WASHINGTON STATE DEPARTMENT OF ECOLOGY

Upper Chehalis River Fecal Coliform Bacteria Total Maximum Daily Load

Submittal Report

May 2004

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by
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Waterbody Numbers: see Tables 1, 2, and 3

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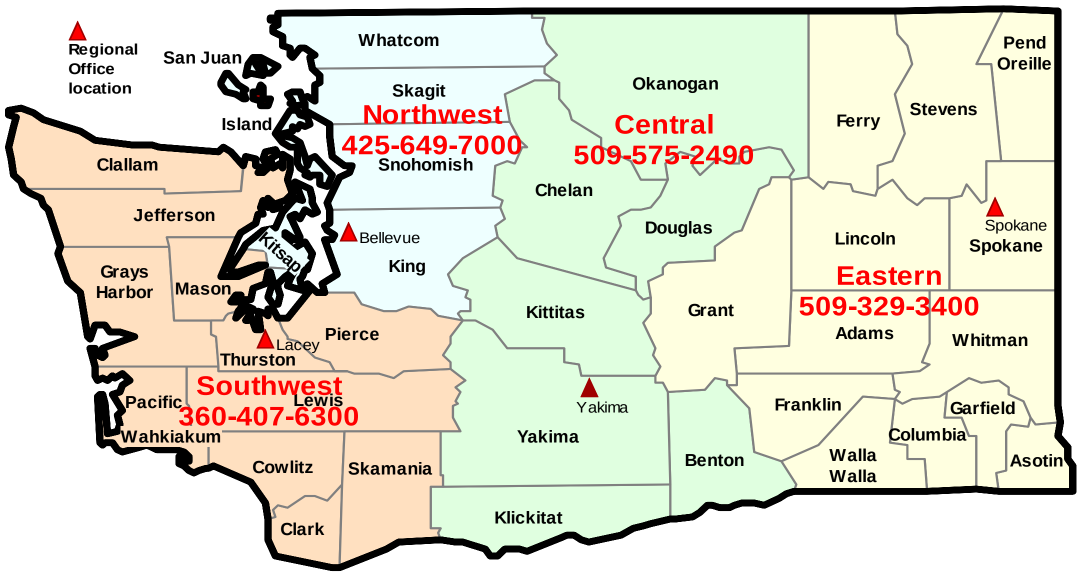

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Abstract

The Upper Chehalis watershed has been identified as a major source of fecal coliform bacteria to the Lower Chehalis watershed that includes Grays Harbor. Within the Upper Chehalis watershed, fecal coliform concentrations in excess of the Washington State water quality criteria are widespread. To improve water quality, best management practices (e.g., fencing riparian corridors, implementing dairy waste management, re-vegetating riparian areas) have been implemented at select locations. A total maximum daily load (TMDL) for fecal coliform bacteria also has been completed for a major sub-watershed, the Black River. However, areas of non-compliance remain in the Upper Chehalis watershed.

This document provides a comprehensive evaluation of fecal coliform data for the Upper Chehalis River and its tributaries. All available data from sources within and outside the Department of Ecology were considered. Year-round data were used for evaluating trends. However, data from the most critical periods when bacteria levels were highest, were used to calculate reduction goals. Target reductions necessary to bring bacterial concentrations down to water quality standards were established at selected segments using the statistical roll-back method.

Implementation strategies recommended include (1) implementing and improving best management practices for nonpoint sources, (2) replacing failing on-site sewage treatment systems, and (3) developing a monitoring strategy to evaluate the effectiveness of the TMDL implementation measures.

Discharges from seven major permitted facilities also were considered in this TMDL study. All of the facilities were determined to be meeting water quality standards, so no further bacteria reductions were recommended for these facilities.

Acknowledgements

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Introduction

Segments of the Upper Chehalis River and its tributaries have been placed on Washington State's 303(d) list (1996, 1998, and proposed 2002) of water bodies not meeting the state water quality standard for fecal coliform bacteria. Thus, under the federal Clean Water Act of 1972, a total maximum daily load (TMDL) must be developed and implemented to address these impairments and bring the waterbody segments into compliance with the standard. This document is a TMDL technical report that recommends maximum allowable loads of fecal coliform bacteria to ensure that the standard is met in all segments of the Upper Chehalis River and its tributaries at all times and locations under a reasonable worst-case scenario.

The Lower Chehalis River Watershed Bacteria TMDL (Pelletier and Seiders, 2000) identified the Upper Chehalis watershed as the source of most of the fecal coliform load to the Lower Chehalis watershed. This report is intended to complement the study conducted by Pelletier and Seiders (2000). The sources of fecal coliform bacteria in the Upper Chehalis watershed are nearly all nonpoint. Examples of nonpoint sources are failing on-site sewage treatment systems, livestock operations, dairy farms, hobby farms, stormwater, and wildlife. Nonpoint-source fecal coliform reductions are achieved primarily through best management practices (BMPs).

Target reductions describe what is necessary to achieve the water quality standard. Target reductions may be described in terms of concentration, or load, or both. For the Upper Chehalis watershed, the TMDL is expressed in terms of fecal coliform concentrations as allowed under federal regulations [40 CFR 130.2(I)] as *other appropriate measures*. The concentration measure is appropriate since the water quality standard can be directly compared to fecal coliform measured in the receiving water under all flow scenarios. Therefore, the use of a flow rate to calculate daily loads is deemed unnecessary. However, loads at the mouth of tributaries and segments of the mainstem have been established to provide a relative comparison of contributions of fecal coliform from the different tributaries.

Available fecal coliform data for the tributaries and mainstem in this watershed are extensive in some areas and limited in others. Where applicable, seasonal targets have been set. Where data are limited, annual target reductions have been set. In each case, segments of the mainstem and its tributaries where BMP implementation and monitoring need to take place are identified. Local knowledge of land-use practices is essential for the implementation of recommendations of this TMDL.

Background

The Chehalis River basin is located in western Washington and drains an area of over 2000 square miles. The river begins in the eastern Willapa Hills (near the boundaries of Lewis, Pacific, Cowlitz, and Wahkiakum counties) and discharges into Grays Harbor near Aberdeen (Grays Harbor County). State rules divide the basin into two separate Water Resources Inventory Areas (WRIAs). The Lower Chehalis River, contained in WRIA 22, extends from the town of Porter (river mile (RM) 33.8) to the mouth of the river in Grays Harbor. The Upper Chehalis River watershed forms WRIA 23 (Figure 1) extending from Porter to the Willapa Hills. References to the Chehalis River mainstem, watershed, or basin throughout the remainder of this report will mean the upper river mainstem, watershed, or basin.

The Upper Chehalis watershed extends into five counties: Lewis, Thurston, Grays Harbor, Pacific, and Cowlitz. The city of Tumwater is near the northern end of the basin, and the river passes the cities of Chehalis and Centralia in the center of the basin. The Chehalis Tribal Reservation is on the northwestern portion of the basin along the mainstem Chehalis River. Major tributaries to the Chehalis River in this watershed include South Fork Chehalis, Newaukum, Skookumchuck, and Black rivers (Figure 1). Numerous creeks are tributaries to the mainstem and sub-tributaries to the major rivers (Figure 2).

The Upper Chehalis watershed comprises 1300 square miles of Coastal Range, Puget Lowlands, and Cascade ecoregions. It receives approximately 57 inches of annual rainfall. Approximately 83 percent of the land is forested and privately owned, 14 percent is agricultural, and 2 percent is urban. Most of the approximately 46,000 population live in unincorporated areas.

Long-term analysis of flow data at the U.S. Geological Survey (USGS) gage in Porter, the lower boundary of the watershed, shows that since 1953 there has been a reduction in flow of approximately 1000 cubic feet per second (cfs), primarily due to an increase in water rights (Ecology, 1995).

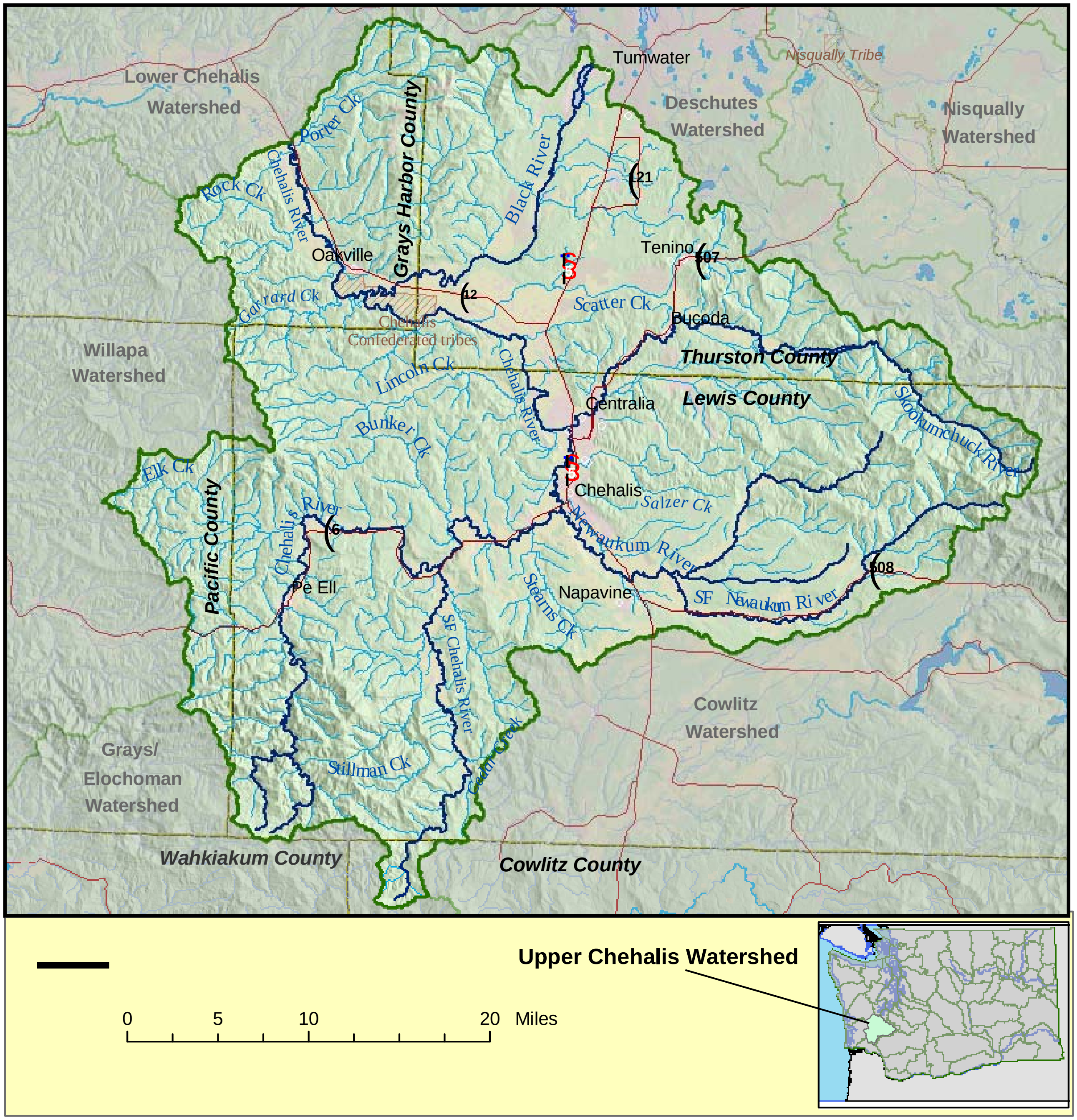

Figure 1. The Upper Chehalis watershed.

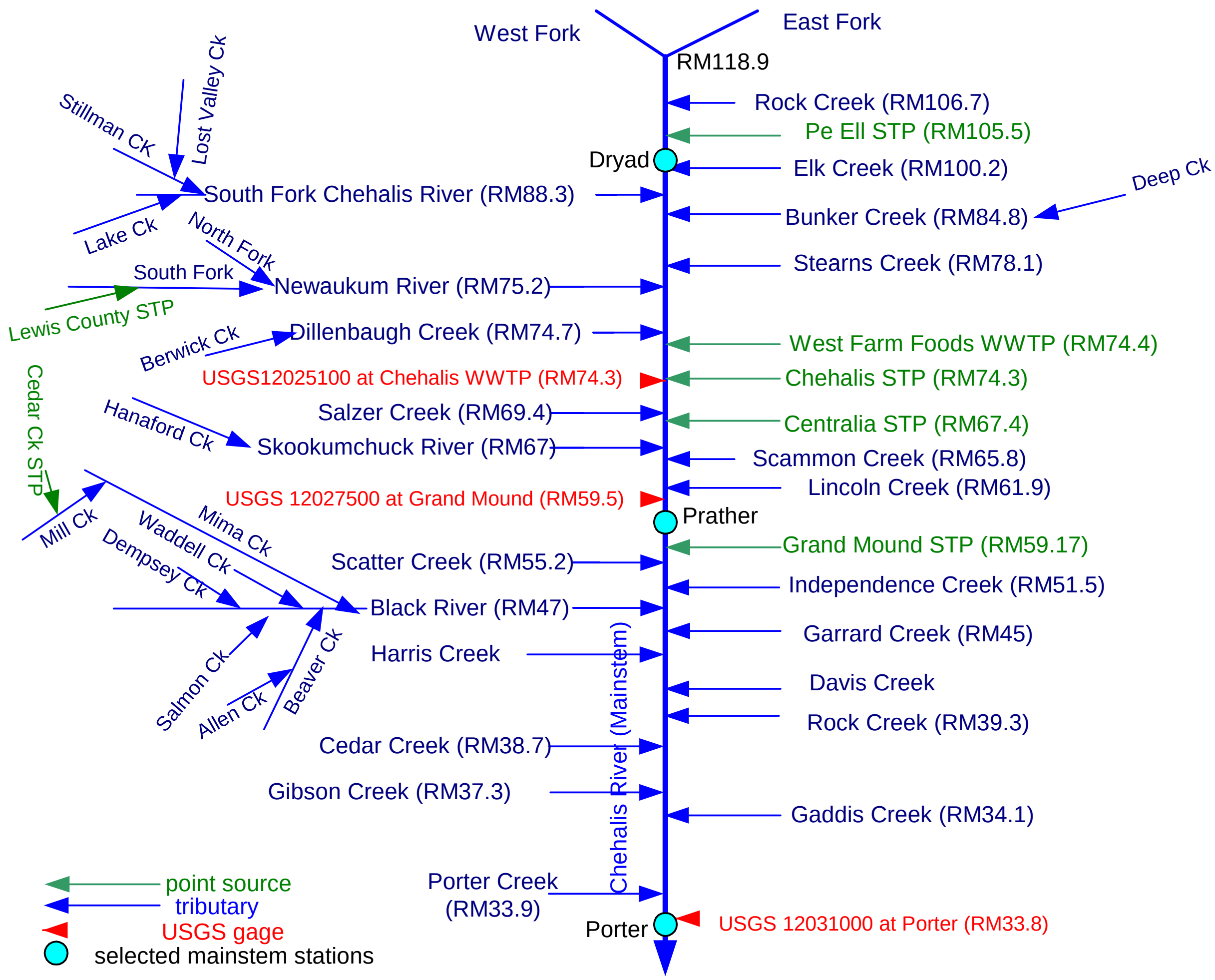

Figure 2. The Upper Chehalis River, its tributaries, and point sources.

Water Quality and Resource Impairment

Applicable Criteria

Water quality standards for Washington (Chapter 173-201A WAC) designate the Upper Chehalis River and its tributaries as Class A. This classification is for excellent waters; the fecal coliform standard calls for a geometric mean of 100 colonies /100 mL with no more than 10 percent of samples greater than 200 colonies/100 mL. The characteristic beneficial uses designated for protection under this classification are: water supply; stock watering; fish migration; fish and shellfish rearing, spawning, and harvesting; wildlife habitat; primary contact recreation; commerce; and navigation.

Certain sections of the mainstem Chehalis River above RM 106.7 and selected tributaries (Rock Creek and all Skookumchuck River segments and tributaries including and above Hanaford Creek) of the Upper Chehalis River are designated as Class AA waters, with a fecal coliform standard of a geometric mean of 50 colonies/100 mL with no more than 10 percent of samples greater than 100 colonies/100 mL. These segments are currently meeting the water quality standards for fecal coliform bacteria and therefore do not appear on the 303(d) list.

The new water quality standards rule (Chapter 173-201A WAC), as adopted in August 2003 (not yet approved by EPA), designates the Upper Chehalis River from Rock Creek (RM 106.7) to Porter (RM 33.8) as having a primary contact recreational use (e.g., swimming and wading in the water) with the same fecal coliform standard as the old rule (geometric mean of 100 colonies/ 100 mL with no more than 10 percent of samples greater than 200 colonies/100 mL). The main change in the new rule is going from the old class-based standard (e.g., Class A waterbody) to the new beneficial use-based standard (e.g., primary contact recreational use).

EPA (2001) now requires that states submit an *Integrated Water Quality Monitoring and Assessment Report* to satisfy the Clean Water Act requirements for both Section 305(b) water quality reports and Section 303(d) lists. In accordance with the EPA guidance, waters in Washington State, except on reservation lands, are assigned to one of the five categories described below. These categories are based on, though not identical to, the categories recommended in EPA (2001).

- Category 1: Waters that meet standards
- Category 2: Waters of concern. Data show concern but not sufficient for listing
- Category 3: Waters with no data available
- Category 4: Impaired waters but one of the following conditions exist:
    - Category 4a: Waters with a TMDL
    - Category 4b. Waters with a pollution control plan
    - Category 4c. Waters impaired by a non-pollutant
- Category 5: Waters on the 303(d) list

For a water body to be placed on the 303(d) list (Category 5), a minimum of five samples is required within the assessment period: a year, a distinct climatic regime, or a shorter period as required to avoid masking noncompliance. The data must show a violation of the water quality standard, based on either the: 1) standard for geometric mean value or 2) standard for more than 10 percent of the samples used for calculating the geometric mean value, with a minimum of two samples exceeding the latter. In some cases, fewer than five samples can support placement on the 303(d) list (Ecology, 2002).

A segment will be placed on the *Waters of Concern category* (Category 2) when the data *do not* meet the requirements above, but at least one individual sample exceeds the standard applicable to more than 10percent of samples used in calculating the geometric mean (Ecology, 2002).

Fecal Coliform Bacteria Pollution

The coliform bacteria group consists of several genera of bacteria belonging to the family *enterobacteriaceae*. These mostly harmless bacteria are passed through the fecal excrement of humans, livestock, wildlife, and domesticated animals. A specific subgroup of this collection is the fecal coliform bacteria, the most common member being *Escherichia coli.*

The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of man or other animals. Fecal coliform bacteria can enter rivers through direct discharge of waste from mammals and birds, indirectly from agricultural and storm runoff, and from untreated human sewage. Residential or commercial on-site sewage treatment system failures may allow untreated human wastes to flow into drainage ditches and nearby waters. Agricultural practices such as animal wastes washing into nearby streams during rainy periods, spreading manure and fertilizer on fields during rainy periods, and allowing unrestricted livestock access to streams can all contribute to fecal coliform contamination.

While fecal coliform bacteria do not directly cause disease, high quantities of these bacteria suggest the presence of disease-causing agents. The presence of fecal contamination is an indicator that a potential health risk exists for individuals exposed to this water. Some waterborne pathogenic diseases include ear infections, dysentery, typhoid fever, viral and bacterial gastroenteritis, and hepatitis A.

Although fecal coliform bacterial die-off rates are not used in this report, nor is modeling done to show how bacteria migrate downstream, a short discussion on survival of microbes in the environment is presented here to portray the fact that microbes are not conservative pollutants but rather eventually die in the environment. Factors that impact the lifespan of pathogens in streams include temperature, pH, ammonia, nutrients, ultra-violet (UV) radiation, and predation. Temperature is important in the destruction of viruses (Scheuerman et al., 1983), bacteria (Farrah and Bitton, 1983), and parasites (Kiff and Jones, 1984). Ward and Ashley (1977) showed that ammonia can be destructive to viruses. Watson (1980) noted that most enteric bacteria survive pH values between 5 and 8, and that outside this range they die rapidly. Under limiting substrate conditions, microbes compete for the nutrient that is limiting, and microbial growth rates decrease (Ahmed, 1990). UV radiation from sunlight is effective in the destruction of microorganisms that are near the surface of the water (Al-Azawi, 1986). Protozoa are thought to be predators of coliform bacteria (Tate, 1978). Hay et al. (1990) noted that fecal coliform were more resistant to thermal inactivation than most enteric bacterial pathogens, and the absence of this group generally indicated the destruction of most enteric bacterial pathogens.

303(d) List for Fecal Coliform Bacteria

Tables 1 through 3 show all segments of the Upper Chehalis River included on the 303(d) list for 1996 and 1998. The proposed 2002 303(d) list, including the category designations used for waterbodies, is also included in Tables 1 through 3. As discussed previously, Category 5 designation (Table 1) means that the segment is included on the 303(d) list, and a TMDL is required for it. Category 2 segments (Table 2) have limited data with some exceedances of the water quality standards but not sufficient to warrant inclusion on the 303(d) list. However, in this study, load allocations have been assigned to most of the Category 2 segments (Table 2) where additional data were available or where seasonal evaluations showed exceedances of water quality standards. In addition, one mainstem segment (Chehalis River at Independence Road) which was not included in any of the categories, was also assigned a load allocation based on data from the Thurston County Environmental Division.

Category 4a segments included in Table 3 are located in the Black River watershed with a fecal coliform TMDL (Coots, 1994) that has a load assigned for the mouth of Beaver Creek. Other segments included in Table 3 were not addressed in the Black River fecal coliform TMDL. Sergeant et al. (2002) used new data to propose load allocations for these segments and reassign load allocations for the mouth of Beaver Creek.

