continue to be unsafe for consumption (Thurston County, 2002).

The lower Nisqually River serves as a transport corridor for all the anadromous salmonids in the Nisqually River basin, and provides important spawning habitat for chum, coho, chinook, and steelhead. In Ohop Creek, anadromous fish are present from the confluence and upstream. Coho, chinook, and pink salmon, along with steelhead and coastal cutthroat, use Ohop Creek. Ohop Lake contains significant populations of self-sustaining, warm-water fish species such as yellow perch, largemouth bass, and bluegill (Kerwin, 1999).

McAllister Creek supports natural runs of chinook, coho, chum, steelhead, and anadromous (sea-run) cutthroat while Red Salmon Creek supports natural runs of coho, chum, steelhead, and sea-run cutthroat. Spawning is limited to the upper reaches due to the salt wedge and poor habitat in the lower reaches.

Historical Data, Seasonal Variation, and Critical Conditions

A complete historical data summary for the Nisqually River, Nisqually Reach, and Ohop, Red Salmon, and McAllister creeks is presented in the *Quality Assurance (QA) Project Plan for the Henderson and Nisqually TMDL Study* (Sargeant, Roberts, and Carey; 2003).

Nisqually River

The monthly ambient monitoring data set (October 1975 - March 2004) was analyzed to determine trends at Nisqually RM 3.4. A nonparametric Seasonal Kendall statistical test (alpha ≤ 0.05) was used to determine that a statistically significant trend toward improving fecal coliform levels is seen at RM 3.4 (Figure 5).

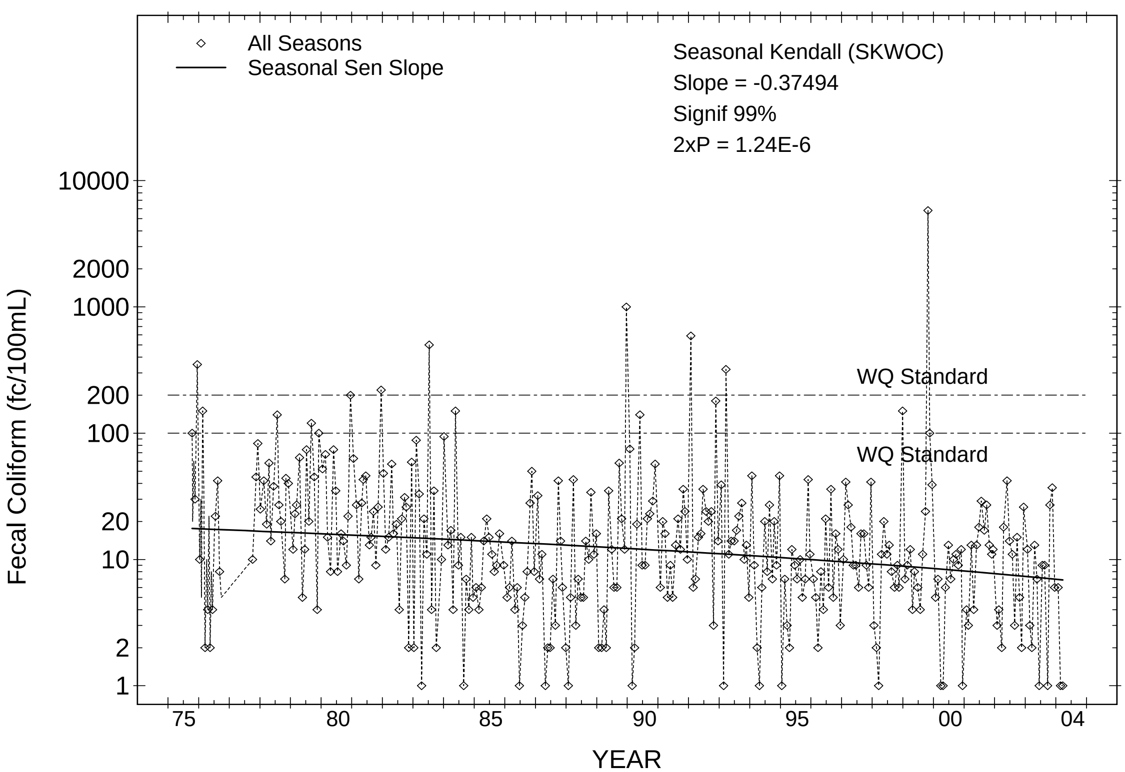

Figure 5. Results of Seasonal Kendall trend test at Nisqually RM 3.4, October 1975 - March 2004.

Since 1975, there have been seven values out of 321 sample events that have exceeded 200 fc/100 mL. Three of the values greater than 200 fc/100 mL occurred in the month of December. In examining the TMDL and ambient monitoring data set (2002-2003), there were no critical periods observed, either seasonally or related to flow.

Nisqually Reach
Analysis of Department of Health Fecal Coliform Bacteria Data

Table 3 summarizes the Washington State Department of Health (DOH) data collected between January 2001 and March 2004, the most recent data available at the time of publication. Station locations are shown in Figure 6a and 6b. All four sites met the water quality standards when all data were pooled, and also for flood and ebb tide data analyzed separately. Historically, station 246, nearest the Red Salmon Creek outlet, had 11.8% of samples >43 colonies/100 mL during ebb tides, but the site now meets both components of the water quality standard for bacteria.

Figure 6a. Department of Health (DOH) shellfish monitoring stations: Nisqually Reach area.

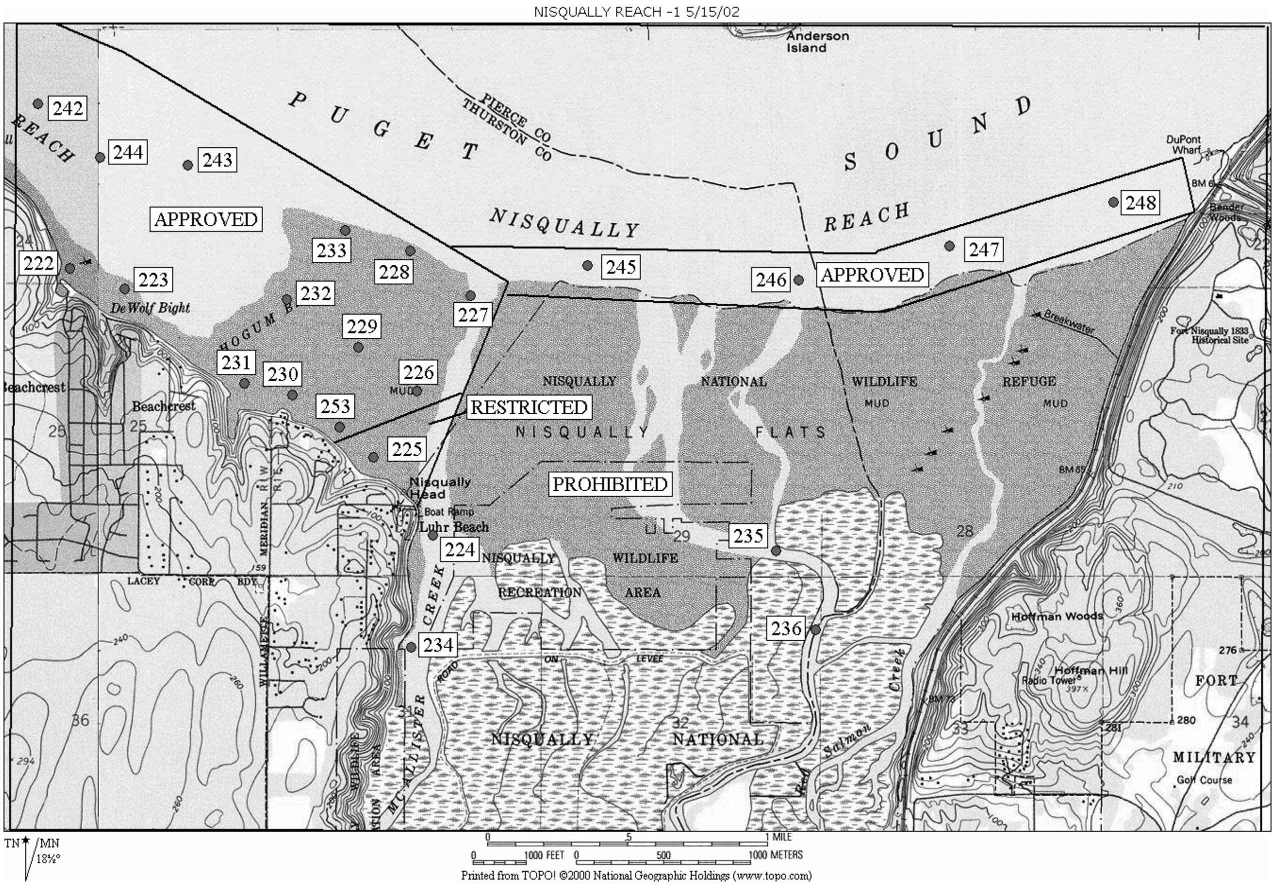

Figure 6b. Department of Health (DOH) shellfish monitoring stations: Nisqually Reach, McAllister Creek, and Hogum Bay area.

Conditions within the Nisqually Reach are strongly affected by the tidal condition, and different geographic areas may contribute to bacteria levels during flood and ebb tides. As described below, DOH fecal coliform data from the four Nisqually River delta stations were analyzed based on pooling all data and separating flood and ebb tide conditions. Therefore, the critical conditions account for tidal conditions.

Table 3. Nisqually Reach annual compliance with fecal coliform water quality standards for marine water (DOH data for January 2001 through March 2004).

Station	Tidal condition	Number of sample events	Geometric mean (<14 fc/100 mL)	Percentage of samples >43 fc/100 mL (<10%)	Meets fecal coliform standard?
245	all	33	3.3	8.4%	yes
246	all	33	3.8	5.6%	yes
247	all	32	3.2	5.7%	yes
248	all	32	2.6	1.0%	yes
245	flood	20	2.7	8.9%	yes
246	flood	20	2.7	0.0%	yes
247	flood	19	2.9	1.8%	yes

Station	Tidal condition	Number of sample events	Geometric mean (<14 fc/100 mL)	Percentage of samples >43 fc/100 mL (<10%)	Meets fecal coliform standard?
248	flood	19	2.6	0.0%	yes
245	ebb	13	4.3	7.7%	yes
246	ebb	13	6.4	7.7%	yes
247	ebb	13	3.7	7.7%	yes
248	ebb	13	2.6	0.0%	yes

In addition, DOH recently developed a trend analysis of fecal coliform bacteria levels in the Nisqually Reach (Determan, 2004). The results of the trend analysis are described below.

Washington State Department of Health Fecal Coliform trends

DOH uses a systematic random sampling (SRS) strategy when sampling stations in shellfish growing areas. At least six samples per year are taken in *Approved* and some *Restricted* growing areas, and up to 12 samples per year in *Conditionally Approved* areas. In addition to using these data to classify commercial shellfish areas, DOH analyzes the data for status and trends of fecal pollution in shellfish growing areas for the Puget Sound Ambient Monitoring Program. To determine trends, the fecal coliform geometric mean and 90th percentiles for each station are graphed against sample dates. Spearman's *rho*, a nonparametric statistical test for trends based on ranks, is used to confirm visual evidence of temporal trend in 90th percentiles (Determan, 2001).

Tim Determan of DOH conducted five-year (1999 through 2003) trend analysis for the 32 DOH stations in the Nisqually area including Hogum Bay and the Nisqually-McAllister delta (Figures 6a and b). Twenty-five stations showed significant reduction of 90th percentiles (Table 4). In Table 4, a negative value of *rho* means a downward trend in fecal coliform concentrations, indicating improving water quality. A positive value means an upward trend in concentrations, indicating degrading water quality. If the probability is less than 0.05, the trend is significant. Two stations showed significant increases, four stations did not change significantly, and three stations were not evaluated because their data records were too short. Based on five years of data, fecal coliform concentrations are declining at stations 245 through 248, and the trend is significant. Overall, Nisqually Reach has improved over the last five years (Determan, 2004).

Table 4. Five-year trends (1999-2003) in fecal coliform for DOH Nisqually Reach, McAllister, and Hogum Bay shellfish area.

DOH Site	Spearmans Rho		Number of Samples	Trend in fecal coliform levels
	Rho	Probability		
222	(short record)		24	Not enough data
223	(short record)		26	Not enough data
224	-0.8553	0.000	45	down
225	-0.8515	0.000	61	down
226	-0.8730	0.000	61	down
227	-0.9114	0.000	60	down
228	0.1363	0.295	61	No significant trend
229	-0.7931	0.000	61	down
230	-0.8212	0.000	61	down

DOH Site	Spearmans Rho		Number of Samples	Trend in fecal coliform levels
	Rho	Probability		
231	-0.5656	0.000	61	down
232	-0.6832	0.000	61	down
233	-0.0762	0.563	60	No significant trend
234	-0.7404	0.000	45	Down
235	-0.6830	0.000	39	Down
236	-0.3513	0.033	37	Down
237	0.5086	0.000	43	Up
238	-0.9042	0.000	44	Down
239	-0.4358	0.003	44	Down
240	-0.4229	0.002	50	Down
241	-0.1067	0.461	50	No significant trend
242	-0.8032	0.000	61	Down
243	-0.5946	0.000	61	Down
244	-0.8833	0.000	61	Down
245	-0.7627	0.000	45	Down
246	-0.8573	0.000	45	Down
247	-0.5904	0.000	44	Down
248	-0.4482	0.002	44	Down
249	0.3161	0.039	43	Up
250	0.2085	0.180	43	No significant trend
251	-0.2364	0.127	43	No significant trend
252	-0.5347	0.000	38	Down
253	(short record)		6	Not enough data

DOH stations 224 and 234 correspond to the two downstream TMDL stations (Figure 6b). Both of these stations show a decreasing trend in fecal coliform levels over the past five years.

Ohop Creek

The report *Nisqually Indian Tribe Identification of Pollution Sources Impacting Salmon Habitat in the Mashel River and Ohop Creek Drainages* (Whiley and Walter, 1997) showed that fecal coliform levels were higher at the lower Ohop Creek sites, at RM 6.0, 3.3, 2.0, and the mouth than farther upstream. During the study, the lower Ohop Creek stations received drainage from two dairy farms that have since closed. Significantly higher levels of fecal coliform were seen in the creek during the dry season, especially at the lower stations.

Figures 7, 8, and 9 show wet season (November - April) and dry season (June - September) fecal coliform results for Ohop Creek at RM 9.9, 6.0, and 0.1 for historical and current periods of sampling.

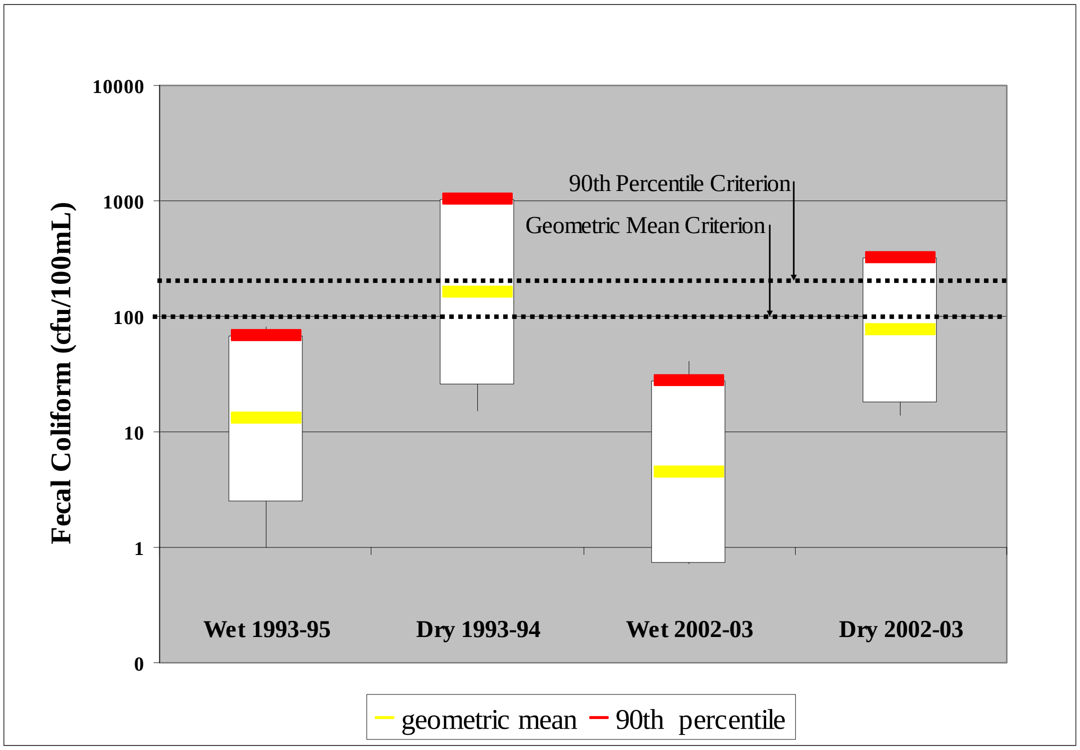

Figure 7. Ohop Creek RM 9.9 wet and dry season fecal coliform levels for 1993-95 and 2002-03.

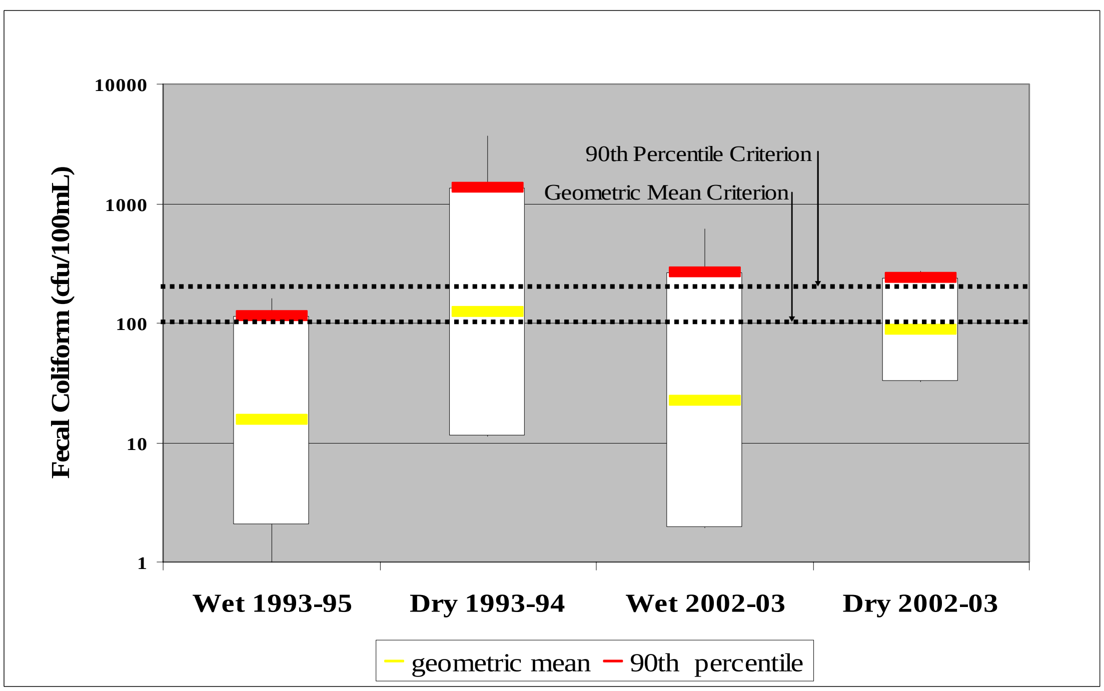

Figure 8. Ohop Creek RM 6.0 wet and dry season fecal coliform levels for 1993-95 and 2002-03.