Table 1. Stream segments in the Upper Chehalis watershed included on the 1996 and 1998 303(d) lists, and on the proposed 2002 303(d) list (Category 5) for fecal coliform bacteria.

Stream	Old waterbody ID	New waterbody ID	Station river mile (RM)	Station location	Reach	1998	1996
*Dempsey Ck	WA-23-2060	FM81JM	RM 1.5	Delphi Rd	Mouth at Black R, RM 24.2 to headwaters	yes	yes
*Lincoln Ck	WA-23-1019	AP15HC	10	Buck Rd	Mouth at Chehalis RM 61.9 to headwaters	yes	yes
*Chehalis R	WA-23-1020	DS29ZH	67.5	Centralia	Scammon Creek (RM 65.8) to Newaukum River (RM 75.4)	yes	yes
† Chehalis R	WA-23-1020	DS29ZH	74.6	Below Dillenbaugh Ck	Scammon Creek (RM 65.8) to Newaukum River (RM 75.4)	yes	yes
*Chehalis R	WA-23-1100	DS29ZH	101.7	Dryad	Newaukum River (RM 75.4) to Rock Creek (RM 106.7)	delisted	yes
*SF Chehalis R	WA-23-1106	AR82EA	4	At Curtis	Mouth at Chehalis RM 88.3 to headwaters		
*Salzer Ck	WA-23-1023	QF44VO	0.2	Mouth	Mouth at Chehalis RM 69.4 to headwaters	yes	yes
*Salzer Ck	WA-23-1023	QF44VO	4	Profit Rd Culvert	Mouth at Chehalis RM 69.4 to headwaters	yes	
*Dillenbaugh Ck	WA-23-1027	EV39SR	0.1	Near mouth	Mouth at Chehalis RM 74.7 to headwaters	yes	yes
*Dillenbaugh Ck	WA-23-1027	EV39SR	1.7	RM 1.7	Mouth at Chehalis RM 74.7 to headwaters	yes	
*Dillenbaugh Ck	WA-23-1027	EV39SR	3.4	Above Berwick	Mouth at Chehalis RM 74.7 to headwaters	yes	
*Dillenbaugh Ck	WA-23-1027	EV39SR	4.6	RM 4.6	Mouth at Chehalis RM 74.7 to headwaters	yes	
*Berwick Ck	WA-23-1028	KB60UI	0.0	mouth	Mouth at Dillenbaugh Creek RM 3.4 to headwaters	yes	yes
*Berwick Ck	WA-23-1028	KB60UI	1.7	At Borovec Rd	Mouth at Dillenbaugh Creek RM 3.4 to headwaters		
*Berwick Ck	WA-23-1028	KB60UI	2.0	At Bishop Rd	Mouth at Dillenbaugh Creek RM 3.4 to headwaters		
*Berwick Ck	WA-23-1028	KB60UI	3.0	At Jackson Hwy	Mouth at Dillenbaugh Creek RM 3.4 to headwaters		
*Bunker Ck	WA-23-1104	GG93MD	0.5	Mouth	Mouth at Chehalis RM 84.8 to headwaters		
*Deep Ck	---	MK50YR	2.4	RM 2.4	Mouth at Bunker Creek RM 0.9 to headwaters		
*Lost (Valley) Ck	---	XQ54GH	0.7	Lost Valley Rd bridge	Mouth at Stillman Creek RM 0.2 to headwaters		
*Lost (Valley) Ck	---	XQ54GH	1.5	Below geodesic dome	Mouth at Stillman Creek RM 0.2 to headwaters		
*Lost (Valley) Ck	---	XQ54GH	2.5	At culvert	Mouth at Stillman Creek RM 0.2 to headwaters		
*Lake Ck	---	VY01TK	0.5	Curtis Hill Rd bridge	Mouth at SF Chehalis RM 1.5 to headwaters		
*Stearns Ck	WA-23-1102	EV19TA	0.6	Twin Oaks Rd bridge	Mouth at Chehalis RM 78.1 to headwaters		
*Stearns Ck	WA-23-1102	EV19TA	3.5	Pleasant Valley Rd bridge	Mouth at Chehalis RM 78.1 to headwaters		

* segments addressed in this TMDL

† the proposed 2002 listing is being changed to Category 2 due to insufficient data.

Table 2. Stream segments in the Upper Chehalis watershed included on the 1996 and 1998 303(d) lists, and on the proposed 2002 list as *Waters of Concern* (Category 2) for fecal coliform bacteria.

Stream	Old waterbody ID	New waterbody ID	Station river mile (RM)	Station location	Reach	1998	1996
*Chehalis R	WA-23-1010	DS29ZH	33.8	At Porter	Porter (RM 33.8) to Scammon Creek (RM 65.8)	yes	yes
*Chehalis R	WA-23-1010	DS29ZH	59.9	Prather Rd	Porter (RM 33.8) to Scammon Creek (RM 65.8)	yes	yes
†† Chehalis R	WA-23-1010	DS29ZH	64.2	RM 64.2	Porter (RM 33.8) to Scammon Creek (RM 65.8)	delisted	yes
†† Chehalis R	WA-23-1010	DS29ZH	72.5	RM 72.5	Scammon Creek (RM 65.8) to Newaukum River (75..2)	delisted	yes
*Chehalis R	WA-23-1100	DS29ZH	77.7	At Claquato	Newaukum River (RM 75.2) to Rock Creek (RM 106.7)	delisted	yes
†† Chehalis R	WA-23-1100	DS29ZH	90	RM 90	Newaukum River (RM 75.2) to Rock Creek (RM 106.7)	delisted	yes
†† Chehalis R	WA-23-1100	DS29ZH	100.5	RM 100.5	Newaukum River (RM 75.2) to Rock Creek (RM 106.7))	yes	yes
** Chehalis R	WA-23-1100	DS29ZH	106.3	RM 106.3	Newaukum River (RM 75.2) to Rock Creek (RM 106.7)	yes	yes
†† Chehalis R	WA-23-1100	DS29ZH	108.2	RM 108.2	Above Rock Creek (RM 106.7)	delisted	yes
†† SF Chehalis R	WA-23-1106	AR82EA	0.7	At Weyco Pump	Mouth at Chehalis RM 88.3 to headwaters	delisted	yes
†† Scatter Ck	WA-23-1018	AQ85FY	0.7	At bridge near mouth	Mouth at Chehalis RM 55.2 to headwaters	yes	yes
*Lincoln Ck	WA-23-1019	AP15HC	1.2	Lincoln Ck Rd	Mouth at Chehalis RM 61.9 to headwaters	yes	yes
† Skookumchuck R	WA-23-1030	BV55DP	0	At mouth	Mouth at Chehalis RM 66.9 to Hanaford CK (RM 3.8)		
*Skookumchuck R	WA-23-1030	BV55DP	2.3	In Centralia Hwy 507 Br	Mouth at Chehalis RM 66.9 to Hanaford CK (RM 3.8)	yes	
**Coal Ck	WA-23-1024	JB32HW	0.87	At National Ave	Mouth at Salzer Creek RM 0.8 to headwaters	delisted	yes
† Cedar Ck	---	XU43HJ	0.8	Near mouth	Mouth at Chehalis RM 38.7 to headwaters		
**Elk Ck	WA-23-1108	WI74SE	0.5	Near Doty	Mouth at Chehalis RM 100.2 to headwaters	yes	yes
*Newaukum R	WA-23-1070	WC81BX	4.2	At Rogers Rd	Mouth at Chehalis RM 75.2 to confluence of NF and SF (RM 10.9)		
*Newaukum R	WA-23-1070	WC81BX	0.15	At mouth	Mouth at Chehalis RM 75.2 to confluence of NF and SF (RM 10.9)	yes	yes
**NF Newaukum R	WA-23-1080	WC81BX	0.1	Near mouth	Mouth at Newaukum RM 10.9 to headwaters	delisted	yes
*Bunker Ck	WA-23-1104	GG93MD	0.6	Near mouth	Mouth at Chehalis RM 84.8 to headwaters	delisted	yes
*Deep Ck	---	MK50YR	3.6	RM 3.6	Mouth at Bunker Creek RM 0.9 to headwaters		
††Porter Ck	---	TP29FX	0.2	At mouth	Mouth at Chehalis RM 33.9 to headwaters		
††Rock Ck	---	GG91SL	0.6	At mouth	Mouth at Chehalis RM 39.3 to headwaters		
*Salzer Ck	WA-23-1023	QF44VO	0.6	At mouth	Mouth at Chehalis RM 69.4 to headwaters		
*Salzer Ck	WA-23-1023	QF44VO	1.7	At Fair St	Mouth at Chehalis RM 69.4 to headwaters		

* segments addressed in this TMDL and assigned a load allocation based on additional data
** limited data; no load allocation assigned but further monitoring recommended
† segment meets standards based on 5 or fewer samples. One data point barely exceeded geometric mean standard. No load allocation assigned
†† two or fewer data points; not addressed in this document

Table 3. Stream segments in the Upper Chehalis watershed on the proposed 2002 list as *Water Has A TMDL* (Category 4a) for fecal coliform bacteria.

Stream	Old waterbody ID	New waterbody ID	Station river mile (RM)	Station location	Reach
Black River	WA-23-1015	GW14BM	1.1	Below Howanut Rd (Chehalis Indian Reservation	Mouth to headwaters
Black River	WA-23-1015	GW14BM	1.2	At Howanut Rd (Chehalis Indian Reservation)	Mouth to headwaters
Black River	WA-23-1015	GW14BM	1.7	Within Chehalis Indian Reservation	Mouth to headwaters
Black River	WA-23-1015	GW14BM	4.1	At US Highway 12	Mouth to headwaters
Black River	WA-23-1015	GW14BM	7.1	At Moon Road bridge	Mouth to headwaters
Black River	WA-23-1015	GW14BM	10.6	At Swecker's Dock	Mouth to headwaters
Black River	WA-23-1015	GW14BM	11.8	At Mima Ck confluence	Mouth to headwaters
Black River	WA-23-1015	GW14BM	14.1	At Canoe Club	Mouth to headwaters
Black River	WA-23-1015	GW14BM	15.2	At wildlife launch	Mouth to headwaters
Black River	WA-23-1015	GW14BM	17	At Littlerock trestle	Mouth to headwaters
Mima Creek	---	LA78CX	At mouth	Black River RM 11.8	Mouth to headwaters
Littlerock Ditch	---	MQ33IV	Near Beaver Ck	Black River RM 16.8	Mouth to headwaters
*Beaver Creek	---	HA04TR	0.1	At mouth	Mouth to headwaters
*Beaver Creek	---	HA04TR	0.9	Sheriff's Posse	Mouth to headwaters
*Beaver Creek	---	HA04TR	2.5	Beaver Ck Ranch	Mouth to headwaters
*Beaver Creek	---	HA04TR	4.2	Case Rd	Mouth to headwaters
**Allen Creek	---	XO13OJ	0.9	At mouth	Mouth at Beaver Ck RM 2.6 to headwaters

* Segments that have a previous load allocation (Coots, 1994) but an updated load allocation is established in this document.

** Segments that do not have a previous load allocation but a load allocation is established in this document. Segments are currently in proposed Category 4a but are being changed to Category 5 because they have no previous load allocations.

303(d) List for Other Pollutants

The proposed 2002 Category 5 (303(d) list) contains additional listings for the Upper Chehalis River watershed for pollutants other than fecal coliform bacteria. These are shown in Table 4. In addition, dioxin was found in fish tissue collected from the Chehalis River and Dillenbaugh Creek, and included in the new 2002 Category 5 list. The 1998 listing for PCB in fish tissue collected from the Chehalis River was carried over to the 2002 Category 5 list.

Table 4. Stream segments in the Upper Chehalis watershed included on the proposed 2002 303(d) list (Category 5) for temperature and pH.

Stream	Old waterbody ID	New waterbody ID	Parameter	Station river mile (RM)	Station location	Reach
SF Chehalis R	WA-23-1106	AR82EA	pH	6.0	Boistfort Rd bridge	Mouth at Chehalis RM 88.3 to headwaters
SF Chehalis R	WA-23-1106	AR82EA	pH	10.8	Wildwood Rd bridge	Mouth at Chehalis RM 88.3 to headwaters
Lost (Valley) Ck	---	XQ54GH	pH	0.7	Lost Valley Rd bridge	Mouth at Stillman Creek RM 0.2 to headwaters
Lake Ck	---	VY01TK	pH	0.5	Curtis Hill Rd bridge	Mouth at SF Chehalis RM 1.5 to headwaters
Stearns Ck	WA-23-1102	EV19TA	pH	0.6	Twin Oaks Rd bridge	Mouth at Chehalis RM 78.1 to headwaters
Stearns Ck	WA-23-1102	EV19TA	pH	3.5	Pleasant Valley Rd bridge	Mouth at Chehalis RM 78.1 to headwaters
Mill Ck	---	UR68OS	Temperature	1.7	0.2 miles south of Chilvers Rd	Mouth at Chehalis RM 77.8 to headwaters
Mill Ck	---	UR68OS	Temperature	2.9	0.05 miles north of Jeffries Rd	Mouth at Chehalis RM 77.8 to headwaters
Stillman Ck	---	MQ11YB	Temperature	0.6	Upstream of Lost (Valley) Ck	Mouth at SF Chehalis RM 5.5 to headwaters
Stillman Ck	---	MQ11YB	Temperature	2.6	Downstream of Halfway Ck	Mouth at SF Chehalis RM 5.5 to headwaters
Stillman Ck	---	MQ11YB	Temperature	4.0	Downstream of Little Mill Ck	Mouth at SF Chehalis RM 5.5 to headwaters
Unnamed Ck/ Cozy Valley Ck	---	SH96KX	Temperature	mouth	Tributary to Scatter Ck	Mouth to headwaters

Historical Data, Seasonal Variation, and Critical Conditions in the Mainstem Upper Chehalis River

Several locations on the mainstem have been monitored from the early 1970s to the present (2003). Figure 3 shows the long-term fecal coliform data at all stations located in the mainstem Chehalis River. The long-term geometric mean and 90th percentile values are also included in the graph. The long-term evaluation suggests that the geometric mean is within the water quality standard of 100 cfu/100mL at all stations. However, the 90th-percentile criterion of 200 cfu/ 100 mL is exceeded between RM 50 and RM 80.

Seasonal variation in the concentration of fecal coliform bacteria has been considered in this TMDL by applying the water quality criteria to observed fecal coliform concentrations at monthly or seasonal intervals. The critical conditions determined to be appropriate for point-source evaluation is when potential dilution is at a minimum. Generally, this condition exists when the river has the lowest seven-day average flow with a recurrence interval of one in ten years (also known as 7Q10 flow). Dilution factors used in the existing National Pollutant Discharge Elimination System (NPDES) permits for the point sources have been based on the 7Q10 stream flows. These were used to evaluate existing effluent limits to determine if water quality standards were being met at the edge of the mixing zone.

The critical conditions for nonpoint sources generally occur during high-rainfall periods, particularly during the start of a rainfall event when bacteria are “flushed” from surface soils into the streams. For example, one of the highest daily loading of fecal coliform bacteria to Grays Harbor occurred in October 1997 following a large storm event (Pelletier and Seiders, 2000).

The Grays Harbor Bacteria TMDL (Pelletier and Seiders, 2000) used the seasonal variation in fecal coliform concentrations to establish a load allocation for the lower boundary of the Upper Chehalis River. A plot of the seasonal fecal coliform loading (1994-2003) in the mainstem Chehalis River (Figure 4) shows the critical months to be November through April for all three stations. However, based on long-term (1994-2003) monthly geometric mean and 90th-percentile concentrations (Figures 5 and 6), November is the most critical month for both Porter and Prather stations. At the Dryad station, the critical months appears to be September and October.

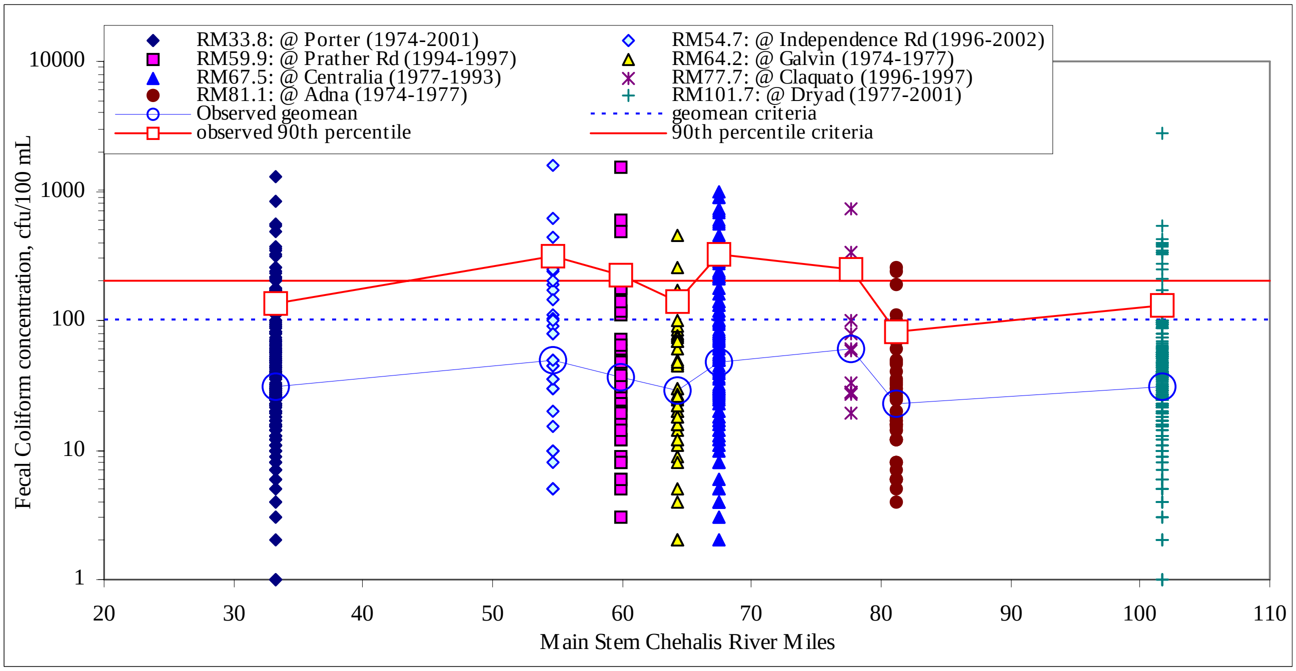

Figure 3. Historical fecal coliform concentrations at eight locations in the Upper Chehalis River, 1974-2002.

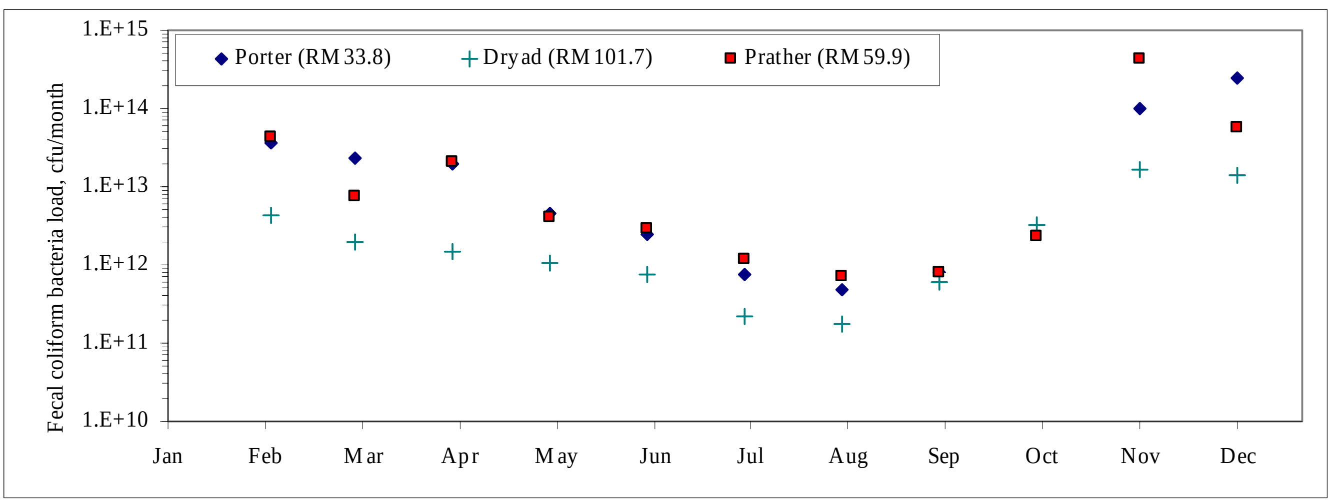

Figure 4. Seasonal variation in fecal coliform loads (90th percentile) at three locations in the Upper Chehalis River, 1994-2003.

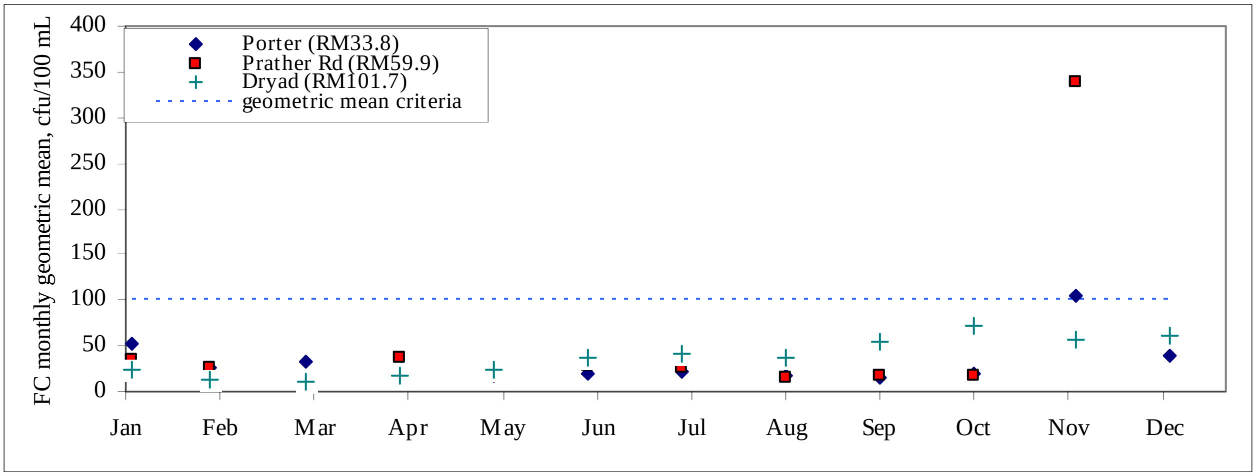

Figure 5. Long-term monthly geometric mean concentrations at three locations in the Upper Chehalis River, 1994-2003.