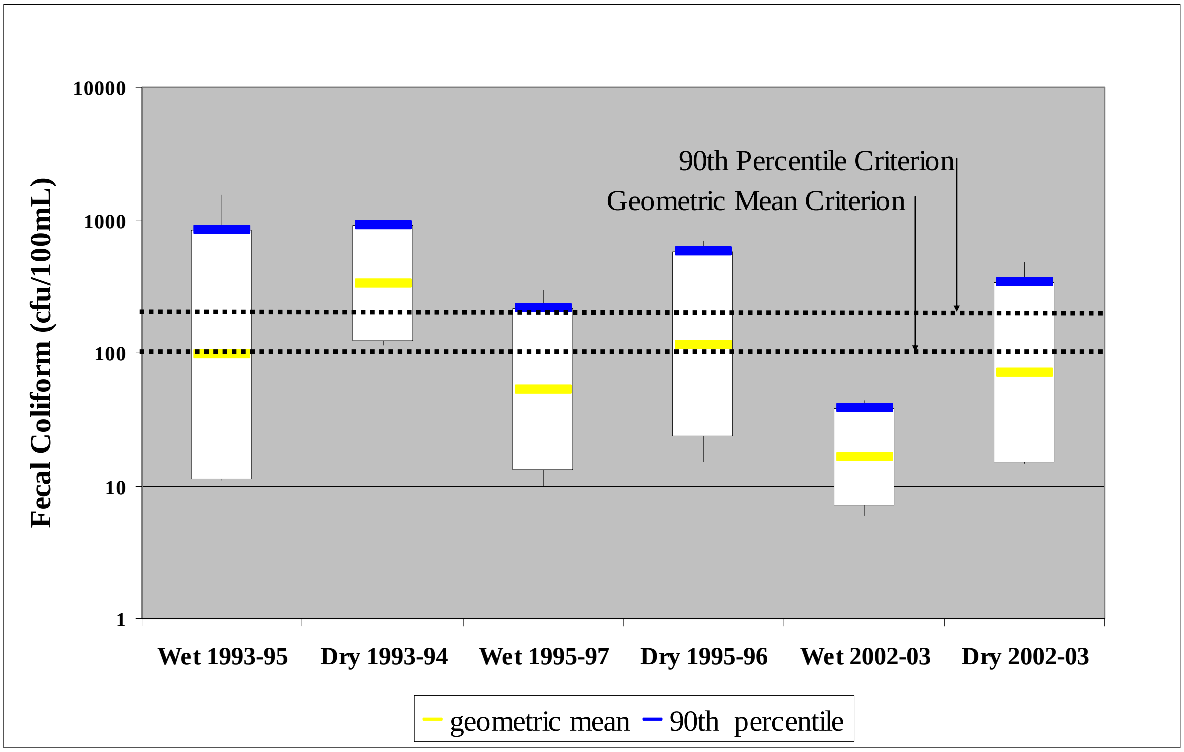

Figure 9. Ohop Creek RM 0.01 wet and dry season fecal coliform levels for three sampling periods.

Figures 7, 8, and 9 show the critical period for Ohop RM 9.9, and 3.3 through 0.1 is the dry season, June through September. At Lynch Creek RM 6.2T (not graphed) and RM 6.0, the critical period is the wet season. At RM 6.0, a slightly higher 90th percentile is seen during the wet season.

To determine the effect of Lynch Creek on Ohop Creek at RM 6.0, fecal coliform concentrations were estimated for Ohop RM 6.0 without bacteria loading from Lynch Creek. To calculate loading at Ohop Creek RM 6.0, flow estimates were obtained by subtracting Lynch Creek flow from USGS flow at the Ohop Lake outlet. Lynch Creek fecal coliform loading estimates were subtracted from loading estimates at Ohop Creek RM 6.0. Without loading and dilution from Lynch Creek, the highest bacteria concentrations at Ohop RM 6.0 are seen during the dry season, with an estimated geometric mean of 63 fc/100mL and a 90th percentile of 650 fc/100 mL.

Improvements in bacteria levels from historical conditions have occurred for both seasons at RM 9.9 and 0.1. At RM 6.0, bacteria levels have improved slightly during the dry season but have increased during the wet season.

Red Salmon Creek

The Nisqually Tribe sampled Red Salmon Creek at RM 1.40 for a number of parameters, including fecal coliform bacteria, from July 1993 - April 1995 (n=31). During that period, there was a significant positive correlation between the two-day antecedent rainfall and fecal coliform levels. Fecal coliform concentrations during that period were chronically elevated, and some of the highest median fecal coliform levels were seen during storm events (Whiley and Walter, 1996).

During the 2002-03 sample period, there was no strong seasonal pattern between the wet and dry season at either Red Salmon RM 1.40 or at the tributary (RM 1.30T) (Figure 10). Due to freshwater inputs of fecal coliform from upstream sources, the critical period is the low tide period annually.

Figure 11 presents historical and current fecal coliform levels for Red Salmon Creek at RM 1.40. The historical data were divided into two periods, so the sample size would be more consistent with the current data set. Red Salmon at RM 1.40 shows improvement in fecal coliform levels from historical levels but still does not meet marine water quality standards.

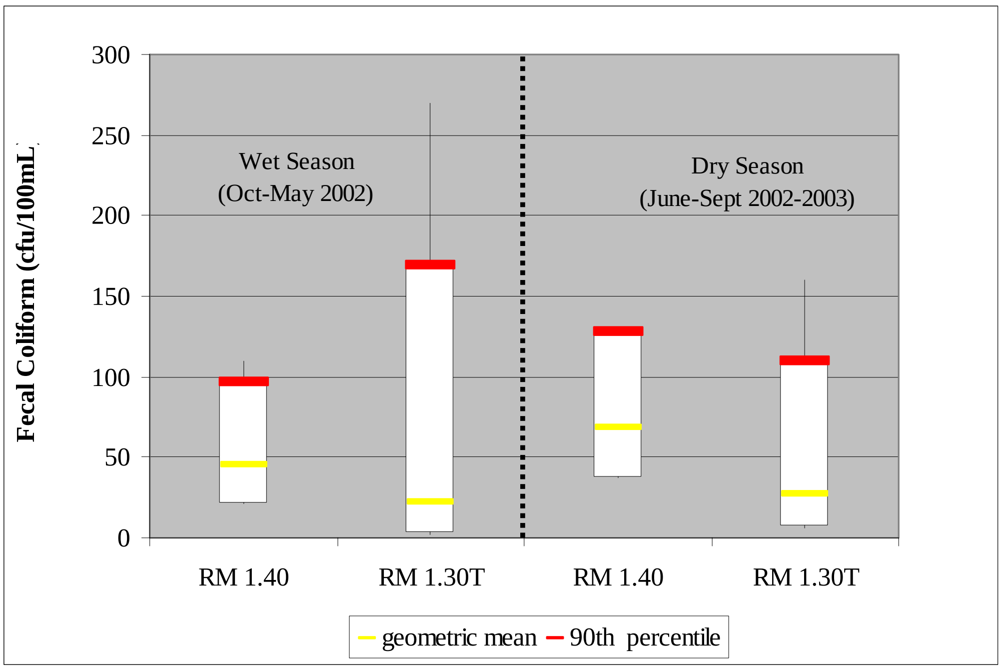

Figure 10. 2002-2003 seasonal fecal coliform concentrations at Red Salmon Creek RM 1.40 and 1.30T.

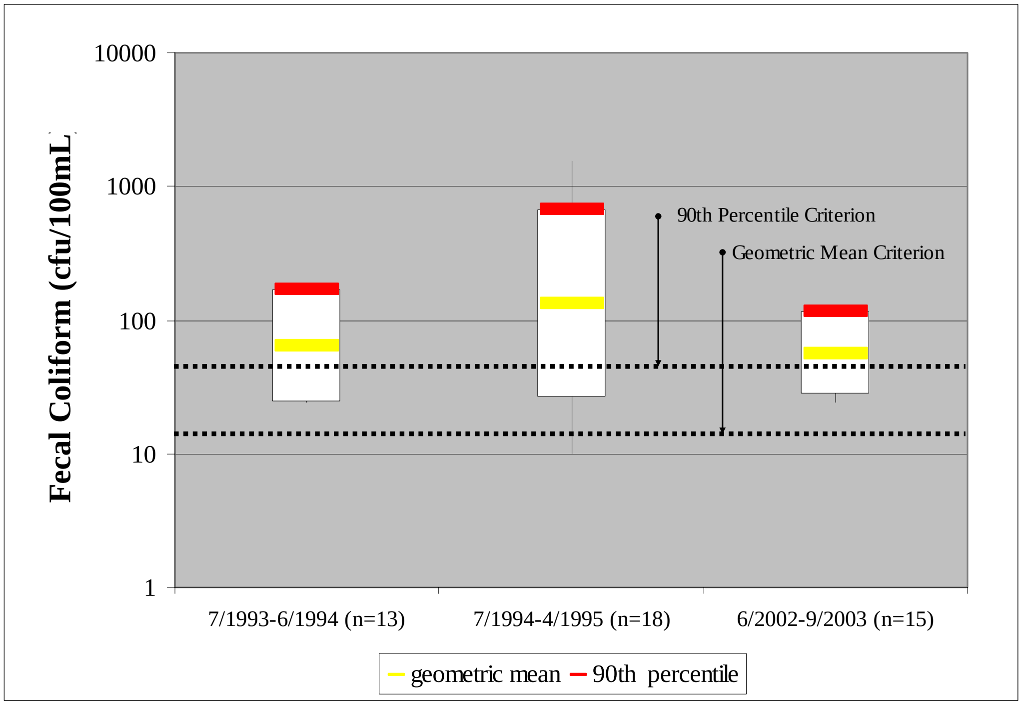

Figure 11. Red Salmon Creek RM 1.40 historical and current fecal coliform levels.

McAllister Creek
Fecal Coliform Bacteria

Historical data were available for several sites on McAllister Creek. From June 1992 - November 1995, the Nisqually Tribe collected baseline water quality data on McAllister Creek. Results showed that McAllister Creek provided the most continuous source of fecal coliform bacteria to the marine waters of Nisqually Reach. McAllister Creek fecal coliform concentrations were chronically elevated and positively related to rainfall. The most upstream site at McAllister Springs was the only site to meet water quality standards for fecal coliform (Whiley and Walter, 1996). From June 1995 - April 1997, the Nisqually Tribe conducted another fecal coliform bacteria study on the Nisqually River and Reach area including McAllister Creek. The study objectives included determining whether specific reaches of the Nisqually River have significantly higher fecal coliform concentrations, and evaluating the role of McAllister Creek and the Nisqually River on bacterial levels in the Nisqually Reach shellfish growing area.

From March through June 2001, Ecology conducted fecal coliform sampling on McAllister Creek. Monitoring was conducted in response to a shellfish downgrade in the Nisqually Reach area by the Washington State Department of Health (DOH). Results indicate high concentrations of bacteria, nutrients, and sediment entering the mainstem from tributaries as well as from the agricultural tide gates and storm water. Data showed that McAllister Creek contributes high concentrations of fecal coliform bacteria into the estuary area below the Interstate-5 Bridge. Bacteria concentrations increased in the McAllister Creek mainstem in response to precipitation especially on the days with greater than 0.5″ of rain (Dickes, 2002).

To evaluate trends, two sets of data were used: (1) the historical Nisqually Tribe data set from 1993-95 and 1995-97 for McAllister Creek at RM 3.1, and (2) a more recent set from 2001-2003 including the data from the current 2002-03 study and the Dickes (2002) data from March through June 2001.

To determine if there is a statistically significant improvement in water quality since 1997, a nonparametric step trend test, Seasonal Wilcoxon Mann-Whitney, was used to determine water quality differences between the historical and more recent data set. The statistical analysis program WQHYDRO (Aroner, 2001) was used, with a significance level of 0.10 (α=0.10). No statistically significant difference in water quality was seen.

Figure 12 presents geometric mean and 90th percentile fecal coliform levels from the historical and more recent data sets. Some improvements in fecal coliform levels were seen at the upstream McAllister sites. These differences could be due to improvements in water quality or to differences in rainfall for the sample periods.

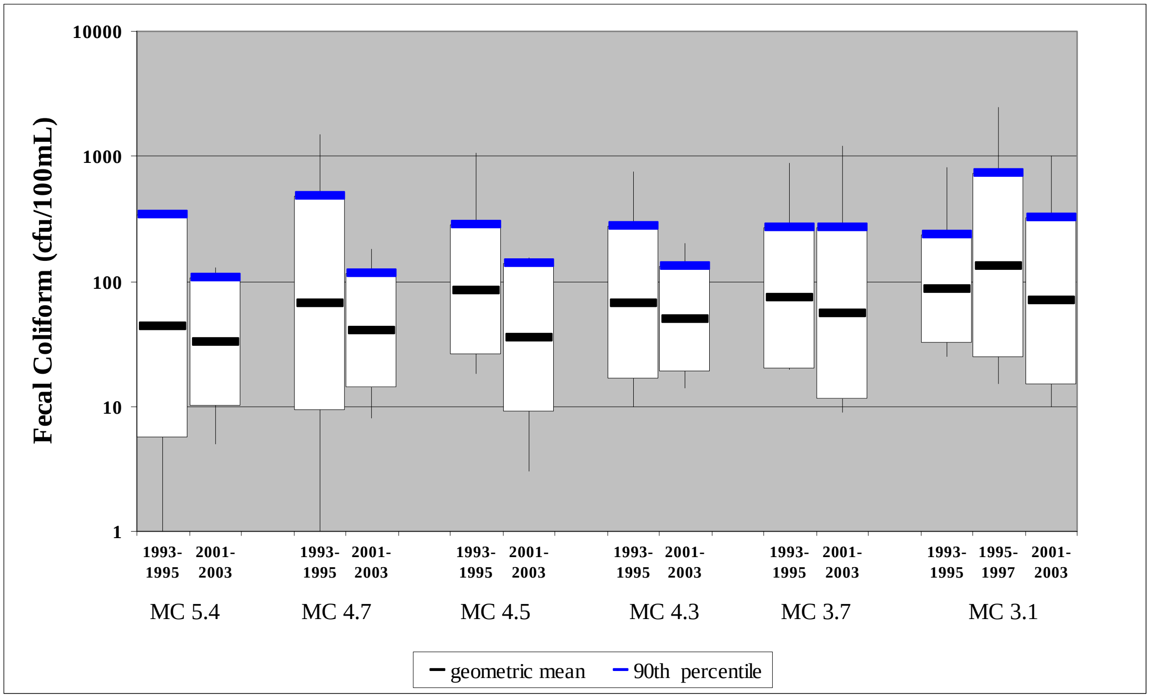

Figure 12. McAllister Creek historical and recent fecal coliform levels.

Figure 13 presents total rainfall data for the wet (November - April) and dry (May - October) season for the study periods. Precipitation data are from the Olympia Airport National Weather Service station. Figure 13 shows the initial sampling conducted by the Nisqually Tribe occurred during a period of below average and average precipitation (1993-95). During the second period of tribal sampling (1995-97), precipitations levels were greater than normal. This could explain the increases in bacteria levels seen during the 1995-97 period.

During Ecology pre-TMDL sampling in 2000-2002 (Dickes, 2002), both lower and higher than average precipitation occurred. During the current TMDL sampling period, March 2002 through September 2003, precipitation totals were lower than average for the wet season. Improvements in bacteria levels seen during the current TMDL period could be due to less rainfall during the sampling period.

Both the Tribe (Whiley and Walter, 1996) and Ecology (Dickes, 2002) found elevated fecal coliform levels in McAllister Creek during rain events. A review of the entire fecal coliform data set (1993-2003) for McAllister Creek at RM 3.1 does show a positive correlation with rain events. Higher bacteria levels occur when there is rainfall the day of sampling and during the 24 hours preceding sampling. The critical period for McAllister Creek is during periods of ebbing tide during rain events on an annual basis.

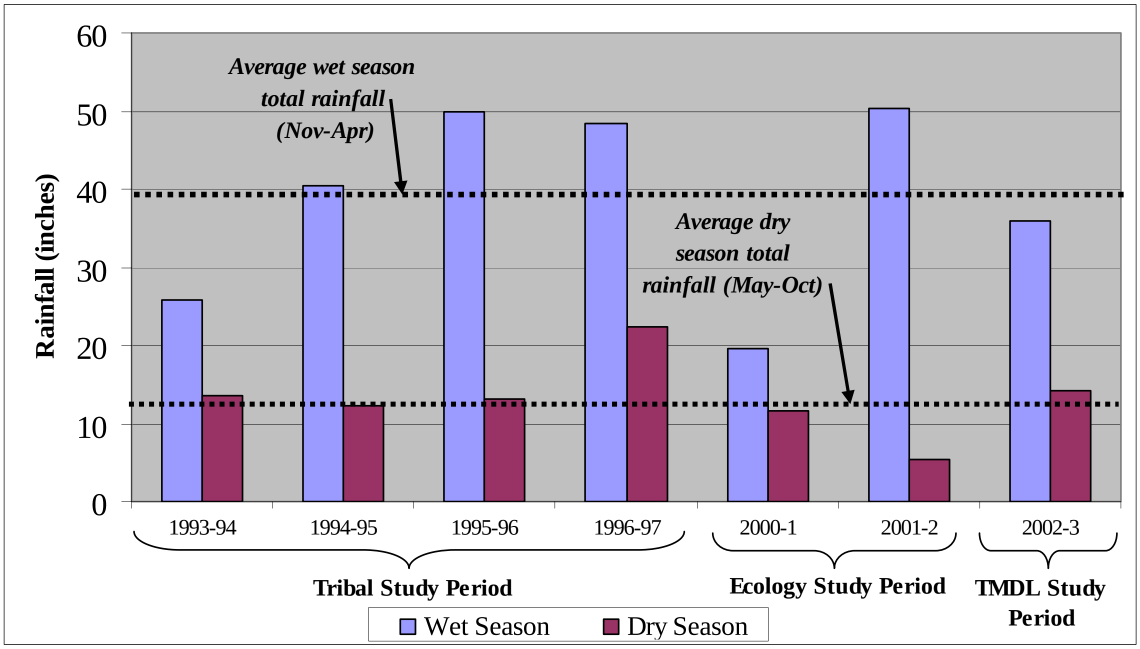

Figure 13. Average wet and dry season total rainfall for the historical and recent study periods.

Dissolved Oxygen

The *Extraordinary* (Class AA) marine criteria for dissolved oxygen applies at McAllister RM 4.7, at Steilacoom Road bridge and downstream. Upstream sites must meet the *Extraordinary* (Class AA) freshwater quality criteria.

In 1989, Ecology sampled several fish hatcheries throughout the state during the critical summer low-flow season including Nisqually Trout Farm #1 located at the end of the remnant channel on McAllister Creek. Influent and effluent samples were obtained from the trout farm on August 17, 1988. Effluent increases were seen in temperature, pH, total suspended solids, ammonia-nitrogen, total nitrogen, and phosphorus. Nitrate+nitrite-N decreased, and dissolved oxygen decreased from 11.6 to 5.9 mg/L, from 104 to 56% saturation (Kendra, 1989).

From June 1992 - November 1995, the Nisqually Tribe collected baseline water quality data on McAllister Creek (Whiley and Walter, 1996). The Tribe found that dissolved oxygen varied little throughout the length of McAllister Creek. Dissolved oxygen levels at McAllister Springs ranged from 5.8 to 10.6 mg/L over a year period with a median concentration of approximately 8.0 mg/L. Median dissolved oxygen levels were similar from McAllister Springs to McAllister Creek RM 4.7. Below RM 4.7, the creek flows through a series of riffles that serve to aerate the water. This is the first turbulent mixing zone in the creek. Below this point, the median dissolved oxygen level increased to 8.8 mg/L. Dissolved oxygen concentrations above RM 4.7 were chronically low during the winter months and increased during the summer months, perhaps due to primary production.

Minimum and maximum dissolved oxygen readings for continuous monitoring conducted over several time periods on different McAllister Creek stations for the current 2002-03 study period are presented in Table 5.

Table 5. Minimum and maximum dissolved oxygen levels for continuous recording Hydrolabs installed at McAllister Creek sites.

Site and Time Period	Minimum DO (mg/L)	Maximum DO (mg/L)	Range of Percent DO Saturation *
McAllister Creek RM 6.0 (McAllister Springs)			
June 21 - 26, 2002	5.8	7.9	53-75 %
McAllister Creek RM 5.8			
July 30 - August 2, 2002	4.9	10.1	45-96 %
January 21- 27, 2003	5.2	7.4	46-64 %
January 28 - 31 2003	6.1	7.6	54-65 %
March 19 - 24, 2003	5.4	8.0	47-71 %
July 11 - 14, 2003	5.8	9.9	53-99 %
August 27 – 31, 2003	3.9	8.6	35-83 %
McAllister Creek RM 4.7			
June 21 - 27, 2002	5.6	9.7	55-97 %
July 30 - August 2, 2002	5.2	11.0	49-107 %
January 28 - 31, 2003	6.1	7.8	53-72 %
March 19 - 24, 2003	5.4	7.9	46-72 %
July 11 - 14, 2003	5.5	10.8	52-108 %
August 27 - Sept 2, 2003	4.3	9.4	41-92 %
McAllister Creek RM 3.7			
January 28 - 31, 2003	6.3	7.8	55- ? %**
March 19 - 24, 2003	6.6	9.0	57-87 %
July 11 - 14, 2003	5.2	9.9	54-? %**
August 27 - Sept 2, 2003	5.0	10.6	50-127 %

* Dissolved oxygen percent saturation corrected for temperature but not salinity. The oxygen content of water decreases exponentially as salinity increases, such that the difference between solubility in seawater and freshwater is about 20 percent (Wetzel, 1983)

** Probe out of water at high tide, highest saturation levels unknown.

For McAllister Creek RM 5.8 and 4.7, the low dissolved oxygen levels are seen in both January and during late August. As concluded by the Tribe, dissolved oxygen levels tend to be chronically low in the winter months. A greater diurnal range in dissolved oxygen is seen during the summer months, with higher maximum dissolved oxygen levels and lower lows. It is likely the increases are due to primary production as evidenced by the diurnal swings in dissolved oxygen seen during July and late August (Figures 14 and 15). The lowest minimum dissolved oxygen levels are seen in late August. While McAllister Creek has chronically low dissolved oxygen levels during the winter months, the lowest values and critical period occur during the summer months. The tributaries, including tide gates, show no consistent seasonal pattern in dissolved oxygen levels.

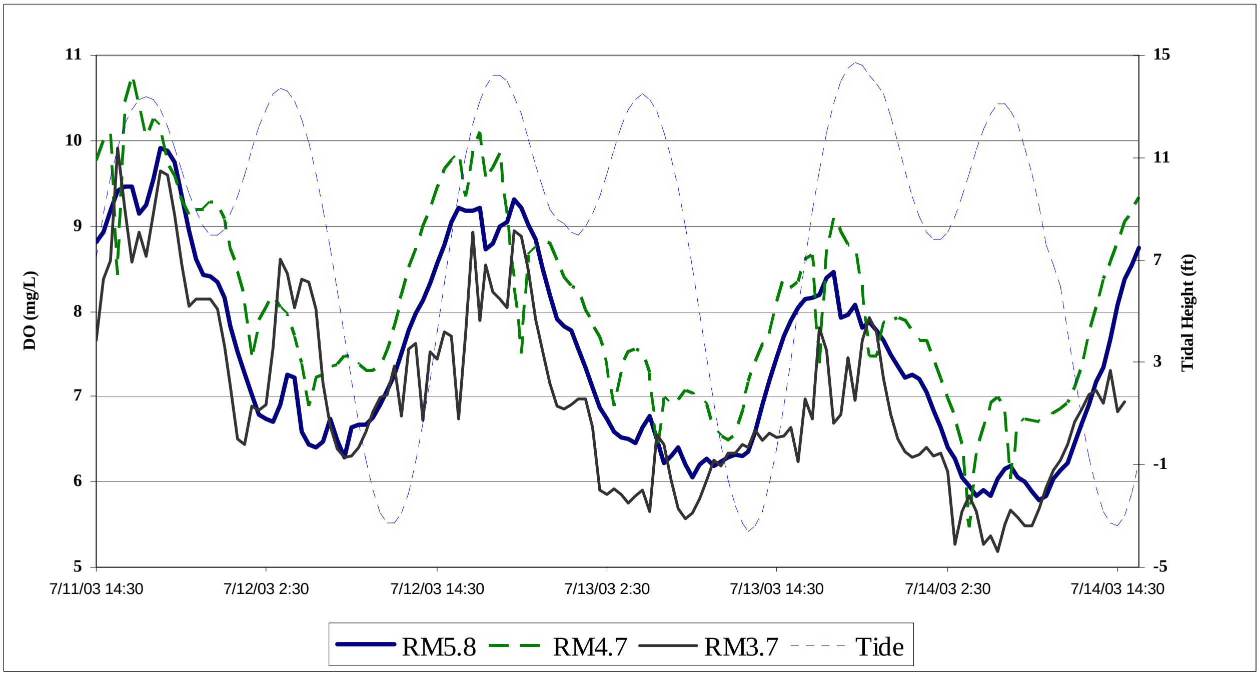

Figure 14. July 11-14, 2003 continuous dissolved oxygen monitoring for McAllister Creek RM 5.8, 4.7, and 3.7.

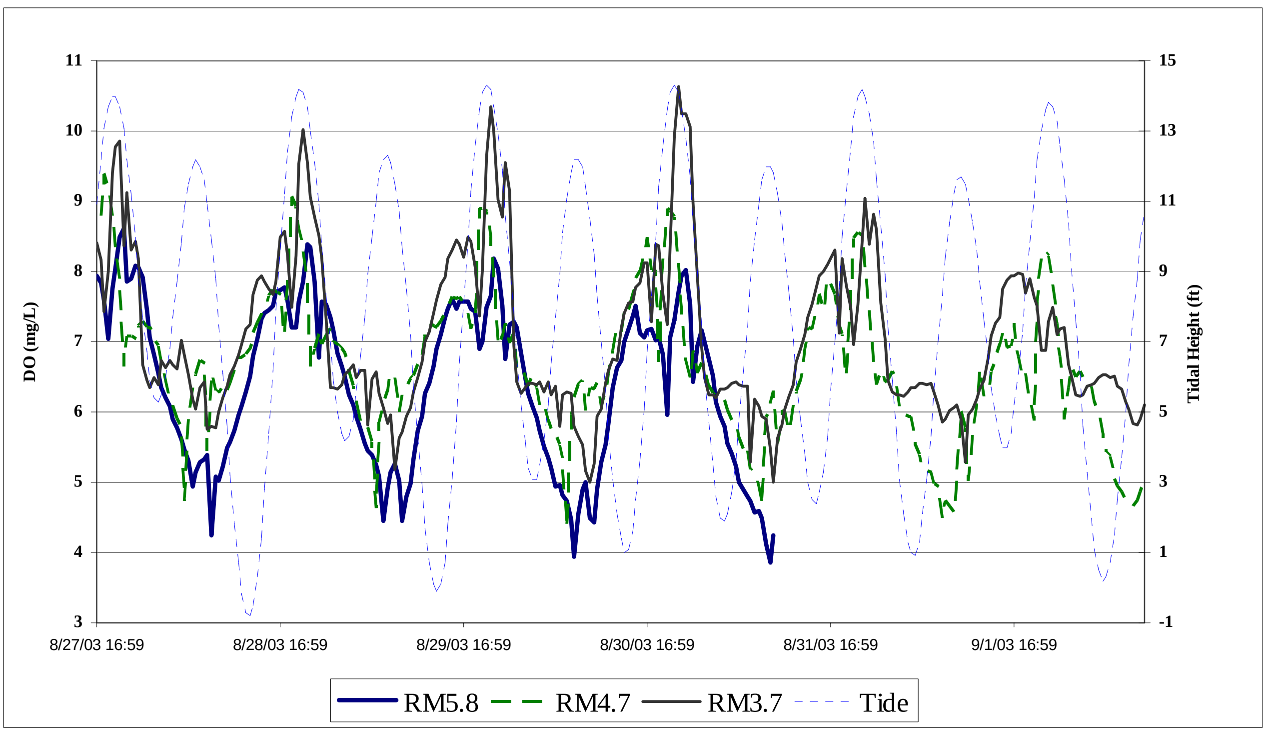

Figure 15. August 27 - September 1, 2003 continuous dissolved oxygen monitoring for McAllister Creek RM 5.8, 4.7, and 3.7.

Technical Analysis, Loading Capacity, Load and Wasteload Allocations

The technical analyses are based on historical and recent field and laboratory data collection and statistical analysis. *The Quality Assurance Project Plan* (Sargeant, Roberts, and Carey; 2002) describes the data collection program and methods. A discussion of field and laboratory data quality, and field and laboratory results are presented in appendices of *Nisqually River Basin Fecal Coliform Bacteria and Dissolved Oxygen Total Maximum Daily Load Study (Sargeant, 2005)*, available online at http://www.ecy.wa.gov/biblio/0503002.html

Fecal Coliform Bacteria

Load and Wasteload Allocations

The loading capacity is the maximum load of a pollutant that can be assimilated by the receiving water without violating water quality standards. The loading capacity is allocated among load and wasteload sources. Load allocations are set for diffuse (nonpoint) sources, and wasteload allocations are set for discrete (point) sources.

There are no point source discharges in the Red Salmon study area; therefore, the wasteload allocation is zero, and the entire load capacity is allocated to nonpoint sources and the margin of safety in this area.

In McAllister Creek, Nisqually Trout Farm #1 discharges to a pond that discharges to a remnant channel of the creek at approximately RM 4.2. During the current sampling period, March 2002 – September 2003, the trout farm did not meet Ecology's threshold size for a General NPDES Fish Hatchery permit, and is not a permitted facility, but a wasteload allocation must still be given for the facility (Mann, 2004).

Since 2002, EPA requires that all TMDLs in jurisdictions with NPDES permits for stormwater systems include the pollutant loads from those systems as a wasteload allocation (Joy, 2004). The Washington Sate Department of Transportation (WSDOT) has a Phase I NPDES permit for their stormwater systems. Pierce County has a Phase I NPDES municipal permit for their stormwater systems. Portions of the west bank of McAllister Creek are within Thurston County's Phase II NPDES permit area.

The Nisqually River meets water quality standards for fecal coliform bacteria, and therefore no loading capacity determination is necessary. The Nisqually Reach stations monitored by DOH also meet water quality standards and also do not require loading capacity determination.

Determining Fecal Coliform Loading Capacity

Fecal coliform *concentrations* are important for evaluating a waterbody's compliance with water quality criteria. Fecal coliform *loading* calculations can provide a more comprehensive water quality analysis than fecal coliform concentrations. Loading is a function of both concentration (bacteria density) and flow. Loading analysis can reveal the presence of additional contaminant sources, dilution and dispersion characteristics, as well as transport mechanisms.

Fecal coliform has a two-part water quality standard for concentration. For most areas, the criterion that is not met is that 10 percent of samples are not to exceed a given value, which is interpreted as must not exceed the 90th percentile. To calculate the fecal coliform bacteria loading capacity, the following formula is used:

$$LC_{90\%tile} = Q \text{ x } (90^{th} \text{ percentile fc standard/100mL}) f_{convert}$$

Where LC is the load capacity in billion fecal coliform per day, Q is discharge in cubic feet per second (cfs), and $f_{convert}$ is 0.0246 to convert cfs x #fc/100mL to billion fecal coliform per day.

Load allocations are determined using the rollback method to calculate reduction factors necessary to meet both parts of the water quality standard. In most cases, application of the rollback method yields a more stringent target for one part of the standard (GM or 90th percentile) than the applicable water quality standard. If the 90th percentile is limiting, then the goal would be to meet the 90th percentile goal (e.g., 50 or 100 fc/100 mL in freshwater). No goals would be set for the geometric mean since, with the implementation of target reductions, the already low geometric mean would only get better. Similarly, if the geometric mean is limiting, the goal would be to achieve a geometric mean that meets standards with no goal set for the 90th percentile.

Nisqually River and Reach

The Nisqually Reach stations monitored by DOH meet the water quality standards for fecal coliform bacteria. The Nisqually River at RM 3.4 also meets standards. Therefore, the Nisqually Reach and River do not require load allocations. However, given previous water quality problems near these important shellfish growing areas, continued attention is recommended, as described in the *Recommendations* section of this report.

Ohop Creek

Loading capacity for three sites on Ohop Creek is presented in Figure 16. For the sites at RM 6.0 and Lynch Creek, load allocations are set for the wet season critical period. For all remaining sites, including RM 1.0, the critical period is the dry season, and the load allocation is based on lower dry season flows. For all sites, the 90th percentile (the portion of the criteria that did not meet standards) is set as the target to meet.

Table 6 describes bacteria reductions needed for the critical period by site. It is likely that high wet season fecal coliform levels from Lynch Creek impact wet season bacteria levels at Ohop RM 6.0. Improvements in Lynch Creek bacteria levels should improve bacteria levels at Ohop RM 6.0.

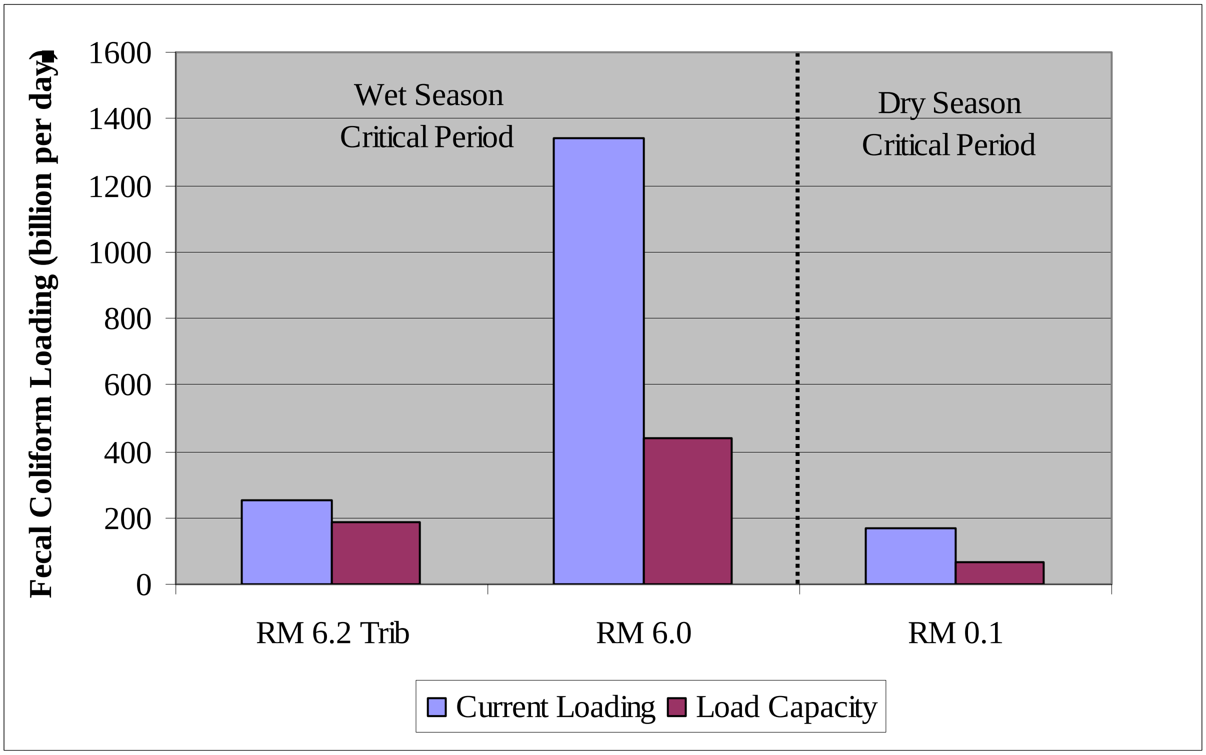

Figure 16. Fecal coliform bacteria loading capacity for Ohop Creek.

Table 6. Ohop Creek bacteria reductions and targets.

Site	Critical season	# of sample events in period	Geometric mean	90th percentile	FC reduction needed to meet standards	Limiting criterion	Target value fc/100 mL
Lynch Creek RM 6.2T	Wet	8	27	260	13%	90th percentile	200
Ohop Creek RM 6.0	Wet	16	22	264	24%	90th percentile	200
Ohop ditch at RM 2.2D	Dry	5	113	452	56%	90th percentile	200
Ohop Creek RM 0.1	Dry	4	102	383	48%	90th percentile	200

Fecal Coliform Wasteload Allocations

Stormwater discharge from Pierce County Phase I areas, which includes Eatonville storm water, were not directly sampled. Lynch Creek receives storm water from the city of Eatonville. Stormwater best management practices, including programmatic measures, must be applied to stormwater discharge to meet water quality standards. Discharge to Ohop and Lynch creeks meet a 90th percentile fecal coliform target of 200 fc/100 mL.

Red Salmon Creek

There is no seasonal critical period for Red Salmon Creek. The critical period is the low tide on an annual basis. Red Salmon Creek annual loading capacity at low tide is presented in Figure 17. The bacteria load allocations were calculated based on Red Salmon at RM 1.40 and RM 1.30T meeting the marine bacteria standard. Red Salmon Creek at RM 1.44 met fecal coliform freshwater standards, but Wash Creek at RM 1.42T did not.

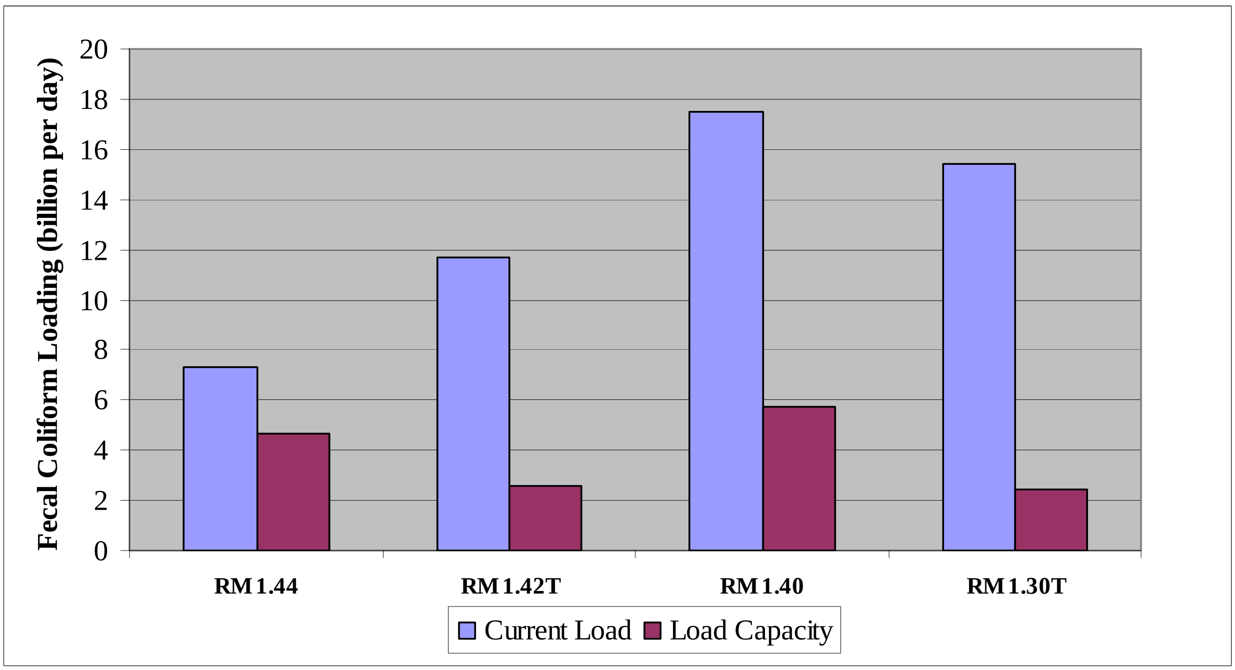

Figure 17. Fecal coliform bacteria loading capacity for Red Salmon Creek.

Even if both Red Salmon RM 1.44 and Wash Creek met the Class AA freshwater standard, Red Salmon at RM 1.40 would not meet marine standards during the low tide period because the marine criterion is more stringent. Therefore, upstream sites need to meet a more stringent water quality standard so that Red Salmon RM 1.40 can meet marine standards.