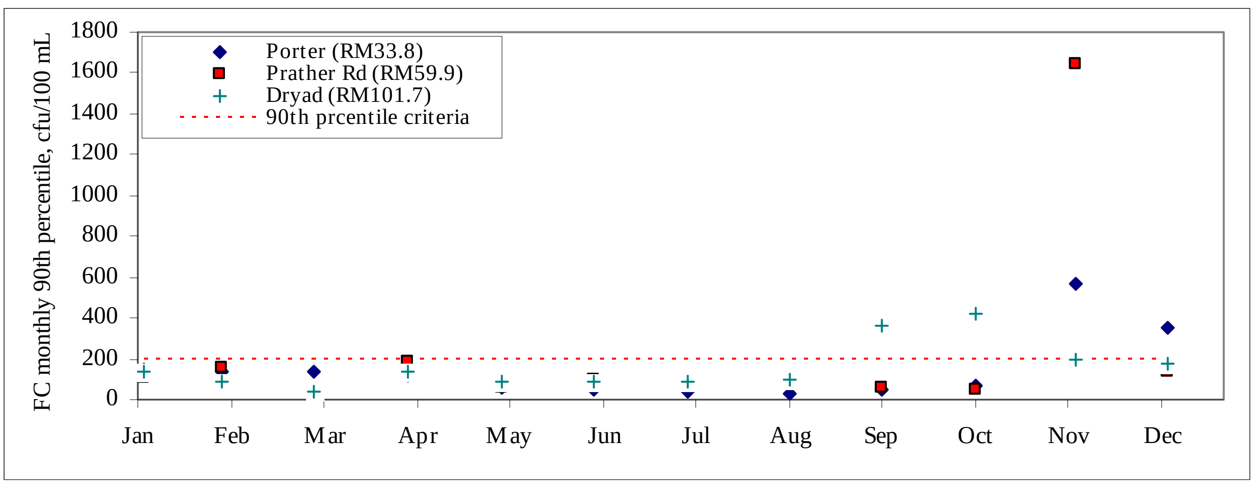

Figure 6. Long-term monthly 90th-percentile concentrations at three locations in the Upper Chehalis River, 1994-2003.

Load Allocations

Technical Analysis

Historical and recent field data have been used in the technical analysis presented in this report. Historical data were obtained from Ecology's Environmental Information Management database (http://www.ecy.wa.gov/services/as/iip/eim/index.htm) and the Thurston County Environmental Health Division database (http://www.geodata.org/swater/). Recent data were obtained from Ecology's ambient monitoring station database (http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?wria=23), and from the Chehalis Indian Tribe (Pickernell, 2003). Flow data, where applicable, were obtained from the USGS watershed gaging station data.

Excel® spreadsheets were used to evaluate the data including mass balances, statistical analyses, and plots.

The statistical roll-back method (Ott, 1995) was employed to establish fecal coliform reduction targets for all segments of the mainstem, tributaries, and sub-tributaries. This method has been employed by Roberts (2003), Coots (1994), Joy (2000), and Pelletier and Seiders (2000).

The roll-back method assumes that the distribution of fecal coliform concentrations follows a log-normal distribution. The cumulative probability plot of the observed data gives an estimate of the geometric mean and 90th percentile which then can be compared to the fecal coliform bacteria standards. The roll-back procedure is as follows:

a) When data are plotted on a log-scale against a linear cumulative probability function, a straight line signifies a log-normal distribution of the data.

b) The geometric mean of the data has a cumulative probability of 0.5.

c) The 90th percentile of the data has a cumulative probability of 0.9. This is equivalent to the "no more than 10% samples exceeding …." criterion in the fecal coliform standard (Chapter 173-201A WAC).

d) Alternately, the 90th percentile also can be estimated by using the following statistical equation:

$$90^{th}\text{ percentile} = 10^{(\mu_{\log} + 1.28 * \sigma_{\log})}$$

where: $\mu_{\log}$ = mean of the log transformed data

$\sigma_{\log}$ = standard deviation of the log transformed data

e) The target percent reduction required is the highest of the following two comparisons.

either: $$\left[\frac{observed\ 90th\ \ percentile - 200\ cfu/100mL}{observed\ 90th\ \ percentile}\right]x100$$

or: $$\left[\frac{observed\ \ geometric\ mean - 100\ cfu/100mL}{observed\ \ geometric\ mean}\right]x100$$

f) As "best management practices" for nonpoint sources and treatment technologies for point sources are implemented and target reductions are achieved, a new but similar distribution (same coefficient of variation) of the data is assumed to be realized with the previous mean and standard deviation reduced by the target percent reductions.

g) If the data do not meet the 90th percentile criteria, then the goal would be to meet a 90th-percentile fecal coliform of 200 cfu/100 mL. No goals would be set for the geometric mean since, with the implementation of the target reductions, the already low geometric mean (<100 cfu/100mL) would only get better. Similarly, if the data do not meet geometric mean criteria, the goal would be to achieve a geometric mean of 100 cfu/100mL with no goal for the already low (<200 cfu/100mL) 90th percentile.

The procedures and assumptions discussed above were used to evaluate fecal coliform data in the respective segments of the mainstem and tributaries to establish target bacterial reductions necessary to meet water quality standards.

For presentation of the technical analysis, the Upper Chehalis River study area has been divided into three segments:

1. Lower Mainstem Segment (RM 33.8 to RM 65.8)
2. Middle Mainstem Segment (RM 65.8 to RM 75.4)
3. Upper Mainstem Segment (RM 75.4 to RM 118.9)

The fecal coliform reduction targets for each of these segments and its associated tributaries are discussed below.

1. Lower Mainstem Segment

The lower-most mainstem segment on the 303(d) list in the study area is between RM 33.8 and RM 65.8. This segment includes one listed tributary (Lincoln Creek) and one listed sub-tributary to the Black River (Dempsey Creek). Scatter Creek was listed in 1996 and 1998 but has been placed in Category 2 waters on the proposed 2002 list. The Prather monitoring station (RM 59.9) is located at the upper end of this segment, while the Porter station (RM 33.8) is located at the downstream end. Figure 4 shows that the fecal coliform loading in this mainstem segment is higher during the wet season. The fecal coliform concentration at the upper end of this segment (Prather Road station at RM 59.9, below Lincoln Creek) is higher than that at the lower end of the segment (Porter station at RM 33.8) (see Figures, 3, 4, 5, and 6). Thus, it may be presumed that if the water quality standard is met at Prather Road (RM 59.9) and at the mouth of the listed creeks below this station, then it is likely that the water quality standard also would be met at the Porter station (RM 33.8).

Mainstem near Porter (RM 33.8)

The mainstem Chehalis River at Porter (RM 33.8) defines the lower boundary of the Upper Chehalis watershed. The fecal coliform loading in the mainstem at Porter (Ecology Station 23A070 at RM 33.8) accounted for 36% of the total load to Grays Harbor between May 1997 and April 1998 (Pelletier and Seiders, 2000).

The current loading of fecal coliform at RM 33.8 was estimated at 4.9 x 10^{15} cfu/year (Pelletier and Seiders, 2000) or approximately 1.3 x 10^{13} cfu/day. A 74% reduction was necessary at this location to meet the water quality standard of 200 cfu/100 mL. The geometric mean standard of 100 cfu/100 mL was met at this location during all months of the year (Figure 7). The recommended load reduction at Porter was 3.6 x 10^{15} cfu/year (or approximately 9.9 x 10^{12} cfu/day), and the loading capacity under critical conditions was 1.3 x 10^{15} cfu/year (or approximately 3.6 x 10^{12} cfu/day, based on reducing a 90th-percentile concentration of 756 cfu/100 mL to the water quality standard of 200 cfu/100 mL). This analysis was based on fecal coliform data collected until 1998.

Figure 7 shows a plot of all monthly data gathered from December 1970 to September 2001. The long-term monthly geometric means are well within the standard of 100 cfu/100 mL for all months. The critical month for exceedance of the 90th-percentile criteria of 200 cfu/100 mL is November. This was also the critical month in the study conducted by Pelletier and Seiders (2000). However, the 90th percentile with the additional three years of data was 563 cfu/100 mL instead of the 756 cfu/100 mL estimated by Pelletier and Seiders (2000). This amounts to a 25% reduction in bacteria concentrations and is attributed to some best management practices (BMPs) that have been implemented throughout the basin. For example, Sargeant (2002) estimated a 23% reduction in fecal coliform concentrations in Beaver Creek following implementation of BMPs. Also, lower bacterial levels at Porter likely resulted from Ecology's enforcement action on a commercial dairy farm, upstream of Porter, that addressed chronic discharge problem from the site in 2002 (Smith, 2004). The additional reduction necessary to meet the water quality standard at RM 33.8 is 64%.

The segment at RM 33.8 was included in the 303(d) list in 1996 and 1998. However, it is currently designated as Category 2 in the proposed 2002 list based on evaluation of data from individual years. This TMDL contains a seasonal target reduction for fecal coliform concentrations at this location.

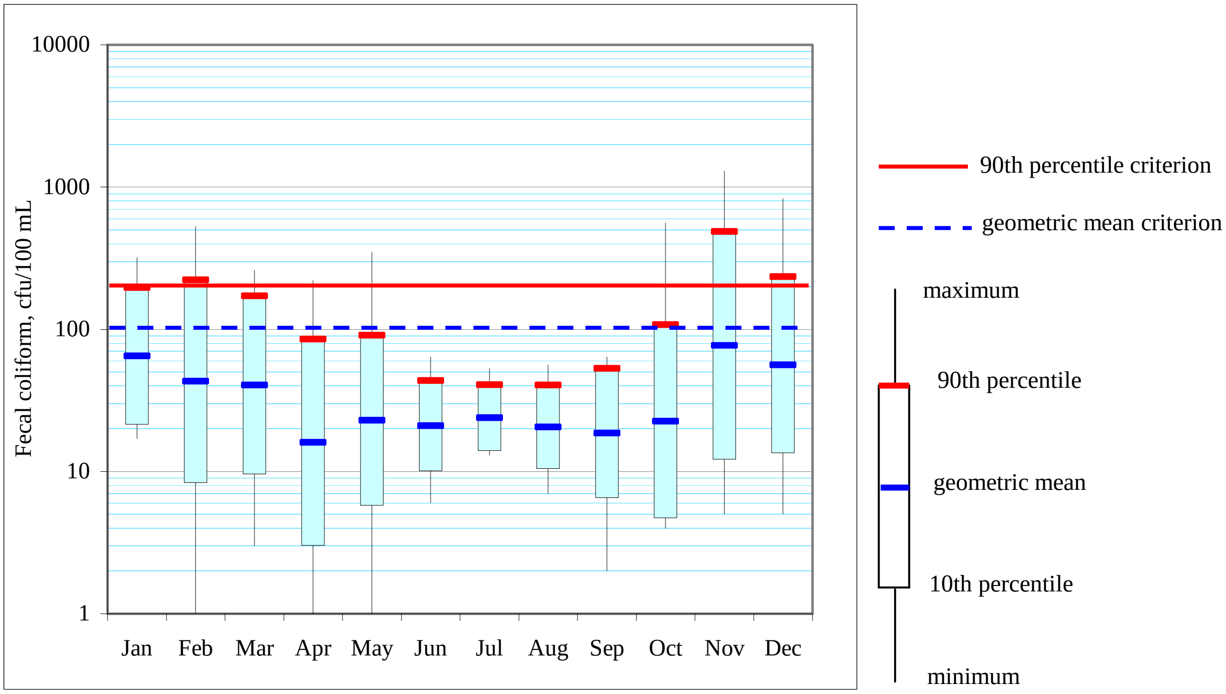

Figure 7. Long-term monthly fecal coliform concentrations at RM 33.8 (Porter), 1970-2001.

Mainstem at Independence Road (RM 54.7)

This location of the mainstem was monitored, intermittently, by the Thurston County Environmental Health Division between March 1996 and July 2002. No samples were collected in May, June, October, or November. Only one data point was available for April. The geometric mean and 90th percentile of monthly fecal coliform concentrations are shown in Figure 8. Although high concentrations were observed in December, February, and July, the December concentrations were more restrictive since both the geometric mean and 90th percentile concentrations were the highest. Therefore, the recommended target reduction is based on December as shown in Table 5.

This mainstem segment has not been listed in any of the prior or current 303(d) lists. The data discovered during this TMDL development is now being considered in the 2002 listing process.

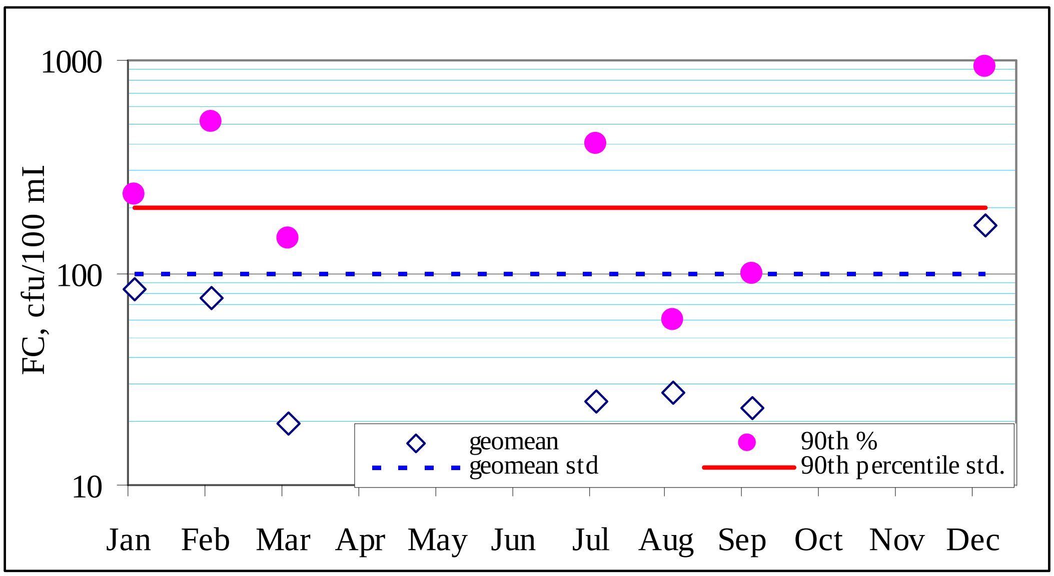

Figure 8. Monthly geometric mean and 90th percentile fecal coliform concentrations in the mainstem Chehalis at RM 54.7, 1996-2002.

Table 5. Fecal coliform concentrations and target reductions in the mainstem Chehalis River at RM 54.7, 1996-2002.

Month	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reductions (%)
December	5	168	935	90th percentile	79

Mainstem at Prather Road (RM 59.9)

This location has been monitored by Ecology from 1994-2003, the Chehalis Indian Tribe from 2000-2003, and the Thurston County Environmental Health Division from 1996-1998. However, data from only 1994-1996 were considered during the 2002 listing process, and a Category 2 designation has been proposed for this mainstem segment as per the new guidance (Ecology 2002). The additional data discovered during this TMDL development is now being considered in the 2002 listing process. All data were used to estimate monthly geometric mean and 90th percentile fecal coliform concentrations as shown in Figure 9. Bacterial concentrations tend to be high in the winter season. High bacterial concentrations were historically observed in November. Therefore, the recommended target reduction is based on November as shown in Table 6.

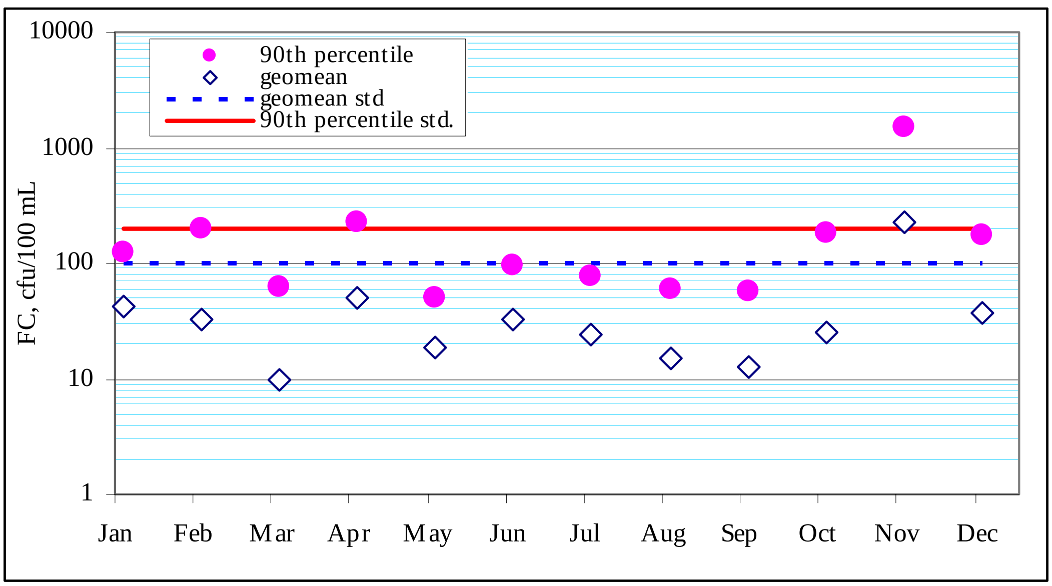

Figure 9. Monthly geometric mean and 90th percentile fecal coliform concentrations in the mainstem Chehalis at RM 59.9, 1994-2003.

Table 6. Fecal coliform concentrations and target reductions in the mainstem Chehalis River at RM 59.9, 1994-2003.

Month	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reductions (%)
November	6	231	1475	90th percentile	86

Black River (RM 47)

A TMDL for fecal coliform was completed for the Black River in 1994 (Coots, 1994). The Black River drains into the Chehalis River at RM 47, two miles southeast of Oakville. The last 3.5 miles of the river winds through the Chehalis Indian Reservation. Land uses in the drainage area for Black River consist of mainly agricultural which represents potential nonpoint sources of fecal coliform. The Black River drains about 128 mi^2 and has five major sub-basins corresponding to the following creeks: Beaver, Mima, Salmon, Waddell, and Dempsey. All the tributaries, except Dempsey Creek, were addressed in the Black River fecal coliform TMDL (Coots, 1994). Among the tributaries addressed in the TMDL, only Beaver Creek was assigned a fecal coliform target reduction of 92 percent. The water quality standard was met in the other creeks. Dempsey Creek has been listed in the 1996, 1998, and the proposed 2002 303(d) list. However, no load allocation for fecal coliform has been previously established for Dempsey Creek. The allowable loading to the mainstem Chehalis River from Black River, during the critical wet season, is 0.7×10^{12} cfu/day (Coots, 1994).

Extensive BMPs were identified and recommended by Coots (1994) to reduce the fecal coliform concentrations in the Black River to within the water quality standard. The effectiveness of BMPs in reducing the fecal coliform concentrations were later studied and reported by Sargeant et al. (2002). A winter waste holding pond was installed at a large dairy operation (900 milking cows and 150 dry cows) in 1996. Also, the Chehalis Fisheries Restoration Program funded BMPs at four sites on Allen Creek, a major tributary to Beaver Creek. These BMPs included over a mile of stream fencing to exclude livestock, 130,000 ft^2 of stream corridor re-vegetation, and construction of limited access livestock watering sites. The BMPs were installed in 1994-97 by the Thurston Conservation District and the Chehalis Basin Task Force. An evaluation of data (Sargeant et al., 2002) suggests that even though some improvements were observed (23 percent reduction in Beaver Creek and no reduction in Allen Creek), the proposed target was not met at the mouth of Beaver Creek. An additional 73 percent reduction in fecal coliform is necessary at the mouth to meet the water quality standards.

Dempsey Creek is a Class A 3.1-mile tributary to Black River (mouth at Black River RM 24.2). It was placed on the 1996 and 1998 303(d) lists for seven exceedances beyond the criteria measured during the 1992-1993 period at Delphi Road (RM 1.5). The Black River TMDL (Coots, 1994) did not specifically address fecal coliform reductions for this creek. Data for Dempsey Creek were obtained from the Thurston County Environmental Health Division database (Davis, 2003). Only nine data points from the 1992-1993 period were available (Figure 10). The geometric mean and 90^{th} percentile of the data are 439 cfu/100 mL and 2964 cfu/100 mL, respectively. A 93 percent reduction in fecal coliform bacteria is necessary to reduce the 90th-percentile concentration to 200 cfu/100 mL. This would likely also result in a geometric mean below 50 cfu/100 mL.