The more stringent freshwater fecal coliform criterion was derived by calculating the reduction in bacteria loading that occurs from the upstream sites (RM 1.44 and Wash Creek) to the downstream site (RM 1.40). A 10% reduction in bacteria loading occurs from upstream to downstream (n=6). At the downstream site (RM 1.40), the 90th percentile (43 fc/100mL) was the limiting criteria. For equity, it was decided to set the same target bacteria concentrations for both upstream sites. If a 10% reduction in bacterial loading occurs from upstream to downstream, the upstream sites need to meet a target 90th percentile of 48 fc/100 mL so that the downstream site meets marine water quality standards. Table 7 describes bacteria reductions needed for each site during the critical period.

Table 7. Red Salmon Creek fecal coliform bacteria reduction targets.

Site	# of samples	Geometric mean #fc/100mL	90^{th} percentile #fc/100mL	FC reduction needed to meet target limits	Limiting criterion	Target 90^{th} percentile #fc/100mL
Red Salmon RM 1.44	6	28	97	51%	90^{th} percentile	48
Wash Creek RM 1.42T	6	130	285	83%	90^{th} percentile	48
Red Salmon RM 1.40	15	25	131	37%	90^{th} percentile	43
Unnamed Trib RM 1.30T	15	57	116	14%	90^{th} percentile	43

McAllister Creek

Fecal Coliform Bacteria

The critical period for McAllister Creek is during low tide events when there is more freshwater input to the Nisqually Reach and Luhr Beach. The McAllister Creek mainstem also has higher bacteria levels during rain events. In accordance with the state water quality standards, McAllister Creek must meet the marine fecal coliform standards at McAllister RM 3.7.

For McAllister RM 3.7 to meet marine standards, fecal coliform levels would need to be much lower throughout McAllister Creek, including the most upstream site at RM 5.8. McAllister Creek at RM 5.8 represents natural background levels with no known human-caused sources of fecal coliform. Upstream of RM 5.8 is a large wetland complex that extends to RM 6.3 where McAllister Springs is located. McAllister Creek at RM 5.8 meets the *Extraordinary* water primary contact recreation standard for fecal coliform, with a geometric mean of 35 fc/100 mL and a 90^{th} percentile of 98 fc/100 mL.

To determine if these freshwater targets can be met at McAllister RM 4.3 with current background conditions, it was necessary to look at a flow balance and fecal coliform loading in McAllister Creek.

Fecal coliform loads in the McAllister Creek mainstem can only be estimated, due to difficulty in obtaining flow measurements. Total flow in the creek is influenced by tidal flushing, where salt water moves upstream from Puget Sound during high tide and is released during low tide. Streamflow measurements are complicated by tidal backwater effects and associated flow reversals (Pacific Groundwater Group, 2000). Flow at the headwaters is measured at the McAllister Springs weir. Downstream from the headwaters, several springs, ground water, tributaries, and tide gate inputs contribute to flow in the creek.

In August 2000, the consultant conducted an intensive analysis of McAllister Creek flow to document the aquifer sources and the rates of groundwater flow (Pacific Groundwater Group, 2000). Precipitation was about 20 percent higher than the long-term average during the Pacific Groundwater Group study. Flow estimates to calculate bacteria loading are derived from the Pacific Groundwater Group study.

Table 8 presents estimated flow discharge and fecal coliform loading for McAllister Creek sites based on flow estimates provided by Pacific Groundwater Group (2000). Tide gate flow discharge information was collected at low tide 1-3 times. The average of the tide gate flow data is also included in the flow balance. There are no flow data for tide gates 14, A, and B, the culvert at tide gate 11, and for several tributaries; therefore, a conservative estimate of 0.5 cfs was assigned to these tide gates for the purpose of developing a flow balance on the creek. The 90th percentile fecal coliform values were used to calculate loading.

Table 8. Estimated fecal coliform loading and bacterial reductions for McAllister Creek.

McAllister Creek Site	**Estimated flow (cfs)**	**90th Percentile FC (fc/100 mL)**	**Current FC loading (billions/day)**	**Target FC loading (billions/day)**	**Estimated 90th percentile FC with reductions to meet load capacity (fc/100 mL)**
McAllister Springs	15.5				
Abbott Springs	7.5				
Deep groundwater inflow from upstream of RM 5.8	5.0				
McAllister RM 5.8	28.0	98	67.5	67.5	98
Tide gate 15	2.22			5.46	100
Tide gate 14	0.5			1.23	100
Tide gate 13	7.93			19.5	100
Tide gate 12	1.5			3.69	100
Little McAllister Creek and flow from TG 11	4.6			11.3	100
Culvert at TG 11	0.5			1.23	100
Tide gate 10	1.33			3.27	100
Tide gate 9	1.56			3.84	100
Tide gate 8	0.03			0.07	100
Medicine Creek at mouth	0.6			1.48	100
Tributary at RM 4.6 (LB)	0.03			0.07	100
Tributary at RM 4.42 (LB)	0.5			1.23	100
Tributary at RM 4.41 (LB)	0.5			1.23	100
Medicine Creek at mouth	0.6			1.48	100
Tributary at RM 4.34 (LB)	0.5			1.23	100
Tributary at RM 4.3 (LB)	0.5			1.23	100
Groundwater flow not accounted for by inputs above (32.2cfs - 23.4 cfs=8.8 cfs)	8.8			0.00	0
McAllister RM 4.3	60.2	123	182	125*	84
Tide gate 5	0.57			1.40	100
Tide gate 4	0.61			1.50	100
Tide gate 3	0.14			0.34	100
Groundwater (7.1cfs-1.32cfs=5.8 cfs)	5.8			0.00	0
McAllister RM 3.7	67.3	80	132		

* Loading capacity is based on McAllister RM 5.8 meeting current standards, and all tributary and tide gates meeting the Class AA fecal coliform standard.

With a natural background (RM 5.8) fecal coliform concentration of 98 fc/100 mL (90th percentile) and subsequent loading value of 67.5 billion fecal coliform per day, the most downstream freshwater site at RM 4.3 could achieve a 90th percentile fecal coliform concentration of 84 fc/100 mL (Table 8). This is provided that all inputs including tide gates and tributaries meet a 90th percentile fecal coliform value of 100 fc/100 mL.

To determine if McAllister Creek at RM 3.7 can meet marine standards if the most downstream freshwater site at RM 4.3 met a 90th percentile fecal coliform of 84 fc/100 mL, the die-off and dilution rate between the two sites (RM 4.3 and 3.7) was examined. Figure 18 presents geometric mean and 90th percentile fecal coliform concentrations for the mainstem stations on McAllister Creek; the marine and freshwater standards are included. Figure 18 shows decreasing fecal coliform values downstream of RM 4.3, with the exception of a source of bacteria between RM 3.7 and 3.1.

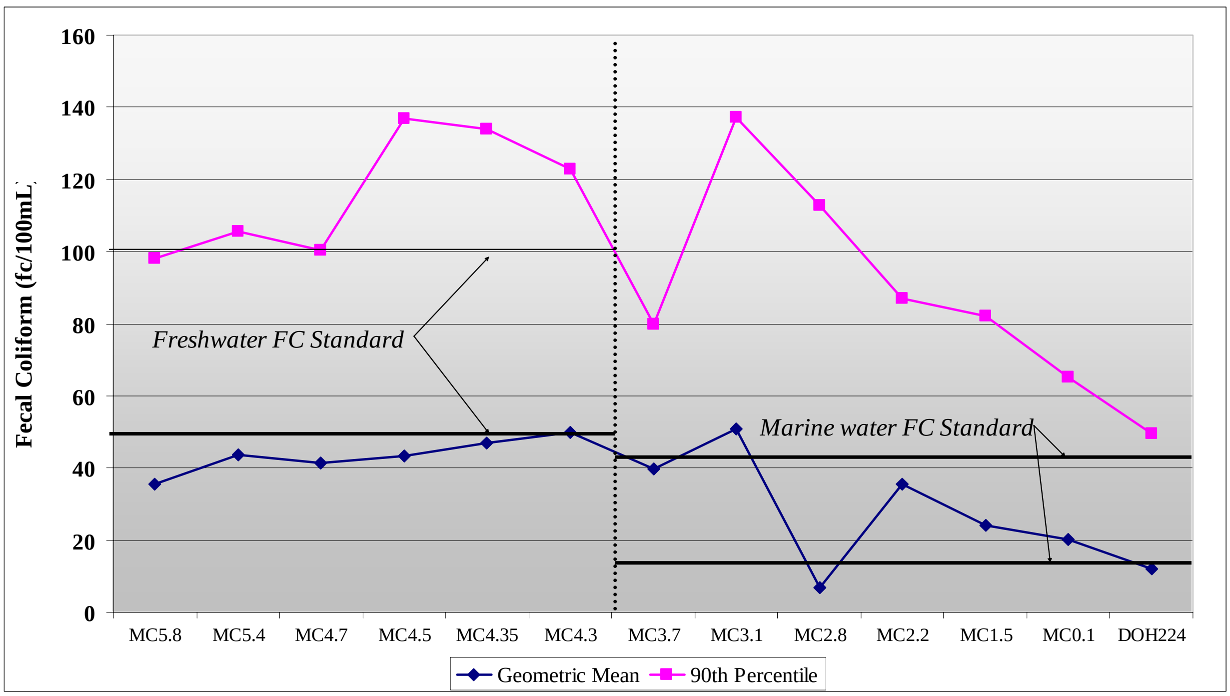

Figure 18. June 2002 - August 2003* McAllister Creek mainstem geometric mean and 90th percentile fecal coliform concentrations. *MC0.1 and DOH224 include data to March 2004.

Table 8 shows that a 27 percent reduction in bacterial loading occurs between RM 4.3 and 3.7 (from 182 to 132 billion fecal coliform per day). Reductions in loading and concentrations are likely due to bactericidal effects and dilution from marine water.

If the freshwater site at McAllister RM 4.3 meets a 90th percentile of 84 fc/100 mL, and a 27% reduction in loading occurs between RM 4.3 and 3.7, RM 3.7 could meet a 90th percentile fecal coliform concentration of 55 fc/100 mL. This is slightly higher than the marine water quality standard of 43 fc/100 mL. Given the natural background concentrations of bacteria in McAllister Creek, it is unlikely that McAllister Creek RM 3.7 can meet the marine standard.

Flow, and thus loading data, are not available for McAllister RM 0.1, so it is not possible to calculate downstream loading reductions. It is likely that if bacterial sources between McAllister RM 3.7 and 3.1 are cleaned-up that the downstream DOH shellfish harvesting site at RM 0.1 will meet the marine water quality standard. Table 9 describes the freshwater TMDL target for McAllister Creek at RM 4.3 and reductions needed to meet this target, as well as reductions needed at McAllister RM 0.1 to meet the marine water quality standard.

Table 9. Fecal coliform bacteria target geometric mean, 90th percentile, and percent bacteria reduction for McAllister Creek.

McAllister Creek Site	Target geometric mean fecal coliform (# fc/100 mL)	Target 90th percentile fecal coliform (# fc/100 mL)	Bacteria reduction needed
RM 4.3	34	84	32%
RM 3.7	27	55	Based on RM 4.3 meeting targets
RM 0.1	14	43	34% *

* Based on DOH and Ecology TMDL sampling from July 2002 - March 2004 (n=28)

Table 10 describes bacteria reductions needed for tributaries and tide gates to McAllister Creek. Reductions are based on freshwater sites meeting a 90th percentile of 100 fc/100 mL and marine sites meeting a 90th percentile of 43 fc/100 mL.

Table 10. McAllister Creek tributaries estimated fecal coliform loading, current geometric mean and 90th percentile fecal coliform, and percent reduction need to meet fecal coliform targets

Site	FC loading based on 90th percentile values (billions per day)	Current FC geometric mean (fc/100 mL)	Current 90th percentile FC (fc/100 mL)	Percent reduction in FC needed to meet water quality standard
Little McAllister Creek	38.2	48	378	74%
Tide gate 13	32.8	22	168	40%
Tide gate 9	12.5	54	325	69%
Tide gate 4	7.8	36	520	81%
Tide gate 15	7.3	17	134	0%
Tide gate 5	6.4	38	545	78%
Tide gate 12	6.4	42	172	42%
Tide gate 10	4.5	20	137	27%
Tributary at RM 4.3 (LB)	3.1	51	254	61%
Culvert at TG 11	3.1	24	251	60%
Medicine Creek at mouth	3.1	59	208	52%
Tide gate 14	2.2	16	175	43%
Tide gate 2	2.1	14	51	0%
Tributary at RM 4.34 (LB)	1.2	8	99	0%
Tide gate 8	1.2	75	1615	94%
Tributary at RM 4.42 (LB)	1.2			0%
Tide gate A	**.59**	**12**	**48**	**10%**
Tributary at RM 4.41 (LB)	.48	12	39	0%

Site	FC loading based on 90th percentile values (billions per day)	Current FC geometric mean (fc/100 mL)	Current 90th percentile FC (fc/100 mL)	Percent reduction in FC needed to meet water quality standard
I-5 Stormwater Pipe	.41	29	212	53%
Tide gate 1	.41	84	1652	94%
Tide gate B	**.41**	**8**	**33**	**0%**
Tide gate 3	.38	22	110	9%
Tributary at RM 4.6 (LB)	.13	26	175	43%

Bold = Indicates site must meet marine bacteria standard

Current fecal coliform bacteria loading and loading capacity for McAllister Creek are presented in Figure 19. Load and wasteload allocations are included and are based on reductions described in Tables 9 and 10. The statistical rollback method was used to calculate the bacteria reductions needed to meet marine fecal coliform standards at McAllister RM 0.1, and for the TMDL targets set for at RM 4.3 and 3.7.

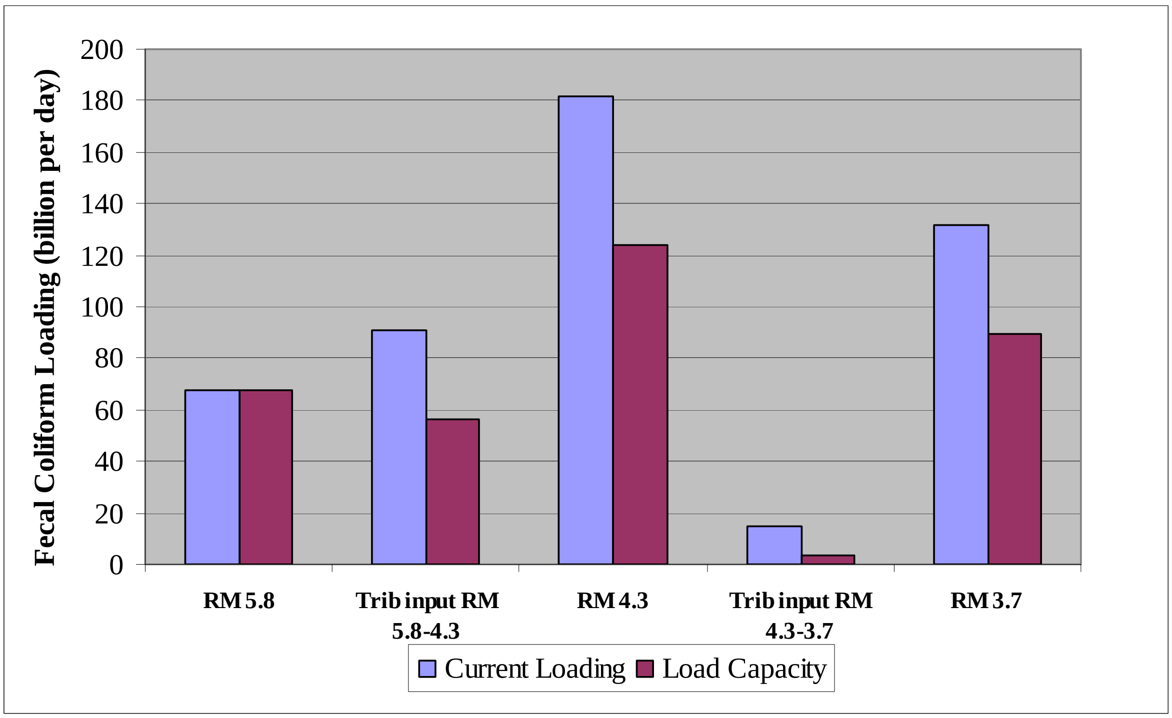

Figure 19. McAllister Creek fecal coliform loading capacity.

Uncertainty in Loading Estimates

To determine how natural background fecal coliform levels affect downstream fecal coliform concentrations, it is necessary to look at loading. However, there is some uncertainty associated with the loading estimates described in the section above due to the lack of flow data for McAllister Creek. The flow data used for loading estimates were obtained during a low-flow summer condition. However, precipitation was about 20 percent higher than the long-term average during the 2000 water year up until the flow study. Therefore, resulting dry season flow estimates shown may be about 20 percent higher than the long-term average, and these measurements are likely an underestimate of wet season flows.

During the TMDL study, an attempt was made to measure flow in McAllister Creek; instantaneous flow measurements were obtained at RM 4.5 during several low tide events. Table 11 presents flow at RM 4.5. Note that on some days there are multiple flow values; flow measurements were obtained in sequence in an attempt to capture low tide flow. Flow measurements at RM 4.5 range from 40-93 cfs. Flows at RM 4.5 should be roughly equivalent to the McAllister RM 4.3 site described in the Pacific Groundwater Group (2000) study. The results of their study estimated a flow of 60.2 cfs at McAllister RM 4.3. Flow estimates provided by Pacific Groundwater Group for RM 4.5 are within the range of flows measured at McAllister Creek RM 4.5, but flows do vary to a great extent from season to season.

Table 11. Instantaneous flow measurements at McAllister Creek RM 4.5.

Date	Time	Flow in cfs
5/19/03	17:15	75.34
6/16/03	16:10	61.41
6/27/03	13:35	41.62
7/11/03	12:00	56.15
7/15/03	16:45	54.43
7/15/03	17:00	53.46
7/25/03	13:25	42.63
7/25/03	13:40	44.68
12/31/03	8:15	53.69
12/31/03	8:35	44.57
3/19/04	13:15	99.87
3/19/04	13:35	96.62
3/19/04	13:50	92.68

Fecal Coliform Wasteload Allocations

There are generally no sources of fecal coliform bacteria associated with a freshwater fish farm. Fecal coliform sampling showed no increases in fecal coliform bacteria above background levels. The Nisqually Trout Farm #1 wasteload allocation for fecal coliform bacteria is set at no increase above background levels.

Fecal coliform load and concentrations from Interstate-5 storm water are described in Table 10; data for this site are included in *Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix E (Sargeant, Roberts, Carey, 2004). The WSDOT stormwater outfall discharges primarily during rainfall events. WSDOT must apply best management practices including programmatic measures to stormwater discharge to meet water quality standards. Stormwater discharge to McAllister Creek must meet a 90th percentile fecal coliform target of 100 fc/100 mL. A 53 percent reduction in bacterial levels is needed to meet this target.

Stormwater discharges from Thurston County Phase II areas were not sampled for this study. Stormwater best management practices including programmatic measures must be applied to stormwater discharge to meet water quality standards. Stormwater discharge to McAllister Creek should meet a 90th percentile fecal coliform target of 100 fc/100 mL.

Thurston County Environmental Health Division Nisqually Reach Pollution Source Identification

During the current 2002-03 study, Thurston County staff conducted a bacterial source tracking (BST) study using DNA ribotyping analysis. Sampling locations were chosen based on six land use categories. Water samples were collected at select tributary and tide gate sites on McAllister Creek: at the two DOH marine sites near the mouth of McAllister Creek and at Luhr Beach on Nisqually Reach. Most sampling was conducted at the same time as the TMDL sampling. *E. coli* cultures were isolated from the water samples, and the analysis of the *E. coli* DNA for source type was conducted at a private laboratory. Thurston County analyzed the results of the study and their findings are presented in the report, *Nisqually Reach Pollution Source Identification* (Thurston County, 2004).

Their conclusions include the following sources of bacteria:

- Birds are the dominant source.
- Cows are the second most frequent source in actively grazed agricultural fields.
- After birds, canine and rodents (wildlife) are predominant at sites where human activity is limited.
- Humans are the second most frequent source in residential sites.

That birds are the most dominant source means that bird DNA isolates turned up most frequently during the sampling events. Frequency means how often a particular source appeared over the course of sampling; it does not refer to the number of source isolates found in the samples. A minimum of 60 isolates were identified for each sampling event. Because of the cost of DNA source tracking, it was possible to test only a small portion of the *E. coli* isolates that were found in a water sample.

Thurston County recommendations include working with animal owners to manage animal waste, continuing to investigate the Luhr Beach neighborhood for sources accounting for the elevated bacteria levels in stormwater, and supporting improvements to the stormwater system serving the Meadows subdivision.

Dissolved Oxygen

Results

Dissolved oxygen (DO) concentrations in McAllister Creek were generally low. *Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix H, Tables H-5 and H-6 (Sargeant, Roberts, Carey, 2004) summarize DO data collected during the synoptic surveys. With the exception of tide gate 1, none of the tributaries or tide gates met the *Extraordinary* water quality standards for DO. Most of the mainstem sites, with the exception of McAllister Creek RM 4.5 and 2.2, did not meet *Extraordinary* DO standards either.

Continuous DO, temperature, pH, and conductivity monitoring was conducted at McAllister Creek RM 5.8, 4.7, and 3.7 on the dates described in Table 5. Dissolved oxygen results for all sites when sampled simultaneously are presented in Figures 14, 15, and 20 minimum and maximum dissolved oxygen levels for continuous recording Hydrolabs installed at McAllister Creek sites.

The McAllister RM 5.8 site, located at the downstream end of the wetland, generally had low DO levels. In July and August, there was a 3.5-4.7 mg/L diel range, following the normal pattern of higher DO levels during the late afternoon when plant photosynthesis is at its peak, and lowest at night when plant respiration was occurring. Temperature and DO followed the same cyclic pattern during a 24-hour period. In March, there was a 2 mg/L diel range in DO, with temperature and DO following the same pattern. There were small spikes and drops in DO due to tidal influence. In January, there was no diel variation in temperature or DO (*Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix F, Figure 3 (Sargeant, Roberts, Carey, 2004)). Dissolved oxygen levels increased slightly with higher tides.

McAllister Creek at RM 4.7 followed a similar pattern as RM 5.8, with July and August having a 3.5-5.8 mg/L diel range, and temperature and DO levels having the same pattern. Tidal influence was more notable at this site with summertime high tides causing increases in temperature and slight fluctuations in DO levels. In January, there was little or no variation in temperature and DO, with higher tides causing slight increases in DO levels. In March, there was a 2 mg/L diel range in DO. Again, temperature and DO followed the same pattern, with spikes and drops in both due to tidal influence.

Temperature and DO levels at McAllister RM 3.7 were affected by tide. March water temperatures were lower, and DO levels higher compared to upstream sites. In March, there was no noticeable diurnal pattern in DO levels. In July and August, a 3.7-5.6 mg/L diel range in DO occurred. While temperature and DO levels follow the same pattern, spikes and drops in DO levels were noted with the tide. During high tide, higher temperatures and slightly higher DO levels were seen.

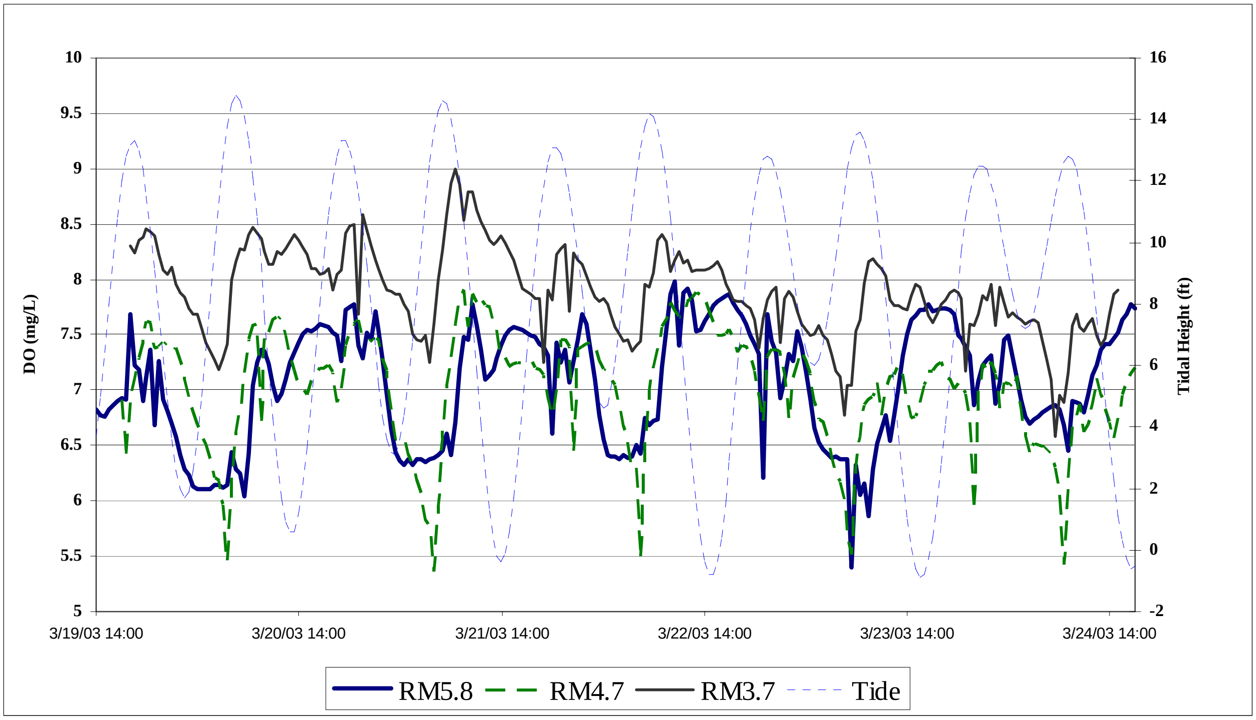

Figure 20. March 19 - 24, 2003 continuous dissolved oxygen monitoring for McAllister Creek RM 5.8, 4.7, and 3.7.

Dissolved Oxygen Conditions in the Natural Environment

McAllister Creek is largely a groundwater fed system, and low dissolved oxygen levels in the groundwater contribute to low dissolved oxygen (DO) levels in the creek. The large upstream wetland and drainage from surrounding wet areas may contribute to already low levels of DO. Dissolved oxygen levels in wetland systems can vary seasonally, with very low DO levels in mid-summer and fall (1- 3 mg/L range) due to algae and plant decomposition after thriving during the spring and early summer. Microbes use oxygen when they aerobically decompose organic matter (Jackson Bottoms Wetland Preserve, 2004).

McAllister Creek DO levels start out low, with the headwaters being fed by McAllister, Abbott, and Lodge springs. The mean DO value for McAllister Springs is about 4.9 mg/L (44% of saturation). The median DO for the wells and springs sampled in the USGS study near McAllister Springs was 4.9 mg/L, with a range of 0.10 to 9.3 mg/L. The median DO value from the three wells sampled in the current study was 7.3 mg/L (*Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix A (Sargeant, Roberts, Carey, 2004).

Figures 14, 15, and 20 show that DO levels start out low at the wetland at RM 5.8. There are slight increases in DO levels downstream. The sites at RM 5.8 and 4.3 generally follow the same diurnal pattern, with greater swings in DO at RM 4.3. Dissolved oxygen at RM 3.8 is controlled largely by tidal fluctuation.

The low gradient in McAllister Creek and twice-daily tidal shifts combine to form an environment that does not allow for significant re-aeration. The creek has a total of 18 tide gates. Water flows out of the tide gates into the creek during low tide, but for most of the day water is contained behind a series of ditches where there is little or no water movement. The ditch system allows for little or no re-aeration of water draining from the fields.

While lower DO levels are somewhat of a natural condition on McAllister Creek, excessive plant growth during the summer months may contribute to lower than natural DO levels downstream of RM 5.8. Figure 21 is a photo taken in August 2002 from the Steilacoom Road bridge (approximately RM 4.7) showing plant growth downstream of the bridge. Excessive nutrients may increase submerged plant growth in the summer months, creating low diel levels of DO and creating DO demand when plants decay (Cusimano and Ward, 1998). The addition of nutrients may reduce DO levels in the mainstem during the growing season, thus contributing to the already low values seen in the creek.

Figure 21. Photograph of plant growth in McAllister Creek mainstem, taken from Steilacoom Road bridge just downstream of RM 4.7.

Nutrient Sampling

The U.S. Environmental Protection Agency (EPA) provided guidance for nutrient levels in rivers and streams in our region: Nutrient Ecoregion II, level III, the Puget Sound lowlands (EPA, 2000). Table 12 summarizes the EPA guidance recommendations for rivers and streams.

Table 12. EPA nutrient guidance for Ecoregion II, level III.

Parameter	No. of streams sampled	Reported Values		25th percentiles based on all seasons data for the decade
		Min	Max	
Total Phosphorus (mg/L)	133	0.0025	0.33	0.02
Total Nitrogen (mg/L)	37	0.08	2.6	0.24
NO_2/NO_3 (mg/L)	129	0.01	3.7	0.08

While the EPA guidance is useful, it is not meant to be representative of estuary conditions. Much of McAllister Creek is tidally influenced and receives a twice-daily influx of marine water.

In comparison to EPA nutrient values (Table 12), McAllister Creek mainstem nutrients were generally 50-100 % higher than EPA 25th percentile values (Figure 22).

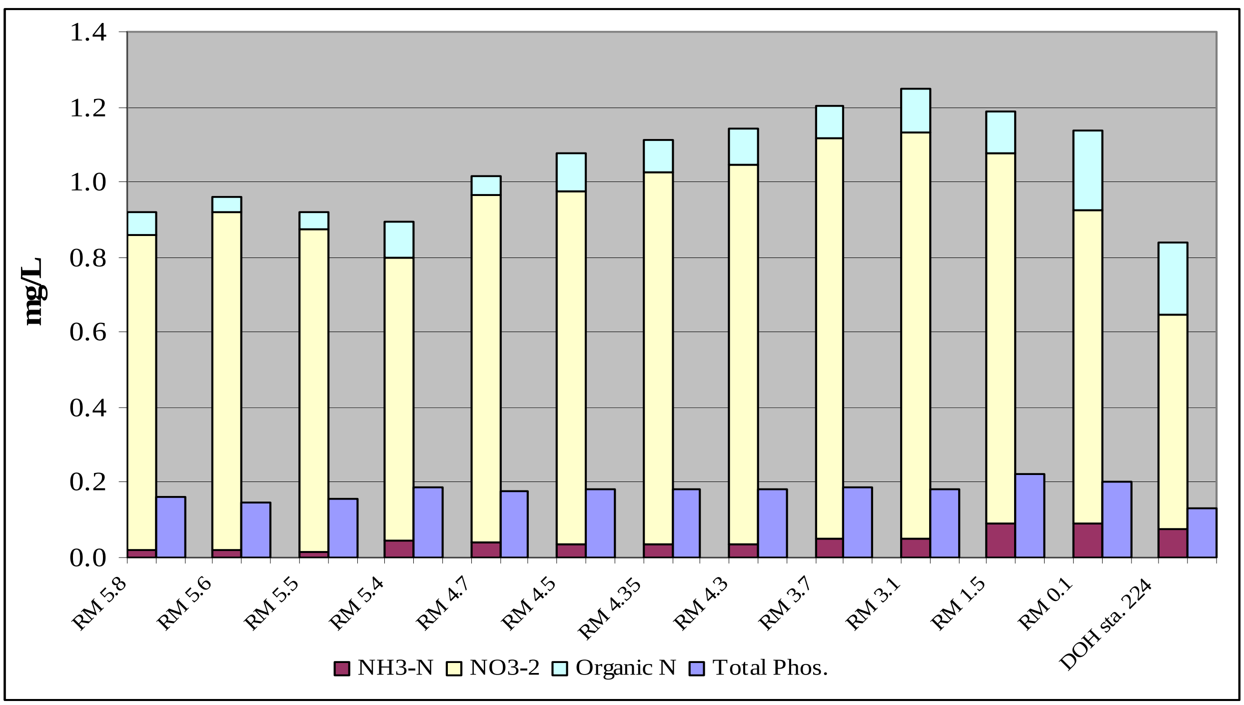

Figure 22. Nutrient levels for McAllister Creek mainstem sites.

Tributaries and tide gates also had high nitrogen and phosphorus levels, with some sites near the maximum reported values for nitrate+nitrite-N (Figures 23 and 24). Tide gate 11 (which includes Little McAllister Creek discharge), the tributary culvert near tide gate 11, the tributaries at RM 4.6, RM 4.4 (upstream and downstream), RM 4.34, RM 4.3, and Medicine Creek all had very high nitrate+nitrite-N values. All of these tributaries, with the exception of Medicine Creek, drain the west bank or west side of McAllister Creek (Figure 24). Ground water flow near McAllister Creek is toward the creek from the west. Ground water discharges to the western bank of the creek via seeps and springs.

Ground water levels of nitrate+nitrite-N were high, with the mean of three of the McAllister Creek area wells at 2.0 mg/L. The mean nitrate+nitrite-N concentration at McAllister Springs in the current 2002-2003 study, 1.2 mg/L, is somewhat lower than the two USGS values in 1988-89 (mean of 1.6 mg/L) but still elevated compared to surface levels. High ground water levels of nitrogen are the biggest contributor of nutrient levels in the form of nitrogen loading to the creek.

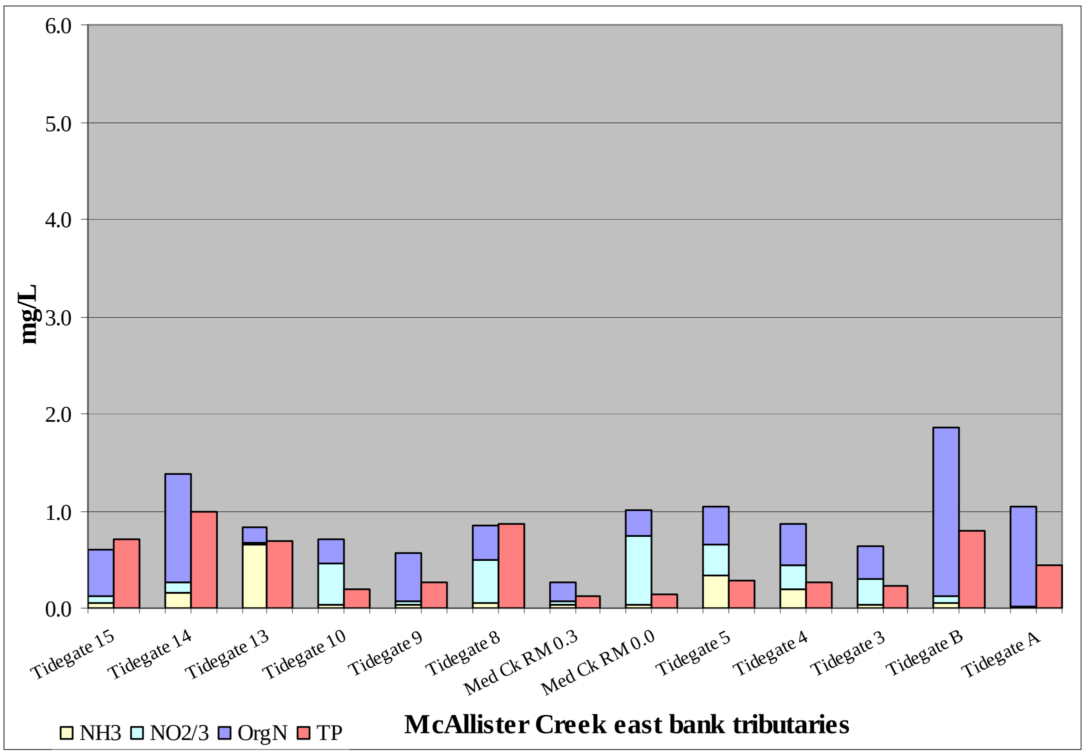

Figure 23. Nutrient levels for McAllister Creek east bank tributary sites.

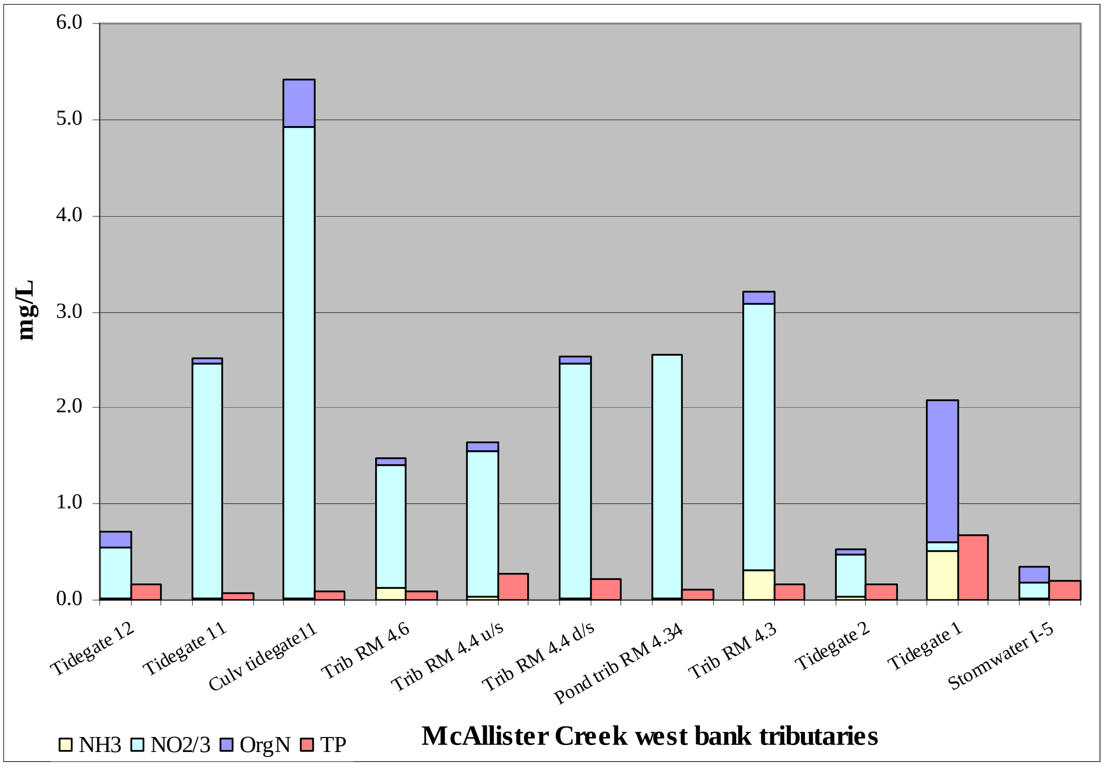

Figure 24. Nutrient levels for McAllister Creek west bank tributary sites.

The nutrients of primary importance for algal development and growth are phosphorus and nitrogen. The ratio of nitrogen to phosphorus is generally accepted as an indicator of which nutrient is more limiting to algal growth. An analysis of limiting nutrients for algal growth are described in *Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix J (Sargeant, Roberts, Carey, 2004). The McAllister Creek mainstem had an abundance of both nitrogen and phosphorus available for algal growth. Tributaries and tide gates discharging from the east bank were generally nitrogen-limited, while tributaries from the west bank were phosphorus- limited. It is likely that the most limiting factor for plant growth in lower McAllister Creek is the toxic effect of saltwater on freshwater plants.