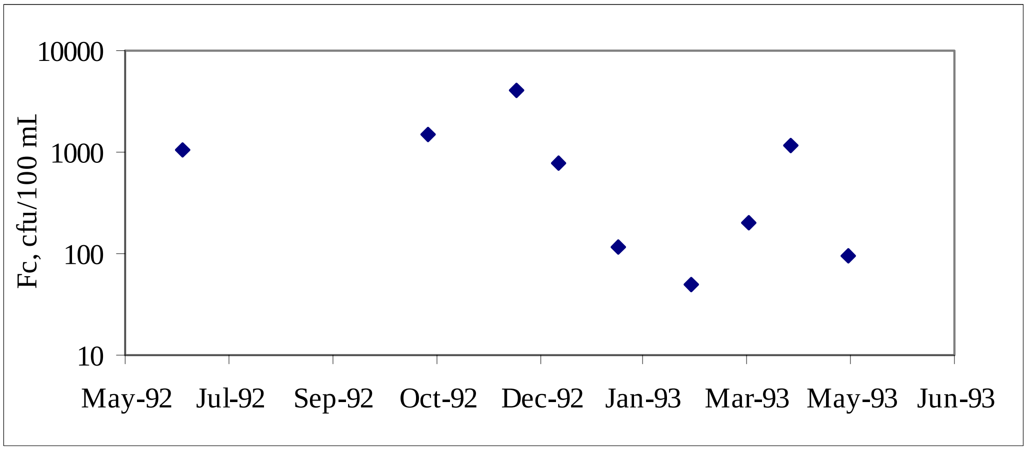

Figure 10. Fecal coliform concentrations in Dempsey Creek, 1992-1993.

Coots (1994) established the load reduction targets for the mainstem Black River and some tributaries. These are not included here since they have been submitted and approved as a TMDL by EPA. Additional load reductions, as proposed by Sargeant (2002), and the new load reduction for Dempsey Creek are included in Table 7. Data collected by Sargeant et al. (2002) along Beaver Creek suggest that fecal coliform reductions are necessary throughout the creek from its mouth to headwaters.

Table 7. Fecal coliform concentrations and target reductions for selected tributaries to Black River, 1992-2000.

Black River Reach/Tributary	Number of samples	Geometric Mean (cfu/100 mL)	90^{th} Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
Beaver Creek mouth	15	169	735	90^{th} percentile	73*
Allen Creek mouth (at Beaver Ck RM 2.6)	15	116	436	90^{th} percentile	54*
Dempsey Creek	9	439	2964	90^{th} percentile	93

* As proposed by Sargeant (2002) and confirmed by roll-back calculations in this study

Scatter Creek (RM 55.2)

Scatter Creek is a 20.6-mile creek with its mouth at Chehalis RM 55.2. Scatter Creek was listed on the 1996 and 1998 303(d) lists for exceedances of the fecal coliform geometric mean criteria based on two data points collected at RM 0.7 in 1991 (Pickett, 1994). However, based on new guidance for listing (Ecology, 2002), Scatter Creek has been designated as Category 2 waters in the proposed 2002 list. Additional data were collected by Thurston County between 1993 and 2001 at six stations along the creek. The additional data discovered during this TMDL development is now being considered in the 2002 listing process.

The Thurston County data suggest that the upper reaches of Scatter Creek exceed the water quality standard for fecal coliform bacteria. The geometric mean and 90th-percentile fecal coliform concentrations for this data set are shown in Figure 11. The fecal coliform concentrations generally decrease towards the mouth. The load reduction target for Scatter Creek (Table 8) is based on meeting the limiting 90th-percentile concentrations of 200 cfu/100 mL. The resulting loading at the mouth of the creek, based on an average flow of 66 cfs (1993-2001) and the 90th percentile criterion of 200 cfu/100 mL, would be 3×10^{11} cfu/day. Flow in Scatter Creek is dominated by flows from two permitted aquaculture facilities (Global Aqua and Seafarm Washington), particularly during the dry season. Livestock access has been identified at several stretches along the creek by the U.S. Fish and Wildlife Service (USFWS) (Pickett, 1994). Priority areas where BMP implementation and follow-up monitoring should be considered are between RM 8 and RM 16.5 and above RM 19.

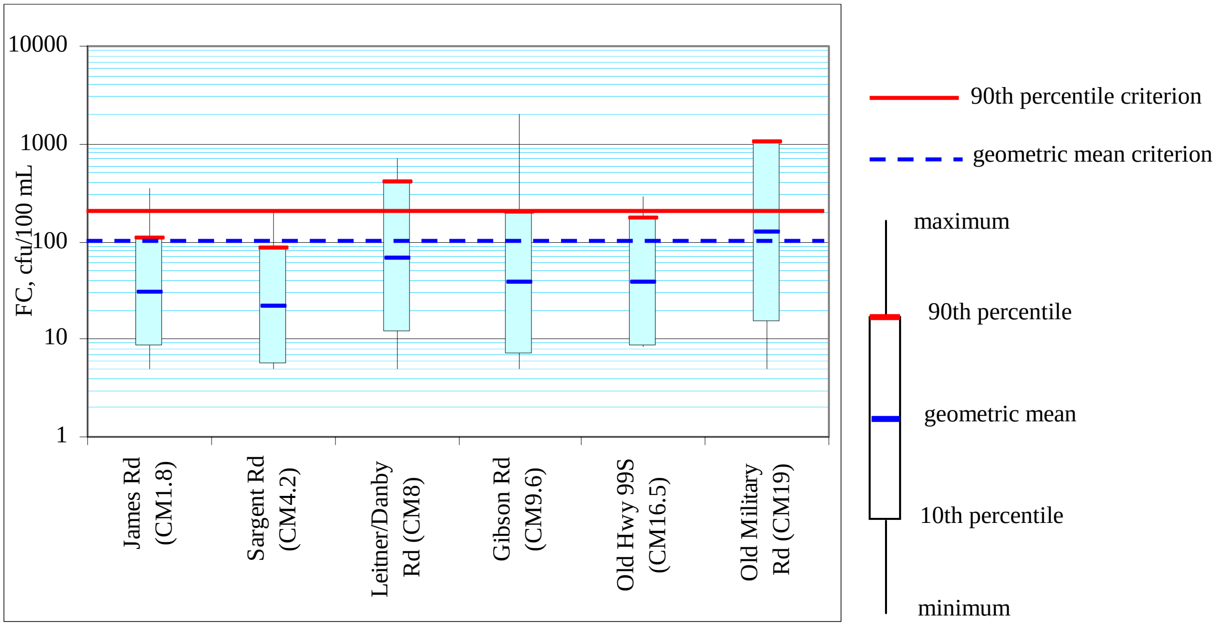

Figure 11. Fecal coliform concentrations in Scatter Creek, 1993-2001.

Table 8. Fecal coliform concentrations and target reductions for Scatter Creek, 1993-2001.

Location	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reductions (%)
RM 8	13	68	405	90^{th} percentile	51
RM 19.9	14	124	1045	90^{th} percentile	81

Lincoln Creek (RM 61.9)

Lincoln Creek flows into the Chehalis River at RM 61.9 near the town of Galvin. The lower reaches of the creek are in broad stream valleys, and they flood annually to at least RM 4.0. The soils in these lower valleys are a heavy clay alluvium. Stream gradients are very low with sand and silt being the primary bed material. The banks are low cut, with deciduous brush and trees adjacent to the water course. The upper reaches flow through narrower valleys, and gravel is the predominant streambed material. The adjacent slopes are in timber production. The Lincoln Creek watershed drains an area of 43.2 square miles. The creek is 17.1 miles long. The mean annual flow is 123 cfs (Chehalis River Council, 1992). For a concentration of 200 cfu/100 mL, the 90th-percentile loading would be a maximum of 6 x 10^{11} cfu/day.

The creek had two listings in 1996 that were carried over to the 1998 303(d) list. One listing is at RM 1.2 based on two data points gathered in 1991 (Pickett, 1994). The other listing is at RM 10 based on five data points gathered by the Chehalis Tribe in 1995 (Burns, 1995). In the 2002 list, RM 1.2 is being proposed as Category 2 and RM 10 as Category 5. Additional data gathered at RM 1.2 in May-June 1995 by the Chehalis Tribe (Burns, 1995) showed no exceedances of the water quality standards. However, all the data at station 1.2 have been pooled to establish a target reduction at this location.

The Chehalis Tribe also gathered fecal coliform data at seven other locations in May-June 1995. These additional data discovered during this TMDL development are now being considered in the 2002 listing process. Three locations monitored by the Chehalis Tribe had four or fewer data points but showed exceedances of the standard. These three stations were at RM 7 and mouths of the north and south forks. Further monitoring at only the mouths of north and south forks are recommended. Locations adjacent to RM 7 have recommended target reductions for fecal coliform concentrations. Therefore, no further monitoring is recommended at RM 7. Figure 12 shows the concentrations of fecal coliforms at all stations with five or more data points. Table 9 shows the recommended target reductions in fecal coliform bacteria in the mainstem Lincoln Creek.

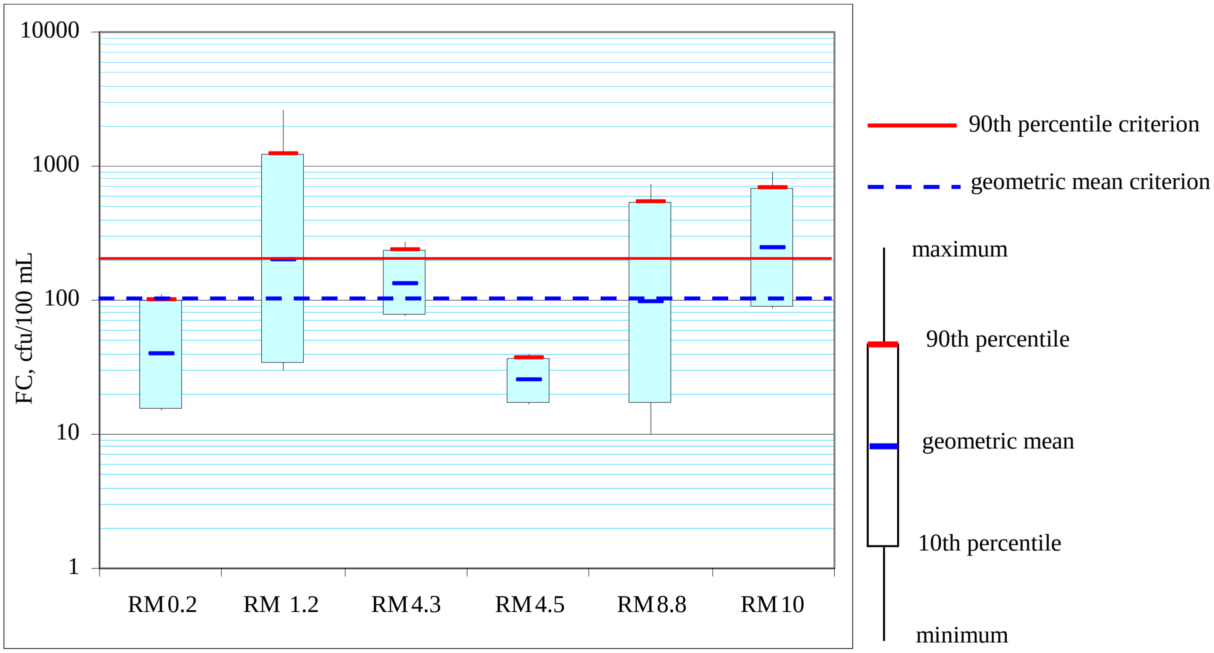

Figure 12. Fecal coliform concentrations in Lincoln Creek, 1991-1995.

Table 9. Fecal coliform concentrations and target reductions for Lincoln Creek, 1991-1995.

Location	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 ml)	Limiting basis for reduction	Target Reduction (%)
Mainstem at RM 1.2	7	201	1240	90th percentile	84
Mainstem at RM 8.8	7	96	546	90th percentile	63
Mainstem at RM 10	5	244	683	90th percentile	70

2. Middle Mainstem Segment

The second mainstem segment on the 303(d) list (1996, 1998, and proposed 2002) is between RM 65.8 and RM 75.4. It includes two proposed Category 5 listings for the mainstem in this segment. However, the proposed mainstem listing at RM 74.6 is being re-evaluated and will likely be included as Category 2 due to limited data. Only the proposed mainstem listing at RM 67.5 will be addressed in this section. However, further monitoring is recommended at mainstem RM 74.6. There are ten proposed Category 5 listings for the tributaries in this segment. Salzer Creek has two segments on the 303(d) list, and Dillenbaugh Creek has four. Berwick Creek, a sub-tributary to Dillenbaugh Creek, has four segments in Category 5 waters on the 2002 303(d) list. Segments of the Newaukum and Skookumchuck rivers previously included on the 303(d) list (1996/1998) are being proposed as Category 2 waters on the 2002 list. In addition, two segments of Salzer Creek are included as Category 2 waters.

Mainstem in Centralia (RM 67.5)

The 303(d) listings (1996, 1998, and proposed 2002) for the mainstem segment in this reach were based on data gathered by Ecology at the ambient monitoring station 23A120 in Centralia at RM 67.5. Limited data also were gathered by Pickett (1994) at this location in 1991.

Pickett (1994) observed that the high fecal coliform bacteria in this mainstem reach were likely due to high fecal coliform concentrations in the tributaries, particularly Salzer Creek. Extensive cattle access areas along the mainstem above the golf course also may be responsible for the high bacterial counts. Pickett (1994) also indicated Centralia urban stormwater was a potential source of fecal coliform bacteria.

Figure 13 shows the long-term monthly geometric mean and 90th percentile fecal coliform concentrations at RM 67.5. This is based on 15 data points for each month during 1978-1993. The critical period for exceedance of the water quality standard is from October through May. However, the month with the highest concentrations was November. Therefore, the recommended target reduction is based on November as shown in Table 10.

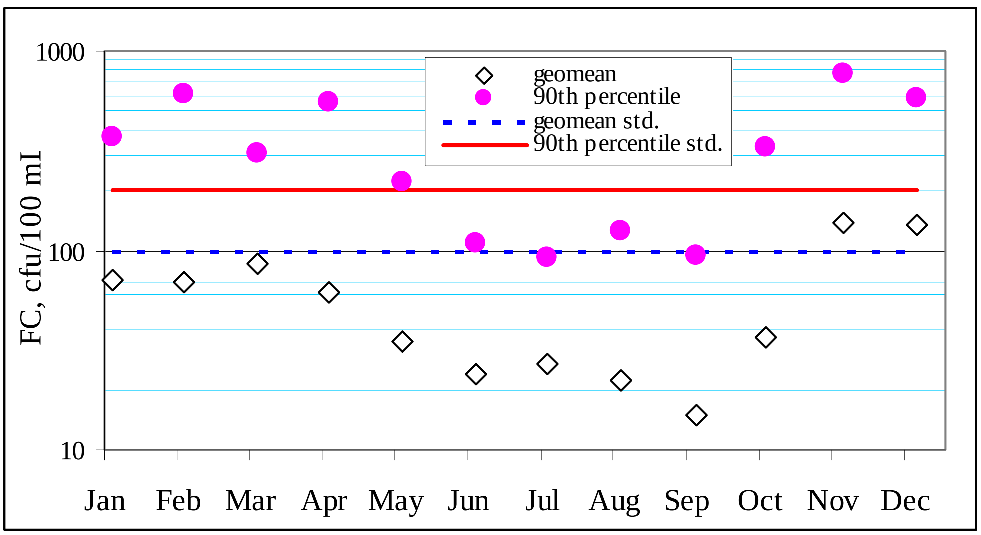

Figure 13. Long-term monthly geometric mean and 90th percentile fecal coliform concentrations at RM 67.5, 1978-1993.

Table 10. Fecal coliform concentrations and target reductions for the mainstem Chehalis River at RM 67.5, 1978-1993.

Month	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 ml)	Limiting basis for reduction	Target Reduction (%)
November	15	139	763	90th percentile	74

Skookumchuck River (RM 67)

The Skookumchuck River originates in the westernmost region of the Gifford Pinchot National Forest and flows in a northwesterly direction to the town of Bucoda, and from there to the confluence with the Chehalis River near Centralia (at Chehalis RM 67). Including its tributaries, it drains 202 square miles. The average annual flow in the mainstem before merging with the Chehalis River near Centralia was 285 cfs from 1990 to 2000, with the lowest annual average flow of 155 cfs in 1992 and the highest annual average flow of 409 cfs in 1999. Most of the drainage area is comprised of forest and agricultural land, with a small percentage of area served by municipal sewers. Major water uses are irrigation, mines, gravel quarries, domestic, and livestock (Chehalis River Council, 1992). About 20 percent of the land is used for agriculture with dairy farms, tree farms, grazing lands, and crop lands.

The lower reach of Skookumchuck River from its mouth to Hanaford Creek (mouth at Skookumchuck RM 3.8) has been designated as Class A waters (Chapter 173-201A WAC). The upper reach above and including Hanaford Creek has been designated as Class AA. No listings exist in the upper reach. The 1998 303(d) list contains one listing for the lower Skookumchuck River based on 1991-1996 data from Ecology Station 23D055 (RM 2.3). The listing was based on pooled data that showed 2 out of 12 samples exceeding the 200 cfu/100 mL criterion. The proposed 2002 list contains two Category 2 listings. The previous 1998 listing was moved to Category 2 based on 1997 data that showed no exceedances of fecal coliform standards in 9 samples. In addition, the proposed 2002 list contains another Category 2 listing for the mouth of Skookumchuck River. This was based on data collected between 1991 and 1992 by Pickett (1994) which showed one sample out of four exceeding the geometric mean criterion. However, the overall geometric mean was within the standard. For this TMDL, the 1991-1996 data for RM 2.4 were pooled for establishing target reductions.

Based on an annual average flow of 285 cfs (USGS gage 12026150, near Centralia), the maximum loading capacity based on meeting the 90th percentile fecal coliform criterion of 200 cfu/100 mL is 1.4×10^{12} cfu/day.

An analysis of overall fecal coliform data available (1992-1997) for the Skookumchuck River at RM 2.3 in Centralia indicates that only a 16 percent reduction in the fecal coliform population is necessary to bring the water body into compliance with the water quality standard for fecal coliform. However, seasonal evaluation of the data gave a different target reduction goal. Geometric mean and 90th percentile bacterial concentrations were evaluated for consecutive three-, four-, and five- month periods. The geometric mean and 90th percentile values are shown in Figures 14 and 15, respectively. The three-month running geometric means and the 90th percentiles showed maximum exceedance of the criteria during September-November. The seasonal target reduction for this period, based on meeting the limiting 90th percentile criterion of 200 cfu/100 mL, is 79% (Table 11).

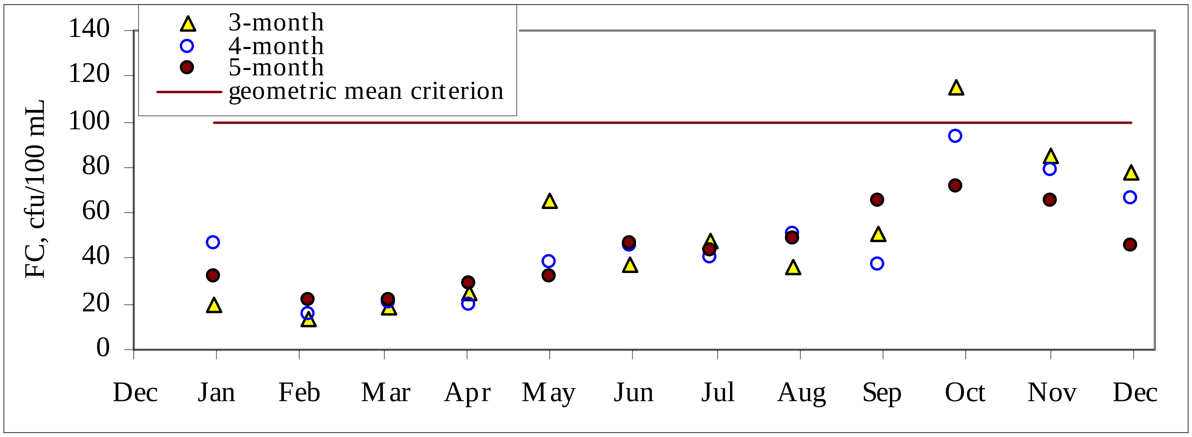

Figure 14. Running 3-, 4- and 5-month geometric mean fecal coliform concentrations for the Skookumchuck River, 1992-1997.

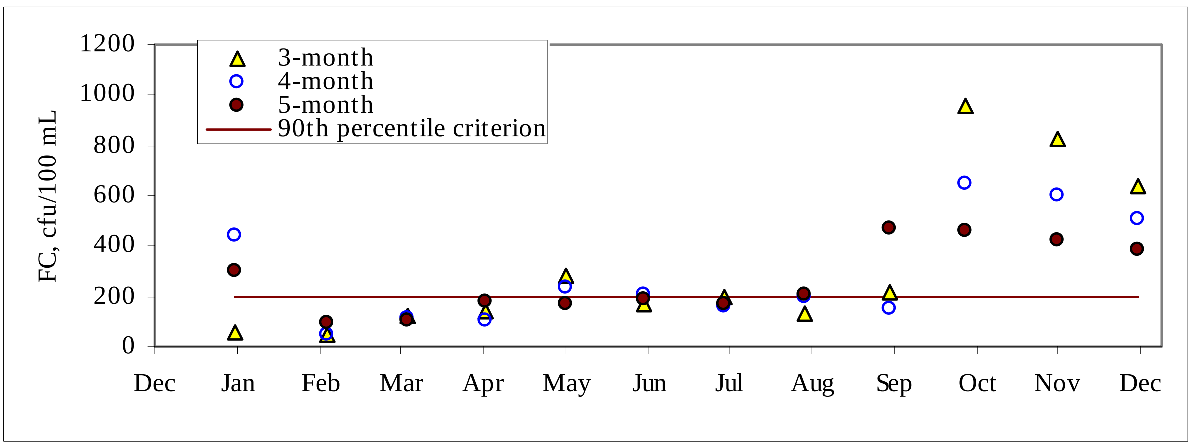

Figure 15. Running 3-, 4- and 5-month 90th percentile fecal coliform concentrations for the Skookumchuck River, 1992-1997.