Load Capacity and Natural Conditions

McAllister Creek has naturally low levels of dissolved oxygen. The abundance of nutrients present in the creek likely contributes to increased submerged plant growth in the summer months, creating low diel levels of dissolved oxygen and creating oxygen demand when plants decay. To determine if nutrients could be contributing to excessive plant growth in the creek, a mass balance was performed using nutrient concentrations and loading at McAllister RM 5.8 as the natural or background condition. As mentioned earlier, McAllister Creek RM 5.8 is at the downstream end of a large wetland complex that is not diked or drained as is the creek downstream. Results of the mass balance are presented in *Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix J (Sargeant, Roberts, Carey, 2004). Both total phosphorus and nitrogen inputs occurred above natural background levels seen at RM 5.8. While some nitrogen and phosphorus inputs are natural, some are clearly from anthropogenic sources.

High groundwater levels of nitrate+nitrite-N are the primary source of nitrogen to McAllister Creek. Groundwater nitrate+nitrite-N levels vary, with lows of 1.2 mg/L seen at McAllister Springs to highs of 3-3.5 mg/L seen at a spring flowing to the fish farm near RM 4.3. Pre-development groundwater data for nitrogen is not available, so it is difficult to determine if these nitrogen levels are natural or due to impacts from anthropogenic sources.

Phosphorus is greatly affected by sediment oxygen levels. When oxygen levels drop, dissolved phosphorus can be released into the sediment pore waters where it is free to diffuse into the overlying water (*Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study*, Appendix J (Sargeant, Roberts, Carey, 2004)). Lower dissolved oxygen levels found in some of the ditches behind tide gates could contribute to higher phosphorus levels.

Human and animal wastes contain substantial amounts of phosphorus and nitrogen (Chapra, 1997). In areas where high bacteria levels are seen, there are associated releases of nutrients.

No load or wasteload allocations will be given in this report for dissolved oxygen or nutrients due to the difficulty in differentiating between natural and anthropogenic sources of nutrients. Recommendations for nutrient controls are included in this report. As per the Washington State Water Quality Standards, dissolved oxygen levels at McAllister RM 5.8 represent natural water quality conditions and shall constitute the dissolved oxygen water quality criteria for McAllister Creek.

Margin of Safety

A margin of safety to account for scientific uncertainty must be considered in TMDLs for load allocations to be protective. The margin of safety for this TMDL is implicit; it is contained within conservative assumptions used to develop the TMDL. Factors contributing to a margin of safety for fecal coliform bacteria are:

- Sampling was restricted to low tide; no other tidal cycles were sampled. Sampling did not include periods when the marine water would provide dilution and a bactericidal effect. By not sampling during all tidal regimes, the marine sites close to freshwater were biased high. This provides a margin of safety if targets are met.

- The rollback method assumes that the variance of the pre-management data set will be equivalent to the variance of the post-management data set. As pollution sources are managed, the occurrence of high fecal coliform values is likely to be less frequent, and thus reduces the variance and the 90^{th} percentile of the post-management condition.

- The smaller the sample set used for the rollback calculation, the more stringent the reduction necessary. A smaller sample set has greater variability in the data set, causing higher 90^{th} percentiles.

- The simple mass-balance calculations for Red Salmon Creek and subsequent derivation of target values in freshwater assume no fecal coliform die-off. Mass-balance calculations for fecal coliform from Red Salmon Creek also disregarded die-off and dilution in the marine waters.

- To be conservative, when determining reduction rates due to dilution and die-off for the lower reaches of McAllister Creek (RM 4.3 to 0.1), reductions in tide gates and tributaries along this reach were not factored in when calculating target bacteria concentrations at McAllister RM 3.7 and 0.1.

- Low dissolved oxygen levels are largely a natural condition, but to be conservative, recommendations are included for nutrient reductions as well as for investigating the source of high nitrate+nitrite-N levels in ground water.

Summary Implementation Strategy

Overview

The Nisqually River is one of the least developed rivers in southern Puget Sound - but water quality concerns are mounting. In November 2000, the Washington State Department of Health restricted harvest status on 74 acres of commercial shellfish beds in the marine waters near the mouth of the River (Nisqually Reach) because fecal coliform bacteria concentrations exceeded standards for commercial shellfish harvest. Although water quality in the Reach has subsequently improved, currently 40 acres of commercial shellfish beds remain restricted for harvest and adjacent public tidelands at the mouth of McAllister Creek are closed to harvest due to bacterial pollution. In addition, bacteria concentrations above water quality standards have been measured in other parts of the watershed and dissolved oxygen levels in McAllister Creek are of concern.

The TMDL study conducted by the Department of Ecology (Ecology) in 2002-2003 evaluated areas of the Nisqually watershed with known or suspected water quality issues including, McAllister Creek, Red Salmon Creek, Lynch Creek, Ohop Creek, and one station on the Nisqually River. Key results of that study are presented in other parts of this submittal report, and you can review the entire report on the study, *Nisqually River Basin Fecal Coliform Bacteria and Dissolved Oxygen Total Maximum Daily Load Study* (Sargeant, 2004) online at http://www.ecy.wa.gov/pubs/0503002.pdf

Land use in the Nisqually watershed is a mix of hobby and small commercial farms, rural communities, national and state parks and forests, public and private timberlands, municipal hydropower projects, the Nisqually Indian Reservation, and the Fort Lewis Military Reservation. The Nisqually Wildlife Refuge sits between McAllister Creek and the Nisqually River, at the head of the Nisqually estuary.

There is a high degree of interest in the Nisqually River and watershed, and a number of public and private organizations have established programs for monitoring, protection, and restoration. This voluntary support for maintaining water quality is vital to maintaining the quality and function of the River.

This Summary Implementation Strategy is intended to describe the framework for cleanup. It describes the roles and authorities of cleanup partners (*i.e.*, those organizations with jurisdiction, authority, or direct responsibility for cleanup) and the programs or other means through which they will address these water quality issues.

Following EPA approval of this TMDL submittal package, interested and responsible parties will work together to develop a Detailed Implementation Plan. That plan will describe and prioritize specific actions planned to improve water quality and achieve water quality standards.

Issues

The following have been identified as primary issues for cleanup of bacteria:

- *On-site septic systems.* Several areas along the west bank of McAllister Creek and Nisqually Reach are known or potential sources of bacteria from on-site septic systems including Luhr Beach, the commercial area near Interstate 5, and several residential areas. Other areas of interest in the watershed include the Ohop/Lynch Creek area, Ohop Lake, and possibly the Red Salmon Creek drainage.

- *Agricultural practices.* The TMDL identified agricultural sources of pollution in the lower reaches of McAllister Creek, Red Salmon Creek, and Ohop Creek. Inadequate maintenance of some tide gates along McAllister Creek and resulting backflooding may be exacerbating the pollution contribution from this source.

- *Storm water.* The TMDL study identified several areas where storm water is a consideration:
    - City of Eatonville and possibly Pierce County outfalls to Lynch Creek, and possible outfalls to Ohop Creek and Ohop Lake.
    - West bank of McAllister Creek.
    - Interstate 5 outfall to McAllister Creek.

Along McAllister Creek, a large commercial development including an RV park and nearby dike trail often used for dog walking may be contributing to increasing bacteria in the RM 3.1-3.7 stretch. Another suspected source is human feces resulting from the lack of restroom facilities for fishermen between RM 3.1 and RM 5.8.

Wildlife is abundant in the lower Nisqually and McAllister watersheds, especially birds. In general, wildlife is considered part of natural background, and cleanup will focus primarily on human-caused, controllable sources. However, where human actions have altered the natural system, for instance by construction of conveyance systems or adding impervious surface, opportunities to address wildlife sources will be evaluated during detailed implementation planning. Water quality changes will be tracked as human influences are reduced to evaluate whether actions related to wildlife impacts are possible and/or appropriate.

Wetland and ground water flows into McAllister Creek are naturally low in oxygen. But these naturally low levels may be exacerbated by human-related sources including:

- *Surface water sources* providing nutrient inputs from various sources on both banks of the creek, including :
    - animal waste (livestock, pet, and wildlife)
    - fertilizer application
    - storm water

- *Ground water* which flows into the creek is naturally low in dissolved oxygen. It is likely also delivering nutrients to the creek from:

- on-site septic systems
- agricultural sources and
- yard care products that have leached into the ground water.

Addressing the Issues

Implementers will use existing regulations and programs to reduce bacteria where problems are identified or likely.

- Regulatory authority for on-site septic systems is largely under Thurston County and Tacoma Pierce County Health Department. Investigation and possible correction work is needed in the areas of known and potential concern. Thurston County has a low-interest loan program for septic system repairs, or for sewer connection, where available, for failing or failed systems. In Pierce County, low interest loans and small grants may be available from a variety of funding sources to assist property owners in the repair or replacement of their failing on-site sewage systems (some of the funding is only available to low income and/or elderly property owners).

  The city of Eatonville should evaluate on-site densities and sewering requirements for new developments, especially those in proximity to Lynch or Ohop Creeks, or drainages into these creeks.

- The Thurston and Pierce Conservation Districts will have a major role in reducing pollution by improving agricultural practices through a voluntary, technical assistance approach to working with landowners. The conservation districts work with landowners to develop farm plans, design and install best management practices, and manage nutrients to prevent their runoff to surface water or leaching to ground water. Through a variety of state and federal funding sources, they are often able to provide cost-share assistance for installing best management practices. At this time, both Pierce and Thurston Conservation Districts have stable base funding provided by county-wide assessments.

  The federal Natural Resources Conservation Service (NRCS) works in partnership with the Conservation Districts to address agricultural issues. Cost-share is available in both Pierce and Thurston Counties for landowners who commit to certain conservation practices through several NRCS incentive programs. In addition, the NRCS provides important technical assistance.

  The Nisqually Tribe, Pierce Conservation District, the NRCS, South Puget Sound Salmon Enhancement Group, and local landowners are working together on restoring the lower approximately four miles of Ohop Creek. The project will address the degraded and incised reaches, including restricting livestock access, restoring meander and wetlands, reconnecting the creek to the flood plain, and reestablishing a healthy riparian corridor. The project will be phased, with construction anticipated in 2006. While the impetus for this project is to restore the salmon run, the water quality benefits are significant. The project will continue as funding and willingness of landowners allows.

Thurston Conservation District and NRCS are working with landowners along McAllister Creek, including a major fencing project adjacent to one of the priority tidegates. The Nisqually Tribe and Pierce Conservation District will work together, and with the land manager, to address the animal access issues on Red Salmon Creek.

Detailed implementation planning will evaluate issues related to maintaining tide gates along McAllister Creek to prevent backflooding of agricultural lands. Clarification of ownership and responsibility for these tidegates will be the first step.

In addition to the conservation districts' voluntary approach, Thurston County and Ecology have enforcement authority.

- Pending further field investigation it appears that the City of Eatonville, Pierce County (under a Phase I permit), Thurston County (under a Phase II permit), and the WA Department of Transportation (under a statewide NPDES (National Pollution Elimination Discharge System) permit) all have some responsibility in the stormwater issues.

  Ecology is in the process of developing the NPDES Phase I and II permits, including DOT's statewide permit. These permits are expected to be final by early 2006.

- Additional investigation is needed. Water quality monitoring will be needed for additional source identification, to evaluate whether cleanup actions are reducing bacteria concentrations and, eventually, to determine whether water quality standards have been achieved. Field investigation is needed to identify potential bacteria sources in the area to the east of McAllister Creek, and along Lynch and Ohop Creeks, as well as other areas.

- Reducing sources of bacteria to McAllister Creek will also reduce nutrients and benefit dissolved oxygen levels. In addition, investigation is needed into possible widespread changes in groundwater nitrate concentrations in the McAllister Basin, and into possible anthropogenic sources of nitrogen to ground water such as over-application of nutrients.

Challenges to Cleanup

The key to achieving clean water is implementation of measures identified above. Although this is the ideal, there will be several challenges to rapid implementation.

While partners have established water quality programs in place and are willing participants in cleanup, resources to adequately fund additional demands will be a challenge. A series of citizen's initiatives and a slow economy statewide have impacted governments in Washington; local governments have been particularly hard hit. It can be challenging to maintain even base programs; new demands on resources often have to wait.

In addition to affecting government, reductions in public money have reduced funding to grant programs that provide cost-share or other support to landowners. This reduces the incentive for

landowners and increases their burden when they choose to cooperate, and may be a source of slowing progress on water quality protection.
Implementation projects identified in the Detailed Implementation Plan will need to be prioritized and phased. Resource availability will be a major consideration in the implementation schedule.

In addition to cleanup activities, additional monitoring will be needed for source identification, to evaluate effectiveness of implementation measures and make needed adjustments and, eventually, to determine compliance. While existing water quality monitoring programs are able to address some of these needs, available resources are not adequate for all the needs. Partners will coordinate on future monitoring, and seek grant funding as needed to augment the capacity of local programs. Ecology may be able to assist through special project requests to their Environmental Assessment Program.

Anticipated residential and commercial growth will increase impacts to both surface and ground water, making reductions more difficult to achieve. Additional pervious surfaces, more on-site septic systems, improper management of domestic animals, riparian degradation, and other effects of development will continue to increase the challenge of keeping our waters healthy for the economic, recreational, and aesthetic uses we value.

Our intent is to achieve water quality standards for bacteria at the points of compliance identified in the TMDL study by 2015. Progress towards this goal will be measured in terms of both numeric concentrations and cleanup actions taken. Interim targets and tracking will be developed and discussed in the Detailed Implementation Plan.

Implementation Plan Development

There are a number of organizations involved in water quality related efforts in the Nisqually watershed. Following is a description of the organizations that will have key responsibilities or authorities in this TMDL water cleanup plan. Following Environmental Protection Agency approval of the Nisqually TMDL, these organizations will be integral to developing and implementing the Detailed Implementation Plan.

City of Eatonville

The city of Eatonville (population 2,172) manages storm water from the city. Approximately three quarters of the city's stormwater drains to Lynch Creek through one unimproved drainage. The city recently purchased this drainage, with plans for future development of pollution filtration controls. New development within the city must meet specifications of the Pierce County Stormwater Manual.

While Tacoma Pierce County Health Department has jurisdiction over on-site septic systems, the city of Eatonville controls the development standards, i.e., density, placement, and sewering requirements for new developments.

Environmental Protection Agency (EPA)

EPA is responsible for seeing that the federal Clean Water Act is implemented. EPA must approve TMDL submittal reports. They also provide water quality-related grant funding.

Natural Resources Conservation Service (NRCS)

The NRCS works in partnership with Pierce and Thurston Conservation Districts to improve water quality and conservation. Resources are targeted to address water quality priorities identified through local processes including watershed planning, Department of Health surveys, TMDLs, etc. The NRCS administers all of the programs in the 2002 Farm Bill, including:

- Conservation of Private Grazing Land Initiative
- Conservation Security Program
- Conservation Technical Assistance
- Environmental Quality Incentives Program
- Emergency Watershed Protection Program
- Farm and Ranch Lands Protection Program
- Grassland Reserve Program
- Plant Material Program
- Resource Conservation and Development Program
- Snow Survey and Water Supply Forecasts Program
- Soil Survey Programs
- Technical Service Providers
- Wetlands Reserve Program
- Wildlife Habitat Incentives Program

These programs are available to landowners in both Pierce and Thurston counties. Several of the programs provide cost-share incentives to landowners who commit to implementing certain conservation practices. For more information on Farm Bill programs, go to http://www.wa.nrcs.usda.gov/programs/index.html

In addition to these programmatic resources, the NRCS provides staff time and technical expertise to support restoration efforts.

Nisqually Reach Shellfish Protection District citizen advisory group

In December 2001, in response to downgrades in shellfish harvest status, the Board of Thurston County Commissioners created shellfish protection districts for Henderson Inlet and the Nisqually Reach. The following spring, the commissioners appointed a stakeholder group for each shellfish protection district. The groups developed recommendations for restoring water quality in Henderson Inlet and Nisqually Reach to standards. The stakeholder groups submitted their recommendations to the county commissioners in 2003, including improvements in management of on-site septic systems, stormwater management, agricultural practices, land use, and wildlife.

As a result of the recommendations of the Henderson and Nisqually Shellfish Protection District stakeholders groups, the two groups were combined and tasked with developing an Implementation Work Plan. In December 2003, the combined shellfish protection district stakeholder group became the core members of a larger citizen advisory committee to help develop a risk-based operation and maintenance program for on-site septic systems in the Henderson Watershed. It is in response to degrading water quality in Henderson Inlet and a Henderson DNA-typing study showing human waste is contributing to the problem.

At this time the Septic System Operation and Maintenance Proposal for Henderson Inlet Watershed is still in the development phase. While the shellfish protection district stakeholders group is recommending that this program be expanded into the Nisqually Shellfish Protection District, any such decision would require a public process similar to that underway for the Henderson proposal and approval by the county Board of Health.

The recommendations of the original Nisqually stakeholders group (available online at http://www.co.thurston.wa.us/shellfish/publicationsmedia.htm), will be incorporated into the Detailed Implementation Plan. In addition, the current Shellfish citizen advisory group will be involved in Plan development.

Nisqually Tribe

The Tribe's interest in the Nisqually watershed includes the reservation and "usual and accustomed" areas throughout the watershed. In addition they have purchased some private property. During the 1990's, the Tribe conducted extensive water quality monitoring in the watershed, including an ambient monitoring program. The monitoring program ended when grant funding ended, however, and the Tribe has no water quality monitoring program at this time. Salmon habitat is currently the highest priority of their natural resources program.

The Tribe is one of the primary partners in a major restoration effort on the lower four miles of Ohop Creek. The project will restore healthy stream function and the riparian corridor. While driven by salmon habitat considerations, the project will have major water quality benefits.

Most of the agricultural land near Red Salmon Creek, where livestock access appears to be the primary contributing source, is owned (although not currently managed) by the Tribe.

The Tribe convened and chaired the state-sponsored watershed planning effort for WRIA (water resource inventory area) 11, the Nisqually watershed. This watershed plan is complete. The water quality component primarily consists of a GIS-enabled database that will allow data sharing among users.

The Tribe is also a cooperator with USGS (U.S. Geological Survey) for the flow gauge on Ohop Creek, which has provided a continuous reading, reported in daily average, since 1993.

Nisqually River Council

The Nisqually River Council is a coordination, advocacy and educational organization with no independent authority. Comprised of government and private interests, the council seeks to integrate the history, culture, environment and economy of the watershed. The council implements the Nisqually River Management Plan, created by the Nisqually River Task Force and approved by the state legislature in 1987. A separate Nisqually River Citizens Advisory Committee assures citizen representation during implementation of the Nisqually River Management Plan.

Development of the implementation plan for this TMDL will be coordinated with the Nisqually River Council and Citizens Advisory Committee.

Pierce Conservation District

Pierce Conservation District, under authority of Ch. 89.08 RCW, Conservation Districts, provides education and technical assistance to residents, develops conservation plans for farms, and assists with design and installation of best management practices. When developing conservation plans, the district uses guidance and specifications from the U.S. Natural Resources Conservation Service. Farmers receiving a Notice of Correction from Ecology will normally be referred to Pierce Conservation District for assistance.

In 2002, the district requested, and was granted, fee funding from the Pierce County Council, in accordance with Chapter 89.08.400 RCW. This provided a stable source of funding and allowed an increase in services. In addition, the district receives funding from local governments and the Washington Conservation Commission, and grant funds from Ecology, the Washington State Salmon Recovery Funding Board, and others.

Pierce Conservation District is one of the primary partners on the Ohop Creek restoration project, a major engineering effort that will restore the most degraded section of the creek to a healthy system. They currently have a Salmon Recovery Funding Board grant for engineering design, and a USDA grant for the permits and consensus-based process. Considerable work has already been done with landowners in developing the restoration plan. Construction is expected to begin in 2006, pending funding and agreement of additional landowners.

Pierce Conservation District's Stream Team provides education to the public through workshops, tours, and displays at special events. Stream Team volunteers improve water quality through a variety of activities from water quality monitoring to planting native vegetaton along streams.

Pierce County

Pierce County manages water quality and flooding through basin-specific plans. These plans are developed through an approximately 2.5 year process, in two phases:

- Characterization, which includes gathering existing data, water quality sampling and physical surveys, and public input.

- Data analysis to identify and prioritize potential water quality and flood projects.

The plan for the Ohop basin is currently in the early stages of development.