Table 11. Fecal coliform concentrations and target reductions for the Skookumchuck River, 1992-1997.

Critical months	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
September-November	6	115	960	90th percentile	79

Salzer Creek (RM 69.4)

Salzer Creek enters the Chehalis River from the east at RM 69.4 between the cities of Centralia and Chehalis. The stream is similar to Lincoln Creek in physical characteristics, but is only about three-fourths as long. The Salzer Creek watershed drains an area of 17.3 square miles, and the mean annual discharge is 38 cfs (Chehalis River Council, 1992). For a concentration of 200 cfu/100 mL, the loading would be a maximum of 2×10^{11} cfu/day.

The Salzer Creek valley has been highly developed for residential and commercial uses in the lower third of its length. Serious flood damage has occurred by increasing residential encroachment on the flood plain, from both reduction of valley flood storage and structures constructed in the floodplain.

Coal Creek is a short stream that flows from the east, just north of Chehalis, and enters Salzer Creek between Chehalis and Centralia at RM 1. The lower reaches of Coal Creek are heavily developed commercially. The streambed is of low gradient and primarily has a silty, sandy bed. The upper reaches are in a narrow valley bordered by rural home sites, with the adjacent slopes in timber production. Coal Creek was included on the 1996 303(d) list for one exceedance of the upper criterion, but not included on the 1998 list due to the one single exceedance. Coal Creek has been designated as Category 2 waters in 2002. No target reductions will be required for this Creek. However, this Creek should be monitored due to livestock access locations identified by USFWS (1993).

Salzer Creek is 11.7 miles long with its mouth at Chehalis RM 69.4. One segment at RM 0.2 has been included on the 1996, 1998, and proposed 2002 Category 5 list for fecal coliform bacteria. Another segment at RM 4 has been included on the 1998 and 2002 list. Data used for these listings were collected in 1991-1992 and 1986 for RM 0.2 and RM 4, respectively. Additional data were collected by the Chehalis Indian Tribe in 2000-2002 and evaluated for this TMDL as discussed later. The data are currently being considered for the proposed 2002 list.

In order to establish the percent reduction targets for Salzer Creek, the following should be noted:

- Between the mouth of Salzer Creek (Chehalis RM 69.4) and below the mouth of Coal Creek (Salzer Creek RM 1), a Southwest Washington fairground sump was identified as the source of high fecal coliform bacteria (Pickett, 1994). The sump drains a ditch that serves the fairground, an auction yard, and urban areas.

- Upstream of the mouth of Coal Creek (Salzer Creek RM 1), above Fair Street, the USFWS identified extensive livestock access in the area (USFWS, 1993).

- A failing on-site sewage system was identified upstream of Fair Street and connected to the city sewers in August 1992. This source was likely responsible for elevated concentrations of fecal coliform bacteria during 1992 (Pickett, 1994).

- The Chehalis Indian Tribe monitored Salzer Creek at its mouth and at Airport Road bridge between 2000 and 2002. Since there was a ten-year gap between the monitoring conducted in 1991 by Pickett (1994) and that collected by the tribe, and the probable source of high bacteria during the 1991-1992 period has been eliminated, this study used only 2000-2002 data to establish fecal coliform target reductions at the mouth of the creek. This is shown in Table 12.

Table 12. Fecal coliform concentrations and target reductions for Salzer Creek, 2000-2002.

Year Sampled	Number of samples	Geometric Mean (cfu/100 mL)	90^{th} Percentile (cfu/100 mL)	Limiting basis for reduction	Limiting Target Reduction (%)
2000-2002	22	61	460	90^{th} percentile	57

Dillenbaugh Creek and Tributary (Berwick Creek) (RM 74.7)

The are four fecal coliform listings on the 1998 list for the 8.4 mile segment of Dillenbaugh Creek from the mouth (Chehalis RM 74.7 about a mile below the mouth of Newaukum Creek) to headwaters. Three listings are at or below RM 3.4 at the confluence of Dillenbaugh and Berwick creeks, and one listing is at RM 4.6. There is only one 1996 and 1998 listing for the entire Berwick Creek from the mouth at Dillenbaugh (RM 3.4) to headwaters. Four Category 5 listings each for Dillenbaugh and Berwick creeks are being proposed for the 2002 list based on data collected by Sargeant et al. (2002).

The lower reach of Dillenbaugh Creek between its mouth (RM 0) and its confluence with Berwick Creek (RM 3.4) is an urbanized area with urban stormwater discharge from both Interstate 5 and the city of Chehalis. In addition, an industrial park tributary flows into Dillenbaugh Creek (mouth at RM 3.2) and has been identified as the primary source of fecal coliform bacteria in this reach (Pickett, 1994). The geometric mean of the limited fecal coliform bacteria data (n = 2) at the mouth of the industrial tributary was 1625 cfu/100 mL. Thus, the mouth of this tributary should be monitored, and bacterial sources identified and controlled, during the TMDL implementation phase. Between RM 3.2 and the mouth of Dillenbaugh Creek, the geometric mean and 90th percentile concentrations are 133 cfu/100 mL and 1532 cfu/100 mL respectively.

Primary land uses in the Berwick Creek basin include industry in the lower basin, and agriculture, rural residential, and forestry in the upper basin. Sargeant et al. (2002) collected fecal coliform data from several stations along Berwick Creek and in Dillenbaugh Creek at RM 3.5 between 1998 and 2000. Figure 16 shows that the geometric mean of 100 cfu/100 mL is met in Dillenbaugh Creek before mixing with Berwick Creek. However, within Berwick Creek the water quality standard is exceeded in most of the downstream segments. Since the reach between Berwick Creek RM 5.3 to its mouth shows increasing fecal coliform concentrations, *this should be the priority reach for Berwick Creek where BMPs should be implemented and follow-up monitoring conducted.*

Between 1994 and 1996, the Lewis County Conservation District (LCCD) implemented BMPs on properties adjacent to Berwick Creek as part of the Chehalis Fisheries Restoration Program. No BMPs were implemented above Berwick Creek RM 5.3 (station BW6). Between RM 5.3 and RM 3 is a sheep pasture where 1000 feet of fence and an acre of native vegetation were implemented along the riparian corridor in 1995. Between RM 3 and RM 2 no BMPs were implemented by the LCCD. Between RM 2 and RM 1.7 is a large dairy operation with a few horses where the creek was fenced, with a pasture pump in place for watering the animals. No new BMPs were implemented in this reach by LCCD. Between RM 1.7 and RM 0.6 almost 2600 feet of fencing was installed in 1994-1996 along the riparian corridor, with almost an acre of riparian zone planted with new native trees and shrubs. A large dairy with an approved farm plan occupies the stretch downstream of RM 0.6. It has a waste storage pond, and the creek is fenced on both sides with a ten-foot buffer zone. Although no new BMPs were implemented between RM 0 and RM 0.6, some fencing problems (animals accessing the creek) were associated with high fecal coliform levels in the creek in 1999. This was subsequently corrected.

The ambient monitoring conducted during 1998-2000 (Sargeant et al., 2002) followed the limited BMPs implemented by LCCD and other BMPs already in place. The only additional BMP during the 1998-2000 monitoring period was correction of fencing problem between RM 0 and RM 0.6. Thus, for the mouth of Berwick Creek only the 2000 data will be used. Figure 16 includes all the data for the mouth of Berwick Creek. Figure 17 shows only the 2000 data for the mouth of Berwick Creek.

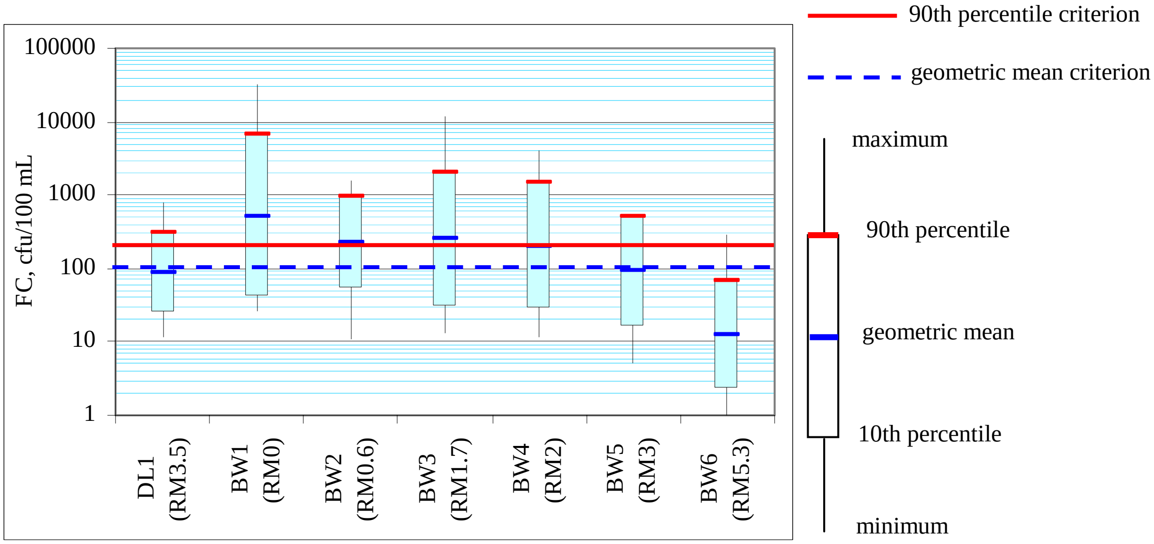

Figure 16. Fecal coliform concentrations in Upper Dillenbaugh and Berwick creeks, 1998-2000.

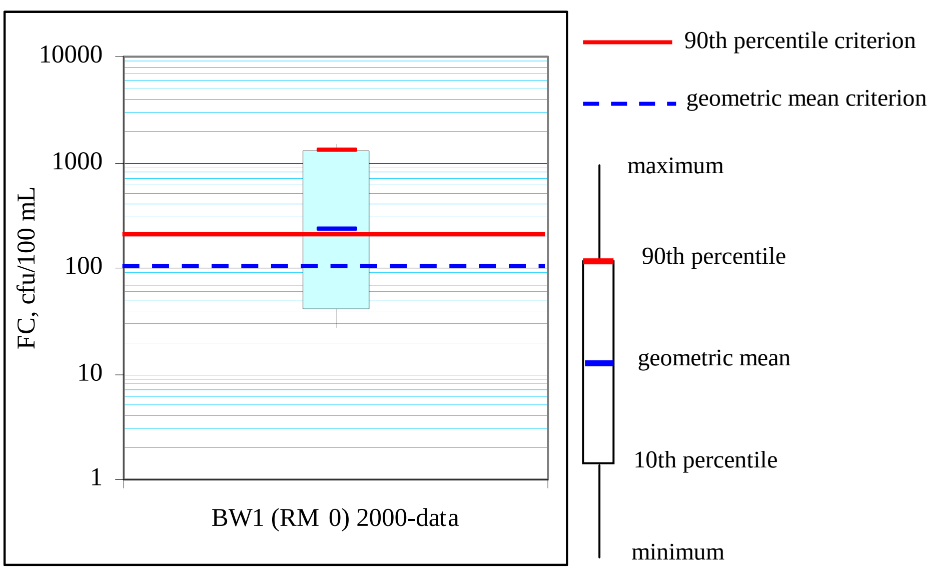

Figure 17. Fecal coliform concentrations at the mouth of Berwick Creek in 2000.

Additional BMPs and proper maintenance of existing BMPs are necessary to further reduce the fecal coliform populations in Berwick Creek and comply with the state water quality standard (Sargeant et al., 2002). The necessary target reductions for both Dillenbaugh and Berwick creeks are shown in Table 13. The annual average flow at the mouth of Dillenbaugh Creek is approximately 58 cfs. For a concentration of 200 cfu/100 mL, the loading would be a maximum of 3 x 10^{11} cfu/day.

Table 13. Fecal coliform concentrations and target reductions for Dillenbaugh and Berwick creeks, 1998-2000.

Location	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
Dillenbaugh Creek at mouth	12	133	1532	90^{th} percentile	87
Dillenbaugh Creek above Berwick Creek (RM 3.4)	25	69	313	90^{th} percentile	36
Berwick Creek at mouth	11	228	1500	90^{th} percentile	87

Newaukum River (RM 75.2)

The mainstem Newaukum River is a 10.9-mile river from the mouth at Chehalis RM 75.2 to the confluence of the North and South forks (RM 10.9). There is one fecal coliform listing on the 1996 and 1998 303(d) lists for the Newaukum River segment at RM 0.15. In the proposed 2002 list, two segments of the Newaukum River (RM 0.15 and RM 4.2) were placed on the Category 2 list. These listing were based on data from 1991-1993 (RM 0.15) and from 1996-1997 (RM 4.2). For RM 0.15, the data showed 1 out of 9 samples exceeding the upper criterion of 200 cfu/100 mL in 1993. For RM 4.2, 1 of 3 samples and 1 of 9 samples exceeded the upper criterion in 1996 and 1997 respectively. Data collected between 1991 and 1993 were pooled for RM 0.15, and data between 1996 and 1997 were pooled for RM 4.2 as discussed below.

The Newaukum sub-basin in eastern Lewis County comprises a drainage area of 173 square miles or 6% of the total drainage area of the Chehalis River basin. The average annual flow in the mainstem (USGS gage 12025000 near Chehalis) was 548 cfs during 1990-2000, with the lowest annual average flow of 330 cfs in 1992 and the highest annual average flow of 747 cfs in 1996.

Crop and pastureland comprise about 19 percent of the drainage area. Agriculture represents the largest single-purpose use of water. The existing population is less than 13,000 people and is not expected to be higher than 15,000 by 2010. Residential houses are on on-site sewage treatment systems. However, 98 percent of the total acreage is considered to have severe on-site sewage treatment system limitations due to poor soils and a high groundwater table (Chehalis River Council (1992). The Chehalis River Action Plan (Chehalis River Council, 1992) contains recommendations for maintenance of existing on-site sewage treatment systems and identification/repair/elimination of failing on-site sewage treatment systems.

Figure 18 shows historical fecal coliform data for the Newaukum River. Data from the mouth of Newaukum River (RM 0.15) collected during 1991-93 show that the geometric mean was well within the water quality standard. However, the 90^{th} percentile criterion (200 cfu/100 mL) was exceeded in 25 percent of the samples. At RM 4.5 near Chehalis, relatively recent data (1996-97) show a geometric mean of 97 cfu/100 mL and a 90th percentile of 365 cfu/100 mL. Data for the North and South forks are 28 years old. However, they show that the North Fork had substantial exceedances of the 90^{th} percentile criterion. Additional monitoring is recommended for the North and South forks to gather more current data. In addition, the mouth of the Newaukum River should be monitored while BMPs are being implemented.

Figure 19 shows the seasonality of the fecal coliform concentrations at the mouth of the Newaukum River. Bacteria concentrations tend to be high in April, November, and December.

Table 14 shows the necessary fecal coliform reductions at the mouth of the Newaukum River needed to meet state water quality standards. The most restrictive criterion is the 90^{th} percentile standard of 200 cfu/100 mL. Based on an average flow of 548 cfs, the loading corresponding to a concentration of 200 cfu/100 mL is 2.7×10^{12} cfu/day.

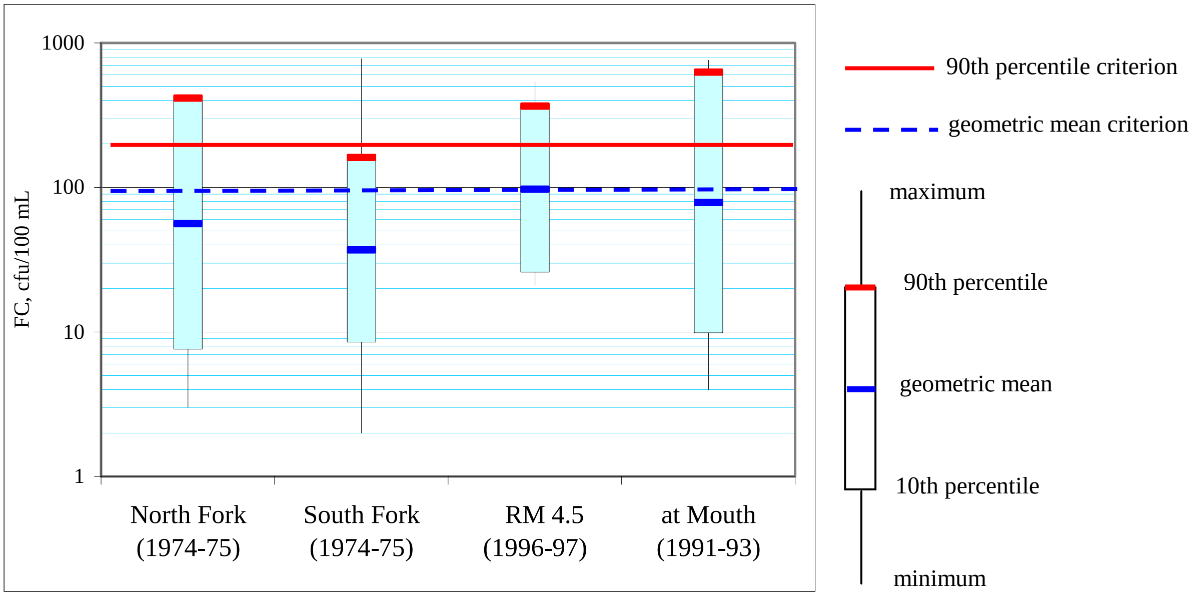

Figure 18. Fecal coliform concentrations along the Newaukum River, 1974-1997.

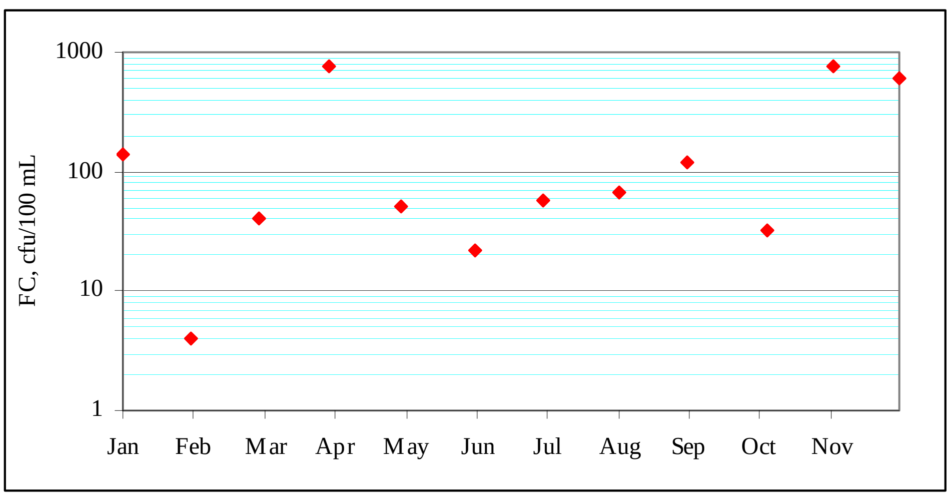

Figure 19. Seasonality of fecal coliform concentrations at the mouth of the Newaukum River, 1991-1993.

Table 14. Target reductions for the Newaukum River, 1991-1993.

Location	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 ml)	Limiting basis for reduction	Target Reduction (%)
Newaukum River at mouth	12	78	625	90th percentile	68

3. Upper Mainstem Segment

The third mainstem segment on the 303(d) list (1996, 1998, and proposed 2002) is between RM 75.4 (above Newaukum River) and RM 106.7 (below Rock Creek). It includes one listing for the mainstem Chehalis River and six listings for tributaries and sub-tributaries. Four segments of the mainstem are being proposed as Waters of Concern (Category 2) on the 2002 list. Elk Creek was listed on the 303(d) list in 1996 and 1998, but included on the proposed 2002 list as Category 2 waters.

Bunker Creek was listed in 1996, de-listed in 1998, and re-proposed for listing as Category 5 waters on the 2002 list, along with its tributary Deep Creek. The South Fork Chehalis River and two of its tributaries, Lost (Valley) Creek and Lake Creek, are being proposed for Category 5 2002 listing: one segment in SF Chehalis River, three segments in Lost (Valley) Creek, and one segment in Lake Creek. Two segments in Stearns Creek are also being proposed for Category 5 2002 listing.

Mainstem in Dryad (RM 101.7)

Ecology has been collecting monthly ambient data at the mainstem Chehalis River station in Dryad (RM 101.7) since 1978. Figure 20 shows the long-term geometric means and 90th percentile fecal coliform concentrations for all months of the year. September and October are the critical months, with the highest concentrations of fecal coliform bacteria. The 90th percentile fecal coliform concentration in November is just below the 90th percentile criterion. The geometric mean criterion of 100 cfu/100 mL is met in all months. However, the 90th percentile criterion of 200 cfu/100 mL is not met during September and October. Concentrations in September were the highest. Therefore, the recommended target reduction is based on September as shown in Table 15.

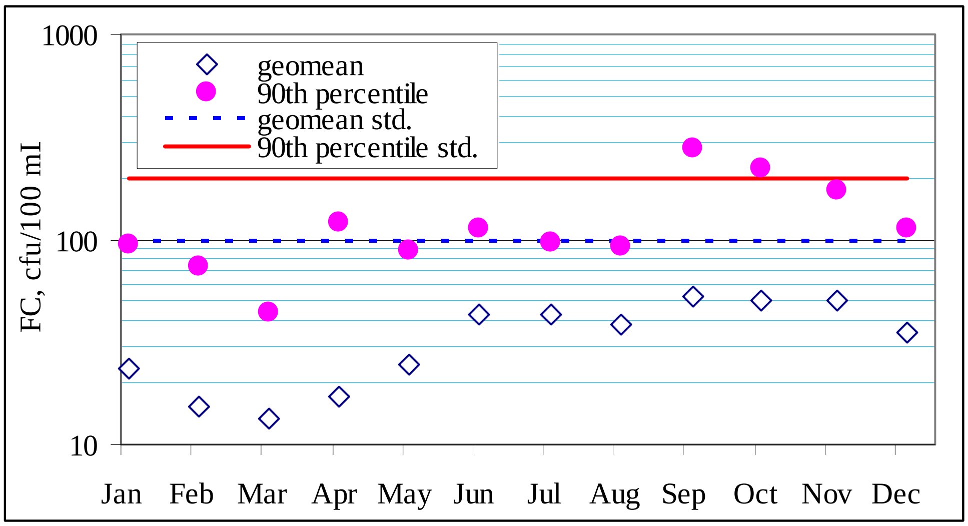

Figure 20. Long-term monthly geometric mean and 90th percentile fecal coliform concentrations at RM 101.7, 1978-2002.

Table 15. Fecal coliform concentrations and target reductions for the mainstem Chehalis River at RM 101.7, 1978-2002.

Month	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 ml)	Limiting basis for reduction	Target Reduction (%)
September	24	52	280	90th percentile	29

Stearns Creek (RM 78.1)

Two listings for Stearns Creek are being proposed on the 2002 Category 5 list, based on data collected in 1998-99 by Schlorff (1999). Stearns Creek flows into the Chehalis River at RM 78.1 near State Route 6 and the town of Adna. The drainage area is approximately 20 square miles. Below Stearns Creek RM 3.5, there are at least two dairies and a cattle ranch. There are a few residential dwellings that are on on-site sewage treatment systems. Above Stearns Creek RM 3.5, there are also several individuals who have cattle, horses, and sheep; however, the lower reach of the creek (below RM 3.5) has more animals per square mile (Schlorff, 1999). USFWS (1993) estimated that 26% of the stream miles of this creek were degraded by livestock impacts.

Evaluation of the data collected during the 1998-1999 wet season by Schlorff (1999) at RM 0.6 (Twin Oaks Road bridge) and RM 3.5 (Pleasant Valley Road bridge) shows that coliform bacteria reductions are needed along the whole reach of Stearns Creek (Figure 21). The target reduction at the mouth of Stearns Creek is shown in Table 16. During the 1998-1999 wet season, the average flow in the creek was 219 cfs. For a concentration of 200 cfu/100 mL, the loading would be a maximum of 1.1 x 10^{12} cfu/day.

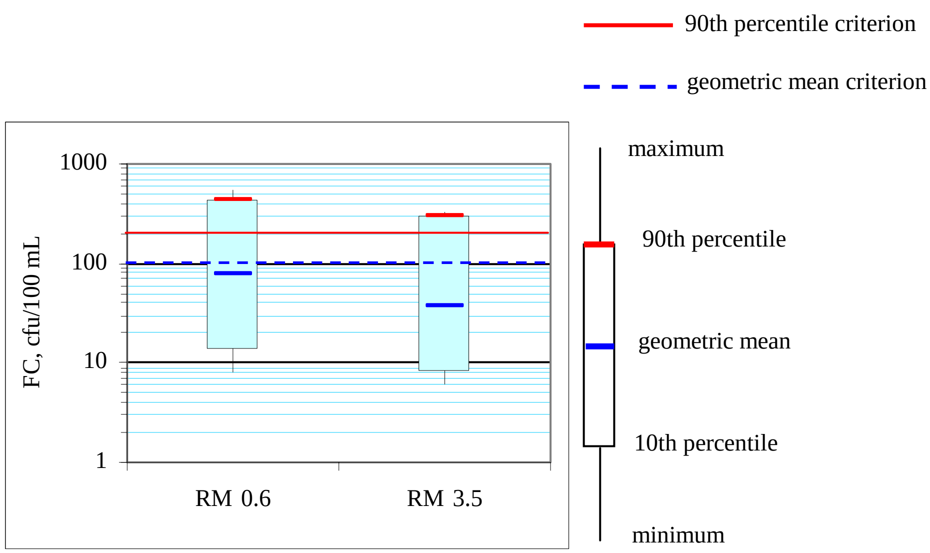

Figure 21. Fecal coliform concentrations along Stearns Creek, 1998-1999.

Table 16. Fecal coliform concentrations and target reductions for Stearns Creek, 1998-1999

Segment	Number of samples	Geometric Mean (cfu/100 mL)	90^{th} Percentile (cfu/100 ml)	Limiting basis for reduction	Target Reduction (%)
Stearns Creek near mouth	12	77	443	90^{th} percentile	55

Bunker Creek and Tributary (Deep Creek) (RM 84.8)

Bunker Creek enters the Chehalis River at RM 84.8. Deep Creek, the main tributary to Bunker Creek, is 6.4 miles long and drains a network of smaller tributaries including Canyon Creek, Rudolph Creek, and Tapp Creek. Within the lower four miles of Deep Creek, land use is primarily rural residential with numerous small animal-keeping operations. Above Deep Creek RM 4.5, land use is primarily forestry and recreation.

In 1996, Bunker Creek was included in the 303(d) list based on one of two samples (collected in 1991) exceeding the upper criterion at RM 0.6 (Pickett, 1994). Due to limited data, the segment was delisted in 1998 and included in Category 2 in the proposed 2002 list. From 1994 to 1999, data were collected in Bunker Creek (RM 0.5) and at several locations (RM 2.4, RM 3.6, RM 3.9) along Deep Creek (Sargeant et al., 2002). Based on these data, Bunker Creek (RM 0.5) and Deep Creek (RM 2.4) were included on the proposed 2002 Category 5 list. Deep Creek segment at RM 3.6 was included on the proposed Category 2 list based on 3 data points collected in 1999 that showed exceedance of the upper and lower criteria but did not meet the guidance policy (Ecology 2002) for Category 5 listing. Additional data collected in prior years were considered in establishing the overall geometric mean and 90th percentile fecal coliform concentrations at this station. This is discussed below.

Several BMPs have been installed along Deep Creek both prior to and during the 1994-1999 monitoring period. The landowner just above RM 3.9 keeps a herd of cattle, and the property along the creek has been fenced for many years. A site above RM 3.6 where 11 heads of cattle were kept received 1300 feet of fencing in 1994-95, with additional fencing completed for Rudolph Creek, a sub-tributary to Deep Creek, in 1997 (Sargeant et al., 2002). Between RM 3.6 and RM 2.4 a landowner keeps approximately 20 cattle and a few horses. Between 1995 and 1996, fencing was installed along 3000 feet on both sides of the creek with one animal access point. In 1997 an independent review of BMPs showed that the animal access point allowed livestock access to the upstream riparian zone (Sargeant et al., 2002).

Data collected near the mouth of Bunker Creek (1994-1999) show that the geometric mean concentrations were at or below the water quality standard, but the 90th percentiles were not (Figure 22 and Table 17). The geometric mean and 90th percentile fecal coliform concentrations at RM 2.4 of Deep Creek are an order of magnitude higher than that at the mouth of Bunker Creek. It is likely that reducing fecal coliform bacteria in Deep Creek will bring Bunker Creek to within water quality standards. Fecal coliform target reductions of 85% and 30% are necessary for Deep and Bunker creeks, respectively, to comply with water quality standards. Source reduction efforts should be focused between RM 2.4 and RM 3.9 of Deep Creek. Average flow in Bunker Creek based on 1994-1999 data is 26 cfs. For a concentration of 200 cfu/100 mL, the loading would be a maximum of 1.3×10^{11} cfu/day.

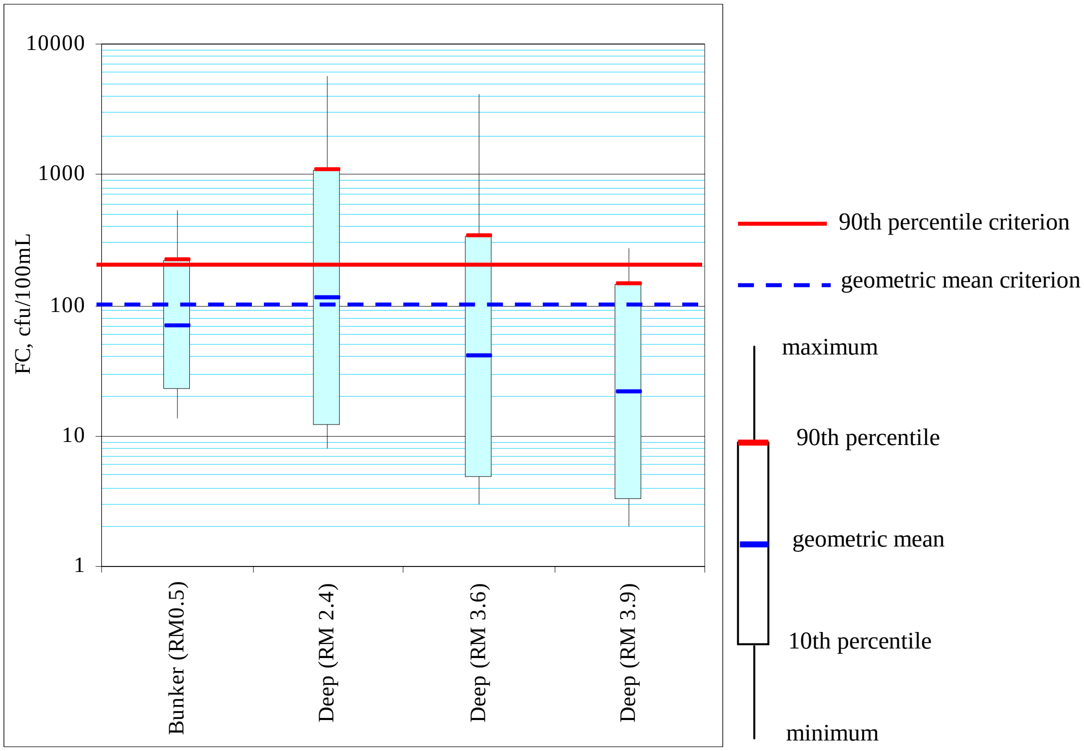

Figure 22. Fecal coliform concentrations near the mouth of Bunker Creek and along Deep Creek, 1994-1999.

Table 17. Fecal coliform concentrations and target reductions for Bunker and Deep creeks, 1994-1999.

Segment	Number of samples	Geometric Mean (cfu/100 mL)	90th Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
Bunker Creek (RM 0.5)	23	71	286	90th percentile	30
Deep Creek (RM 2.4)	23	136	1348	90th percentile	85

South Fork Chehalis River and Tributaries (Lake, Stillman, and Lost Creeks) (RM 88.3)

The mouth of the South Fork Chehalis River is at RM 88.3. The major tributaries to the South Fork Chehalis River are Lake Creek (mouth at SF Chehalis River RM 1.5) and Stillman Creek (mouth at SF Chehalis River RM 5.5). Lost Creek is a tributary to Stillman Creek at RM 0.2.

Segments of the South Fork Chehalis River, Lake Creek, and Lost Creek included on the 2002 proposed 303(d) list have not been previously listed (i.e., on the 1998 or 1996 list). The 2002 proposed listing for the South Fork is based on ambient data collected by Ecology during 1996-97. The data were not available when the 1998 303(d) list was finalized. Data collected in1998-1999 by Schlorff (1999) were used to include Lake and Lost creeks on the proposed 2002 list. One segment of the South Fork Chehalis River (RM 0.7) was listed in 1996 but was delisted in 1998 and later included in Category 2 on the proposed 2002 list due to only two data points at this location.

The USFWS (1993) identified cattle access over 21% of the stream miles in the South Fork basin. Numerous dairies have been identified in the South Fork basin, including one at the mouth of Lake Creek near Curtis and ten in the Boistfort area.

Data from the South Fork Chehalis River, collected by Ecology (12 data points in the 1996-1997 period) at Curtis (RM 4), show the geometric mean at 117 cfu/100 mL and the 90th percentile at 481 cfu/100 mL (Figure 23 and Table 18). The target reduction based on meeting a 90th percentile criteria of 200 cfu/100 mL is 58%. The wet weather average flow (1997-2001) is 346 cfs. For a concentration of 200 cfu/100 mL, the loading would be 1.7 x 10^{12} cfu/day.

Lake Creek

Lake Creek is a tributary to the South Fork Chehalis River (RM 1.5). Along the creek, there are several farms with cattle, sheep, and horses. Field observations (Schlorff, 1999) noted that very few of the animals were restricted from the stream, and BMPs were minimal or not being used. Data gathered at RM 0.5 at the Curtis Hill Road bridge during the 1998-99 wet season (13 data points) showed a fecal coliform geometric mean of 74 cfu/100 mL and a 90th percentile of 320 cfu/100 mL (Schlorff, 1999). The target reduction based on meeting the 90th percentile of 200 cfu/100 mL is 40% (Table 18).

Lost Creek

Lost (Valley) Creek is a tributary to Stillman Creek (RM 0.2) which, in turn, is a tributary to the South Fork Chehalis River (RM 5.5). Samples were taken at approximately RM 0.7 (Lost Valley Road bridge, west of Boistfort Road), downstream of the geodesic dome (RM 1.5) and at the culvert where the creek crosses the road (RM 2.5). Data from the upstream station are very limited (2 or 3 data points) and could not be evaluated. Data from the mouth of Lost Creek (Schlorff, 1999) show the geometric mean and 90th percentile concentrations to be 56 cfu/100 mL and 462 cfu/100 mL, respectively (13 data points). Based on meeting a 90th percentile criteria of the 200 cfu/100 mL, the target reduction for this creek at the mouth is 57% (Table 18).

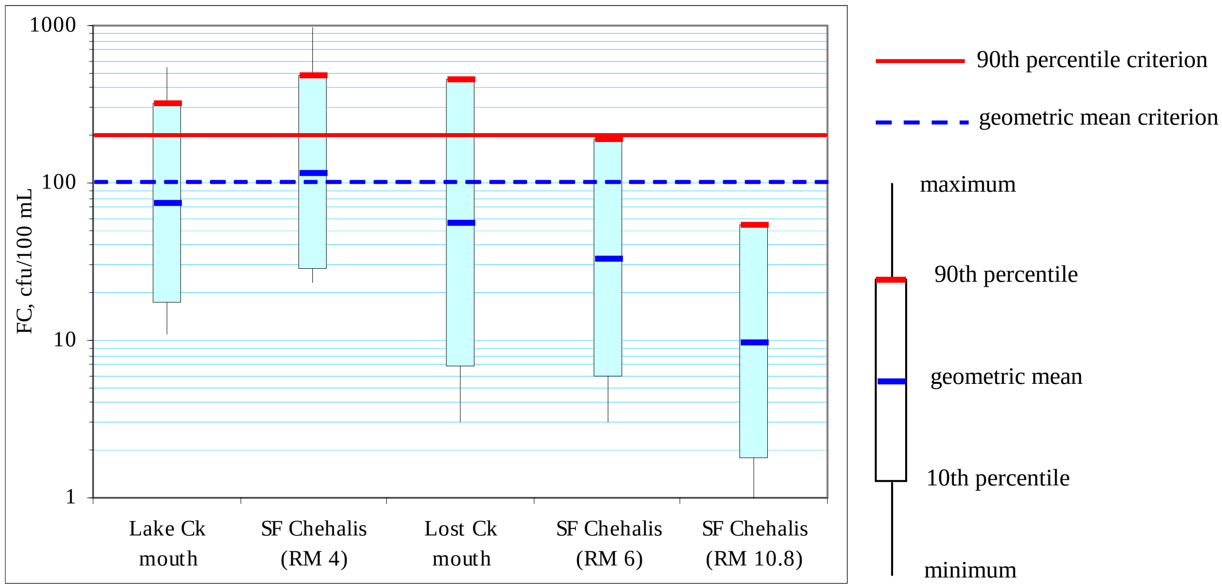

Figure 23. Fecal coliform concentrations along the South Fork Chehalis River and tributaries, 1996-1999.

Table 18. Fecal coliform concentrations and target reductions for the South Fork Chehalis River and tributaries, Lake and Lost (Valley) creeks, 1996-1999.

Segment	Number of samples	Geometric Mean (cfu/100 mL)	90^{th} Percentile (cfu/100 mL)	Limiting basis for reduction	Target Reduction (%)
South Fork Chehalis River RM 4.0	12	117	481	90^{th} percentile	58
Lake Creek	13	74	320	90^{th} percentile	40
Lost (Valley) Creek	13	56	462	90^{th} percentile	57

Wasteload Allocations

All point sources in the watershed should meet the water quality standards for fecal coliform bacteria either at the end-of-pipe or at the edge of an authorized mixing zone. There are seven major point sources of fecal coliform bacteria in the mainstem Upper Chehalis River: Grand Mound sewage treatment plant (STP), Centralia STP, Chehalis STP, West Farm Foods wastewater treatment plant (WWTP), Pe Ell STP, Cedar Creek Department of Corrections STP, and Lewis County Water District No. 2 STP. The Maple Lane School STP is now being routed to the Grand Mound STP. All seven facilities have NPDES permits that limit the fecal coliform concentrations in the effluent. These are discussed below.

1. The Grand Mound STP (RM 59.17) is located in Rochester and has an NPDES permit No. WA0042099 issued in December 2003. The permit limits the fecal coliform concentrations at the outfall to a monthly geometric mean of 200 cfu/100mL and a weekly geometric mean of 400 cfu/100 mL (technology-based limits as per Chapter 173-221 WAC). With a dilution factor of 22, the water quality standard for fecal coliform bacteria is met at the edge of the mixing zone. Maximum monthly average flow is 0.38 million gallons per day (MGD). The maximum monthly average fecal coliform loading from the plant is 2.9×10^{9} cfu/day. The facility currently uses chlorination to reduce fecal coliform bacteria populations. The effluent limits are deemed protective of water quality standards.

2. The Centralia STP (RM 67.4) has an NPDES permit No. WA0020982 issued in May 2002. The permit limits the fecal coliform concentrations at the outfall to a monthly geometric mean of 200 cfu/100mL and a weekly geometric mean of 400 cfu/100 mL (technology-based limits as per Chapter 173-221 WAC). With a dilution factor of 4 (May-Oct) and 6.8 (Nov-Apr), the water quality standard for fecal coliform bacteria is met at the edge of the mixing zone. Therefore, the current effluent limits are deemed protective of water quality standards. The maximum monthly average flow is 4.3 MGD. The maximum monthly average fecal coliform loading from the plant is 3.3×10^{10} cfu/day. A new treatment plant has been built downstream of the confluence of the Skookumchuck and Chehalis rivers. A new outfall has also been constructed. The new treatment facility, expected to be operational in 2004, employs a dual (redundant) ultra-violet disinfection system, which provides relatively higher level of treatment compared to chlorination used in the old treatment facility.

3. The Chehalis STP (RM 74.3) has an NPDES permit No. WA-002110-5 issued in October 1996. The permit limits the fecal coliform concentrations at the outfall to a monthly geometric mean of 200 cfu/100mL and a weekly geometric mean of 400 cfu/100 mL (technology-based limits as per Chapter 173-221 WAC). With a dilution factor of 6.8 (May-Oct) and 10.6 (Nov-Apr), the water quality standard is met at the edge of the mixing zone. Maximum monthly average flow is 4 MGD. The maximum monthly average fecal coliform loading from the plant is 3×10^{10} cfu/day. The facility currently uses chlorination to reduce fecal coliform bacteria populations. The effluent limits are deemed protective of water quality standards.

The city of Chehalis is currently soliciting funds for a new wastewater treatment plant. Plans and specifications for the new plant have been approved by Ecology. The new treatment plant will include coagulation, filtration, UV disinfection, and post-chlorination abilities. The new plant is intended to produce reclaimed water for reuse during periods of low river flow (seven-day average flow of less than 1000 cfs) with no discharge to the Chehalis River. When flows are higher (seven-day average flow greater than 1000 cfs), the new STP will discharge to the river. However, the new ultra-violet disinfection system will provide relatively higher level of treatment compared to chlorination used in the existing facility.

4. West Farm Foods (formerly Darigold) WWTP (RM 74.4) has an NPDES permit No. WA0037478 issued in June 2000 and modified in May 2003. Currently, the effluent limits for fecal coliform bacteria are a monthly geometric mean of 200 cfu/100mL and a daily maximum of 400 cfu/100 mL (technology-based limits). With a dilution factor of 17.7 (May-Oct) and 61.7 (Nov-Apr) (Anderson, 2003), the water quality standard is met at the edge of the mixing zone. The maximum monthly average fecal coliform loading from the plant based on a flow of 0.9 cfs is 4.4×10^9 cfu/day. The facility currently uses chlorination to reduce fecal coliform bacteria populations. The effluent limits are deemed protective of the water quality standard.

5. The Pe Ell STP (RM 105.5) was issued an NPDES permit No. WA0020192 in 1995. A new NPDES permit is being issued to the facility with new effluent limitations reflective of the plant upgrade. The previous fecal coliform limitations of 200 cfu/100 mL and 400 cfu/100 mL as monthly and weekly geometric mean, respectively, will be changed to 100cfu/100 mL and 200 cfu/100 mL, respectively. The new technology-based limitation is reflective of a new state-of-the-art, ultra-violet disinfection system installed at the facility. The dilution factor at the edge of the chronic mixing zone has been estimated at 19.4. Since the facility is now meeting water quality standards at the end-of-pipe, the maximum monthly average loading from the plant based on a maximum monthly flow of 0.78 MGD is 2.95×10^9 cfu/day.

6. The Cedar Creek Department of Corrections STP (on Mill Creek) is located in Littlerock and has a NPDES permit WA0037737 issued in March 2001. The facility discharges to Mill Creek, which is a tributary to Mima Creek, Black River, and the Chehalis River. This facility currently meets the water quality standard at the end of the pipe and has a NPDES permit that limits the fecal coliform bacteria to 100 cfu/100 mL and 200 cfu/100 mL as monthly and weekly geometric mean, respectively. The facility currently uses an ultra-violet disinfection system. The maximum monthly average loading from the plant based on a maximum monthly flow of 0.067 MGD is 5×10^8 cfu/day.