The county regulates land use in unincorporated areas through a Critical Areas Ordinance (Ch. 18E.60.050), in accordance with Washington State's Growth Management Act, Ch. 36.70A. For new developments, the ordinance requires a 150 foot buffer of undisturbed natural vegetation along streams and rivers.

The Water Programs Division of Pierce County's Public Works and Utilities Department is responsible for compliance with the stormwater quality management requirements of the Clean Water Act. Pierce County manages a stormwater system in this watershed, with potential discharges to Lynch Creek, Ohop Lake, and Ohop Creek. The unincorporated areas of the county are covered under a stormwater municipal NPDES Phase I permit, under CFR Title 40 122.26. Property owners are charged a fee for surface water management services. The county has a storm water manual and a best management practices manual.

Chapter 11.05 of the Pierce County Code, Illicit Stormwater Discharges (Ordinance No. 96-47), makes it unlawful for any person to discharge any pollutants into municipal drainage facilities. The county usually addresses nonpoint source pollution entering drainage ditches through education and technical assistance, but can require immediate cessation of discharges and implementation of best management practices.

Other Water Program Division responsibilities include stream gauging and water quality monitoring, gathering of rainfall data, emergency response during floods, and public education regarding stormwater quality and quantity.

Minimum on-site requirements are established by Washington Department of Health (DOH) in Chapter 246-272A WAC, and the county has established further standards under Tacoma-Pierce County Board of Health (BOH) Resolution 2002-3411. Low interest loans and small grants may be available from a variety of funding sources to assist property owners in the repair or replacement of their failing on-site sewage systems in Pierce County. Some of the funding is only available to low income and/or elderly property owners.

Pierce County can acquire riparian lands, especially for flood management, salmon habitat, and county parks.

Puget Sound Water Quality Action Team

The Puget Sound Water Quality Action Team, under authority of Chapter 90.71 RCW, works with governments and organizations across the region to carry out the Puget Sound Water Quality Management Plan. Under different parts of the plan, agencies and governments provide technical and financial assistance to control pollution from septic systems, farm animal wastes and stormwater runoff. Support staff of the Action Team assist directly with programs to protect and restore shellfish harvesting in Puget Sound. The Action Team also administers grant funds for public involvement and education projects.

Tacoma-Pierce County Health District (TPCHD)

TPCHD regulates on-site sewage systems in Pierce County in accordance with Ch. 246-272 WAC and the Tacoma-Pierce County Board of Health Land Use Regulations. An On-Site Sewage System (OSS) Operation and Maintenance (O&M) Program requires enrolled high and moderate risk systems (both commercial and residential) to be evaluated for function through a permit renewal process. All real estate transactions are required to prove that the OSS is functioning properly prior to transfer of title. The O&M Program provides for education and outreach through presentations, newsletters, access to OSS construction records (as-builts), and technical assistance.

Investigation of complaints is funded by revenue from new development and the O&M Program and receives no discretionary funding. Sanitary surveys or other large-scale investigations must be funded through other sources, such as grants.

Thurston Conservation District

Thurston Conservation District under authority of Ch. 89.08 RCW, Conservation Districts, provides education and technical assistance to residents, develops conservation plans for farms, and assists with design and installation of best management practices. When developing conservation plans, the district uses guidance and specifications from the U.S. Natural Resources Conservation Service. Farmers receiving a Notice of Correction from Ecology will normally be referred to Thurston Conservation District for assistance.

Thurston Conservation District is funded by a county-wide district assessment, in accordance with Chapter 89.08.400 RCW. The district assessment excludes properties within the city limits of Yelm, Tenino, and Rainier, as those cities were formed before 1948 and chose to be excluded, per the RCW. The district regularly receives funding from the Conservation Commission, and grants funding from Ecology, the Salmon Recovery Funding Board, and others. A new federal incentive effort, the Conservation Securities Program, will be kicked-off in the Nisqually watershed, through NRCS and Thurston Conservation District. In 2005, the district will provide a cost share program to landowners in the Shellfish Protection District through the Shellfish Fund. They hope to continue the program in following years.

Under a grant through Ecology, Thurston Conservation District participated in the Nisqually TMDL water quality study, and has been working with land managers in the lower basin to plan and implement conservation measures. The grant expires in June 2005.

In addition to conservation planning, technical and cost-share assistance to landowners, the Conservation District has a yearly native plant sale and provides a majority of the funding for South Sound GREEN, a student-based volunteer monitoring and education program.

Thurston County

Thurston County has maintained a county-wide ambient surface water monitoring program for over 15 years. The program has focused mostly on the more urbanized north part of the county, and has tracked flow, macroinvertibrates, and ambient water quality. At any given time the program includes approximately 20 sites on major and priority streams and rivers, with site selection being somewhat adaptive based on issues, needs, and funding. In the north part of Thurston County the program is funded by the stormwater utility.

The Thurston County Storm and Surface Water Utility was created in 1985 to help curb flooding and pollution problems caused by stormwater runoff. It is funded by fees from residents who own property in unincorporated Thurston County within the utility rate boundary. The utility reduces pollution and flooding damage through a combination of capital facilities, public-education, facility operations and maintenance, and drainage and erosion control standards for new development. Some areas of Thurston County will be covered under the Phase II NPDES stormwater permit, expected to be final by early 2006.

During 2002-2004, under a grant from Ecology, Thurston County conducted a microbial source tracking study to discern pollutant source types at Nisqually Reach and along McAllister Creek. The results of this study have helped the County target water quality work and will help in the ongoing cleanup effort. The study is available online at http://www.co.thurston.wa.us/shellfish/publicationsmedia.htm. The county also participated in water quality monitoring and source tracking monitoring as part of the Nisqually TMDL water quality study.

The county regulates land use in unincorporated areas through a Critical Areas Ordinance (Ch. 18E.60.050), in accordance with Washington State's Growth Management Act, Ch. 36.70A. They are currently updating the ordinance. The update, which proposes increased buffer requirements along all classes of streams, as well along marine shorelines, will go to the Board of County Commissioners in summer 2005.

The county has created a Low Impact Development Steering Committee to investigate the feasibility of developing a Low Impact Development regulations and standards. The committee plans to take a proposed action plan to the Board of County Commissioners in April 2005.

Minimum on-site requirements are established by Washington Department of Health (DOH) in Chapter 246-272A WAC, and the county has established further standards under Article IV of the Thurston County Sanitary Code. County compliance staff deals with on-site failures, usually in response to complaints. In addition, the health department conducts on-site investigations. These investigations are usually grant-funded, and conducted in response to known problems with specific geographic focus. Thurston County maintains a loan fund for repair of failing or failed on-site septic systems, or to correct a failing or failed on-site system with connection to municipal sewer service where available.

Article VI, 4.2, of Thurston County Sanitary Code, requires preventing domestic animal waste from being washed into surface water, prohibits exceeding agronomic rates when applying manure, sludge and crop residues, and prohibits intentional dumping of pet waste that will affect surface or storm water. An update of this ordinance, assuring enforceability, is expected to be complete in 2005.

Washington Department of Ecology (Ecology)

Washington State Department of Ecology has been delegated authority under the federal Clean Water Act by the U.S. Environmental Protection Agency to establish water quality standards, coordinate water cleanup projects (TMDLs) on water bodies that fail to meet water quality standards, and enforce water quality regulations under the Water Pollution Control Act, Chapter 90.48 RCW. In addition to this regulatory role, Ecology provides financial assistance to local governments, tribes, conservation districts, and citizens groups for water quality projects. Projects that implement water cleanup plans for TMDLs are a high priority for funding.

For non-dairy agricultural problems, if Ecology confirms that poor farm management practices are likely to be polluting surface waters, farmers are typically referred to conservation districts for technical assistance. If necessary, Ecology can require specific actions under Ch. 90.48 RCW, such as implementation of an approved farm plan, to correct the problem.

Ecology is currently developing stormwater municipal NPDES Phase I and II permits, including a statewide permit for the Department of Transportation. These permits are expected to be final by early 2006.

Washington Department of Health (DOH)

The Department of Health (DOH), under authority of Ch. 43.70 RCW, monitors marine water quality in commercial shellfish growing areas of the state, including Nisqually Reach. DOH has restricted commercial shellfish harvest in areas of the Reach due to fecal coliform levels in excess of public health-based water quality standards. Currently one sampling station is under restricted status. DOH continues to monitor water quality in the Reach at least six times/year.

Washington Department of Transportation (DOT)

DOT manages storm water from highways, including the Interstate 5 stormwater outfall that discharges to McAllister Creek. DOT is currently working with the Department of Ecology to develop a statewide stormwater NPDES permit that will establish, among other things, best management practices. It is anticipated that DOT's general permit will be final by early 2006.

In addition, DOT owns some of the tidegates along McAllister Creek.

Implementation Activities

Cleanup of bacteria pollution in the Nisqually watershed will focus primarily on the issues identified in the TMDL study, on-site septic systems, agricultural practices, stormwater management (including land use and development practices), and problems with pet waste and lack of sanitary facilities for recreational users in some places. Additional investigation is needed in several areas, and effectiveness monitoring will be important. Responsible agencies will work together during Detailed Implementation Plan development to identify, prioritize and, to the extent possible, schedule cleanup activities. Cleanup actions will be implemented, on the basis of the prioritization, as funding can be secured. Implementation will build on the work of the Shellfish Protection District citizen advisory group and be coordinated through the Nisqually River Council and affiliated organizations.

Activities currently planned or underway include:

- Thurston County has focused an on-site septic system investigation and education effort in the Luhr Beach neighborhood near the mouth of McAllister Creek, where sampling has shown elevated bacteria levels in the neighborhood drainage system.

- The Nisqually Tribe, Pierce Conservation District, NRCS, South Puget Sound Salmon Enhancement Group, and landowners will continue restoration of the lower four miles of Ohop Creek, including riparian revegetation and restricting animal access. This restoration project is well under way. While driven by salmonid habitat restoration, the project will have significant water quality benefits as well. Most landowners are cooperative supporters of the project, and Pierce Conservation District and other partners (the Nisqually Tribe, the NRCS, and the South Puget Sound Salmon Enhancement Group) have received a Salmon Recovery Funding Board grant to cover engineering design costs, to be completed in 2005.

- The Nisqually Tribe owns the agricultural land where animal access restrictions are needed in the Red Salmon Creek drainage. It is currently under a "reserved life estate," allowing a defined set of uses for the lifetime of the current resident. The Tribe and Pierce Conservation District will work with the current resident to restrict animal access.

- Thurston Conservation District, under a grant through Ecology, will continue conservation planning, riparian revegetation and technical assistance with landowners along McAllister Creek, with priority in the areas of tide gates 9, 13, 12, 4, and 5. They are working with NRCS on fencing a large property adjacent to tidegate 9 – a priority recommendation in the TMDL study. This is expected to provide a reduction in bacteria and nutrient loading to that reach of the creek.

- Strategies for addressing pet waste issues will be considered as part of the Detailed Implementation Plan development. Thurston County, the cities of Lacey, Olympia, and Tumwater, and the Pacific Shellfish Institute are cooperating on an area-wide pet waste outreach effort than includes brochures, posters, presentations, pet waste stations, and pledges. Information is being targeted through pet supply stores, veterinary offices, home owners associations, and license renewal notices.

  Thurston Conservation District and Thurston County Environmental Health are implementing a pilot watershed pledge project for the Nisqually and Henderson Shellfish Protection Districts. The project involves asking property owners to commit to behavior changes to protect water resources. As part of the pledge, homeowners can promise to clean up after their own pets and/or host a Pet Waste Station to encourage others to do the same.

- During DIP development, partners will develop strategies for addressing the lack of sanitary facilities in certain areas during fishing season.

- Lynch Creek was identified in the TMDL study as a source of bacteria to Ohop Creek below the lake (approximately RM6), and storm water is believed to be a main problem. City of Eatonville stormwater is known to discharge to Lynch Creek. Eatonville has recently purchased the drainage to Lynch Creek, allowing them to develop pollution filtration controls.

- Ecology is in the process of issuing the stormwater municipal NPDES Phase II permit, reissuing the Phase I permit, and developing a statewide stormwater NPDES permit with DOT. All are expected to be final by early 2006. It is anticipated that TMDL stormwater requirements will become permit requirements. However, until the permit development process is complete, the permit conditions that are based on approved TMDL requirements cannot be considered final.

- Additional field assessment is needed to evaluate Pierce County's potential stormwater discharge to Lynch Creek and possible other areas of the Ohop basin. The unincorporated areas of Pierce County will be covered under their stormwater municipal NPDES Phase I permit.

- The Department of Transportation's Interstate 5 stormwater discharge to McAllister Creek will be subject to their statewide permit, currently being developed with Ecology.

- In the Red Salmon Creek drainage, animal access appears to be the primary source of bacteria. The Nisqually Tribe and Pierce Conservation District will work together with the land manager to restrict livestock access to the creek.

Summary of Public Involvement Methods

Ecology and partners have worked together on this TMDL from the QAPP, to field work, to developing this SIS. Ecology has briefed the Shellfish Protection District Citizens Advisory Group and Nisqually River Council of progress and findings. Briefings on the TMDL study have been provided at public meetings sponsored by the Shellfish Protection District Stakeholder Groups. As part of Thurston County's work with the Luhr Beach community, Ecology has provided regular updates on study findings.

In addition to continuing to work with partners to finalize the TMDL submittal report, Ecology will conduct a public review of the draft report, including public notice, public meetings, and soliciting of comments on the draft report. The submittal report and supporting documentation will be posted on Ecology's TMDL website, and placed in local libraries for public review during the comment period. Ecology will produce a Response to Comments subsequent to the public comment period, to document comment received and how they were addressed.

Reasonable Assurances

Partners in this cleanup plan, identified above under Implementation Plan Development, as well as many watershed residents, have a commitment to protection and restoration of water quality. That commitment is demonstrated by the many cleanup actions already planned or underway, described in the *Implementation Activities* section above, including:

- Thurston County on-going investigative and outreach work in Luhr Beach and in other neighborhoods within the watershed.
- Thurston Conservation District and NRCS are working with landowners to reduce agricultural sources along McAllister Creek.
- The Nisqually Tribe and Pierce Conservation District will work together and with the current resident of the property in the Red Salmon Creek drainage that was identified as a source during the TMDL study.
- The Nisqually Tribe, Pierce Conservation District, NRCS, and the South Sound Salmon Enhancement Group and landowners are working on restoring the lower approximately four miles of Ohop Creek.
- The city of Eatonville has recently purchased the Lynch Creek drainage, giving them the ability to develop stormwater controls in the drainage.
- Under Article VI, 4.2, of Thurston County Sanitary Code, Thurston County has enforcement authority to prevent domestic animal waste from being washed into surface water. Article IV provides similar authority for violations of the on-site sewage regulations.
- Under Chapter 90.48 RCW and other existing regulations, Ecology has authority to ensure that known unpermitted fecal coliform discharges will be corrected.
- The Department of Transportation is currently developing a statewide general stormwater NPDES permit with Ecology. Interstate 5 stormwater discharge to McAllister Creek will be subject to this permit.
- Phase I and II municipal stormwater NPDES permits are expected to be final by early 2006. Phase one will include the unincorporated areas of Pierce County, and Phase II will include parts of Thurston County.

Adaptive Management Approach

TMDL reductions should be achieved by 2015. The Detailed Implementation Plan will identify interim targets. These targets will be described in terms of concentrations and/or loads, as well as in terms of implemented cleanup actions. Partners will work together to monitor progress towards these goals, evaluate successes, obstacles, and changing needs, and make adjustments to the cleanup strategy as needed.

It is ultimately Ecology responsibility to assure that cleanup is being actively pursued and water quality standards are achieved.

Monitoring Strategy

Additional source monitoring needs were identified in the TMDL study, as well as the need for an ongoing monitoring program to evaluate success of cleanup actions. Compliance monitoring will be needed when water quality standards are believed to be achieved.

There will also be a need to monitor the implementation and maintenance of implementation actions. Entities with enforcement authority will be responsible for following up on any enforcement actions. Stormwater permittees will be responsible for meeting the requirements of their permits. Those conducting restoration projects or installing BMPs will be responsible for monitoring plant survival rates and maintenance of improvements, structures and fencing.

DOH’s bimonthly water quality monitoring in Nisqually Reach, Thurston County ambient monitoring program, and Ecology monitoring of Nisqually River at RM3.4 will continue. Pierce County has begun additional monitoring at several critical points in the Lynch Creek and Ohop Lake area. Other partners have expressed a willingness to conduct monitoring when grant funding is secured to support it. Ecology may be able to provide additional monitoring or data analysis support through the Environmental Assessment Program project request process.

The Detailed Implementation Plan will describe the coordinated monitoring strategy.

Potential Funding Sources

In addition to normal funding sources for existing programs, various assistance programs could help with implementation and monitoring costs. These include:

- Centennial Clean Water Fund, Washington State Water Pollution Control Revolving Fund and Federal Clean Water Act Section 319 Funds, administered by Ecology
- Environmental Quality Incentives Program, Conservation Reserve Enhancement Program, and Wildlife Habitat Incentives Program cost-share money from the U.S. Dept. of Agriculture's Natural Resources Conservation Service
- Public Involvement and Education funding from the Puget Sound Action Team
- Salmon Recovery Funding Board grants and Washington Wildlife and Recreation Program grants from the Washington Interagency Committee for Outdoor Recreation
- HOME Rehabilitation/Utility Loans to lower income households, funded by the U.S. Department of Housing and Urban Development (contact Pierce County Housing Programs).

- U.S. Department of Agriculture Rural Development, Home Repair Loan and Grant Programs (as authorized by Section 504 of the Housing Act of 1949, 7 CFR Part 3550; contact U.S.D.A. Service Center of Puyallup, Washington, (253) 845-0553).
- Shellfish District Cost Share Program, administered by Thurston Conservation District

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Appendix A
Public Involvement

Public Involvement

During April of 2005, Ecology held a public comment period on *Nisqually Watershed Bacteria and Dissolved Oxygen Total Maximum Daily Load Submittal Report.*

- ✓ Stakeholders and others who have expressed a direct interest in the TMDL were mailed a copy of the submittal report, 39 copies total.
- ✓ A public-notice factsheet was mailed to 792 residences in the lower Nisqually valley, and bulk-mailed to all residences around Ohop Lake (approximately 500 mail stops). A copy of the public-notice factsheet follows as attachment 1 in this appendix.
- ✓ During the week prior to the beginning of the comment period, a display ad ran in the Olympian, the Nisqually Valley News, and the Eatonville Dispatch. A copy of the display ad follows as attachment 2 in this appendix.
- ✓ The Submittal Package and the TMDL study report were posted to Ecology's website.

Public involvement was also conducted during the course of the TMDL process. Stakeholders were involved in sampling plan design, study field work (as discussed in the TMDL study report), and pre-public review of the TMDL study and submittal package.

In addition, Ecology has coordinated with the Nisqually Reach Shellfish Protection District citizen advisory group since the beginning of the TMDL process. Ecology has provided several briefings on findings of the water quality study, and some advisory group members have provided useful information in support of the study. The advisory group had pre-public review of the TMDL study report and of the submittal report, as well as the opportunity to comment during the public comment period.

In the fall of 2002, the citizen advisory group conducted a public meeting at which they presented their recommendation for protection of water quality in Nisqually Reach. Ecology provided a presentation on the TMDL study and process at that public meeting, and worked with other agencies to develop a handout describing water quality issues, and what was being done to address those problems. The handout developed for that meeting follows as attachment 3 in this appendix.

Attachments follow:

1. Public notice factsheet
2. Public notice display ad
3. Handout for Nisqually Reach Shellfish Protection District citizen advisory group outreach meeting, fall 2002.

Photo by Justin Hall

Do you care about the Nisqually Watershed?

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A recent study conducted by the Department of Ecology (Ecology), in cooperation with Thurston County and the Thurston Conservation District, found water quality problems in some parts of the Nisqually watershed. There is too much fecal coliform bacteria in McAllister, Red Salmon, Ohop, and Lynch creeks. High bacteria levels are a concern because they can pose a health risk to people who come into contact with the water or to people who eat shellfish from contaminated water. The bacteria can also cause economic hardship when commercial shellfish harvesting is restricted.