7. The Lewis County Water District No. 2 STP is located in Onalaska and has a NPDES permit No. WA0024546B issued in May 1999. The facility discharges to the South Fork Newaukum River at RM 20.1. Currently, the effluent limits for fecal coliform bacteria are a monthly geometric mean of 200 cfu/100mL and a weekly geometric mean of 400 cfu/100 mL (technology-based limits). With a dilution factor of 23.4, the water quality standard is met at the edge of the mixing zone. The facility currently uses an ultra-violet disinfection system. The maximum monthly average loading from the plant based on a maximum monthly flow of 0.2 MGD is 1.5×10^9 cfu/day.

Loading Capacity Summary

"Loading capacity" means the maximum amount of pollution a waterbody can withstand and still fulfill beneficial uses (i.e., meet state water quality standards). In this TMDL, it is assumed that if the individual tributaries and segments of the mainstem Chehalis River were to meet the water quality standard, then the water quality standard at the lower watershed boundary will be met.

Load Allocation

"Load allocations" are the nonpoint source reductions needed in each segment for the load capacity to be met. Individual load allocations for the tributaries and mainstem are summarized in Table 19.

Table 19. Summary of fecal coliform target reductions.

Waterbody/Segment	Waterbody ID	Proposed 2002 category	Number of segments in each category	Loading capacity (cfu/day)	% reduction needed
Chehalis Mainstem at RM 33.8 (Porter)	DS29ZH	Category 2	1	3.6×10^{12}	64
Chehalis Mainstem at RM 54.7 (Independence Road)	DS29ZH	----			79
Chehalis Mainstem at RM 59.9 (Prather Road)	DS29ZH	----			86
Chehalis Mainstem at RM 67.5 (Centralia)	DS29ZH	Category 5	1		74
Chehalis Mainstem at RM 101.7 (Dryad)	DS29ZH	Category 5	1		29
Tributaries to Black River (Chehalis Rm 47)	GW14BM			0.7×10^{12}	
Beaver Creek at mouth (at Black RM 16.8)	HA04TR	Category 4a	4		73
Allen Creek at mouth (at Beaver Ck RM 2.6)	XO13OJ	*Category 4a	1		54
Dempsey Creek at mouth (at Black RM 24.2)	FM81JM	Category 5	1		93
Scatter Creek (Chehalis RM 55.2)	AQ85FY			3×10^{11}	
Mainstem at RM 8	AQ85FY	----			51
Mainstem at RM 19	AQ85FY	----			81
Lincoln Creek (Chehalis RM 61.9)	AP15HC			6×10^{11}	
Mainstem at RM 1.2	AP15HC	Category 2	1		84
Mainstem at RM 8.8	AP15HC	----			63
Mainstem at RM 10	AP15HC	Category 5	1		70
Skookumchuck River at mouth (Chehalis RM 67)	BV55DP	Category 2	1	1.4×10^{12}	79
Salzer Creek at mouth (Chehalis RM 69.4)	QF44VO	Category 5	2	2×10^{11}	57
Dillenbaugh Creek at mouth (Chehalis RM 74.7)	EV39SR	Category 5	2	3×10^{11}	87
Mainstem at RM 3.4	EV39SR	Category 5	2		36
Berwick Creek at mouth (at Dillenbaugh RM 3.4)	KB60UI	Category 5	4		87
Newaukum River at mouth (Chehalis RM 75.2)	WC81/BX	Category 2	2	2.7×10^{12}	68
Stearns Creek (Chehalis RM 78.1)	EV19TA	Category 5	2	1.1×10^{12}	55
Bunker Creek at mouth (Chehalis RM 84.8)	GG93MD	Category 5	1	1.3×10^{11}	30
Deep Creek at RM 2.4	MK50YR	Category 5	1		85
South Fork Chehalis River (Chehalis RM 88.3)	AR82EA			1.7×10^{12}	
Mainstem at RM 4 (Curtis Road)	AR82EA	Category 5	1		58
Lake Creek at mouth (at SF Chehalis RM 1.5)	VY01TK	Category 5	1		40
Lost (Valley) Creek at mouth	XQ54GH	Category 5	3		57

---- Being considered for listing based on recent data

*Currently in Category 4A but being proposed as Category 5 because it has no previous load allocation

Wasteload Allocation

"Wasteload allocations" are effluent limits recommended for point sources for meeting water quality standards either at the end of pipe or at the edge of an authorized mixing zone. The existing water-quality-based effluent limits contained in NPDES permits, issued by Ecology, in the Upper Chehalis River watershed are deemed protective of the water quality standards. The existing effluent limits for the point sources in the Upper Chehalis River watershed are summarized in Table 20.

Table 20. Summary of effluent limitation for fecal coliform bacteria in NPDES permits for point sources.

Point Sources		Geometric Mean (cfu/100 mL)	
		monthly	weekly
1	Grand Mound STP	200	400
2	City of Centralia STP	200	400
3	City of Chehalis STP	200	400
4	West Farm Foods WWTP	200	400*
5	City of Pe Ell STP	100	200
6	Cedar Creek Department of Corrections STP	100	200
7	Lewis County Water District No. 2 STP	200	400

* Daily maximum limit

Margin of Safety

The target reductions recommended in this report for all segments of the mainstem Upper Chehalis River and its tributaries are based on observed fecal coliform concentrations. Compliance with the water quality standards will ultimately be achieved through BMP implementation and follow-up monitoring to determine what, if any, adjustments to cleanup strategies are needed.

The target reductions are assumed to be achieved through implementation and maintenance of BMPs. However, it is likely that BMPs may reduce bacteria concentrations in excess of the target reductions. For example, if cattle access is responsible for high bacterial concentrations, then if access is restricted, the source may be completely eliminated, resulting in higher reduction of bacteria than the target.

The estimated targets do not account for any bacterial die-off in the water column or during longer travel times. As sources (i.e., cattle) are removed further from the stream by riparian fencing and an increased buffer zone, this would allow for increased bacterial travel time from the cattle to the stream during a storm event. There would be greater exposure of the bacteria to the environment and potential bacteria die-off.

Where possible, target reductions were established based on consideration of a critical month - the month with the highest bacterial concentrations. BMPs based on such target reductions, and applied year-round, would substantially reduce annual bacterial loads.

In some instances, like for the Skookumchuck River, target reductions were higher (79%) when based on running three-month 90th percentile concentrations than when based on all the data (16%). BMPs based on the higher target will substantially reduce the annual load from the Skookumchuck River.

Target reductions were based on a 90th percentile of fecal coliform distribution which takes into account the variability of the data, and is more conservative than the 10 percentile water quality criterion which allows for 10 percent of the samples to exceed the criterion without considering the distribution of the data.

Another example helps illustrate how the margin of safety is carried into implementation of the TMDL. In the discussion of the mainstem Chehalis River at Prather Rd, Figure 9 shows the geometric mean and the 90th percentile values for each month of the year based on data from six years. Figure 9 also illustrates that a high spike in concentration was observed during November. The target reduction goal (Table 6) was calculated using the November data because that was the critical month demonstrated to need the most protection (reduction of bacteria levels). Bacteria concentrations either exceeded the criteria or were close to failing during at least five other months (Figure 9). Consequently, the TMDL expects that cleanup actions should be applied throughout the year with special focus during November.

Monitoring Strategy Recommendations

The Upper Chehalis River watershed consists of many segments, tributaries, and sub-tributaries that do not meet Washington State water quality standards for fecal coliform bacteria. Target load reductions established in this report should help focus and prioritize cleanup strategies in impaired segments. The following recommendations are made to help in this effort.

- Use the highest reduction targets to prioritize where resources should be invested first.
- Begin implementation of best management practices (BMPs) first at the most upstream segment, tributary, or sub-tributary. Monitoring should follow wherever BMPs are implemented.
- As the segment, tributary, or sub-tributary with the worst problem is brought into compliance with water quality standards, the monitoring effort should be moved to a less severe area where the next set of BMPs would be implemented.
- Basic BMPs such as fencing and riparian buffer zones to keep cattle out of rivers and streams should be required throughout the watershed. Also, failing on-site sewage treatment systems within the watershed need to be replaced to improve the long-term health of the watershed.

Ongoing monitoring of water quality trends and activity implementation is essential in order to:

- Show where water quality is improving
- Help locate sources of pollution
- Help indicate effectiveness of cleanup activities
- Document achievement of compliance with state water quality standards

In addition to monitoring segments that have recommended target reductions, other segments are recommended for monitoring (Table 21). These segments have limited data that show potential exceedances of the water quality standards.

Table 21. Segments with limited data and recommended for further monitoring.

Waterbody	Monitoring Location
*Chehalis River	RM 74.6 (below Dillenbaugh Creek)
Chehalis River	RM 106.3
Coal Creek	RM 0.87 (at National Avenue)
Elk Creek	RM 0.5 (near Doty)
NF Lincoln Creek	RM 0.8 (at Lincoln Creek Road)
SF Lincoln Creek	RM 1.4 (at Lincoln Creek Road)
NF Newaukum River	RM 0.3 (at Forest)
SF Newaukum River	RM 0.2 (at Forest)

* The proposed 2002 listing is being changed from Category 5 to Category 2 due to insufficient data.

Water quality monitoring plans will continue to be implemented in different parts of the watershed. Ecology is developing a comprehensive monitoring plan to help focus and coordinate the monitoring being planned by various parties in the Chehalis Basin. These include those with direct responsibility for implementing the TMDL, as well as those who serve in a coordinating role such as the Chehalis Basin Partnership (CBP) and a water quality committee of the CBP.

Ecology's comprehensive monitoring plan is due for completion during the summer of 2004. The plan will identify the parties doing sampling as well as what, where, when, how, and why. The plan is intended to serve as a Quality Assurance Project Plan that can guide the monitoring work either individually or collectively by different parties throughout the basin. The monitoring plan will be one outcome of a Detailed Implementation (cleanup) Plan for the Chehalis basin.

This TMDL study used the most current monitoring data available. While some data were from last year (2003), others were from previous years. Land-use changes since the sampling took place may have resulted in changes in pollution levels. Implementation of a monitoring strategy should provide a more accurate picture of current water quality conditions in the basin. Ongoing monitoring will help prioritize areas and strategies for cleanup**.**

If ambient monitoring data show that progress towards targets is not occurring, compliance water quality monitoring will occur. Compliance monitoring will be designed to verify preliminary data and then identify the specific sources of fecal coliform bacteria. Sampling over time will be adjusted to locate the sources by narrowing the geographic area where contamination is occurring.

A new sampling site in the Upper Chehalis River was added to Ecology's ambient monitoring program in October 2001. This station at Prather Road will be in place at least through 2004.

Ecology, and EPA with use of their 319 nonpoint water quality protection grants, will continue to support monitoring work by others throughout the basin:

- The Chehalis River Council will continue their Upper Chehalis sampling through 2004.
- Grant funding is expected to supplement monitoring by conservation districts and local volunteer groups.
- A water quality education and monitoring project operated by Educational Service District 113 and the Chehalis Basin Education Consortium will continue to involve 4^{th} through 12^{th} grade and community college students. By testing chemical and biological parameters, the students will learn scientific methods and develop a better understanding and appreciation for their watershed.

Data provided by non-Ecology sources will have positive informational value to help document progress being made to meet the TMDL targets. Results also will help to refine and adapt water cleanup strategies of the TMDL.

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Summary Implementation Strategy

Introduction

The majority of the elements required for EPA approval of this submittal report were fully addressed in the *Grays Harbor/Chehalis Watershed Fecal Coliform Bacteria Total Maximum Daily Load Submittal Report, December 2002*. The only item missing for achieving approval of TMDL's for fecal coliform bacteria impairments in the upper Chehalis was the actual Loading Capacity and Load Allocation calculations for the upper river segments.

An advisory group worked with Ecology during the development of the Grays Harbor and lower Chehalis cleanup planning to deliberately address cleanup strategies for the upper Chehalis bacteria impairments. This was simply out of recognition that cleanup of the Harbor would be equally reliant upon cleanup of the lower <u>and</u> upper Chehalis system.

As a result, the elements of the approved Grays Harbor TMDL submittal report that equally address the upper Chehalis bacteria impairments are reproduced in the following sections. The Loading Capacity and Load Allocations presented earlier in this report, along with the following cleanup strategies and assurances represent a complete submittal report to accomplish approval of TMDL's for 18 impaired bacteria segments in the upper Chehalis.

The purpose of this Summary Implementation Strategy (SIS) is to present a clear, concise, and sequential concept (i.e. vision statement) of how agencies with involvement of citizens and industry will achieve water quality standards in the watershed over time.

This SIS meets the requirements of a TMDL submittal for approval as outlined in the 1997 Memorandum of Agreement between the U.S. Environmental Protection Agency and the Washington State Department of Ecology.

This SIS was developed with guidance from an extensive advisory group consisting of citizens, landowners, Tribes, local and state government representatives, health departments, shellfish and industrial interests in Grays Harbor, and others. The group also chose to address their broader purpose: "To define needed cleanup strategies for protecting the many beneficial uses that clean water provides people and the environment in the Grays Harbor/Chehalis watershed."

The cleanup strategies described in this SIS are relevant to both the upper and lower watershed. This SIS is an abridged version of the more comprehensive cleanup plan written for both the upper and lower Chehalis basin (*Grays Harbor/Chehalis Watershed Fecal Coliform Bacteria TMDL Submittal Report*, December 2002). The 2002 TMDL calculated that about 40% of the total fecal coliform bacteria load originated in the upper basin. Numerical cleanup goals for individual water body segments in the upper Chehalis were not available when the 2002 TMDL was completed. They are provided in this report instead, as the final "installment" to provide the fecal coliform bacteria cleanup goals (load allocations or LA's) for the watershed overall.

Water quality sampling data utilized in the accompanying study report confirmed the need for cleanup of 25 separate polluted segments in the upper basin (Table 19). Fewer upper Chehalis water bodies were actually named on the last formal listing of polluted water bodies in 1998, (known in the Federal Clean Water Act as the '303-d list').

The following table (Upper Chehalis Bacteria TMDL Waterbody Segments) identifies just the 18 LA's that are being reported to the EPA strictly for tracking purposes. There are two reasons why the upper Chehalis bacteria TMDL identifies more segments for cleanup than what are being tracked by EPA:

1) Since 1998, more data has become available to further identify smaller sections of polluted water within several of the larger segments identified in 1998. Consequently, separate cleanup targets were calculated for each smaller section in order to help better focus cleanup priorities to those sections within the larger segments. For example, Table 19 of the accompanying technical report identifies cleanup goals for 5 separate sections within the 68 mile segment identified as just one polluted waterbody on the 303-d list and tracked as 'Chehalis Mainstem at Porter'.
2) More impaired waterbodies have been identified since the 1998 list was developed. Cleanup of the new segments is necessary in order to achieve cleanup of the watershed overall. Also, cleanup of the segments more recently found will mean that they won't need to be added to the next 303-d list for action.

Table 22: **Upper Chehalis Bacteria TMDL Waterbody Segments**
*.

Waterbody/Segment	Old waterbody ID	New waterbody ID	1998 List	1996 List	Unlisted Impaired	Proposed Cat 5	Proposed Cat 2
Chehalis River							
Mainstem at RM 33.8 (Porter)	WA-23-1010	DS29ZH	X	X			X
Mainstem at RM 67.5 (Centralia)	WA-23-1020	DS29ZH	X	X		X	
Mainstem at RM 101.7 (Dryad)	WA-23-1100	DS29ZH	X	X		X	
Allen Creek	----	XO13OJ			X	X*	
Dempsey Creek	WA-23-2060	FM81JM	X	X		X	
Scatter Creek	WA-23-1018	AQ85FY	X	X			X
Lincoln Creek	WA-23-1019	AP15HC	X	X		X	X
Skookumchuck River	WA-23-1030	BV55DP	X				X
Salzer Creek	WA-23-1023	QF44VO	X	X		X	X
Dillenbaugh Creek	WA-23-1027	EV39SR	X	X		X	
Berwick Creek mouth	WA-23-1028	KB60UI	X	X		X	
Newaukum River	WA-23-1070	WC81/BX	X	X			X
Stearns Creek	WA-23-1102	EV19TA			X	X	
Bunker Creek	WA-23-1104	GG93MD		X		X	
Deep Creek	----	MK50YR			X	X	X
South Fork Chehalis River	WA-23-1106	AR82EA		X		X	X
Lake Creek	----	VY01TK			X	X	
Lost (Valley) Creek	----	XQ54GH			X	X	

*Currently in Category 4A, being proposed as Category 5 because it has no previous LA.
Bold indicates main waterbody.

It is impractical to predict when the entire upper Chehalis watershed will meet water quality standards because it encompasses a very large area (all of WRIA 23), water quality is determined by so many sources, and because cleanup will require vigilance by many agencies, citizens, and landowners throughout the watershed. Assuming that best management practices are implemented for animal management and on-site sewage systems, and that facilities continue managing their discharges at the permitted operating levels, bacteria loading should steadily decline. In fact, indications are that improved animal management practices or other non-point controls are helping reduce bacteria pollution (approximately 25 percent lower concentrations at Porter compared to 1998). The current best estimate to achieve water quality standards in this water body is October 2010.

The following plan is intended to complement, not duplicate, the work of others already underway. For example the Chehalis Basin Partnership formed under the '2514 Watershed Management Act' (HB 2514, RCW 90.82) is considered an umbrella organization with water quality objectives that this plan supports.

Existing Programs Implementing TMDL Recommendations:

The following is a description of the key agencies, and other groups that have influence, regulatory authority, involvement, or other controls that will be incorporated into a coordinated effort to implement the Water Cleanup Plan. Ecology will lead the coordination effort as needed to affect plan implementation. The plan addresses the following sources of fecal coliform bacteria pollution in particular:

- *Septic tank maintenance;*
- *Agricultural/livestock waste management; and*
- *Point-source discharges from NPDES permittees.*

Reasonable Assurance that Non-Point Source Load Allocations Will be Achieved:

Described in the sections below are steps that responsible organizations will take to implement cleanup strategies. Affected interests have already been helping to develop a Detailed Implementation Plan (DIP) for correcting dissolved oxygen, temperature as well as fecal coliform bacteria pollution in the upper and lower watershed. The DIP is due for completion by July 2004.

Organizations will need to commit efforts to solicit financial and other assistance to implement their respective responsibilities. A variety of grant and loan programs, and various forms of community support providing services-in-kind are accessible to the TMDL area. For instance, the Department of Ecology continues to award grants and loans for the kinds of programs and activities described below (e.g., Conservation District technical assistance to landowners, adult and student volunteer monitoring programs for evaluating water quality trends, loans for county managed septic system improvement programs.) Another mechanism in place to help acquire funding is that the Chehalis Basin Partnership (CBP) is identified as a group to review financial assistance applications for water quality protection projects. The CBP will rank, and recommend the projects for financial assistance by the Department of Ecology. The CBP is a viable organization with a solid plan for long-term watershed management. Several recommendations of their plan are expected to advance water quality protection activities. For example, one concept is to establish a position to research and apply for financial assistance to implement the actions of the plan.

County Health Departments

The county health departments have the specific requirement to: "Identify failing septic tank drainfield systems in the normal manner and will use reasonable effort to determine new failures." (RCW 70.118.030) "The normal manner" implies the use of inspections and responses to citizen complaints. Inspections are to take place in areas where water quality standards have been violated. Ongoing water quality sampling/monitoring by the conservation districts, Ecology, and others will supplement information gathered by the health departments in order to better characterize probable locations of failing septic systems. This will help prioritize sub-basins or other locations for follow-up by the health departments. State regulations (246-272 WAC) also direct local health departments to assure that system operators:

- Are aware of the need for ongoing operation and maintenance;
- Know how to provide the needed operation and maintenance; and
- Have access to professional services.

The health departments have each developed an administrative plan to respond to on-site sewage system failures, including, where appropriate, inspection of these systems. Health departments also must have a process to review their on-site septic program for effectiveness.

The following implementation strategy outlines the steps that health departments will take to control on-site septic sources. Health departments will also pursue development of financial assistance programs. They may specifically request Centennial Grant and State Revolving Fund loans to support local projects.

A. <u>Identify Sources</u>

- Phased Approach
- Develop Complete and Accurate List of Septic Systems in Basin
- Oversee a Septic Maintenance Inspection Program (Statewide Requirement for Homeowners)
- Use Monitoring Results to Focus Efforts

B. <u>Identify Control Measures</u>

- Provide List of Certified/Licensed Inspection Contractors.
- Provide List of Certified Pumpers and Repair Contractors.
- Provide Educational Materials.
- Require Repairs or Replacements if Necessary.

C.

<u>Develop/Conduct Community Education, and Broker Financial Assistance Programs</u>

- Prioritize local "pre-emptive" audiences: public officials, banks/lenders, dealers of pre-manufactured homes, and real-estate industry.
- Prioritize system owners/neighborhoods according to monitoring program results.
- Hold educational meetings for communities in various priority subbasins of the Watershed.
- Coordinate grant assistance to OSS operators, advise and advocate for local utility districts in order to develop financial support for effective local OSS protection programs.

State Departments of Ecology, and Agriculture

Ecology has been delegated authority under the Federal Clean Water Act by EPA to establish water quality standards, administer the General NPDES permitting program, and enforce water quality regulations. Ecology will continue to implement its statutory duties.

In 1998, Washington State passed the Dairy Nutrient Management Act (DNMA). The act requires all commercial dairies with a milk license from the Washington Department of Agriculture to have a farm plan by July 1, 2002. After receiving a farm plan, dairies must fully implement them by December 31, 2003. All of the dairies in the Chehalis basin have been inspected at least once. The operations with actual or probable pollution problems have received notices of correction and/or enforcement actions as appropriate, along with follow-up inspections when necessary.