Besides bacteria, the study also found that dissolved oxygen levels in McAllister Creek are below healthy levels for aquatic life (some causes of low dissolved oxygen are natural), and that nitrates levels are higher than normal in underground water (ground water).

The study identified some potential sources of pollution including:

- On-site septic systems in developments on the west side of McAllister Creek.
- Livestock management practices on the east side of McAllister Creek, and along Red Salmon and Ohop Creeks.
- Stormwater runoff from the city of Eatonville to Lynch Creek.
- Pet waste, especially along the McAllister Creek dike trail near the commercial area on Martin Way.
- Human waste during fishing season along McAllister Creek.
- Fertilizers applied to residential and agricultural lands.

Manure and sewage that contain bacteria also consume oxygen when they decay in water. Fertilizers encourage growth of aquatic plants and algae that also consume oxygen when they decay.

The water quality study and a Summary Implementation Strategy (the framework for cleanup) have been combined into a document called *Water Cleanup Plan for Bacteria and Dissolved Oxygen in the Nisqually Watershed.* Ecology must submit this report to the Environmental Protection Agency (EPA) for approval, but before we do we'd like to know what you think. We welcome your comments during the comment period in April (see box at right).

Following EPA approval, Ecology will work with residents, local jurisdictions, and other interested parties, using information from the water quality study, to develop a detailed cleanup plan. That plan will guide subsequent actions to restore water quality.

If you would like us to meet with your group to talk about the water quality study and cleanup process, or for more information, please call Christine Hempleman at 360-407-6329, or e-mail chem461@ecy.wa.gov.

Public comment period April 1 – 30, 2005

The Plan is available for review online at http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-swro.html#nisqually: at the Lacey Timberline Library, 500 College St.SE: the Olympia Timberline Library, 313 8th Ave. SE: and at the Ohop Library, 207 Center St. W.

Please send comments by April 30 to Christine Hempleman, Department of Ecology, PO Box 47600, Olympia WA 98504-7600, or email chem461@ecy.wa.gov
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Are you interested in keeping the Nisqually watershed healthy?

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A recent study conducted by the Department of Ecology (Ecology), in cooperation with Thurston County and the Thurston Conservation District, found water quality problems in parts of the Nisqually watershed.

There is too much fecal coliform bacteria in McAllister, Red Salmon, Ohop, and Lynch creeks. In addition, nitrate levels are higher than normal in underground water (ground water) in the lower watershed, and dissolved oxygen levels in McAllister Creek are below healthy levels for aquatic life.

The study identified some potential sources of pollution including on-site septic systems, livestock and pet waste, stormwater runoff, human waste during fishing season, and fertilizers applied to residential and agricultural lands.

The water quality study and a Summary Implementation Strategy (the framework for cleanup) have been combined into a document called *Water Cleanup Plan for Bacteria and Dissolved Oxygen in the Nisqually Watershed.* Ecology must submit this report to the Environmental Protection Agency for approval, but before we do we'd like to know what you think. We welcome your comments during April.

Following EPA approval, Ecology will work with residents, local jurisdictions, and other interested parties, using information from the water quality study, to develop a detailed cleanup plan. That plan will guide subsequent restoration activities.

If you would like us to meet with your group to talk about the water quality study and cleanup process, or for more information, please call Christine Hempleman at 360-407-6329, or e-mail chem461@ecy.wa.gov.

Public comment period
April 1 – 30, 2005

The Plan is available for review online at http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-swro.html#nisqually: Lacey Timberline Library, 500 College St.SE: Olympia Timberline Library, 313 8th Ave. SE: and the Ohop Library, 207 Center St. W.

Please send comments by April 30 to Christine Hempleman, Department of Ecology, PO Box 47775, Olympia WA 98504-7775, or email chem461@ecy.wa.gov
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Water quality in the lower Nisqually watershed… what's the problem?

There are some concerns about water quality in the lower Nisqually watershed. In places, bacteria are found in concentrations above state water quality standards.

These bacteria, called fecal coliform bacteria, are found in the feces of warm-blooded animals – such as humans, livestock, pets, and wildlife. When fecal coliform bacteria concentrations increase, it indicates that other bacteria and viruses also found in feces may be increasing.

People can be exposed to bacteria or viruses if they swallow polluted water, get it in small cuts, or eat shellfish that are taken from polluted water. Possible human health effects range from earaches and rashes to more serious illnesses such as hepatitis and salmonella.

Elevated concentrations of bacteria have caused intermittent downgrades of commercial shellfish areas in Nisqually Reach since 1992.

Some areas of freshwater also have low levels of dissolved oxygen. Fish and other animals that live in the water need a certain level of oxygen to thrive.

To keep the water healthy for people and our natural resources we need a better understanding of the sources and causes of pollution.

What's being done about it?

Thurston County, Thurston Conservation District, and the state Departments of Health and Ecology are working together to better understand the causes of pollution. We are conducting a study to identify where pollution is coming from. We're also evaluating how much of the bacteria come from humans, domestic animals, or wildlife. The steps of the study are:

- Look at existing water quality information for the area.
- Develop a sampling plan to provide missing information.
- Conduct field work.

- Work with citizens when we find problems.
- Analyze all the information and write a summary report.

The study area will extend from the Nisqually Reach to McAllister Springs, and from Red Salmon Creek to the bluff west of McAllister Creek.

What happens next?

We started the field work last fall. You may notice instruments that we have left in streams to take measurements (please leave them where you see them). You may see us around the study area gathering water samples from boats and from land. We're also gathering samples of feces so that the DNA (genetic "fingerprint") can be compared to the DNA of the bacteria in the water. You may see us putting small floats in the water (grapefruits or oranges are sometimes used) and following them downstream so we can understand circulation patterns. You're welcome to stop and watch or ask questions.

The study, analysis and report writing will take roughly two years. When that's done, we'll use the information to work with you to make decisions about how to improve water quality in the area.

Want more information?

Please call us with your questions or comments:

Sue Davis (Thurston County).. 754-4111 x7356
daviss@co.thurston.wa.us

Kirk Robinson (Thurston Conservation District).... 754-3588 x136
krobinson@Thurstoncd.com

Don Melvin (Dept. of Health).. 236-3320
djm0303@DOH.wa.gov

Christine Hempleman (Dept. of Ecology)....................407-6329
chem461@ecy.wa.gov

Appendix B
Response to Comments

Response to Comments

Ecology held a public comment period on the draft *Nisqually Watershed Bacteria and Dissolved Oxygen Total Maximum Daily Load* from April 1 through April 30, 2005. The comments received appear below. Ecology's response follows the comment, or portion of a comment, in italics.

- **From Mathew Bulldis, National Fish and Oyster Co.**

  Thank you for the opportunity to comment on the Nisqually Watershed Bacteria and Dissolved Oxygen Total Maximum Daily Load (Water Cleanup Plan) Draft Submittal Report. As a commercial shellfish grower in Nisqually Reach for the past 60 years, National Fish and Oyster Company has a unique interest and perspective on the Nisqually watershed and its changes over time. We applaud the efforts of the Department of Ecology to address the threats to water quality in this area.

  Overall, we have seen an improvement in the water quality of Nisqually Reach over the past five years and want to see this trend continue. In recent years, most of our shellfish beds have been upgraded from Conditionally Approved to Approved. Previous water quality problems in the area had a significant impact on our ability to harvest shellfish. This area should continue to be carefully monitored to ensure recent improvements in water quality are maintained. However, a large area of our most accessible shellfish beds near the mouth of McAllister Creek still remain Restricted. Once implemented, the Water Cleanup Plan must achieve increases in water quality such that these beds will once again become Approved shellfish growing areas.

  The report notes that "McAllister Creek provided the most continuous source of fecal coliform bacteria to the marine waters of the Nisqually Reach", and we believe that a high priority should be placed on both identifying and addressing these fecal coliform sources. The RV park along the Creek, septic discharges from homes, pet wastes, and agriculture areas are all clearly potential sources of fecal coliform contamination along the creek and should be further investigated and addressed.

  > *This report will be submitted to the Environmental Protection Agency for approval. Following approval, Ecology will work with citizens of the watershed and organizations identified above in the Summary Implementation Strategy to develop a Detailed Cleanup Plan. That plan will describe the ways in which these sources will be addressed. It will be available for public comment in summer 2006.*

  The report also indicates that a significant fraction of fecal coliform input to McAllister Creek originates from avian sources. Waters from the sanctuary, presumably high in avian-based fecal coliform bacteria, are delivered in pulses to the Nisqually Reach as the tidal gates are opened and closed. The strategy for operating the tidal gates must be evaluated so as to evenly distribute the fecal coliform contribution from avian sources. It is clear from the report that addressing the bacterial sources in upper McAllister Creek is critical to maintaining marine water quality standards and shellfish harvesting capabilities.

Tidegates A and B, which discharge from Nisqually Wildlife Refuge, had the lowest fecal coliform levels of any of the tidegates. They actually require very little bacteria reduction to meet strict marine water quality standards (a 10% reduction is needed at Tide gate B). Thurston County's DNA study did have a high incidence of bird DNA in the samples they collected. However, the type of technology used is considered experimental and, while it is helpful in identifying sources and guiding source control, it isn't at the stage where it can be used to quantify the amount of bacteria from sources.

The significant non-wildlife sources identified in the report and recommended for control measures include: agricultural sources, pet waste, on-site sources, and stormwater. Tide gates in upper McAllister, likely being affected by some of these sources, will be evaluated carefully during the upcoming planning and implementation stages.

Development in Thurston County will serve to increase the contribution from many of these fecal coliform sources, so steps must be taken immediately to address existing sources.

We are supportive of improved treatment requirements for stormwater discharge to the Nisqually watershed, including discharge from the town of Eatonville. Bacterial levels in stormwater discharge should not exceed permitted levels, and aggressive strategies should be employed to reach established targets. In addition, periodic monitoring should be conducted to assess the future need for permits from facilities that are below threshold limits and do not currently require permits.

Additional recommendations in the report should include a comprehensive program to educate the public about the impact of non-functioning septic systems and pet waste, as well as providing strategies for homeowners and property owners to address these problems. The Department of Ecology and Thurston and Pierce Counties need to develop a partnership with residents and property owners in order to successfully execute a cleanup plan for the Nisqually Watershed.

Increasing commercial and residential development in north Thurston County will place greater pressure on the watershed. It is critical that efforts continue to address sensitive areas in the watershed and implement policies and programs to protect the watershed in the future.

Thank you for the suggestions. Implementation planning will evaluate these and other strategies.

Again, thank you for the opportunity to comment on this plan. We look forward to its successful implementation. Please feel free to contact me should you have any questions.

- **Howard Glasstetter**

I can't seem to get to the WEB site, in your brochure that gives more detail on plans for McAllister Creek cleanup. If you have it at your fingertips, I'd appreciate you sending it in a reply to me. I have lived in Nisqually Valley for 35 years and know a few things about this area.

One observation I have about McAllister Creek concerns Medicine Creek. Medicine Creek is currently a blocked tributary to McAllister Creek. It was blocked by Thurston County after the February 1996 flood (mostly caused by Tacoma City Light's poor management of the Alder Lake Reservoir). Medicine Creek used to flow under the rail road tracks. After the flood, the county poured huge amounts of rock next to the rail line to build a temporary road until the Durgin Road tunnel (under the rail tracks) could be repaired. This temporary road crushed the culvert that allowed Medicine Creek to flow under the tracks.

Perhaps restoring the flow in Medicine Creek might help allow better flushing of McAllister Creek. There will likely be more to this than simply repairing the culvert, however. I understand that the county suggested to at least one property owner that he plant trees in the creek bed. I also believe that, even before the flood, the Holroyd gravel pit did some blocking of the flow on property they own.

The document is just being posted to the web this afternoon, which is why you couldn't get to it. Here is a little bit of a shortcut http://www.ecy.wa.gov/pubs/0510040.pdf If you'd like to view the sampling plan or the full TMDL study go to http://www.ecy.wa.gov/programs/wq/tmdl/watershed/tmdl_info-swro.html and scroll down to, then click on, the Nisqually/McAllister Creeks listing.

Thank you for the additional information. It will be important to consider when we start developing the detailed cleanup plan.

- **From Heather Kibbey, Water Quality Specialist, Pierce County**

Thank you for the opportunity to comment on the proposed Nisqually TMDL. Overall< I think it is a good document, and you are both to be commended for your responsiveness to comments by agencies affected by this TMDL.

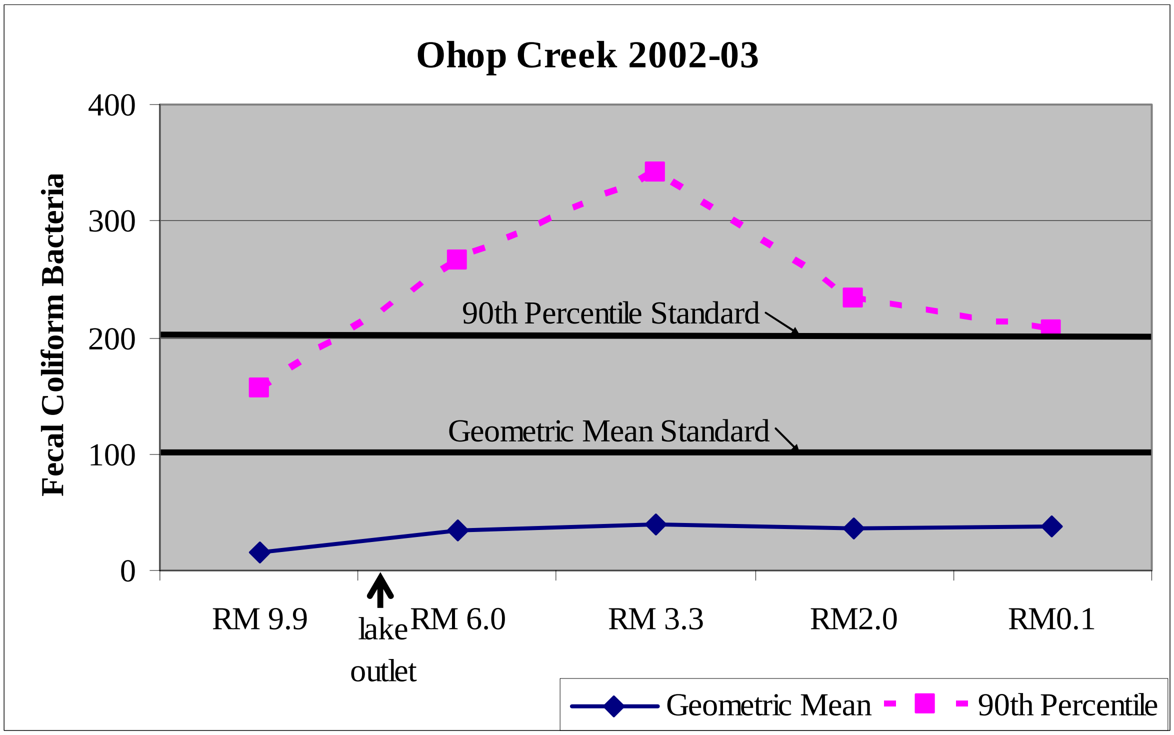
Pierce County is a Phase I NPDES stormwater permittee. This applies only to unincorporated portions of the County. In the portion of the study referring to Ohop Creek, it is stated that our Phase I permit covers the City of Eatonville. This is not the case, and needs to be changed in the final document.

This will be changed in the final document.

Personnel here have rerun some of the numbers given in the report using data located in the report, and have found that some of the numbers were miscalculated, or used to make conclusions over the length of the creek which were probably only warranted for certain sections. A spreadsheet of calculated loads is attached to this letter for your use in comparison. On Ohop Creek, it appears that one site is most of the problem Peterson Ditch) and that the only fecal coliform generating site near it is a farm. It seems to us that a pointed source control effort on this one parcel would be indicated, and that listing the entire creek is probably not warranted.

Ecology checked with Pierce County staff regarding their concerns about calculations in the TMDL. Loading was not a concern but calculation of 90^{th} percentile concentrations was a concern. Pierce County staff questioned the use of qualified data for data analysis. For the dates of concern March 26 and April 29, 2003 a few sample results were qualified because there were over 150 colonies on the plates, two or more bacteria could land in the same place during filtration; therefore the "true" values may be greater than or equal to the reported results. The qualified results are considered acceptable for data *analysis in the TMDL and therefore should not be excluded. The estimated 90th percentile concentrations calculated in the TMDL are correct.*

It is unlikely that Peterson ditch is most of the problem as there is little flow in the ditch and while bacteria concentrations may be high it is unlikely that it is the largest source of loading to the mainstem. The graph below shows that the biggest increases in bacterial concentrations occur from the lake outlet to Ohop RM 3.3. Bacterial concentrations drop off (likely due to dilution, die-off, and settling) downstream of RM 3.3. It is likely that source control measures implemented upstream of RM 3.3 will results in improvements and possibly meeting standards downstream.



We do agree that a pointed source control effort is warranted on parcels adjacent to Peterson ditch.

As stated in the report, the dry season appear to have the most elevated fecal coliform numbers in the Ohop basin. However, limited data sets compared to the wet season were used in compiling that information. As we all know, bacterial counts can be wildly variable, and larger numbers of samples along with appropriate statistics applied for the number of samples is essential. We would suggest that additional sample numbers are compiled before jumping to any conclusions about the dry season.

While reductions needed were based on a limited set of dry season data, conclusions about the critical period were based on an extensive historical data set. The section on Historical data, seasonal variation and critical conditions discusses the Nisqually Tribes findings which support a dry season critical period. While dry season conditions have improved, bacteria concentrations still appear to be higher during this period for some reaches of Ohop Creek. It is likely that decreased dilution during the low flow period results in higher concentrations but loading is higher during the wet season. Because we are trying to address violations in water quality standards we do target critical period based on concentrations and not loading for this area.

Although I have not had time to thoroughly research the topic, I do know that there has been acquisition of property or easements in the Ohop Valley by the Nisqually Tribe and the Pierce Conservation District. The intent is to convert pasture back to a natural state of wetlands and trees, and reroute the creek (meander it) and dig it down to its historical floodplain. I have heard that a figure in the millions will be spent on the project. This type of project, with removal of livestock, should be very helpful in reducing fecal coliform in the creek. Ecology should plan on working with these agencies in pre- and post-restoration sampling efforts to determine the effects of the work.

Thank you, this is important information to include in the detailed implementation plan.

- **Kyle Quaranto, Alder, WA**

I am a certified water system operator in an area of the watershed south of Eatonville. I've been unable to access the online version of the Plan, however from the Department documents that I could assess it appears that the Plan's focus is on the lower part of the watershed. With lower population density and commercial/industrial activity it's clear that areas upstream will have proportionally less impact on water quality. Still activities in this area such as livestock management will contribute to the cumulative effect on ground and surface water quality in the entire watershed. I'd like to know if there is a means for addressing these smaller and more remote sources of non-point pollution.

You raise an important issue. However, the scope of this project was limited to two main areas - the lower watershed and the Ohop Lake and Creek/Lynch Creek area. These are the areas where we know there are water quality problems. In the upper area, livestock management along Ohop Creek will be an important part of the cleanup plan (stormwater management in Eatonville, discharged to Lynch Creek, will be another).

For other areas of the watershed, the Nisqually has a relatively high level of interest and there are a couple of groups that are working to address issues such as those you mention - The Nisqually River Council (http://www.nisquallyriver.org/) and the Ohop Forum, email ohopbob@rainierconnect.com, or call 360-832-7787. Pierce Conservation District is very active with local landowners throughout the county, addressing a variety of land management issues, including livestock (phone (253)845-9770).

Appendix C
Nisqually River Basin Fecal Coliform and Dissolved Oxygen Total Maximum Daily Load Study

Publication No. 04-03-012

Available under separate cover by contacting:

Department of Ecology
Publications Distribution Center
P.O. Box 47600
Olympia, WA 98504-7600

Telephone: (360) 407-7472

Or on the web, at: http://www.ecy.wa.gov/biblio/0403012.html