On July 1, 2003, the Washington State Department of Agriculture (WSDA) assumed the role for overseeing all Dairy Operations in the State. ESSB 5889 enacted this transfer from the Department of Ecology to Department of Agriculture. Ecology and WSDA are negotiating a MOU that will establish Agriculture’s administration of the current Dairy Nutrient Program and development of the larger federal Animal Feeding Operation (AFO) and Confined Animal Feeding Operation (CAFO) program under the Clean Water Act. Under this program, operations classified as either small, medium, or large CAFOs will require an NPDES permit. While WSDA seeks authority to issue these permits from EPA, Ecology will continue to issue and administer all necessary NPDES permits. The WSDA has the primary role of compliance inspections at dairies, but NPDES enforcement authority rests with the Department of Ecology. If necessary, enforcement of state water quality law (90.48 RCW) may occur by the Department of Agriculture in cases of commercial dairy operations.

For non-dairy livestock properties that manage poultry, heifers, beef cattle, pigs, horses, or other animals, Ecology has responsibility to ensure that these operations do not degrade water quality. On these sites, the requirements of the Dairy Nutrient Management Act do not apply, but Ecology’s responsibility to enforce state water quality standards is still in place. For these operations, Ecology typically works in partnership with the landowner and the local conservation district (CD), encouraging voluntary corrective action first, with technical assistance from the CD if the landowner desires, and finally, enforcement by Ecology if corrective action isn't achieved.

Conservation Districts

The conservation districts (CD) in Lewis and Thurston Counties work closely with Ecology and National Resource Conservation Service (NRCS) in developing resource management plans. The CDs also provide education and technical assistance to landowners, as their budgets allow. Ecology will work closely with the CDs and NRCS by identifying and prioritizing referrals for resource management planning.

As part of the water quality inspection program, dairies and other livestock operations with actual discharges or a potential to pollute will be instructed to correct the problem. The services of the CD will be recommended. The CD will develop or modify an existing farm plan under the guidance of NRCS, to eliminate the potential to pollute. At that point, all three entities (CD, NRCS, and landowner) will then develop a monitoring plan to measure the effectiveness of the BMPs.

When funding is available to them, the CDs administer a cost-share grant program using state and federal money that helps pay for development of farm plans, and landowner implementation of BMPs called for in the farm plans. This includes BMPs such as fencing for livestock exclusion, gutters to keep water away from barnyard areas, composting and storage of manure away from surface runoff areas, etc. Such a government/landowner project (the Platter Demonstration Restoration site on Scatter Creek in the upper Chehalis Basin) was recently awarded $33,000.00 from the state Salmon Recovery Funding Board to implement the BMPs described above. The CDs help landowners implement many conservation improvements that help prevent transport of livestock waste to surface waters and improve watershed health overall.

All of the CD's support community information programs at different levels according to funding availability. Educational activities include things like classroom and outdoor education with schools, presentations to local landowner meetings, television programming, community events like county fairs, and organizing land restoration programs that reduce and prevent runoff of animal waste to streams. These education programs are effective in influencing behaviors which protect water quality and must continue.

Additional services that the CDs believe should be supplemented to improve watershed health include:

- More monitoring to evaluate water quality trends.
- Focused BMP-effectiveness monitoring.
- Inventory of farms, including "animal census" information.
- New and expanded financial assistance programs for farm planning and BMP implementation.

USDA Natural Resource Conservation Service

The USDA Natural Resource Conservation Service (NRCS) provides the guidance and general standards and specifications used in developing farm plans. NRCS also does research used to develop BMPs used on farms to protect water quality. The NRCS administers cost share money that is frequently used by farmers to do farm improvements. Many of the costly farm improvements required for water quality protection such as lagoons are constructed according to designs approved by NRCS and funded in part by grants administered by NRCS. The NRCS will help Ecology and the CDs evaluate the effectiveness of the BMPs as they are implemented in the Chehalis Watershed.

Wildlife as a Natural Non-Point Source of Bacteria:

Efforts are focused on reducing bacteria loading from sources that people can influence. The technical study acknowledges that wildlife contribute bacteria to the watershed. Because wildlife loading is considered a natural source and cannot be effectively managed or reduced, efforts must focus on strategies and areas where people can create improvements.

This SIS describes an ongoing process that will occur to identify pollution sources and monitor effectiveness of controls. Information forthcoming from that work will continually help refine strategies and priorities for sub-basins where efforts will be most effective.

As cleanup of human-related sources continues, additional information may also be gathered by the advisory group to help understand the significance of "natural" fecal coliform bacteria sources in the watershed.

A load allocation was not assigned to wildlife because quantitative information was lacking on this source. Should the contribution of wildlife to fecal coliform loads be deemed substantial, wildlife would be considered a natural source and given its own load allocation. This would result in smaller load allocations to human-related fecal coliform sources (e.g. septic systems, livestock management) and require that greater reductions be achieved where the sources are manageable. Such a revision to this TMDL can occur at a future date.

Reasonable Assurance that Point-Source Waste Load Allocations will be Achieved:

The Department of Ecology will continue to regulate permitted facility discharges through its NPDES authorities. Current permit limits for the Chehalis basin facilities are appropriate for achievement of state water quality standards. Permit maintenance and renewal schedules provide for ongoing monitoring of facility and discharge conditions to assure that water quality protections remain in place.

Monitoring of Implementation Activities

Various water quality monitoring projects will continue to be implemented by several groups in different parts of the watershed. Ecology is developing a comprehensive monitoring plan to help focus and coordinate the monitoring being planned by various interests in the Chehalis Basin. Affected interests include those with direct responsibility to implement the TMDL, as well as other groups who serve in a more coordinating role such as the Chehalis Basin Partnership (CBP) and a water quality committee of the CBP. The coordinated monitoring plan is due for completion during summer 2004. The plan will identify the parties doing sampling, why, what, where, when, and how. The plan is intended to serve as a Quality Assurance Project Plan that can guide the monitoring work either individually or collectively by different parties throughout the basin. Monitoring will help identify pollution sources for action and help indicate effectiveness of cleanup activities. Monitoring will also help document water quality trends. In addition to water quality monitoring, ongoing application of local land use knowledge is essential to best prioritize areas and strategies for cleanup**.**

Ecology conducts monthly sampling at several sites in the mainstem Chehalis. An additional sampling site in the upper Chehalis River at Prather Rd. was added to Ecology's ambient monitoring program in October 2001. The Confederated Tribes of the Chehalis and Thurston County supplied monitoring data for this TMDL and those sampling programs are expected to continue. The Chehalis River Council also has an active water quality monitoring project at several locations in the upper Chehalis basin. Grant funding is expected to supplement monitoring by the conservation districts, and local volunteer groups. A water quality education and monitoring project operated by Educational Service District 113 and the Chehalis Basin Education Consortium (CBEC) will continue to involve 4th through 12th grade and community college students. By testing chemical and biological parameters, the students will learn scientific methods and develop an understanding and appreciation for their watershed.

Data provided by non-Ecology sources will have positive informational value to help document progress being made to meet the TMDL targets. Results will also help to refine and adapt water cleanup strategies of the TMDL.

Monitoring Strategy

If ambient or other monitoring data shows that progress towards targets is not occurring or if targets are not being met, compliance water quality monitoring will occur. Compliance monitoring will be designed to verify preliminary data and then identify the specific source(s) of fecal coliform loading. Sampling over time will be adjusted to locate the source by narrowing the geographic area where contamination is occurring. A more extensive explanation of monitoring activities expected to support cleanup planning is provided in the previous 'Monitoring Strategy' section (page 57) of this report.

Adaptive Management

Ecology will periodically evaluate monitoring results from the various programs described earlier. Ecology will determine if fecal coliform water quality standards are being met. If water quality standards are not being met, Ecology will determine if the reduction goals listed in this TMDL are being met, and whether adjustments to the load allocations or implementation strategy are necessary.

Potential Funding Sources

Grants are available from the Centennial Clean Water Fund, Section 319 non-point water quality improvement program, and SRF loans are available to fund activities by jurisdictions to help implement the water cleanup plan. Non-government organizations can apply to be funded by a

319 grant fund to provide additional assistance. Health departments have access to SRF funds to provide homeowners zero-interest loans for repair of failing septic systems.

The Environmental Quality Incentives Program (EQIP) is a federal cost-share program available to many farms. The state has provided additional cost share assistance through the Washington Conservation Commission for commercial dairies that are required by the Dairy Nutrient Management Act to develop and implement farm plans.

Other funding sources, such as salmon recovery funding and watershed grants, will be pursued as they become available.

Ecology will work with grant/loan applicants to prepare appropriate scopes of work to implement this plan, and to identify and assist with applying for grant opportunities as they arise.

Summary of Public Involvement

As described in the introduction to this summary implementation strategy, an advisory group worked with Ecology during the development of the Grays Harbor and lower Chehalis cleanup planning to deliberately address the upper Chehalis bacteria impairments. The elements of that extensive public process are described in the *Grays Harbor/Chehalis Watershed Fecal Coliform Bacteria TMDL Submittal Report* that was approved by USEPA in May 2003.

Additional public involvement activities occurred to complete this "final installment" of the TMDL report package that completes load allocations for fecal coliform bacteria in the upper Chehalis basin.

Those public involvement activities began officially on January 8th with a presentation of the draft *Upper Chehalis River Fecal Coliform Bacteria TMDL Recommendations* technical study to the public and a local advisory group for TMDL's in the Chehalis basin. The meeting was hosted by the Newaukum Grange at their facility near Chehalis. The meeting was widely announced through several e-mail list serves for people throughout the upper and lower watershed interested in water quality and other natural resource management issues. The Chehalis Basin Partnership convenes a Water Quality Committee which serves as Ecology's advisory group for Chehalis TMDL work. They were the primary participants at the January 8 forum. Additional feedback about the upper Chehalis bacteria TMDL was received from the advisory group at their meetings in February and March.

Public access to the technical study was announced on Ecology's public involvement calendar internet website. A formal public comment period was conducted from February 3 through March 15. A public workshop was hosted on March 11 by the Chehalis River Council in Centralia. The *Olympian*, and *Chronicle* newspapers announced the workshop and a story following the March 11 workshop was published in the *Chronicle*.

Responsiveness Summary for the Proposed *Upper Chehalis Fecal Coliform Bacteria TMDL Recommendations.*

Written comments on the technical study were received from the cities of Chehalis and Centralia, the Chehalis River Council, and USEPA Region 10.

The cities suggested clarification that the TMDL does not require additional bacteria reductions from the permitted facilities. They also provided an update about the treatment plant changes underway or planned for the cities. The comments are reconciled in the Abstract and Wasteload Allocations sections of this report. The Chehalis River Council correspondence is shown at the end of this section.

The Chehalis River Council comments primarily cover two general themes: 1) the report lacks the rigorous testing and analysis required for a TMDL study, and 2) implementation procedures provide no assurance that real improvement will occur. The first comment suggests a misunderstanding about the objective of the underlying technical study for a TMDL. The technical report is intended to serve as an initial scoping for more in-depth monitoring that must occur concurrent with implementation of cleanup strategies in obvious priority river segments defined by the technical study. The report does achieve the purpose of documenting the relative pollution levels among the impaired segments, and recommends numerical goals for cleanup of the respective segments. In other words, the report helps prioritize areas for cleanup attention so that cleanup can follow a more strategic sequence while more specific source-identification monitoring occurs as the next level of work. Ecology absolutely agrees with the River Council that more current and ongoing sampling is essential to further refine cleanup priorities and planning. The 'Monitoring Strategy sections of this report describe expectations for long-term monitoring throughout the basin.

Regarding the second comment, implementation procedures are only mentioned briefly in the technical report. They are described in more detail in two other reports that are deliberately focused on the cleanup strategies (i.e., *Grays Harbor/Chehalis Watershed Fecal Coliform Bacteria Total Maximum Daily Load Submittal Report*, approved May 2003 by USEPA, and a Public Review DRAFT Detailed *Implementation (Cleanup) Plan for DO, Temperature, and Fecal Coliform Bacteria in the Chehalis/Grays Harbor Watershed, March 2004*.) The Detailed Implementation Plan in particular, identifies who is responsible and what resources are available for implementing cleanup actions.

The Chehalis River Council commented that the monitoring strategy and general implementation actions described in the technical study report would be effective if implemented. They are concerned however, that there is insufficient will by elected officials, and inadequate funding to accomplish cleanup. They also say that the state does not fully exercise its' regulatory authority to protect water quality. Those comments cannot be reconciled within the context of either the TMDL technical study or subsequent cleanup plan documents. Because the TMDL process is authorized by the Federal Clean Water Act and further validated on a regulatory scale by EPA's approval of the TMDL's, the process is a catalyst to focus local understanding and commitment to cleanup.

What motivates effective cleanup is a government and citizenry who are informed about the degree of water pollution and who understand what that means to our desired life quality. Throughout at least the last ten-plus years of water quality studies and increasing public access to information about water pollution in the Chehalis watershed there has been a big increase in public awareness, and commitment to water quality improvements. There is clearly a long way to go, but water quality in the Chehalis watershed is improving. Discharges from city treatment plants, dairies and some industrial plants, and many agricultural operations have been reduced. Citizens and some government permitting programs are considerably more outspoken and vigilant about proper management of on-site-septic systems. Another product of all this awareness and work has been better partnerships and collaboration towards water quality protection. Assuming that people want to do the right thing to protect their current and future life-quality, we can only continue to work together to build awareness that clean water is a priority that we must protect. That we must continue to plan, budget, and work for.

Acronyms and Abbreviations

BMP	Best Management Practice
CD	Conservation District
CBP	Chehalis Basin Partnership
CBEC	Chehalis Basin Education Consortium
DNMP	Dairy Nutrient Management Plan
Ecology	Washington State Department of Ecology
EPA	United States Environmental Protection Agency
NPDES	National Pollution Discharge Elimination System
NRCS	USDA Natural Resources Conservation Service
OSS	On-Site Sewage System

The Chehalis River Council
417 North Pearl Street
Centralia, WA 98531

March 15, 2004

Dave Rountry
Water Quality Program
Washington State Department of Ecology

Dear Dave:

On behalf of the Chehalis River Council Board of Trustees, I am submitting comments on the proposed Upper Chehalis River Fecal Coliform Bacteria Total Maximum Daily Load Recommendations, draft dated March 4, 2004. The CRC appreciates Ecology's willingness to extend the comment period on this draft TMDL and provide information at a public meeting sponsored by the CRC in Centralia on March 11th.

The Chehalis River Council is an all-volunteer environmental organization dedicated to the protection of natural resources in the Chehalis Basin. We have been actively involved in water quality issues since the early 1990's, when fish kills in the Black River and poor water quality in the Chehalis River drew attention to significant problems in the Basin.

Our main comments are as follows: 1) this report lacks the rigorous testing and analysis required for a true TMDL study; and 2) the implementation procedures briefly outlined in this report and elaborated in the Detailed Implementation Plan (drafted <u>before</u> the Upper Chehalis report was finished) provide no assurance that actual clean-up will occur. Discussion of these points follows.

1. Report lacks the rigorous testing and analysis required for a TMDL study

Rather than a systematic study of bacterial pollution in the Upper Basin, the report is a review of existing data, some from as early as 1974 or as late as 2002 (at Independence Road). Statistical methods are used to calculate percentage load allocations, giving the report a misleading appearance of precision. In fact, the variability of fecal coliform as a function of storm events, or whether or not a cow or beaver has recently visited the testing site, is well known. This variability is especially problematic when the monitoring is not done according to a systematic design and with comparable controls. What we have in this report is a grab-bag of monitoring results forced into a format based on EPA requirements.

An example of the weakness of the data is the discussion of the mainstem Chehalis at Porter (p. 17). It is frequently asserted that most of the fecal coliform load to the lower Chehalis and Grays Harbor comes from the Upper Chehalis (this report, p. 1). Pelletier and Seiders, 2000, estimated that a load reduction of 74% was necessary at Porter to meet water quality standards at Porter and downstream. However, with additional data, this report finds only a 64% reduction is required. The load allocation reduction is based on a 25% reduction in bacteria concentrations at Porter. It is suggested that somehow a 23% reduction in fecal coliform concentrations in Beaver Creek accounts for the reduction at Porter. It seems unlikely to this lay person that bacteria from Beaver Creek travel 18 miles down the Black River and 6 miles down the Chehalis to impact bacterial levels at Porter. What this suggests is that nobody knows where the bacteria at Porter are coming from and what causes their levels to rise or fall. There is no question that bacteria from time to time rise above water quality standards at Porter. A systematic TMDL study would have done independent testing and investigation that could have provided the basis for implementation of measures to improve water quality.

This study fails to look at the watershed as an organic whole. The absence of discussion of the mainstem Black River from this report seems to be based on the fact that it has an EPA approved TMDL already. The organization of the report reflects this. The order of discussion is Porter (RM 33.8), Independence Road (RM 54.7) Prather Road (RM 59.9) and Black River (RM 47). Then follows Scatter Creek (RM 55.2) and Lincoln Creek (RM 61.9). An order recognizing watershed characteristics would follow the River Miles upstream, with Black River second and Scatter Creek fourth. This order would make it easier to form hypotheses about impact of the tributaries to the mainstem stations.

The Black River load allocations are only discussed in those cases in which changes were indicated for Beaver Creek and Allen Creek and new allocations made for Dempsey Creek. Attention to these problem creeks is welcome, but some discussion of the mainstem Black River, even if changes to TMDL approved load allocations are not indicated, would shed more light on the mainstem Chehalis between RM 33.8 and 47.

Another example of the lack of depth of the analysis is the discussion of Berwick creek. Berwick creek, which flows into Dillenbaugh creek near Chehalis, is by all accounts a troubled creek. Sargeant (2002) found extremely high levels of fecal coliform at the mouth of Berwick creek in the wet season 1999 and considerably improved numbers (although still not meeting quality standards) in 1999-2000. In September 1999 it was found that animals had been accessing the creek through a fence. When the fence was fixed, the numbers improved. Because this information was available in the published results of Sargeant's Evaluation Study, the TMDL based its reduction percentage on 2000 data only. The point of this example is that we do not know how many other load allocations might have to be changed if there was more site-specific investigation.

We believe that this study should be considered to be the initial scoping for in-depth sub-basin TMDL studies. However, this would conflict with Ecology's need to move stream segments off the 303(d) list and onto the completed TMDL list as quickly as possible. This may be a bureaucratic necessity, given the lack of resources and the federal requirements. It does not provide a solid basis for real on-the-ground improvements in water quality.

2. Implementation procedures provide no assurance that real improvement will occur

This draft report presents the following "monitoring strategy" (p. 46):

- Use the highest reduction targets to prioritize where resources should be first invested.
- Begin implementation of the BMPs first at the most upstream segment, tributary, or sub-tributary. Monitoring should follow wherever BMPs are implemented.
- As the segment, tributary, or sub-tributary with the worst problem is brought in compliance with water quality standards, the monitoring station should be moved to a less severe area where the next set of BMPs would be implemented.
- In general, however, basic BMPs such as fencing and riparian buffer zones to keep cattle out of the stream should be required, as a rule, throughout the watershed. Also, failing on-site sewage

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treatment systems within the watershed need to be replaced to improve the long term health of the watershed.

There is no question that this strategy, if implemented, would result in a great improvement in fecal coliform in the upper basin. What is missing is any indication of who is responsible for these steps and where the resources to accomplish them are going to come from.

We know how to do the first three bullets. For example, the "strategic initiative or non-dairy livestock sweep" sponsored by Ecology and done by Eric Schlorff for the South Fork Chehalis and Stearns Creek areas showed promise for accomplishing the goals of reduction of nonpoint source pollution in these areas. What it took was a combined attack by Schlorff, a temporary employee at Ecology, partnering with Robert Amrine of the Lewis County Conservation District to reach landowners in the area and persuade and cajole them to change some of their practices. Currently, Ecology has no funding for this program, and the conservation district is greatly restricted in its resources.

Regarding the last bullet, *requiring* fencing and riparian buffer zones and *replacing* failing on-site sewage treatment systems throughout the watershed demand a political vision and will on the part of county officials that seems to be in short supply. Unless this changes, there is no assurance that water quality impairments will be fixed.

The Detailed Implementation Plan for both the Upper and Lower Chehalis TMDLs is still in draft, but at this stage it consists of an extensive snapshot of the responsibilities of various agencies and jurisdictions of government to enforce existing regulations and achieve existing goals for eliminating non-point source pollution. Unfortunately the very agencies that are best suited to take a lead role, such as the conservation districts, are critically short of funding.

Under RCW 90.48, it is illegal to pollute the waters of the state, and Ecology is charged with enforcing that law. It is not enough for Ecology to simply point to polluted waters and suggest how, in some better world, the waters might get cleaned up. If resources are lacking, then Ecology needs make that plain to the Legislature and, if support is still lacking, it needs to ask to be relieved of its legal responsibility. It also needs to make clear to the counties that if they do not have ordinances prohibiting non-point pollution, or are unwilling to enforce them, then Ecology will step in and take enforcement actions.

Although this draft report compares unfavorably to TMDLs of the past, such as the Upper Chehalis Dissolved Oxygen TMDL or the two Black River TMDLs, the answer is not necessarily more detailed TMDLs. Instead, the CRC calls for practical action plans supporting real clean-up efforts, and monitoring focused on assessing the effectiveness of those efforts. We know what needs to be done, we know that it works (Sargeant, 2000), and we know that it has to be maintained. The goal must be real clean up for real streams and not simply fulfilling bureaucratic requirements.

Thanks you for the opportunity to comment.

Sincerely,

Margaret Rader

Margaret Rader
Chair, Chehalis River Council Board of Trustees

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Data Appendix

The Data Appendix is provided as a data supplement (zip file) in Excel at
http://www.ecy.wa.gov/biblio/0403004.html